

EXPOSURE RATE ASSESSMENT FROM SELECTED CATHODE RAY TUBE DEVICES

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Introduction

- Television (TV) receivers and Personal Computer (PC) monitors have become major elements in the modern work environment and everyday life
- X-rays are produced in Visual Display Units when the electrons decelerate as they strike the phosphor at the front of the monitor screen. This phenomenon is not observed in modern flat screens i.e. LCDs
- Watching TV takes up 13.5 years of an average lifetime (Cancer Risk Foundation, 2013)

Research problem/Aim

EMRs from these devices are suspected to be largely part of the cause of health and dermatological problems like: cardiovascular diseases, Cancer, heart rate variability, neurodegenerative diseases and psychiatric disorders (Eck, 1985).



This comparative study is an effort to determine the dose rates of ionizing radiation from these devices

Materials and Methods

- One thousand sample measurements from CRT TV and PC monitors were taken
- The BlueGeiger PG-15 Geiger Muller Counter from France was used to take dose rate measurements
- Background measurements (BG) were taken. Measurements were taken at different distances from screen front and lateral sides.
- While taking the measurements, the devices were isolated as much as possible from other devices with possible EMR emission



Results

The Results show the: 1. Distribution of measurements, 2. Variation of Dose Equivalent Rate (DER) with distance, 3. Comparison between Screen front and Lateral DER as well as 4. Annual Effective Dose (AED) for various exposures

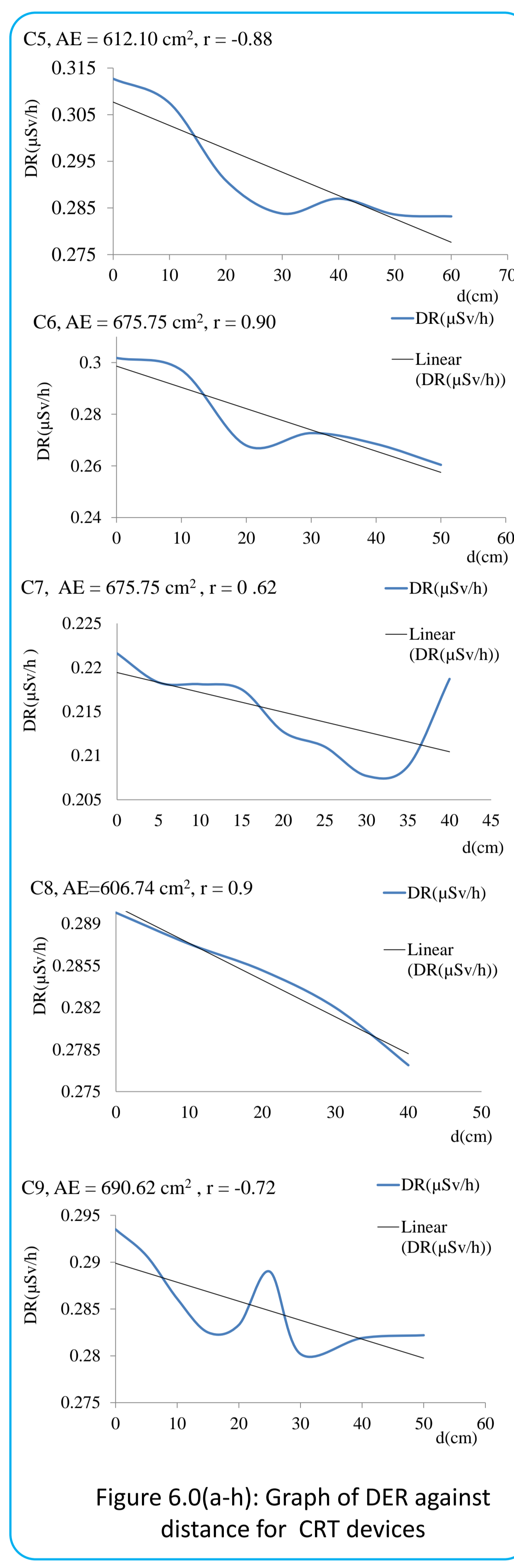
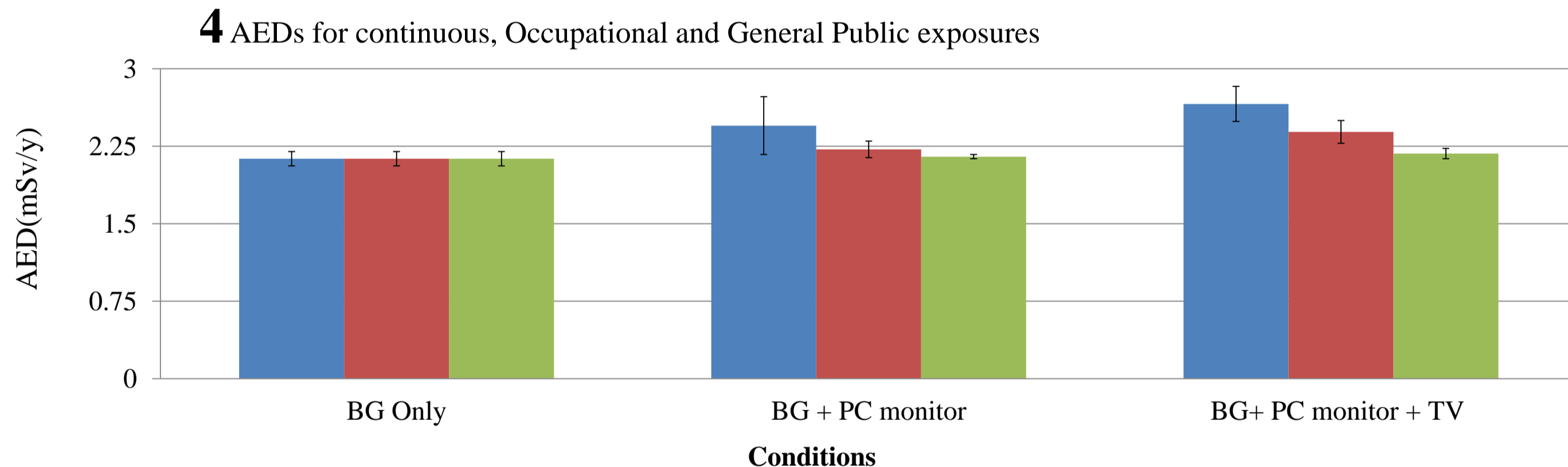
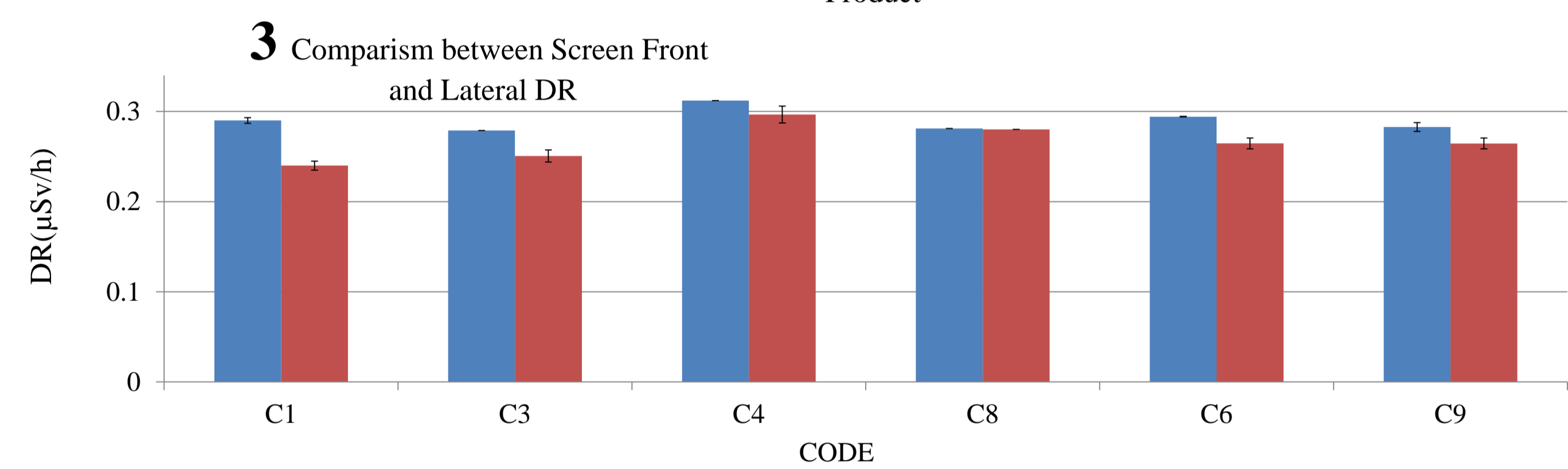
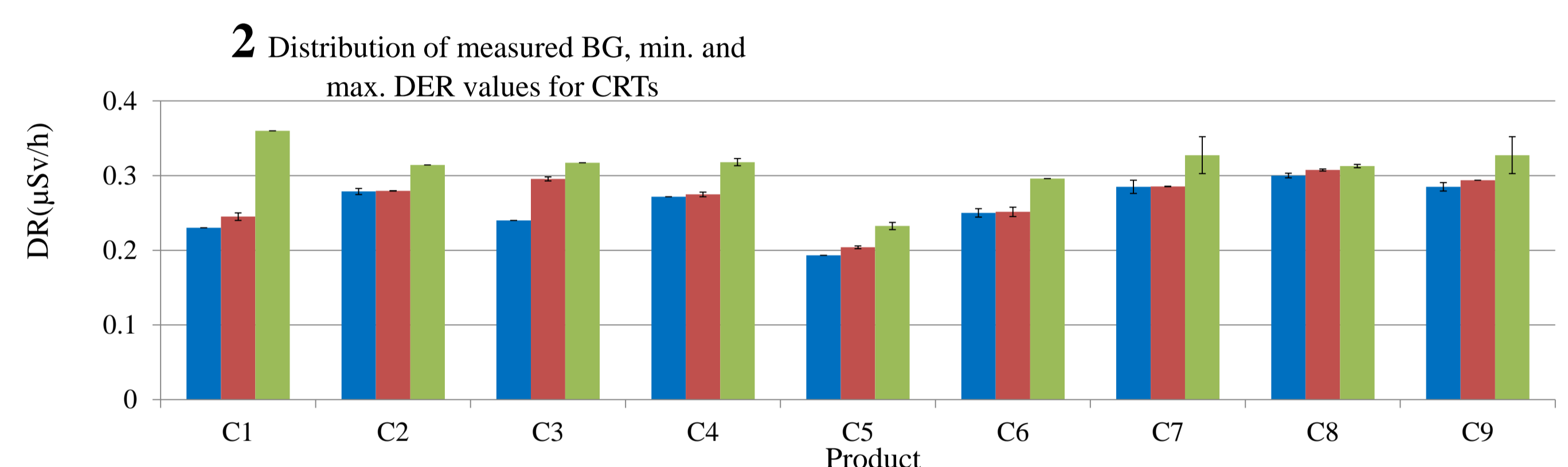
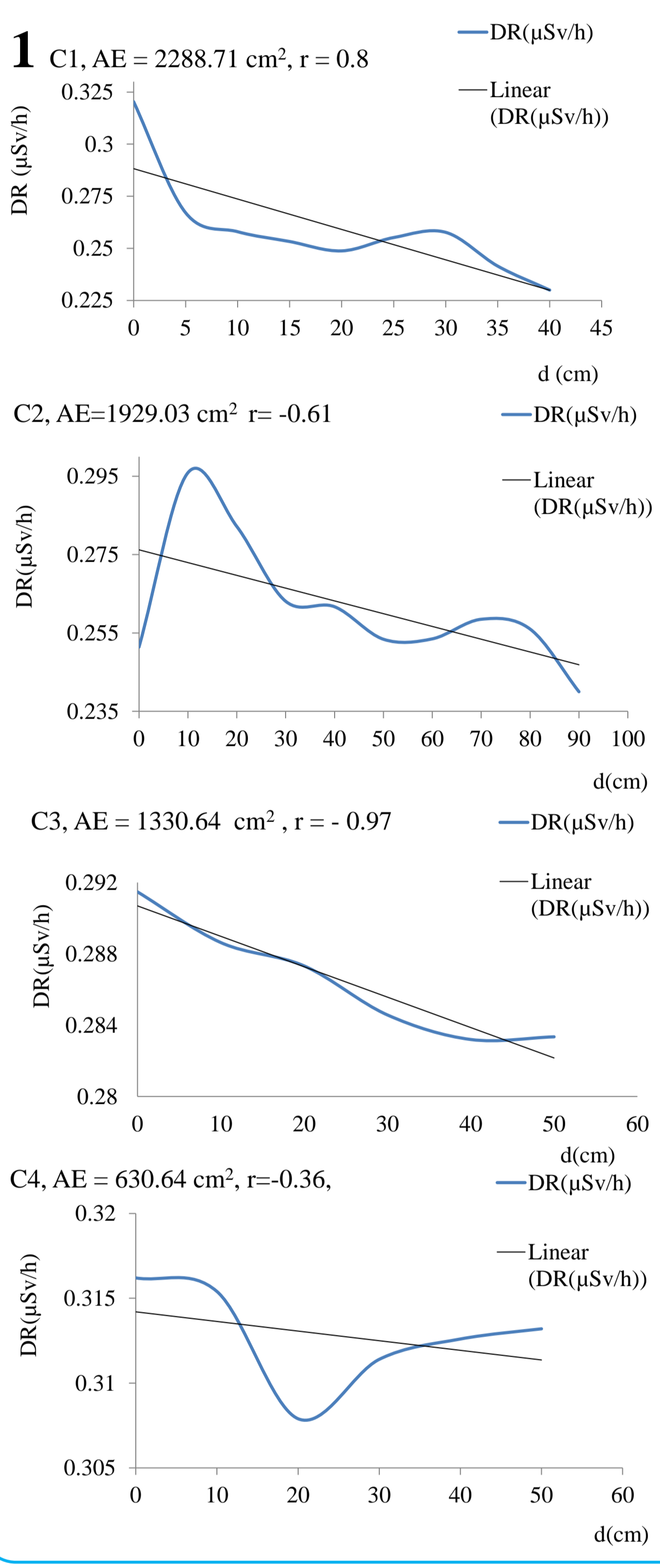


Figure 6.0(a-h): Graph of DER against distance for CRT devices

Discussions

- All the CRT devices show relatively high values of DER ($0.2848 \pm 0.0134 - 0.3232 \pm 0.0093$) $\mu\text{Sv/h}$ average for TV receivers and ($0.2484 \pm 0.0105 - 0.3112 \pm 0.0195$) $\mu\text{Sv/h}$ average for PC monitors above their respective BG measurements 0.2426 ± 0.0077 $\mu\text{Sv/h}$ average.
- CRTs emit X-rays as a result of electron braking (bremsstrahlung) by the screen and walls of the tube and the amount of radiation increasing proportionally to the accelerating voltage (Constantino *et al.*, 2000).
- On the average, CRTs showed the higher average exposure rate 0.3091 ± 0.0113 $\mu\text{Sv/h}$ with 24.85% above BG levels than the LCDs 0.2991 ± 0.0215 $\mu\text{Sv/h}$ with 15.59% above BG levels.
- All the CRT units showed a decreasing trend of Exposure rates with distance with correlation coefficient as high as -0.97. The LCDs show a mix of trend.
- A further investigation of the results of Constantino *et al.* (2000) that not only the screen, but also the lateral surfaces of CRTs emit low-level radiation, reveals that the lateral surfaces for CRTs have a generally lower exposure rate (0.2661 ± 0.0083) $\mu\text{Sv/h}$ than the screen surface (0.2898 ± 0.0050) $\mu\text{Sv/h}$.
- The AED results (2.13 – 2.83 mSv/y) obtained are well below the limits of ICRP 60 recommendations shown in table 9.0 for detrimental effects and those to prevent non-stochastic effects in the ICRP 26 recommendation for the lens of the eye, skin and hands; the AED values however exceed the ICRP 60 recommendation for Foetus/embryo.

Conclusion and Recommendations

- CRT PC monitors and TV receivers were found to emit ionizing radiation higher than the Background levels. The DERs of these CRT devices showed a generally decreasing trend with distance from emission screen
- The results of this research is in contrast with the common assumption that LCD devices don't emit any form of ionizing radiation above the Background levels due to natural sources.
- It can be conclusively stated from the results that maximizing distance from the emission source is a control measure for the amount of ionizing radiation from PC monitors and TV receivers.
- Larger screens result in more tissues/organs susceptible to biological effects of ionizing radiation. Since emission takes place through all the screen and lateral surfaces.
- TV and PC users should maintain the most possible distance from the screen of these devices especially if visibility and ergonomics are not affected (i.e. exposure to radiation from these devices must be kept as low as reasonably achievable – 'ALARA').
- Rather than viewing these screens directly from the front, there should be some angle between the line of sight and surface of the screen for the CRT devices
- Pregnant women especially those whose occupation require the use of PC monitors and TV receivers should avoid long exposure to them as present concerns generally center around adverse pregnancy outcome (spontaneous abortion or birth defects)

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