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# Estimation of Radiation Dose to Korean Population Due to Computed Tomography Examinations

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## 1. Introduction

Computed Tomography (CT) is important tool in modern medical field for diagnosing diseases and injuries of patients. The usage of CT examinations has been increasing over time due to the public interest in health and growth of health industry[1].

CT scans result in high radiation dose among diagnostic radiation radiology. High radiation dose to the population is of concern from the aspect of the radiation safety and public health. Therefore, it is necessary to manage and evaluate radiation dose to the public by CT examinations at national level.

The objective of the present study was to estimate radiation dose to Korean population by CT examinations. Annual number of CT examinations was analyzed and estimated based on nationwide database. Radiation dose by CT examination was calculated using a radiation transport code.

## 2. Methods and Results

### *2.1 Statistical analysis of annual nationwide usages of CT examinations*

Nationwide data of CT usages were collected from the Health Insurance Review & Assessment Service (HIRA). The raw data were analyzed with SAS (Statistical Analysis System) program to estimate annual number of CT usages by examination type.

Table 1 shows the usage and fraction of CT examinations. Annual number of CT scans was about 9 million. The abdomen/pelvis CT examination accounted for the highest fraction of the total CT usage (35%). It was followed by the chest CT (23%) and head CT (22%).

Table 1: Usage and fraction of CT examinations

| Examination | No. of CT scans | Fraction (%) |
|---|---|---|
| Head | 2,003,414 | 22.5 |
| Neck | 277,851 | 3.1 |
| Whole-spine | 26,989 | 0.3 |
| Abdomen/Pelvis | 3,096,527 | 34.8 |
| Upper extremity | 214,525 | 2.4 |
| Spine | 664,065 | 7.5 |
| Lower extremity | 298,339 | 3.4 |
| Chest | 2,009,637 | 22.6 |
| Chest (high resolution) | 300,005 | 3.4 |
| Total | 8,891,352 | 100 |

### *2.2 Calculation of radiation dose and effective dose by CT examination type*

The organ dose and effective dose by CT scan were calculated using the MCNP code and compulational human phantom. CT setting data (e.g. kVp) and radiation exposure data (e.g. dose length products) were collected through literature review[2]. Fig. 1 shows examples of CT scan regions for the radiation dose calculation for head and chest CT examinations.

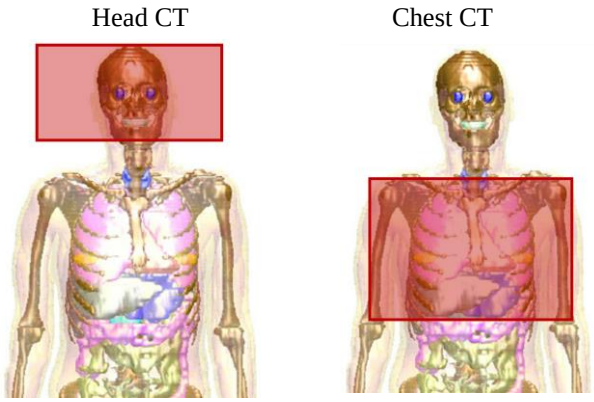


Fig. 1. Examples of examination area during CT scans

Fig. 2 shows effective dose resulting from some CT examinations. The effective doses were generally high for abdomen CT (6.8 mSv), L-spine CT (6.8 mSv), and abdomen/pelvis CT (6.2 mSv).

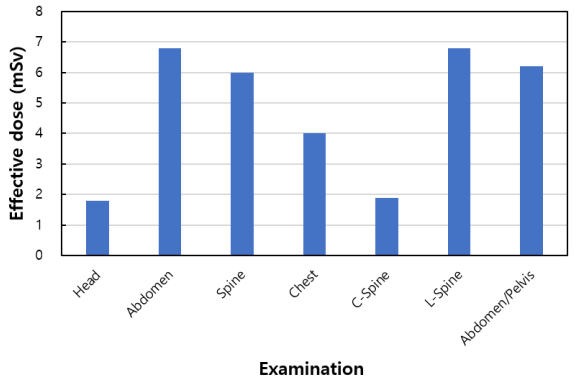


Fig. 2. Examples of the effective dose by CT examination

### *2.3 Estimation of radiation dose to Korean population due to CT examinations*

Annual radiation dose per capita and collective dose due to CT examinations were estimated by combining the annual nationwide usages of CT examinations and radiation doses due to CT examinations.

Fig. 3 shows the effective dose per capita and collective dose by CT examination. Annual effective doses per capita were generally high for abdomen/pelvis CT (0.37 mSv), chest CT (0.16 mSv), and head CT (0.07 mSv). Collective doses for the examinations were about 19 million man·Sv (abdomen/pelvis CT), 8 million man·Sv (chest CT), and 3.6 million man·Sv (head CT).

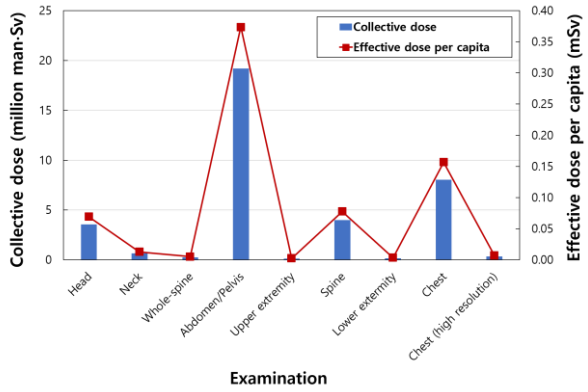


Fig. 3. Effective dose per capita and collective dose by CT examination

Finally, annual nationwide usage of CT examinations was about 9 million. The collective dose resulting from CT examinations was about 36 million man·Sv and the effective dose per capita was 0.71 mSv/year.

## 3. Conclusions

Radiation dose to Korean population due to CT examination was estimated using statistical analysis of nationwide usages of CT examinations and radiation transport simulations.

Annual effective dose per capita resulting from CT examinations was 0.71 mSv/year. This study results can be used as a representative data for the CT usages and resulting radiation dose. In addition, the study results can contribute to the management and optimization of radiation dose of CT scans from the aspect of radiation protection and public health.

## ACKNOWLEDGMENTS

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