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Assessment of Background Ionizing Radiation of Engineering Laboratories in Federal Polytechnic Nekede Owerri, Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In-situ measurement of background ionizing radiation level of the Faculty of Engineering Technology (FET) in Federal Polytechnic Nekede, Owerri, Imo State has been carried out, with the use Radiation meters (Digilert-200). The Global Positioning System (Garmin 765) was utilized in measuring the coordinates of the sampling points. The aim of the study is to assess the rate of radiation exposure to students and staff during practical work in the Laboratories. Four (4)

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engineering laboratories within the faculty were randomly selected. The outdoor exposure dose rate varies from 0.006 - 0.017 mR/hr, 0.006 - 0.015 mR/hr, 0.008 -0.015 mR/hr, 0.009-0.014 mR/hr with mean value of 0.011 mR/hr ,0.009 mR/hr,0.014 mR/hr, 0.012 mR/hr for Computer Engineering Laboratory, Mechatronics Laboratory, Mechanical Engineering Laboratory and Automatic Laboratory respectively. The indoor exposure dose rate varies 0.009 - 0.013 mR/hr, 0.009 – 0.019 mR/hr, 0.006 -0.015 mR/hr, with mean of 0.013 mR/hr,0.012 mR/hr and 0.012 mR/hr for Air Conditioning Laboratory, Mechanical Engineering Laboratory and Automatic Laboratory respectively. The outdoor absorbed dose rate varies from 52.2 -147.9 nGy/hr, 52.2-130.5 nGy/hr, 69.6 -147.9 nGy/hr,78.3 -121.8 nGy/hr, with mean value of 96.76 nGy/hr, 79.75 nGy/hr,111.86 nGy/hr and 100.69 nGy/hr and the indoor absorbed dose rate varies from 78.3-130.5, 78.3- 169.7, 52.2-130.5 (nGy/hr) with mean 111.7 nGy/hr, 109.7 nGy/hr, 101.8 nGy/hr respectively. The outdoor excess life cancer risk (ELCR) varies from $0.22x10^{-3}$ - $0.56 x10^{-3}$,$0.22x10^{-3}$- $0.56x10^{-3}$,$0.299x10^{-3}$-$0.56x10^{-3}$ and $0.34x10^{-3}$-$0.52x10^{-3}$ with mean of $0.44x10^{-3}$,$0.34x10^{-3}$,$0.54x10^{-3}$ and $0.45x10^{-3}$ for Computer Engineering Laboratory, Mechatronics Laboratory, Mechanical Engineering Laboratory and Automatic Laboratory respectively, while the indoor excess life cancer risk (ELCR) varies from 0.36-$0.56x10^{-3}$,$0.34x10^{-3}$-$0.85x10^{-3}$ and $0.22x10^{-3}$-$0.56x10^{-3}$ with mean $0.48x10^{-3}$,$0.48x10^{-3}$ and $0.44x10^{-3}$.The results show that the estimated radiological parameters from the radiation exposure dose rate are all higher than their world standard values, except the annual effective doses and the outdoor and indoor exposure dose rate which are within their respective stipulated standard. This high value of Absorbed dose and excess life cancer risk may not constitute any immediate health effects on students and staff but there is a potential health effects for a long term in the future for an individual who may spent he/her life time within the immediate environment such as development of cancer due to the accumulation of high doses.

Keywords: Background ionizing radiation; Excess life cancer risk; Absorbed dose rate; Annual effective dose; and Faculty of Engineering Technology (FET).

1. INTRODUCTION

The background ionizing radiation within the environment has been on the increase due to human activities here on earth and its health effects has become a huge concern for the public all over the world (Ugbede & Echeweozo, 2017). The sources of background radiation within the environment is of various sources, due to human activities such as medical research, scientific research or medical diagnoses, nuclear weapons testing and nuclear accidents or it may from both natural and artificial sources (Bawuro et al., 2024). The present of the naturally occurring radioactive materials (NORM) within research materials like, water, soil, food and even in air has also increased the quantity of naturally occurring radionuclides changes within the environment (Linda & Shaw, 2004). The Naturally Occurring Radioactive Materials within the environment originate from the terrestrial sources and Man-made sources due to the various applications in research area, industrial area, medical area, and agriculture area (Bradan et al., 2003). Background ionizing radiation has been on the increase due to the consistent utilization of medical tool for medical diagnosis, therapy and also for scientific research work which involved ionizing. In most developed and developing countries with advanced health care system, medical exposures are now the most essential source of background ionizing radiation (World Health Organization [WHO], 2011). Excess exposure to background ionizing radiation sources has related health effects on human and the exposure to high radiation dose might cause or lead to illness in human body or lead to death (Anekwe & Ibe, 2017). The exposure to radiation sources (ionizing radiation) has some related health effects on human which includes skin cancers, kidney cancers, cancer of the lung, cataracts, leukemia and pancreas (Taskin et al., 2009; Kelly-Reif et al., 2023; Wu & Wang, 2024). The related health risks of background ionizing radiation on human and the immediate environment is of great concern, since human being are exposure to radiation from different sources such as; research in science, therapeutic, manufacturing processes and application of X-ray diagnosis (UNSCEAR, 2000). Radionuclide from Man-made sources have entered the environment due to human activities such as medical research and medical procedures that use radionuclides to image the body, and electricity generation that uses radioactive uranium as fuel (UNSCEAR, 2000). Building materials such as rock and soil are contributive sources of high radiation dose to the environment and human likewise a means sources of migration of radionuclides to the immediate environment. Naturally the concentration of radioactivity in soil is basically due to the present of radionuclide content and it might lead to external and internal radiological hazards due to its emission of gamma rays (UNSCEAR, 2008.

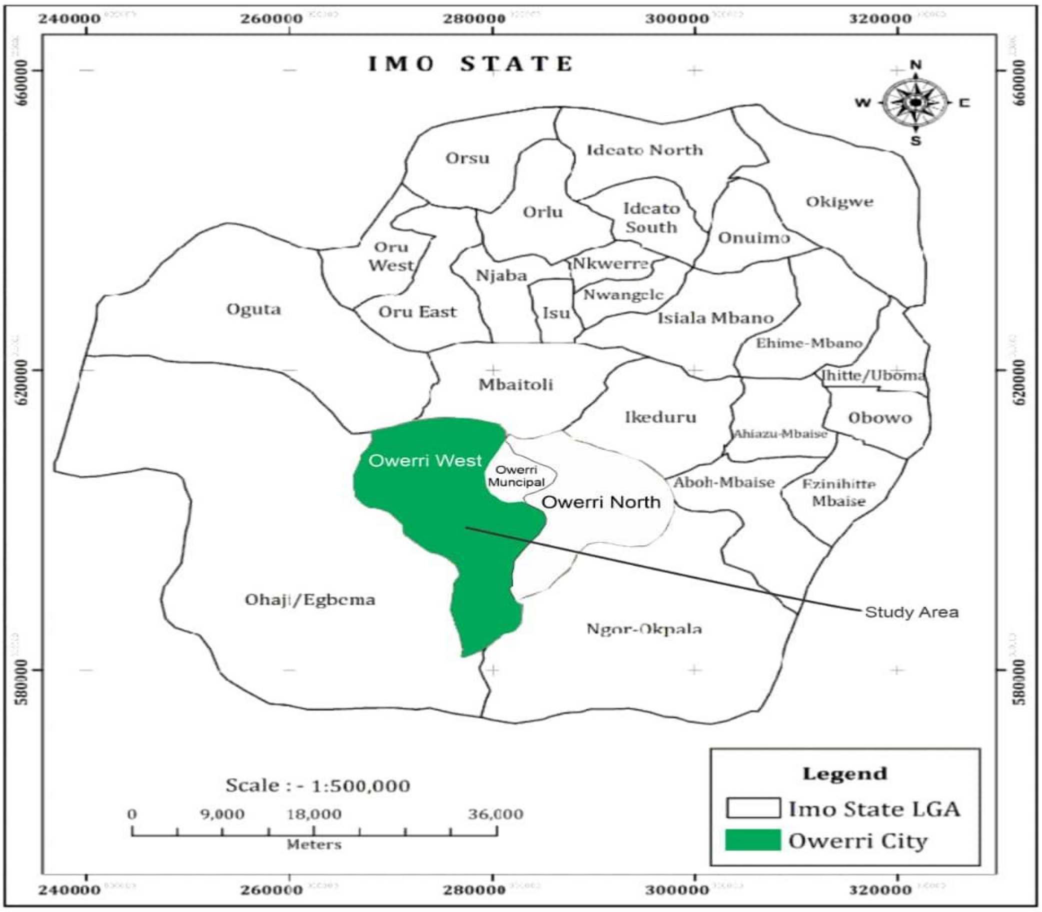
2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out within the engineering laboratories of Federal Polytechnic, Nekede as shown in picture 1. The Federal Polytechnic, Nekede is owned by the federal Government of Nigeria and it is situated at Nekede, in Owerri West Local Government Area of Imo State, South-Eastern Nigeria. The institution was established on a temporary site of Government Technical College Owerri in the year 1978 as College of Technology, Owerri. The institution offers courses at undergraduate level and award certificates in National Diploma (ND) and Higher National Diploma (HND) in the respective courses (Onwuadiochi et al., 2020). The Federal Polytechnic, Nekede has eight (8) faculties (schools) of study and the Faculty of Engineering Technology (FET) was considered for the purpose of the study due it utilization of chemicals which might alter the background ionizing radiation.

2.2 Materials

A well calibrated Radiation meter was utilized for the In-situ measurement of indoor and outdoor radiation exposure level of the selected engineering laboratories of federal polytechnic Nekede. The Radiation meter contains a Geiger-Muller tube which is capable of detecting the alpha, beta, and gamma radiation level within the study area. Global Positioning System (GPS Map76) Garmin product was applied in estimating the geographical coordinates of the selected sampling points within the study area.



Picture 1. The map of the study area

2.3 Methods

The in-situ measurement was carried out in the Faculty of Engineering Technology of Federal Polytechnic Nekede and four (4) Laboratories within the engineering Faculty was considered for the purpose of the study. Maximum of ten (10) sampling points were arbitrarily selected within the selected engineering Laboratories. The outdoor background ionizing radiation (BIR) were taken around the premises of the selected Engineering laboratories by placing the Radiation meter above the ground level, at a height of one meter (1m) from the Ground level. Three different readings were taken at each of the sampling points of the Engineering laboratories and the average was calculated to represent the radiation exposure dose rate of the selected points and the exposure dose rate was measured in milli-Roetgen per hour (mR/hr). The geographical positioning system (GPS) was applied in measuring the precise coordinates of each of the selected sampling points within the selected engineering laboratories of federal Polytechnic Nekede, Owerri.

3. HEALTH HAZARD INDICES

3.1 Absorbed Dose (D)

The physical dose quantity (D) represent the mean energy conveyed to matter per unit mass by ionizing radiation.

Absorbed Dose = Exposure Dose Rate x 8.7 (nGy/hr) (1)

3.2 Annual Effective Dose Equivalent (AEDE)

The annual effective dose equivalent (AEDE) received through the exposure to background ionizing radiation was calculated using the absorb dose, Dose conversion factor of 0.7Sv/Gy and the occupancy factor for indoor and outdoor was 0.70(18/24), and 0.2(6/24) respectively. The annual effective dose is determined using the following equations (Dar & El Saman, 2014).

AEDE (Outdoor) (mSv/yr) =Dose rate (nGy/h) ×8760h×0.75Sv/Gy×0.25 (2)

AEDE (Indoor) (mSv/yr) =Dose rate (nGy/h) ×8760h×0.75Sv/Gy×0.25 (3)

3.3 Equivalent Dose Rate (EDR)

The Equivalent dose is the product of the average absorbed dose of the radiation in tissue and the radiation weighting factor (WR). The equivalent dose is utilized in assessing the damage to biological from the absorbed dose of a certain type of radiation (NCRP, 1990).

Equivalent Dose Rate (mSv/yr) = $\frac{0.96x24x365}{100}$ (4)

3.4 Excess Life Cancer Risk (ELCR)

Excess Lifetime Cancer Risk is the carcinogenic potential effects that are characterized by assessing the probability of developing cancer in the population of individuals for a specific lifetime from the exposure to background ionizing radiation source and chemical specific dose-response data (i.e. slope factors) ([ICRP, 2007). The excess lifetime cancer risk deals with the possibility of developing cancer over a lifetime at a certain exposure level.

ELCR= AEDE × Average Duration of Life (DL)×RISK factor (RF) (5)

The Average duration of life is 70years while Risk factor for public exposure is 0.05.

4. RESULTS AND DISCUSSION

The results of the in-situ measurement of background ionizing radiation of engineering Laboratories of Federal Polytechnic Nekede and the calculated values of the health hazard indices are presented in Tables 1-7. The Tables 1- 4 shows the results of outdoor background ionizing radiation whiles Tables 5-7 shows the results of indoor background ionizing radiation (BIR).

4.1 Discussion

The obtained results of the background ionizing radiation (BIR) are presented in Tables 1- 7. The outdoor background ionizing radiation of the selected Laboratories varies from 0.006 - 0.017 mR/hr, 0.006 - 0.015 mR/hr, 0.008 -0.024 mR/hr, 0.009 - 0.014 mR/hr with mean value of 0.011 mR/hr, 0.009 mR/hr, 0.014 mR/hr and 0.012 mR/hr for Computer Engineering Laboratory, Mechatronics Laboratory, Mechanical Engineering Laboratory and Automatic Laboratory respectively. The obtained result of the outdoor background ionizing radiation of the

Table 1. Radiation exposure level of Computer Engineering Laboratory (Outdoor)

S/N	Sampling Points	GPS Reading	Exposure Dose Rate (mR/hr)	Absorbed Dose Rate (nGy/hr)	AEDE Outdoor (mSv/y)	ELCR Outdoor 10^{-3}
1	Entrance Lab	5.432757” 7.030902”	0.011	95.7	0.117	0.411
2	Window 1	5.432767” 7.030903”	0.008	69.6	0.085	0.299
3	Window 2	5.432773” 7.030878”	0.015	130.5	0.160	0.560
4	Right hand window 1	5.432738” 7.030755”	0.008	69.6	0.085	0.299
5	Right hand window 2	5.432723” 7.030740”	0.011	95.7	0.117	0.411
6	lab toilet	5.432640” 7.030673”	0.013	113.1	0.139	0.485
7	Second entrance	5.432522” 7.030655”	0.006	52.2	0.064	0.224
8	Gpee tank	5.432637” 7.030688”	0.017	147.9	0.23	0.81
	Average		**0.011**	**96.79**	**0.125**	**0.437**
	UNSCEAR (2002)		**0.013**	**84.0**	**1.0**	**0.29×10^{-3}**

Table 2. Radiation exposure level of Mechatronics Laboratory (Outdoor)

S/N	Sampling Points	GPS Reading	Exposure Dose Rate (mR/hr)	Absorbed Dose Rate (nGy/hr)	AEDE Outdoor (mSv/y)	ELCR Outdoor 10^{-3}
1	2m from Entrance	5.433270” 7.030855”	0.011	95.7	0.117	0.411
2	1m from Entrance	5.433327” 7.030801”	0.009	78.3	0.096	0.336
3	Entrance Door	5.433328” 7.030884”	0.008	69.6	0.085	0.299
4	Window 1	5.433361” 7.030858”	0.006	52.2	0.064	0.224
5	Window 2	5.433150” 7.030880”	0.006	52.2	0.064	0.224
6	Residential parts	5.433325” 7.030918”	0.015	130.5	0.160	0.560
	Average		**0.009**	**79.75**	**0.0977**	**0.342**
	UNSCEAR (2002)		**0.013**	**84.0**	**1.0**	**0.29×10^{-3}**

Table 3. Radiation exposure level of Mechanical Engineering Laboratory (Outdoor)

S/N	**Sampling Points**	**GPS Reading**	**Exposure Dose Rate (mR/hr)**	**Absorbed Dose Rate (nGy/hr)**	**AEDE Outdoor (mSv/y)**	**ELCR Outdoor 10^{-3}**
1	Somers	5.431283” 7.032702”	0.015	130.5	0.160	0.560
2	1m from Somers	5.431285” 7.032669”	0.008	69.6	0.085	0.299
3	Welding section	5.431245” 7.032690”	0.024	147.9	0.265	0.931
4	Measurement section	5.431208” 7.032923”	0.011	95.7	0.117	0.411
5	Production Section	5.431208” 7.032543”	0.010	87.0	0.14	0.490
6	Quality control	5.431059” 7.032570”	0.014	121.8	0.149	0.523
7	Water Tank	5.431064” 7.032553”	0.015	130.5	0.160	0.560
	Average		**0.014**	**111.86**	**0.153**	**0.539**
	UNSCEAR (2002)		**0.013**	**84.0**	**1.0**	**0.29×10^{-3}**

Table 4. Radiation exposure level of Automatic Laboratory (Outdoor)

S/N	Sampling Points	GPS Reading	Exposure Dose Rate (mR/hr)	Absorbed Dose Rate (nGy/hr)	AEDE Outdoor (mSv/y)	ELCR Outdoor 10^{-3}
1	Entrance	5.432034” 7.032292”	0.011	95.7	0.117	0.411
2	1m from Entrance	5.432034” 7.032292”	0.009	78.3	0.096	0.336
3	2m from Entrance	5.432034” 7.032292”	0.013	113.1	0.139	0.485
4	Window 1	5.432034” 7.032292”	0.014	121.8	0.149	0.523
5	Window 2	5.432034” 7.032292”	0.013	113.1	0.139	0.485
6	Entrance Behind Lab	5.432034” 7.032292”	0.012	104.4	0.17	0.60
7	1m Entrance Behind Lab	5.432034” 7.032292”	0.009	78.3	0.096	0.336
	Average		**0.012**	**100.67**	**0.129**	**0.454**
	UNSCEAR (2002)		**0.013**	**84.0**	**1.0**	**0.29×10^{-3}**

Table 5. Radiation exposure level of Air conditioning refrigerator Laboratory (Indoor)

S/N	Sampling Points	GPS Reading	Exposure Dose Rate (mR/hr)	Absorbed Dose Rate (nGy/hr)	AEDE Indoor (mSv/y)	ELCR Indoor 10^{-3}
1	Refrigerating equipment	5°43'.024" 7°03'2246"	0.015	130.5	0.160	0.560
2	2m from Refrigerating equipment	5°.432024" 7°03'2246"	0.014	121.8	0.149	0.523
3	Lab. Bench 1	5°43.'2024" 7°03'2246"	0.013	113.1	0.139	0.485
4	Lab. Bench 2	5°.432024" 7°03'2246"	0.009	78.3	0.096	0.336
5	Lab. Bench 3	5°.432024" 7°032246"	0.011	95.7	0.117	0.411
6	Entrance door	5°.432024" 7°032246"	0.015	130.5	0.160	0.560
	Average		**0.013**	**111.65**	**0.137**	**0.479**
	UNSCEAR (2002)		**0.013**	**84.0**	**1.0**	**0.29×10^{-3}**

Table 6. Radiation exposure level of Mechanical Engineering Laboratory (Indoor)

S/N	Sampling Points	GPS Reading	Exposure Dose Rate (mR/hr)	Absorbed Dose Rate (nGy/hr)	AEDE Indoor (mSv/y)	ELCR Indoor 10^{-3}
1	Entrance	5.431272” 7.032644”	0.011	95.7	0.117	0.411
2	Door	5.432119” 7.032119”	0.013	113.1	0.139	0.485
3	Nip part	5.431320” 7.032755”	0.019	169.7	0.30	0.85
4	Milling machine 1	5.431343” 7.032690”	0.013	113.1	0.139	0.485
5	Milling machine 1	5.431343” 7.032687”	0.009	78.3	0.096	0.336
6	Drilling machine 1	5.431266” 7.032666”	0.013	113.1	0.139	0.485
7	Drilling machine 2	5.431273” 7.032570”	0.015	130.5	0.160	0.560
8	Lathe machine	5.431360” 7.032662”	0.009	78.3	0.096	0.336
9	Hydraulic pressing machine	5.431361” 7.032266”	0.011	95.7	0.117	0.411
	Average		**0.012**	**109.72**	**0.1448**	**0.484**
	UNSCEAR (2002)		**0.013**	**84.0**	**1.0**	**0.29×10^{-3}**

Table 7. Radiation exposure level of Automatic Laboratory (Indoor)

S/N	Sampling Points	GPS Reading	Exposure Dose Rate (mR/hr)	Absorbed Dose Rate (nGy/hr)	AEDE Indoor (mSv/y)	ELCR Indoor 10^{-3}
1	Automatic module 1	5.432034” 7.032292”	0.015	130.5	0.160	0.560
2	Automatic module 2	5.432034” 7.032292”	0.006	52.2	0.064	0.224
3	Automatic module 3	5.432034” 7.032292”	0.009	78.3	0.096	0.336
4	Automatic module 4	5.432034” 7.032292”	0.014	121.8	0.149	0.523
5	Automatic module 5	5.420340” 7.032992”	0.015	130.5	0.160	0.560
6	Automatic module 6	5.420340” 7.032992”	0.015	130.5	0.160	0.560
7	Bench 1	5.420340” 7.032992”	0.013	113.1	0.139	0.485
8	Bench 2	5.420340” 7.032992”	0.013	113.1	0.139	0.485
9	Store	5.420340” 7.032992”	0.009	78.3	0.096	0.336
10	Safety Stand	5.432034” 7.035992”	0.008	69.6	0.085	0.299
	Average		**0.012**	**101.79**	**0.1237**	**0.437**
	UNSCEAR (2002)		**0.013**	**84.0**	**1.0**	**$0.29x10^{-3}$**

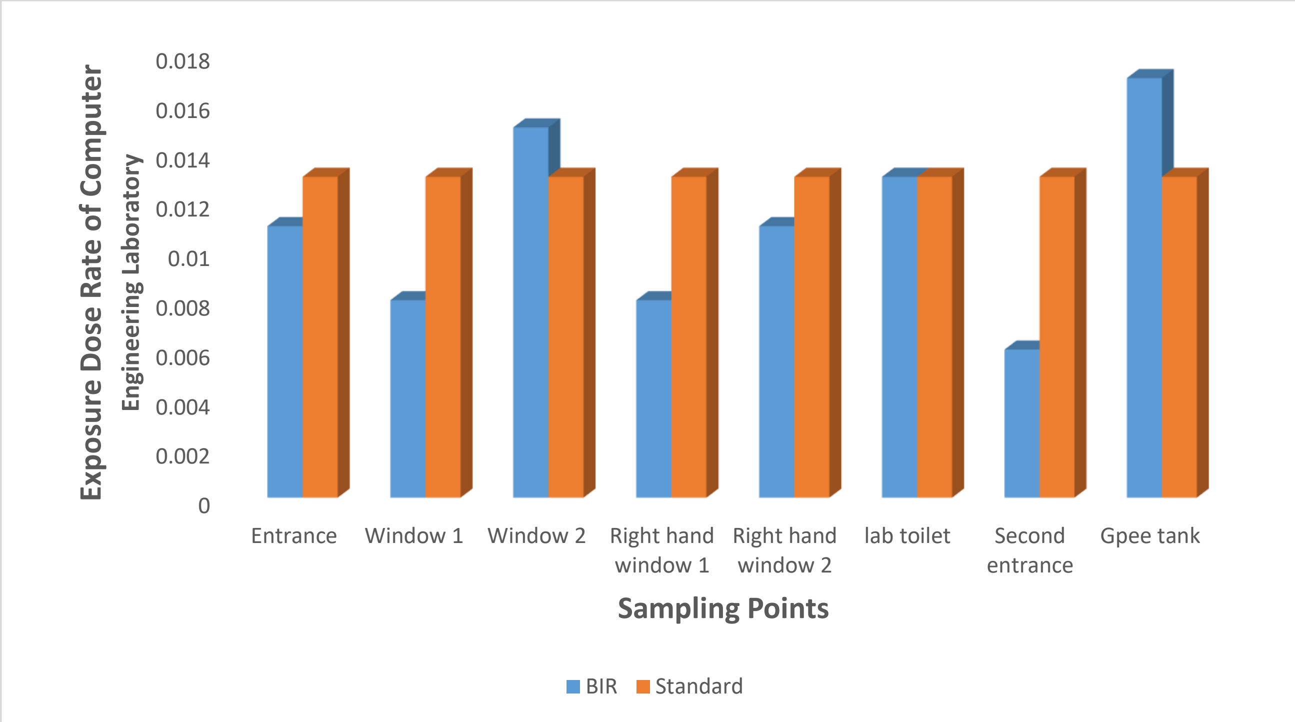


Fig. 1. Radiation exposure level of computer engineering laboratory (outdoor)

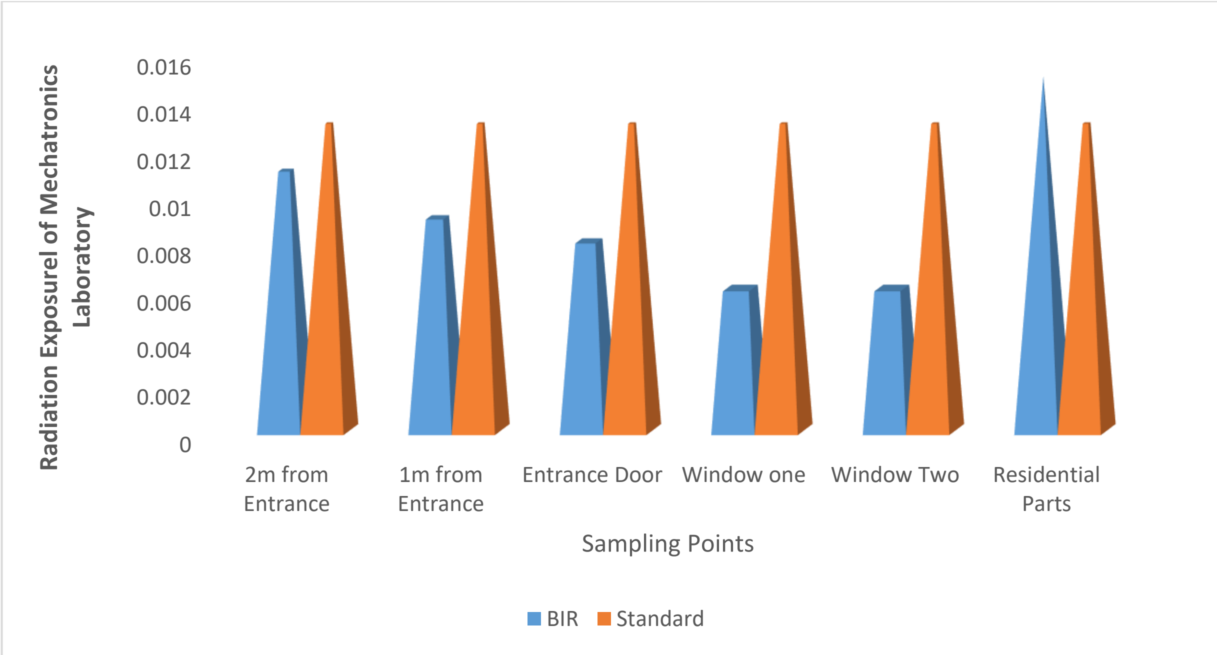


Fig. 2. Radiation exposure level of mechatronics laboratory (outdoor)

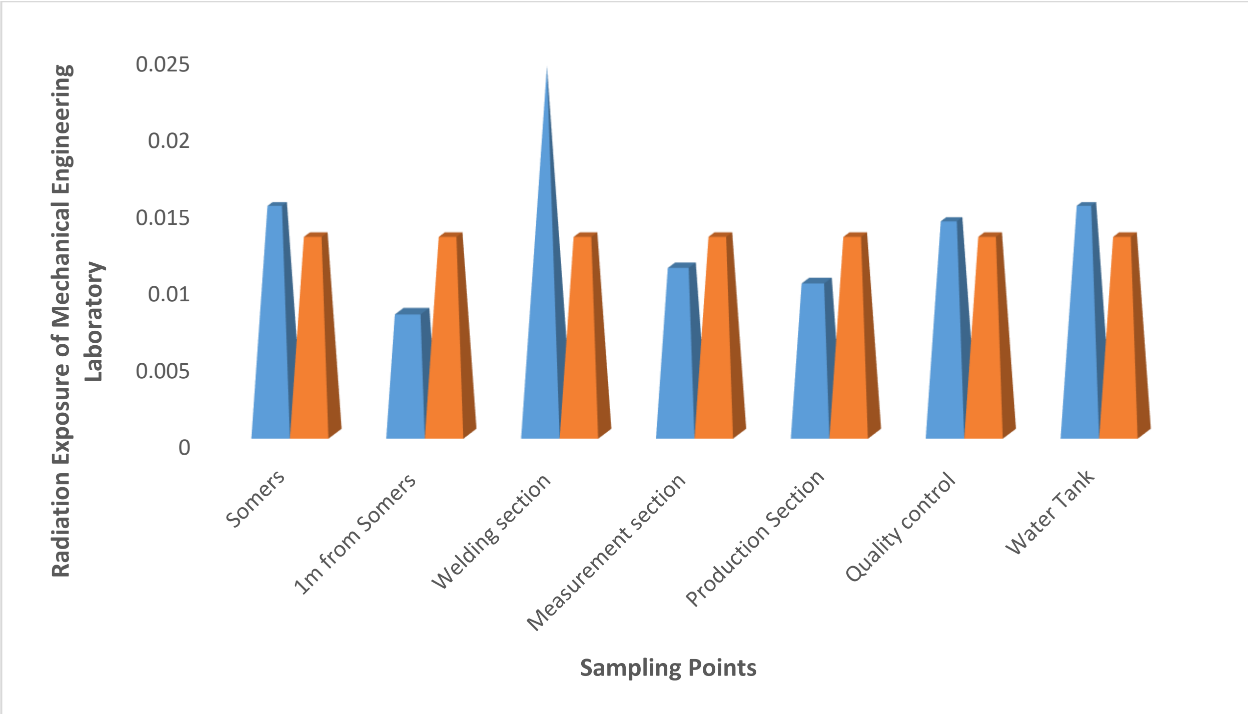


Fig. 3. Radiation exposure level of mechanical engineering laboratory (outdoor)

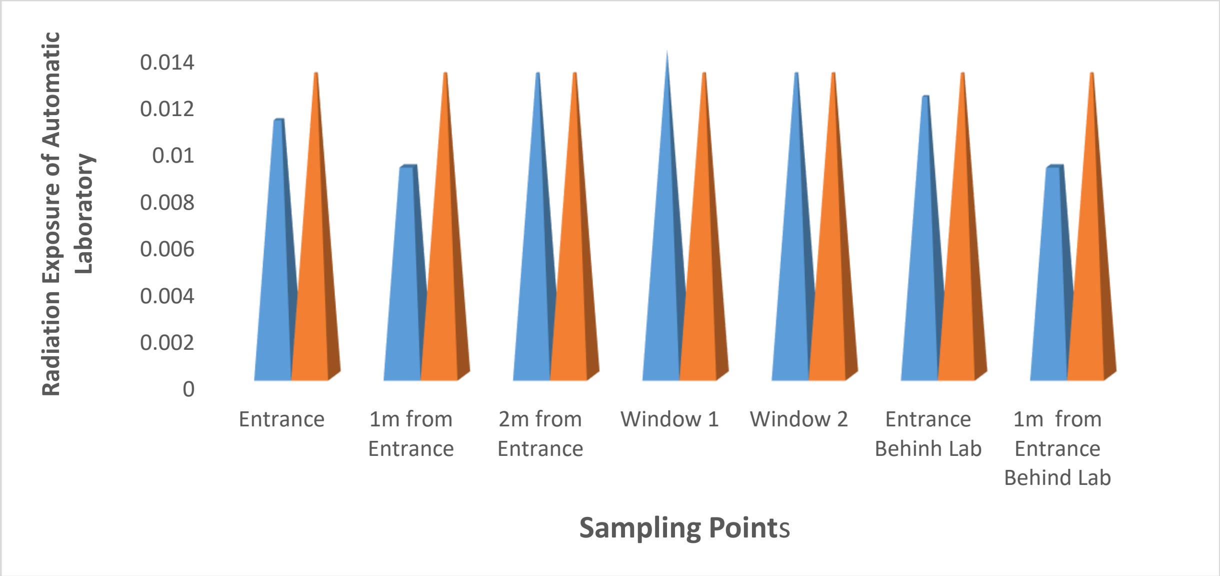


Fig. 4. Radiation exposure level of automatic laboratory (outdoor)

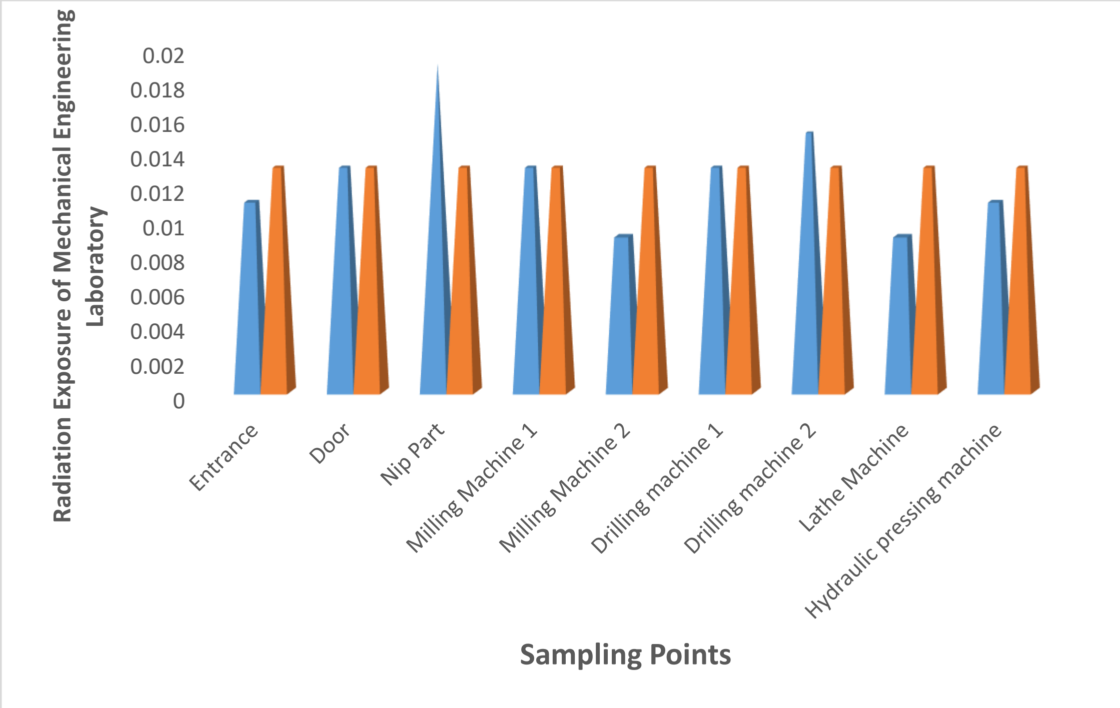


Fig. 5. Radiation exposure level of mechanical engineering laboratory (indoor)

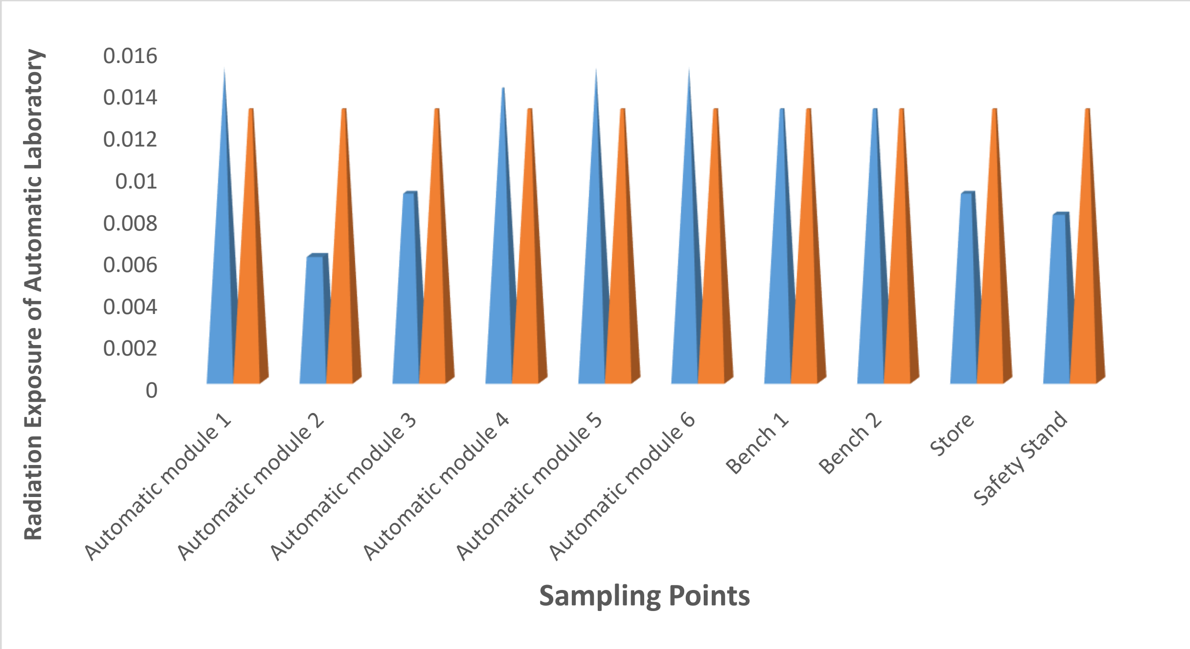


Fig. 6. Radiation exposure level of automatic laboratory (indoor)

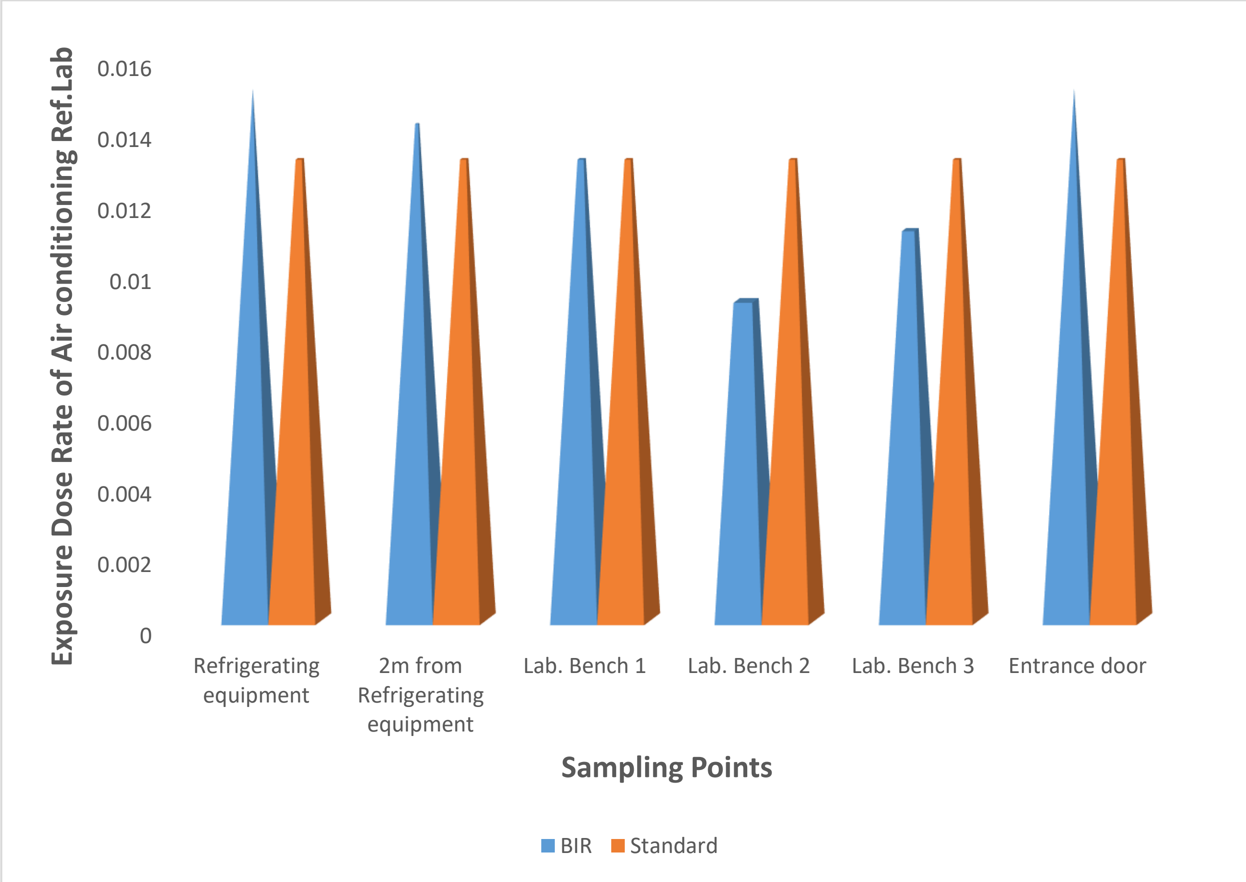


Fig. 7. Conditioning refrigerator laboratories with standard (indoor)

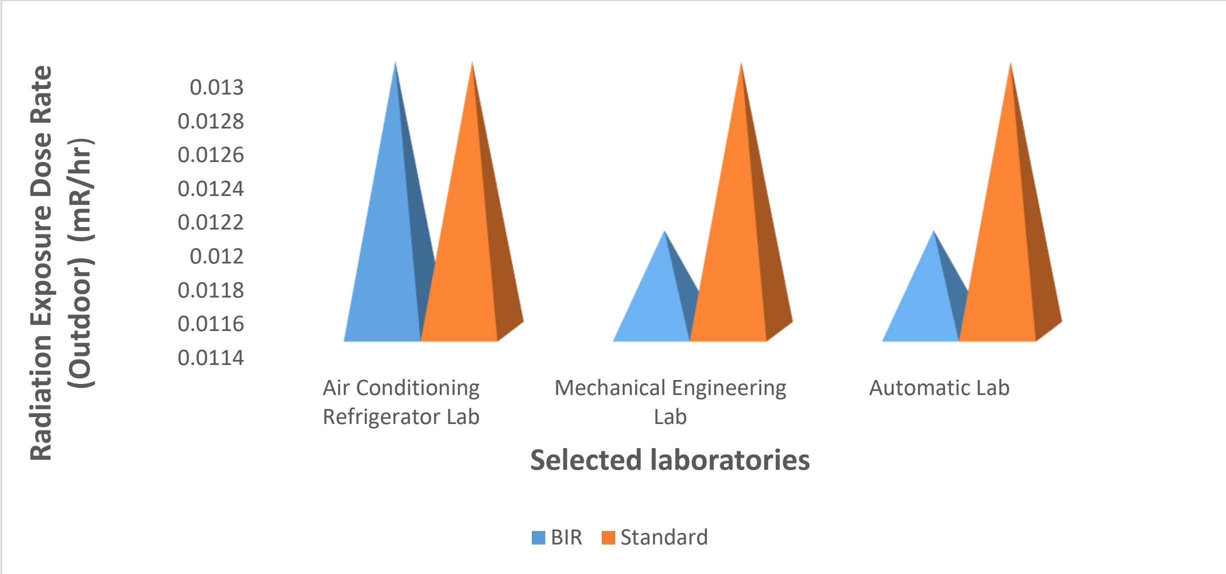


Fig. 8. Comparison of the mean of outdoor radiation exposure of the selected laboratories with standard

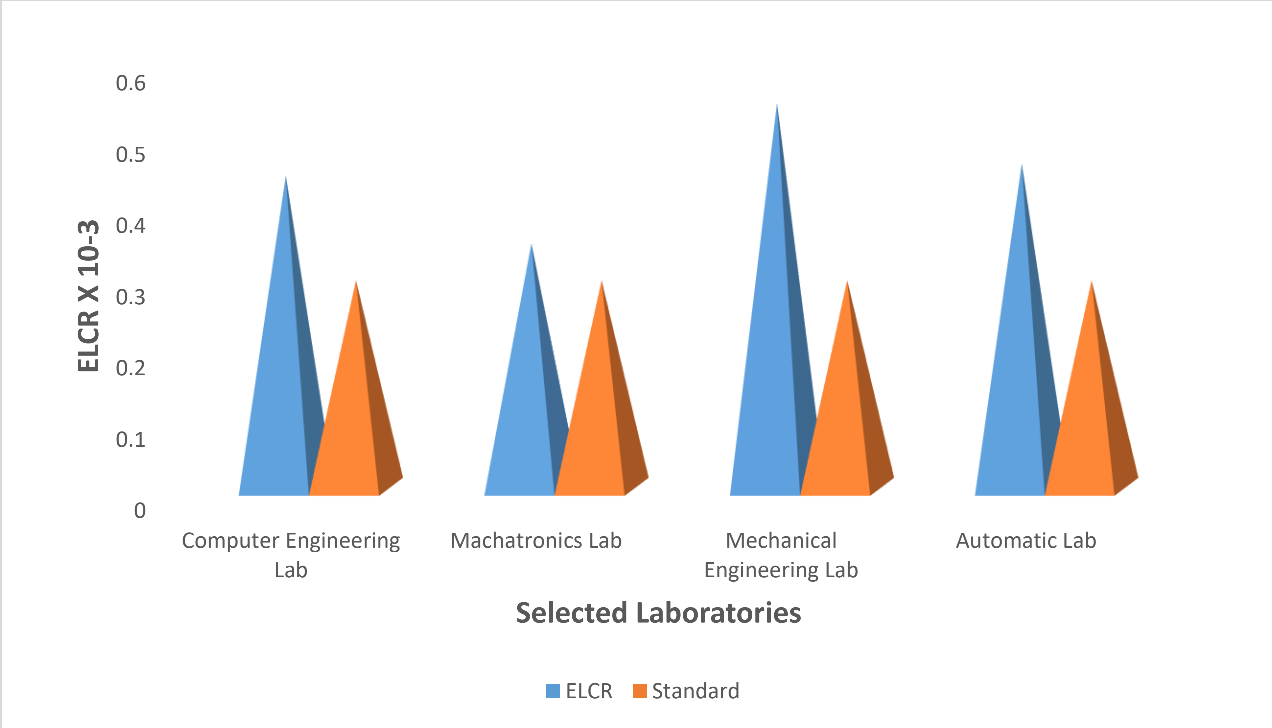


Fig. 9. Comparison of the mean of ELCR of the selected laboratories with standard

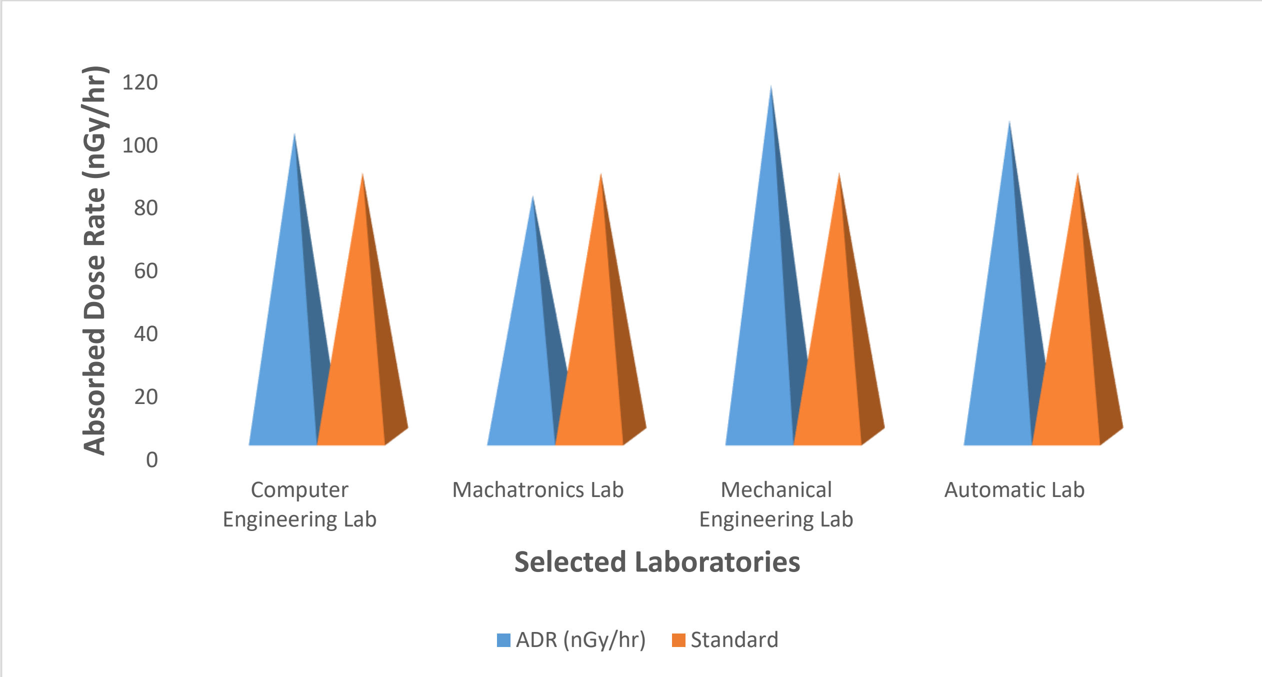


Fig. 10. Comparison of the mean of outdoor absorbed dose rate of the selected laboratories with standard

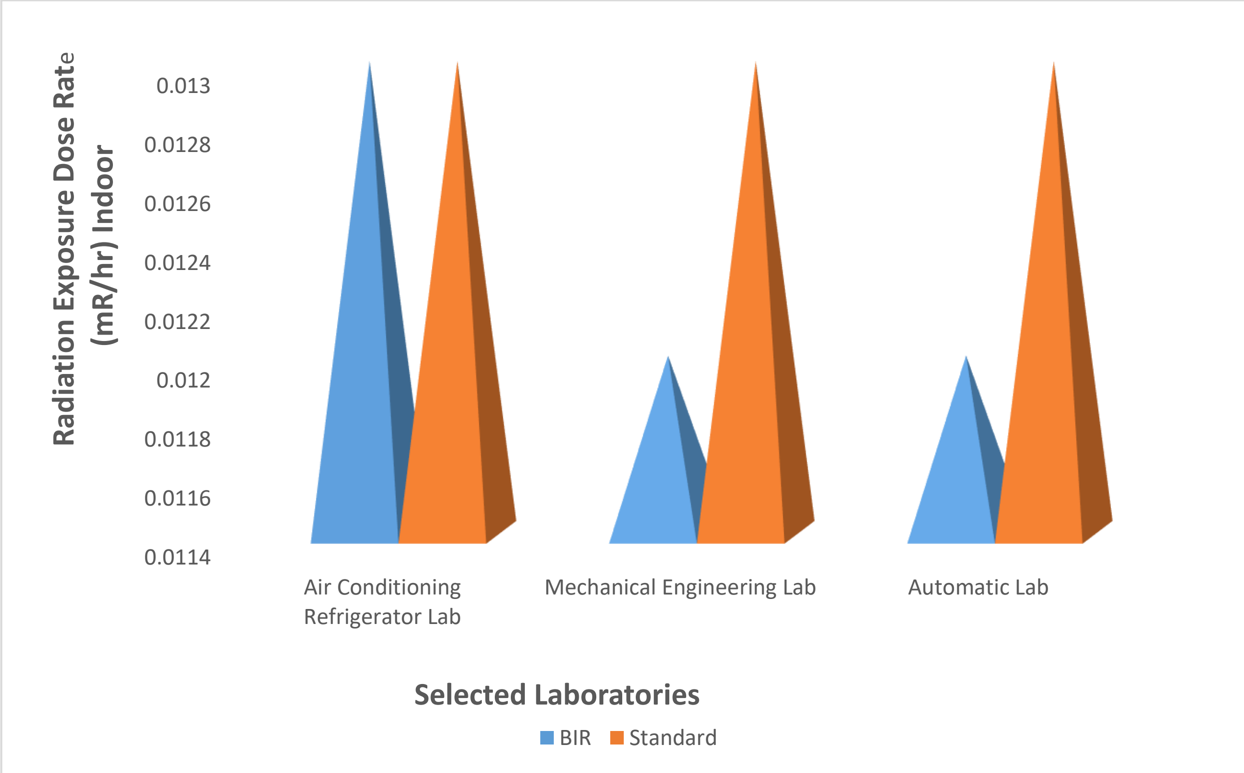


Fig. 11. Comparison of the mean of indoor radiation exposure of the selected laboratories with standard

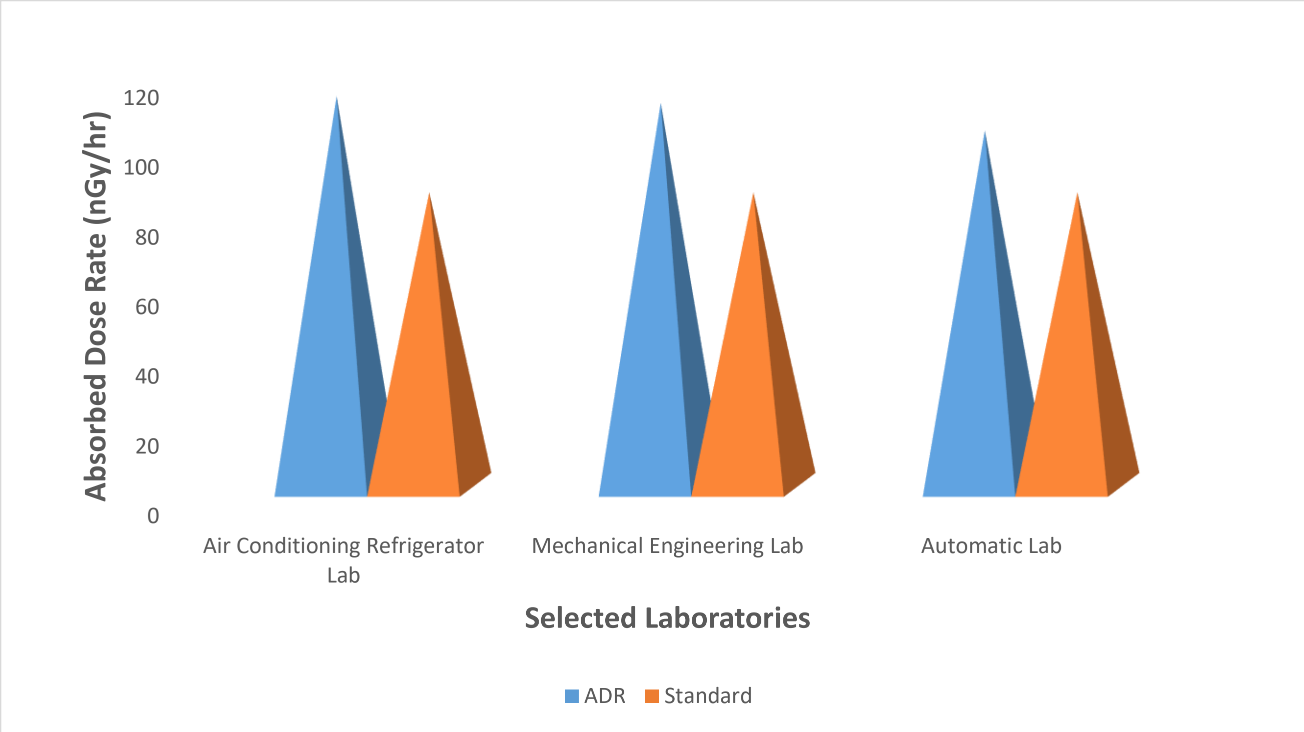


Fig. 12. Comparison of indoor absorbed dose rate of the selected laboratories with standard

Fig. 13. Comparison of ELCR (indoor) of the selected laboratories with standard

selected Laboratories is within the recommended safe limit of 0.013 mR/h as stipulated by the international committee of Radiological protection (ICRP, 2008). While Mechanical Engineering and Automatic Laboratories are higher than the stipulated value of 0.013 mR/h. The obtained BIR result are lower than the reported work by Anekwe and Ibe (2017) Farai and Vincent (2006). The background ionizing radiation variation within engineering laboratories might be due to the presence of radionuclide within the laboratories environment. Figs. 1-4. shows the background ionizing radiation of the sampling points within the selected laboratories. The absorbed dose rate varies from 52.2 -147.9 nGy/hr, 52.2-130.5 nGy/hr, 69.6 -147.9 nGy/hr, 78.3 -121.8 nGy/hr, with a mean of 96.8 nGy/hr, 79.8 nGy/hr,111.7 nGy/hr and 100.7 nGy/hr respectively. The obtained mean value for absorbed dose rate is higher than the stipulated value of 84.0 nGy/hr (ICRP, 2007), and also lower than the reported work of Anekwe and Ibe, (2017) Benson and Ugbede (2018). The annual effective dose equivalent (AEDE) of the selected laboratories varies from 0.064 - 0.160 mSv/y, 0.064 - 0.117 mSv/y, 0.085 - 0.160 mSv/y, 0.096 - 0.149 mSv/y, with a mean of 0.125 mSv/y, 0.098 mSv/y, 0.153 mSv/y and 0.129 mSv/y respectively. The result of AEDE of the selected Laboratories are below the stipulated standard value by ICRP (2007), and within the reported range by Ononugbo and Efere (2016). The results of excess life cancer risks (ELCR) varies from 0.224 $x10^{-3}$- $0.81x10^{-3}$,0.22 $x10^{-3}$- 0.56 $x10^{-3}$, 0.299 $x10^{-3}$- 0.93 $x10^{-3}$, and 0.34 $x10^{-3}$- 0.52 $x10^{-3}$ with a mean of 0.44 $x10^{-3}$, 0.34 $x10^{-3}$, 0.54 $x10^{-3}$and 0.45 $x10^{-3}$respectively. The result of the outdoor excess life cancer risks of the selected laboratories are higher than the standard value of $0.29x10^{-3}$ and also lower than the reported work of Avwiri et al., (2016).

The indoor background ionizing radiation of the selected laboratories varies from 0.009 - 0.015 mR/hr, 0.009 – 0.019 mR/hr, 0.006 - 0.015 mR/hr, with mean of 0.013 mR/hr,0.012 mR/hr,0.012 mR/hr, for Air Conditioning Refrigerator Laboratory, Automatic Laboratory and Mechanical Engineering Laboratory respectively. The mean value of the indoor background ionizing radiation exposure are within the recommended safe limit of 0.013 mR/hr, (ICRP, 2008). Figs. 5-7 shows the background ionizing radiation of the sampling points of the selected laboratories. The indoor absorbed dose rate varies from 78.3-130.5, 78.3- 169.7 (nGy/hr) and 52.2-130.5 with mean 111.7 nGy/hr, 109.7 nGy/hr, 101.8 nGy/hr respectively. The indoor absorbed dose of the selected laboratories is higher than recommended safe limit of 84 nGy/hr and lower than the reported work (Farai & Vincent, 2006). The results of the indoor annual effective dose equivalent (AEDE) of the selected laboratories varies from 0.096-0.160, 0.096-0.160,0.064 -0.16 (mSv/y), with mean value of 0.14, 0.145, 0.124 (mSv/y) respectively. The result of the indoor AEDE of the selected laboratories are below the stipulated value of ICRP (ICRP, 2007). The indoor excess life cancer risks (ELCR) varies from 0.336 $x10^{-3}$-0.560 $x10^{-3}$, 0.336 $x10^{-3}$-0485 $x10^{-3}$ and 0.299 $x10^{-3}$-0.560 $x10^{-3}$ with mean 0.48 $x10^{-3}$, 0.484 $x10^{-3}$, 0. 437 $x10^{-3}$. The indoor ELCR of the selected laboratories are all higher than the stipulated standard value of $0.29x10^{-3}$ and lower than the reported work (Avwiri et al., 2016; UNSCEAR, 2002).

5. CONCLUSION

The *in-situ* measurement of Background Ionizing Radiation (BIR) of the Engineering laboratories of Federal Polytechnic Nekede has been carried out, using a calibrated radiation meter. The results have revealed that the outdoor Background ionizing radiation of the selected laboratories are within the recommended safe limit, except Mechanical Engineering Laboratory which have a higher value than the recommended standard value of 0.013 mR/hr. Though some of the sampling points within the laboratories were higher than the stipulated value. The indoor Background ionizing radiation (BIR) are all within the stipulated value of 0.013 mR/hr. The mean value of the absorbed dose rate of engineering laboratories both outdoor and indoor of the engineering laboratories are above the standard value of 84.0 nGy/hr. The obtained mean of excess life cancer risk (ELCR) for both indoor and outdoor of the selected laboratories are all higher than the recommended safe limit. The variation of the radiation value may be due to the presence of radionuclide within the laboratories environment or due to research waste materials which is capable of emitting gamer radiation within the environment. The obtained values of radiation exposure and other related parameters may not pose any immediate health effects on students and staff of the Federal Polytechnic Nekede but there may be long term, future health effects on the general population of the studied area. However, there should be a regular monitoring of the radiation level within the faculty.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that No generative AI Technologies such as Large Language Models and text-to-image generator have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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