

Annual Radiation Exposure to Workers in a Tertiary Care Hospital in Kashmir : A 10-Year Analysis and Comparison with National Levels of exposure

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ABSTRACT

Objective: To assess the radiation exposure amongst radiation workers in Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, a tertiary care 620 bedded superspeciality hospital was carried out.

Material and Methods: A 10-year retrospective analysis of the whole body radiation exposure to the radiation workers of SKIMS Srinagar, Two blocks of five years each from 1995 to 1999 & 2002 to 2007 were studied and compared with the national pool of radiation workers for the same period. The average annual dose of radiation workers working in different radiation departments of SKIMS was compared with the workers of the similar department of the national pool.

Results & Conclusion: It was observed that in the block of 5 years from 1995 to 1999 the average whole body dose to the radiation works at SKIMS during the latter half showed a rising trend for three years as compared to the national pool. However in the block 2002 to 2005 the average annual dose was mostly similar except for a higher dose to SKIMS workers in 2005. It was observed that the average annual dose received by the workers of Nuclear Medicine department of SKIMS was usually high more so in the five year block of 2000 to 2005. The workers of Radiodiagnosis at SKIMS also received a higher annual dose in 7 of the 10 years of study. *J Med Sci* 2009;12(2):41-45

Key words: Monitoring, TLD badge, Radiation worker, Average annual radiation dose.

Introduction

The use of ionizing radiation in day to day practice of medicine has considerably increased over a period of time. Not only is radiation technology used for diagnostic purposes but its therapeutic applications have increased manifold. Radiation in the form of X rays, gamma rays and beta particles have wide spread therapeutic applications in

a wide variety of diseases notably in oncological and endocrine disease. Radioisotopes like Technetium-99m (Tc-99), Thallium-201 (TL-201), Indium-111 (In-111), Gallium-67 (Ga-67), Flourine-18 (F-18), Iridium-192 (Ir-192), Cobalt-60 (Co-60) etc are used extensively for imaging. Isotopes like Iodine-131 (I-131), Phosphorus-32 (P-32), Strontium-89 (Sr-89), Samarium-153 (Sm-153) etc are used for treatment of diseases like thyroid cancer, metastatic bone pain palliation and thyrotoxicosis.¹ This exponential increase in the use of radiation technology over the last few decades has seen almost all the hospitals of the country establishing mainstream radiation facilities like Radiodiagnosis, Radiotherapy, Nuclear Medicine and other radiation utility departments like Cardiology,

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Gastroenterology, Immunology etc. The issue of radiation safety standards and radiation protection has assumed an important significance. International agencies like International Atomic Energy Association (IAEA) and International Commission on Radiological Protection (ICRP) have from time to time set basic guidelines for radiation safety.^{2,3} In India, Atomic Energy Regulatory Board (AERB) is the apex national authority which regulates the matters of radiation safety and radiation protection.⁴

The present study was a sequel of a previous study done in 2002 where in the over all status of the radiation safety at SKIMS Srinagar was assessed for a period of five years from 1995 to 1999 and compared with the national pooled data of national radiation workers.⁵ In the present study average annual radiation dose received by the radiation workers at SKIMS was assessed for a second block of five years extending from 2002 to 2007 and the results were compared with the previous studied block and also compared with the national data for the same period.^{5,6}

Radiation facilities available at SKIMS include mainstream departments like Radiotherapy, Radio-diagnosis, and Nuclear Medicine and other departments like Cardiology, Immunology and Gastroenterology. There has been a considerable expansion of the facilities in terms of equipment as well as infrastructure over the last ten years. A number of facilities like Spiral CT, MRI, Dual head gamma camera, CT Simulator, Cobalt-60 teletherapy etc have been installed over the last five years. Nuclear Medicine has seen considerable increase both in terms of equipment and work output over the last five years.

Material & Methods

A retrospective analysis of average annual whole body doses to radiation workers at SKIMS for a period of ten years comprising of two blocks of five years each, 1995-1999 and 2002-2006 were compared with the average annual whole body dose to radiation worker of multi institutional national pool for the same period. For the five year block 1995-1999, 109 radiation workers from SKIMS that included 37 workers from Radio-diagnosis, 18 from Radiotherapy 15 from Nuclear medicine and 39 from other departments of Cardiology Immunology, Gastroenterology and Radiological Physics. Their annual whole body doses were compared with the national pool of medical radiation workers. In the second five-year block under study, 2002- 2006, 99 radiation workers from SKIMS were included. These included 34 from Radio-diagnosis, 14 from Radiotherapy 11 from Nuclear Medicine and 40 from departments of Cardiology, Immunology, Gastroenterology and Radiological Physics.

Average annual whole body dose to the radiation workers at SKIMS were monitored using a calcium

sulphate: Dysprosium Thermo-luminescence dosimeter (TLD) supplied by Bhaba atomic Research Centre (BARC), Mumbai, India. All the radiation workers wore the TLD at their chest levels during the working hours. The TLD badges were regularly analyzed and the records maintained for reference.

Results

The average annual whole body radiation dose to the radiation workers at SKIMS for a period of 10 years measured in two blocks of five year each from 1995 to 1999 and 2002 to 2006 (Table-1) was well within the prescribed safety limits of 20 milli Sieverts (mSv).^{7,8,9} When the doses were compared with the national pool of radiation workers, it was observed that the dose received by the radiation workers at SKIMS was higher than the national average of 0.5mSv for 5 out of ten years of study (Table-1 and Fig. 1). There was also a considerable fluctuation in the average annual dose received by the workers at SKIMS as compared to the relatively consistent dose to the radiation workers from the national pool (Fig. 3). The average annual dose to the national radiation workers over the ten years of study is consistently around 0.5mSv where as the SKIMS data shows considerable variation and ranges from 0.13mSv to 0.99mSv. In the first five-year block, the maximum annual dose at SKIMS was 0.99 mSv in the year 1997 while in the second five year block it was 0.72mSv in 2002. At both occasions, the average annual dose at SKIMS was considerably higher than the national average annual

Table 1: Comparison of average annual whole body dose per radiation workers at SKIMS with multi-institutional pool of radiation workers

Year	SKIMS (mSv)	Multi-insitutional pooled data (mSv)
1995	0.40	0.54
1996	0.13	0.46
1997	0.99	0.51
1998	0.86	0.52
1999	0.68	0.55
2002	0.40	0.50
2003	0.32	0.50
2004	0.52	0.50
2005	0.72	0.50
2006	0.38	0.50

dose (Table-1 and Fig. 1).

Discussion

The present 10 years study was done at SKIMS with an objective to asses the quality of existing radiation safety

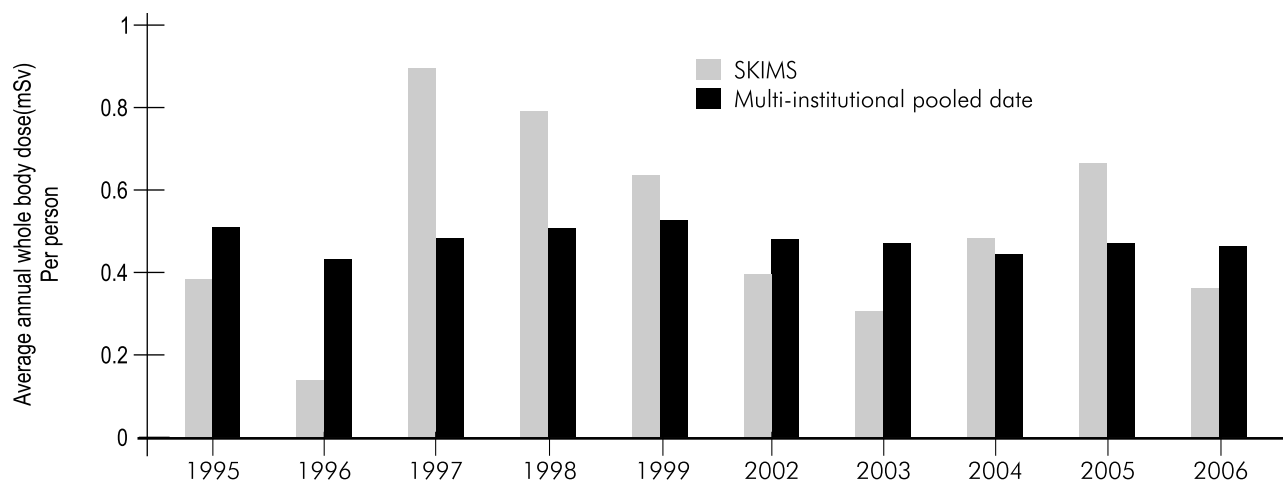


Figure 1: Average whole body dose per radiation worker in comparison with other medical institutions

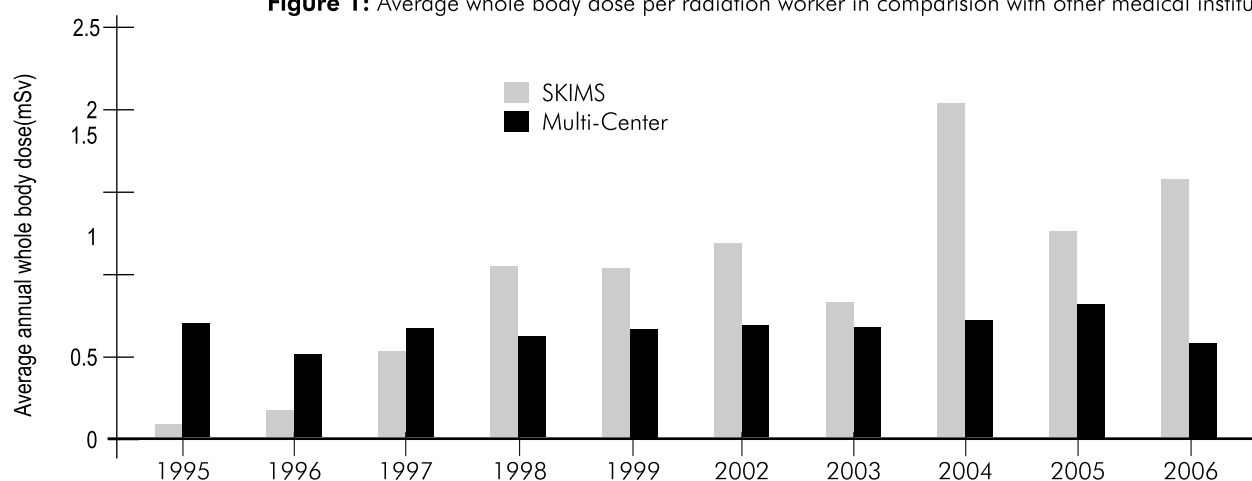


Figure 2: Average annual dose (whole body) of radiation worker in Nuclear Medicine Department at SKIMS and Multi Institutional National Pool

standards by analyzing the annual whole body dose to its radiation workers. It was observed that the overall dose profile of radiation workers at SKIMS during the blocks under study was within the prescribed safe annual limits of 20 milliSieverts (20mSv). However, these doses at SKIMS were higher than the national average for more than five years of the total study duration of 10 years (Table-1 and Fig. 1). In the study block 1995-1999, the average annual doses were persistently high in the later three years as compared to the national average of .50mSv (Fig.1). In the study block from 1995-1999 a rising trend of higher annual dose to the radiation workers at SKIMS was observed, however the exposure doses became relatively uniform in the study block of 2002-06 (Fig. 1). The study block 2002-2006, revealed an annual average whole body dose to the radiation workers at SKIMS well below the national average of .50mSv except in the year 2005. It is clear from the study that even though there was a significant increase in the work load in radiation departments at SKIMS, the average annual whole body doses received by the radiation

workers remained below the prescribed limits of radiation safety. However, the annual whole body doses at SKIMS though within the safe limits are higher than the national average of .50mSv in five out of ten years of study.

One of the reasons which could explain the higher doses received by the radiation workers at SKIMS is the sudden increase in the workload due to the augmentation of the infrastructure in terms of new equipment in the departments of Nuclear Medicine and Radio-diagnosis during the period. In the department of Nuclear Medicine at SKIMS, the handling of more radioactive material along with considerable increase in the work load (Table 3 and Table 4) may have contributed to the increased radiation exposure among its workers.

Conclusions

The average annual whole body dose to the radiation workers at SKIMS are within safe limits but they are above the national average. The comparison of the national

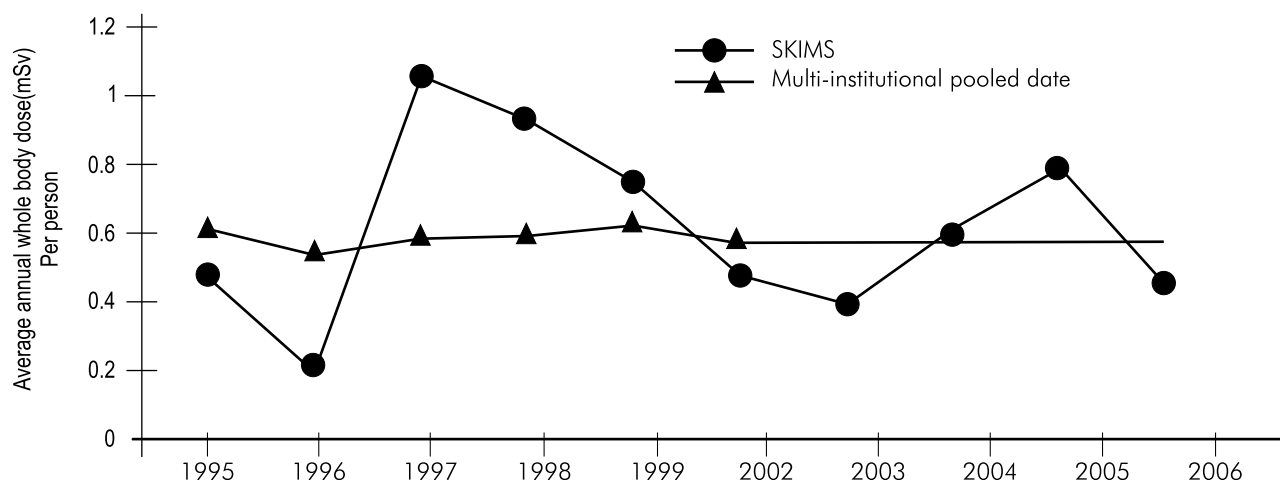


Figure 3: Average whole body dose per radiation worker in comparison with other medical institutions

Table 2: Comparison of average annual whole body dose per radiation worker at SKIMS in different radiation departments with Multi-institutional National pool of radiation workers of same departments

Year	Radio-diagnosis		Radiotherapy		Nuclear Medicine	
	SKIMS	Multi-Institutional Data	SKIMS	Multi-Institutional data	SKIMS	Multi-Institutional data
1995	0.90	0.47	0.08	0.71	0.09	0.73
1996	0.66	0.38	0.25	0.59	0.20	0.57
1997	2.18	0.43	0.48	0.68	0.58	0.70
1998	1.53	0.48	0.47	0.65	1.07	0.65
1999	0.99	0.44	0.49	0.65	1.05	0.71
2002	0.16	0.52	0.07	0.45	1.22	0.71
2003	0.18	0.50	0.12	0.45	0.85	0.70
2004	0.57	0.49	0.35	0.39	2.04	0.75
2005	0.40	0.50	0.17	0.32	1.27	0.85
2006	0.92	0.55	0.22	0.34	1.58	0.60

average annual whole body radiation doses to the radiation workers at SKIMS does reveal a higher dose initially but there is a decreasing trend especially in the study block of 2002-2006. Steps need to be taken to keep the radiation doses at SKIMS comparable to the national dose. Nuclear medicine department at SKIMS that deals with unsealed radioactive sources for diagnostic and therapeutic purposes needs more efforts to minimize the occupational radiation exposure. The addition of the facility for high dose Iodine-131 therapy to thyroid cancer patients makes it imperative for the radiation workers to take necessary stringent protective measures. Radiation safety officers together with concerned medical and technological staff at SKIMS will have to evolve a joint strategy to bring down the exposure to the minimum possible levels in conformity with the well defined national and international guide-

Table-3: Diagnostic and therapeutic work done in the Department of Nuclear Medicine at SKIMS

Year	Tecnetium scans	Iodine-131 uptake	Iodine-131 low dose therapy
1995	148	86	28
1996	148	117	32
1997	1237	86	34
1998	1816	64	20
1999	2160	52	22
2002	3014	80	40
2003	4535	86	45
2004	4519	101	66
2005	4018	70	50
2006	4549	101	60

Table 4: Approximate quantity of Radionuclide's (Gbg) handled in Department of Nuclear Medicine of SKIMS

Year	I-131 (Gbg)	Mo-99 (Gbg)	TC-99m (Gbg)	Total (Gbg)
1995	44.84	-	-	-
1996	44.84	29.6	93.24	167.68
1997	44.84	384.8	1336.52	1721.32
1998	44.84	384.8	1125.26	1510.06
1999	44.84	384.8	1309.10	1639.90
2002	189.14	519.48	1912.46	26.21.08
2003	96.62	577.2	2126.02	2799.84
2004	88.94	577.2	2126.02	2792.16
2005	81.84	577.2	21.26.02	27.85.06
2006	81.84	577.2	2126.02	2785.06

lines.⁷⁻¹³ The cause for sudden peaks in the average annual doses as observed in both blocks of the study period need to

be identified, established, documented and rectified. Besides good working practices among the radiation workers at SKIMS, strict protection measures need to be implemented on regular basis. Regular coordination with the national regulatory bodies on radiation safety should be undertaken.

References

1. Coursey BM. Radionuclides for bone palliation. *Appl Radiation Isot* 1998;49:275-356.
2. Burt P, O'Driscoll R, Notley M et al. Intraluminal irradiation for palliation of lung cancer with high dose rate microselectron. *Thorax* 1990;45:765.
3. Teirstein P, Masullo V, Jani S et al. Cather based radiotherapy to inhibit restenosis after coronary stenting. *N Engl J Med*. 1997;336:1697-1703.
4. ICRP. Recommendations of international commission on Radiological protection 1990; Report 60, Pergamon Press: Oxford..
5. Khan SH. Whole body dose to the radiation workers at a tertiary care hospital in Kashmir. Analysis and comparison with the national pool of radiation workers. *IJNM* 2003;18(3):57-61.
6. ICRP. Recommendations of international commission on Radiological protection 1997; Publication 26, Pergamon Press:New York.
7. Safety code for Nuclear Medicine Laboratories. AERB safety code no SC/MED-4 1989; AERB: Mumbai, India.
8. Hendee INR, Edwards FM. ALARA and an integrated approach to radiation protection. *Seminar Nuc Med* 1986;16(2):142-50.
9. Murphy PH. Guidelines of radiation protection. *Seminar Nucl Med* 1986;16(2);131-41.
10. Nuclear Regulatory Commission. Notices, Instructions and reports to workers. Inspections. Code of Federal Regulations;Title 10:Part19.
11. Evans RD.Radiation protection and the staff of Nuclear Medicine departments. *Eur J Nucl Med* 1990;16:779-80.
12. Basic principals of occupational radiation monitoring. IAEA; 1987;Safety Series No. 84.
13. Vohra KG, Bhatt RC, Bhuwan Chandra et al. A personnel dosimeter TLD Badge on CaSo4:Dy Teflon TLD doses. *Health Physics* 1980;38:193.