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IONIZING RADIATION EXPOSURE DURING ADULTHOOD AND RISK OF DEVELOPING CENTRAL NERVOUS SYSTEM DISEASES: SYSTEMATIC REVIEW AND META-ANALYSES

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CONTEXT AND OBJECTIVES

Humans are daily exposed to low dose ionizing radiation (LDIR) from natural or man-made sources. Many studies have suggested that LDIR could have a deleterious impact on the brain, but results are not consistent and focus principally on childhood exposures.

This study aims to identify evidence from a wide range of literature and presents a synthesis of findings on the impact of low to moderate doses of IR exposure in adulthood on the risk of developing central nervous system (CNS) cancer or non-cancer diseases such as mental and behavioral disorders, cerebrovascular disease, diseases of the nervous system and neurocognitive disorders.

METHODS

We performed a systematic literature search of four databases (PubMed, Web of Science, Scopus and Google Scholar) to retrieve relevant epidemiological studies published in English from 2000 to 2020 following the PRISMA guidelines. Studies with self-reporting exposure and ecological studies were excluded.

Random-effects meta-analyses of log standardized mortality ratios (SMRs) were conducted. SMR is the ratio of observed deaths in the study group to expected deaths in the general population.

The Newcastle-Ottawa Scale for cohort, case-control and cross-sectional studies was used for quality assessment.

RESULTS

Forty-five studies were included in the systematic review of which fifteen in meta-analyses (Figure 1). These studies involved different sources of IR: atomic bomb (Hiroshima and Nagasaki) (n=4), Chernobyl (n=11), nuclear weapon tests (n=2), occupational workers (nuclear (n=17), medical (n=6), aircrew (n=3)) and background radiation (n=2).

Our pooled analyses revealed no statistically significant increase in mortality for brain/CNS cancers, nervous system diseases, or mental and behavioral disorders in people exposed to IR compared with unexposed people (Table 1, Figure 2).

| Outcomes | SMR _{pooled} (95% CI) |
|---------------------------------------|--------------------------------|
| Brain/CNS cancers (n=13) | 1.01 (0.88-1.15) |
| Cerebrovascular disease (n=8) | 0.70 (0.60-0.83) |
| Diseases of the nervous system (n=7) | 0.88 (0.76-1.03) |
| Mental and behavioral disorders (n=4) | 0.97 (0.85-1.12) |

Table 1: Results of meta-analyses carried out on studies with common information

A significant decrease in mortality from cerebrovascular disease was demonstrated (Table 1), whereas an increased risk of morbidity for these diseases was observed (Figure 2).

For morbidity, a large proportion of studies suggest a higher risk for IR-exposed people to develop neurocognitive disorders or mental and behavioral disorders, as compared to unexposed people (Figure 2).

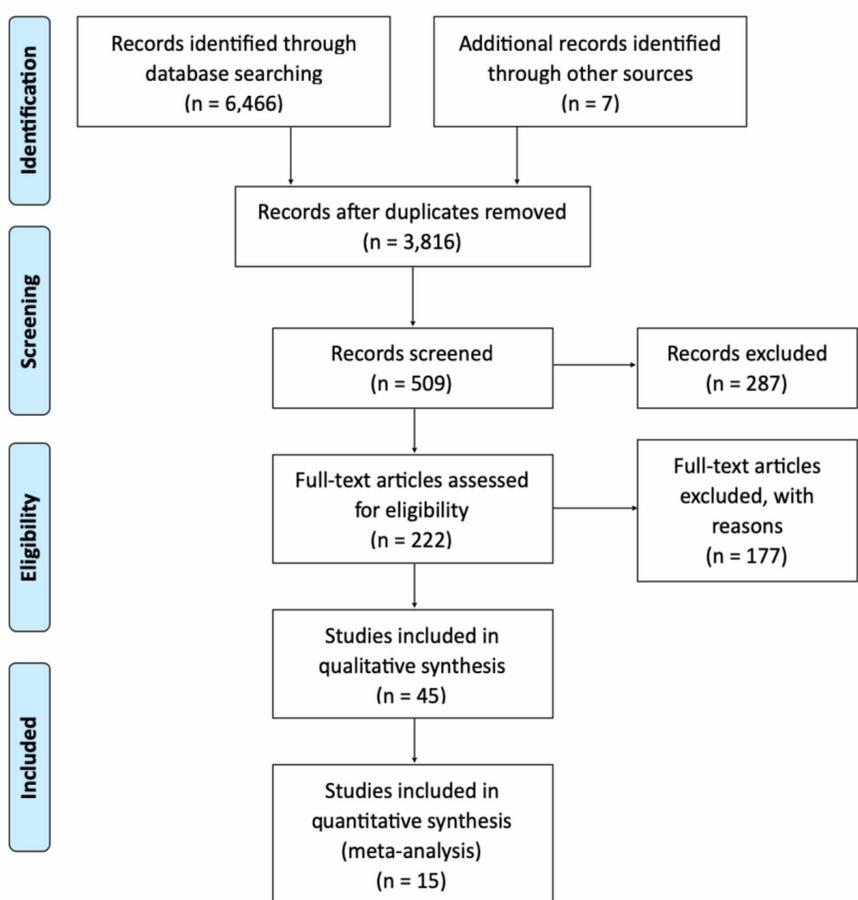
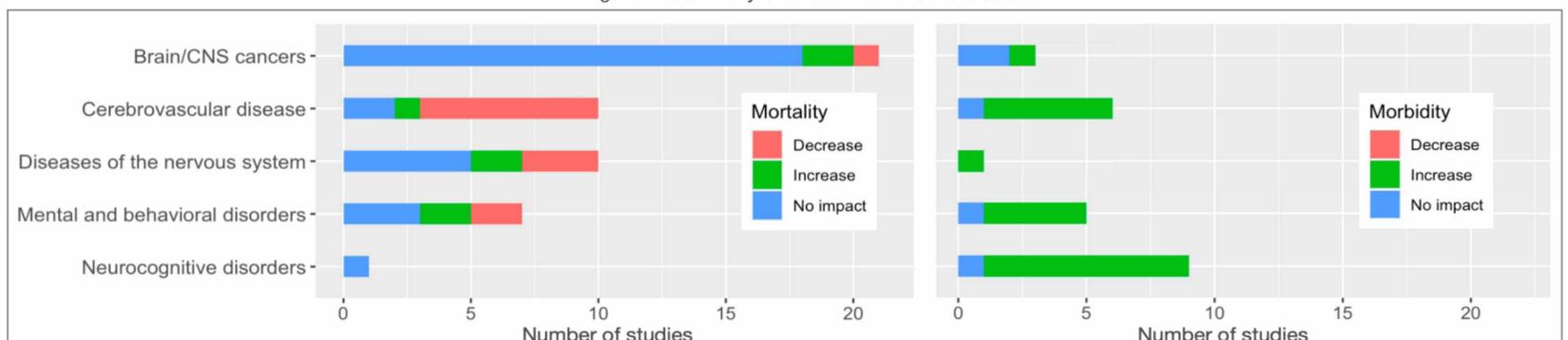


Figure 1: Flow diagram for the results of literature search, screening, and selection of relevant studies

Figure 2: Summary charts of the included studies



CONCLUSION

Our review and meta-analyses did not suggest an increased risk of death linked to brain/CNS diseases in low doses IR-exposed populations compared with the general population. However, these results must be considered in the context of their methodological limitations. Further studies with adequate dosimetry and dose-response assessments would be needed to support these conclusions.

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