An Investigation of Using a Single CT Image to Assess Size-Specific Dose Estimates (SSDE)

A. Abuhaimed[1] and C. Martin[2]
[1]The National Centre for Applied Physics, King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia.
[2]Department of Clinical Physics, University of Glasgow, Glasgow, UK.

JULY 12–16 2020 VIRTUAL
JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

INTRODUCTION

Assessment of size-specific dose estimates (SSDE) for patients undergoing CT scans requires determining water equivalent diameter (D_w) of the region of interest (ROI). The D_w is determined as an average for D_w values assessed for each slice inside the ROI, which means calculating D_w for a large number of slices reaching to hundreds. This process, however, is time-consuming and requires advance software to accomplish the calculation.

AIM

The aim of this study was to investigate the suitability of using a single slice at the center of ROI to assess average D_w.

METHOD

A MATLAB code was developed in house to calculate D_w of each slice for trunks of 351 pediatric and adult phantoms created based on CT images of patients [1]. The trunk was divided into six scan regions: chest, abdomen, pelvis, chest-abdomen, abdomen-pelvis, and the whole trunk (CAP) [2]. $D_{w,mid}$ of the central slice and $D_{w,mean}$ average were assessed for each scan region by the code, which allowed assessment of the percentage differences (PD) as:

$$PD = \left(\frac{D_{w,mid} - D_{w,mean}}{D_{w,mean}} \right) \times 100$$

RESULTS: The percentage differences between $D_{w,mean}$ average and the central slice $D_{w,mid}$ were found to be comparable for pediatric and adult phantoms as shown in the figures below. The PDs were in the ranges of (-10.1 to 12.7)% and (-11.3 to 12.8)%, respectively, with the average being ±5.4% and ±6.0%. Lower differences were in the chest region, whereas the pelvic region produced the largest differences. Beside the scan region, the differences were affected by gender and patient size. Generally, the differences were larger for males and increased with patient size.
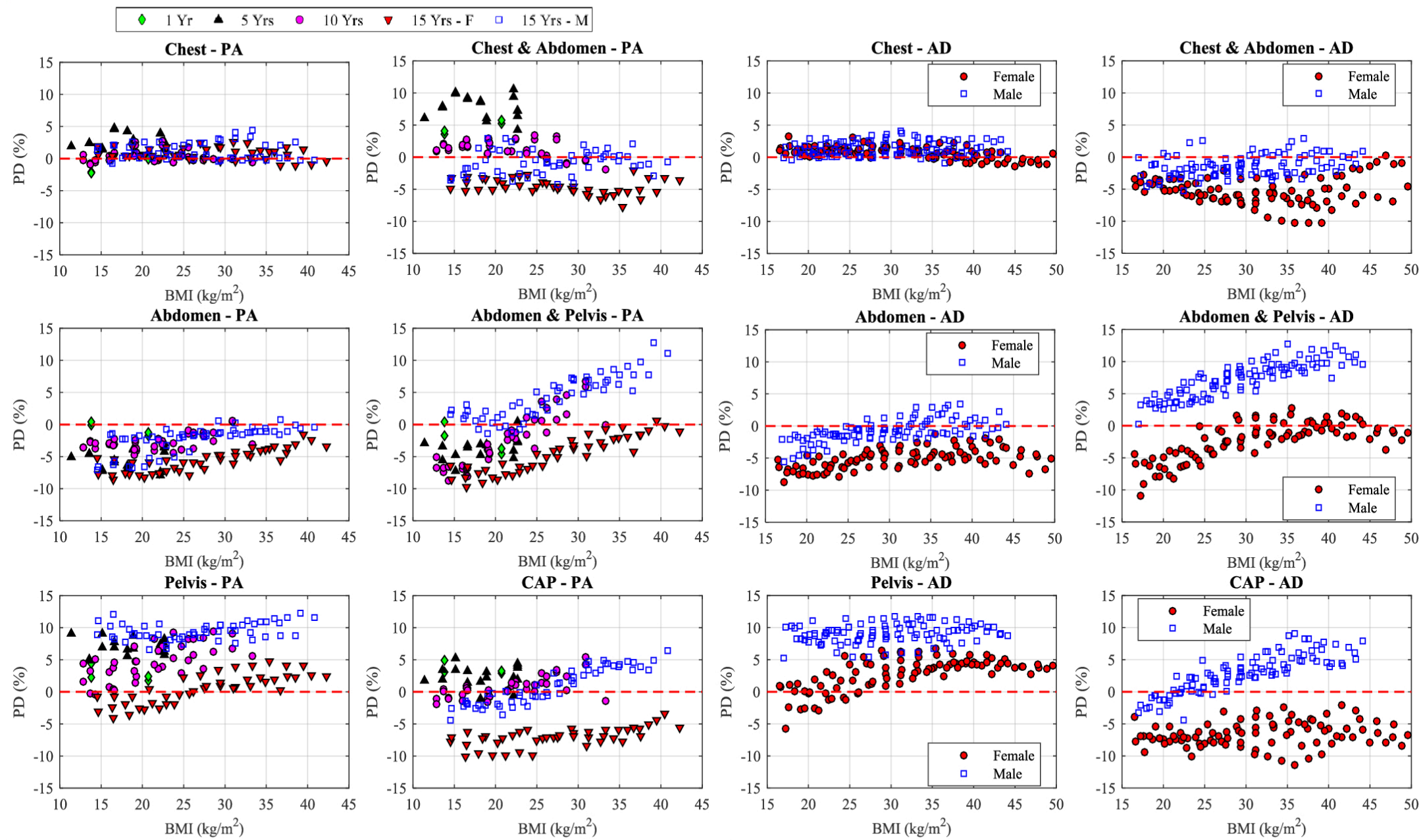

Figure 1: Percentage difference (PD) values between $D_{w,mean}$ and $D_{w,mid}$ for the paediatric phantoms used in the study.

Figure 2: Percentage difference (PD) values between $D_{w,mean}$ and $D_{w,mid}$ for the adults phantoms used in the study.

CONCLUSIONS

Although the use of $D_{w,mid}$ of the central slice gave a reasonable estimation for $D_{w,mean}$ average for some regions, it should not be applied without consideration for the significant differences found for other regions that reached to ±13%. Correction factors or using correlation between $D_{w,mid}$ at the center and the average $D_{w,mean}$ may be considered as practical approaches.

ACKNOWLEDGEMENTS

REFERENCES

1. Abuhaimed, A. and Martin, C. J. (2020) 'Estimation of size-specific dose estimates (SSDE) for paediatric and adults patients based on a single slice', *Physica Medica: European Journal of Medical Physics*. Elsevier, 74, pp. 30–39. doi: 10.1016/j.ejmp.2020.05.001.
2. Lee, C. et al. (2010) 'The UF family of reference hybrid phantoms for computational radiation dosimetry', *Physics in Medicine and Biology*, 55(2), pp. 339–363. doi: 10.1088/0031-9155/55/2/002.

CONTACT INFORMATION

All authors declare that there is no conflict of Interest