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The Association between Exposure to Childhood Ionizing Radiation to Treat Ringworm of the Scalp and Cognitive Ability and Language Skill in Adulthood

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Abstract

The study described in this thesis, examined the association between exposure to ionizing radiation at a young age, and cognitive ability and literacy in late adulthood among “Ringworm children,” compared to a matched group of adults who were not irradiated during childhood.
Previous studies reported an association between exposure of the head and neck to therapeutic high doses of ionizing radiation and systemic damage to neuro-cognitive and literacy functioning among individuals with malignancies. This association was also reported in studies of subjects exposed to atomic bomb radiation in Nagasaki and as a result of the Chernobyl nuclear accident.

A study conducted during the years 1977-1982 in Israel, assessed the learning achievements of children who were treated with ionizing radiation to the scalp for tinea capitis. This assessment was based on scores on scholastic aptitude, IQ, and psychological tests designed to predict army success. The findings of this study showed that subjects who had undergone irradiation had lower scores on high school aptitude, lower IQ scores required to be officers and non-statistically significant lower mean scores of psychological tests of leadership potential in comparison with the unexposed groups.

(Ron, 1982). In the range of 60 years from the time of treatment, a need has arisen for the examination of systemic damage to neuro-cognitive literacy, among adults who were irradiated as treatment for ringworm which has not yet been studied.

The aim of this study is to investigate long term effect of childhood exposure to low to moderate doses of ionizing radiation to the head and neck as a treatment for tinea capitis on cognitive and literate functioning during adulthood.

The study population consisted of sixty subjects from the tinea capitis cohort, randomly sampled from a group of 165 residents of Beersheba (100 irradiated

and 65 not irradiated), aged 56 to 69 years who participated in a previous study and who agreed to take part in future studies. The participants were 30 individuals () who were irradiated and 30 participants from the comparison population non-exposed group (15 men and 15 women).

Response rate was 52% for both irradiated and non-irradiated groups.

Cognitive and literacy functioning were assessed using Wechsler intelligence tests, attentiveness, and executive function test (response delay, working memory and flexible thinking). Additional tests for language skills – Reading accuracy and reading rate of words punctuated (vowelized) and non-punctuated as well as Bland lyrics - These instruments were administered at the examinee's home, performed by the same diagnostician and lasted about two hours. Every examinee signed an informed consent prior to the tests after receiving detailed explanations regarding the objectives of the study.

The scores of cognitive reading and language skills tests were used as dependent variables while the main independent variable was exposure to ionizing radiation. Other independent variables were demographic characteristics, tobacco smoking, income and education defined by school upon graduation.

Differences between the study groups were estimated by Chi squared test for categorized variables, t-test for continuous parameters and Wilcoxon non-parametric test when median of the cognitive scores were considered.

A Generalized Linear Model – GLM was performed to assess differences in the scores of the cognitive and literacy tests between irradiated and non-irradiated subjects, controlling for age and education.

The mean age of the study exposed participants at the time of interview was 65 years, 2 years older than the non-exposed individuals. . Among the study participants, 50% of cases and 13% of controls finished their education at the level of primary school only. No significant differences in the distributions of marital status, level of religiosity, income and smoking were found between the

groups Controlling for age and education, the average score of the intelligence test was lower by 1.7 points among irradiated compared to non-irradiated. It also has been found that age was negatively and significantly associated with operational intelligence. In the Trail Making Test measuring visual attention, and speed of processing (part A), as well as executive functioning (part B), the time taken to complete the test (primary performance metric) were significantly longer in the irradiated group than in the non-irradiated individuals (median scores of 69 vs. 56 seconds in part A and 120 vs. 93.5 seconds in part B).

In the memory test assessed by the digit span test, irradiated subjects exhibited significantly lower scores by an average of 2.5 words than the control group. In language skills tests, non-irradiated individuals succeeded better in segmentation, phonological flip and morphological-analog components, by completing the tests faster and having a greater number of corrected answers than irradiated subjects, controlling for age and education. Regarding language fluency tests, a positive association was demonstrated with education, showing that subjects with high level of education had better scores than the less educated subjects. These latter tests were not found to be associated with exposure to radiation. The pattern of better performance of the non-irradiated compared to the irradiated subjects was also found in the tests evaluating reading ability (speed and accuracy of punctuated, non-punctuated and bland lyrics words).

Strengthening of this important assumption emphasized the possible implication of ionizing radiation on language skills, which enables reading and automatic reading acquisition; an aspect that has not been tested so far at all.

In conclusion, we found an on-going damage to the cognitive-literate abilities and functioning within a group of examinees age 56–67 who have been treated with ionizing radiation being 3–12 years old, compared to a control group of adults with same background that have not been treated with ionizing radiation during childhood