

EFFECTIVE DOSE FROM INTAKE OF SOME RADIOLOGICALLY SIGNIFICANT RADIONUCLIDES IN INDIAN POPULATION

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ABSTRACT

ICRP-67 gave the age-dependent dose coefficients to the members of the public from ingestion of most radiologically significant radionuclides taking into account the various anatomical and physiological characteristics of ICRP Reference Man, Child and Infant. In this regard, Indians differ significantly from their ICRP counterpart. In this paper, efforts have been made to estimate effective dose from ingestion of some radionuclides viz. ^{95}Zr , ^{95}Nb , ^{132}I and ^{134}Cs taking into consideration the organ weights of Indian adult and children of various age groups. The effective dose estimates have been found to be marginally higher as compared to the corresponding values for their ICRP counterpart.

INTRODUCTION

Radiation dose to members of the public from ingestion of most radiologically significant radionuclides, that might be released to the environment due to various human activities are given in ICRP - 67 (1). The ingestion dose coefficients for various organs and tissues have been computed taking into account the various anatomical and physiological characteristics of ICRP Reference Man, Child of various age groups and Infant. In this regard, Indian population differs significantly from their ICRP counterpart (2-4). In the present study, efforts have been made to estimate effective dose from ingestion of some radionuclides viz. ^{95}Zr , ^{95}Nb , ^{132}I and ^{134}Cs for Indian adult and children of various age groups. These effective doses have been compared with the corresponding values as given by ICRP-67.

METHODOLOGY

The weight of five organs, namely, brain, kidney, liver, lungs and spleen was obtained from postmortem records of 3000 accident death cases in Indian population including children of various age groups (3). These organ weights were utilised to estimate dose coefficients in Indian population of various age groups namely 1y, 5y, 10y, 15y and adult by computing the dose transformation factors (DTF) for different organs using the method

suggested by Yanaguchi (5). The dose coefficients to various organs as given in ICRP-67 are multiplied by the corresponding dose transformation factors to give the revised dose estimates for the organs in the Indian population. In the present study, the effective dose has been estimated from ingestion of four radionuclides viz. ^{95}Zr , ^{95}Nb , ^{132}I and ^{134}Cs . The dose transformation factors for the various organs have been estimated for the principal gamma energy emitted by these radionuclides. Thymus is taken as a surrogate to oesophagus. The contribution to the effective dose from thymus as one of the remainder organs is not taken into account as its contribution has been already included while considering contribution from oesophagus. The equivalent dose to colon and gonads is computed in the manner similar to that adopted by ICRP-67 (1).

The effective dose was computed from ingestion of various radionuclides for Indian population utilising the transformation factors as computed for five selected organs mentioned above. For the other organs, if the weight of the organ is less than or equal to 20 g, DTF is taken as 1 and for the others, DTF has been computed considering the organ masses to be proportional to the body weight. For comparison, the relative difference between the E values for ICRP population to that of Indian counterpart has been worked out and expressed as %age change.

Table 1. Effective dose from ingestion of radionuclides

Effective dose(Sv/Bq)	Age at Intake				
	1y	5y	10y	15y	Adult
^{95}Zr					
E ₁	5.7E-9	3.1E-9	1.9E-9	1.2E-9	9.6E-10
E ₂	6.4E-9	3.7E-9	2.4E-9	1.4E-9	1.1E-9
^{95}Nb					
E ₁	3.2E-9	1.8E-9	1.2E-9	7.4E-10	5.9E-10
E ₂	3.5E-9	2.1E-9	1.4E-9	8.4E-10	6.7E-10
^{132}I					
E ₁	2.4E-9	1.3E-9	6.2E-10	4.2E-10	2.9E-10
E ₂	2.5E-9	1.4E-9	6.7E-10	4.5E-10	3.1E-10
^{134}Cs					
E ₁	1.6E-8	1.3E-8	1.4E-8	1.9E-8	1.9E-8
E ₂	1.7E-8	1.4E-8	1.5E-8	2.0E-8	2.0E-8

E₁ : Effective dose as given by ICRP-67 (1)

E₂ : Effective dose estimates for Indian population

Table 2. Relative Difference in Effective Dose Estimates for Indians to that of ICRP Population (%)

Radionuclide	Age at Intake				
	1y	5y	10y	15y	Adult
⁹⁵ Zr	10.9	19.4	26.3	18.7	14.6
⁹⁵ Nb	9.4	16.7	16.7	13.5	11.9
¹³² I	4.2	7.7	8.1	7.1	6.9
¹³⁴ Cs	6.3	7.7	7.1	5.3	5.3

RESULTS & DISCUSSION

Table 1 gives the effective dose (E_1) as given by ICRP-67 and the estimated value of E for Indian population (E_2) from the ingestion of ⁹⁵Zr, ⁹⁵Nb, ¹³²I and ¹³⁴Cs. Table 2 gives the %age change in effective dose estimates for Indian population as compared to the effective dose values for ICRP population. In case of ⁹⁵Zr and ⁹⁵Nb, an increase of 9-26% in effective dose values is found as the maximum contribution comes from colon whose DTF is computed considering its mass proportional to body weight. However, in case of ¹³²I and ¹³⁴Cs, the increase in E values are less (4-8%). In case of ¹³²I, the increase in E values is less as the maximum contribution to comes from thyroid, whose weight in Indians is considered to be the same as that of ICRP counterpart. However, the dose coefficients for ¹³⁴Cs is nearly same in all organs. The effective dose estimates for Indian adult and children of various age groups are higher than their ICRP counterpart as the organ masses in Indians are smaller as compared to ICRP.

In conclusion, it may be said that the revised effective dose estimates for Indian adult and child of various age groups were marginally higher as compared to the corresponding values for their ICRP counterpart for the four radionuclides considered.

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