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Study of Some Foetal Defects Caused by Low-Level Radiation Exposure from High Background Radiation Locations

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Introduction

High background radiation locations (HBRA) offer a unique chance to research potential biological impacts of long-term exposures. Since the local population has been continuously exposed to radiation since conception, HBRAs with uranium or thorium deposits as well as phosphate rock deposits are regarded as natural laboratories for epidemiological investigations. The population in high background locations is exposed to radiation doses that are significantly higher than the estimated global average background dose for a human being of 2.4 mSv per year (High Levels of Natural Radiation,1993). The status of a territory can be divided into four categories based on the annual radiation dose rates in each location: low (up to 5 mSv y1), medium (5-20 mSv y1), high (20–50 mSv y1), and very high (>50 mSv y1) [1].

Description

Kollam is home to prominent HBRA regions in India. The coastal region of Kerala's state, which stretches up to 57 km from Neendakara (Kollam district) to Purakkadu along the country's western coast, is abundant with monazite sand that is rich in thorium. In this region, black beach sand is widely distributed and includes 8–10% thorium and 0.3% uranium, as well as its decay byproducts. According to reports, the activities of 238U, 232Th, and 40K in the research region ranged from 17 to 3081 Bq kg1, 54 to 11976 Bq kg1, and 67.4 to 216 Bq kg1, respectively. There are many people that have lived in the area for many generations. Additional distinguishing characteristics of these locations are their geology and population density, compared to the other areas of India in terms of socioeconomic status, etc. Therefore, scientists are interested in researching any biological impacts that long-term exposure to the local population, who have been exposed to these high radiation fields for generations, may have. According to the Regional Cancer Centre in Trivandrum's technical report on the Natural Background Radiation Cancer Registry (1990-1999), which was based on a thorough research of more than 1,40,000 local residents, the average annual dosage to the population is between 15 and 25 mGy. There are certain coastal areas with radiation levels as high as 70 mGy/yr, indoor radon concentrations as high as 215 Bq/m^3 and indoor thoron concentrations as high as 92 Bq/m^3 [2].

Numerous dosimetric investigations on various facets of radiation exposure and natural radioactivity have been conducted in the area. There have also been reports of minor genetic investigations in rats and cytogenetic research on local flora. According to a local demographic study, there are no appreciable differences between HBRAs and normal radiation zones in terms of reproductive characteristics or newborn mortality. In investigations on cancer occurrences, similar outcomes were attained. However, a higher prevalence of mitochondrial germline point mutations was noted in a study of saliva samples from HBRA residents. The crucial set of investigations includes any research on congenital or hereditary impacts on children and women who are in the reproductive stage. As already stated however, no definitive evidence of carcinogenic hazards has yet been found. Due to the region's high background radiation levels, congenital abnormalities are a worry [3].

The investigation was conducted on people who had one of the two clearly visible congenital abnormalities. Underdeveloped intellectual function and deficiencies in adaptive behaviour are referred to as mental retardation. A cleft palate (palatoschisis) is an opening in the palate that causes an abnormal development of the face, and a cleft lip (cheiloschisis) is the occurrence of one or two vertical fissures in the upper lip. Both deformities are congenital, have a complicated aetiology, and are thought to be influenced by environmental factors. The goal of the current investigation is to determine whether there is a connection between the prevalence of specific congenital abnormalities, cleft lip/palate and mental impairment, using a matched case-control sample of 1:3.

Following stringent exclusion criteria, young adults (35 years old) with the specified abnormalities were chosen as the study's cases from both high background radiation areas (HBRAs) and normal background radiation areas (NBRAs). Age 35 years or under, singleton births without the use of assisted reproductive technology, having a living mother, and never having had a stillbirth or repeated abortions are among the requirements. The radiation dosimetry needed to be done should have been done while the person was still residing in the same place of conception. For each case, three suitable age-matched controls from the area that met additional requirements and had a similar type of housing construction were chosen. In order to obtain a concurrent estimation of radiation doses in all four residences, dosimeters were successively set out after choosing a case and its three controls. Conditional logistic regression analysis of the collected data served as the statistical technique [4].

Kollam, Sakthiklangara, Neendakara, and Chavara were the four panchayaths (hamlets) along Kerala's coastal Kollam district that were chosen for the study. For the studies, 225 control volunteers and 75 subjects (58 mental retardation cases and 17 Cleft lip/palate cases) were chosen. A halogen-quenched Geiger Muller (GM) tube-based survey metre with a microprocessor-based digital display was used to monitor indoor and outdoor gamma exposure rates. The height at which each measurement was taken from the ground was roughly 1 m. Utilizing a dose conversion coefficient of 0.7 Sv/Gy with an indoor occupancy factor of 0.8 and an outdoor effective dose with an occupancy factor of 0.2, measured gamma absorbed doses expressed in Gyh1 were converted to indoor yearly effective doses. The radon and progeny measurements made with the twin cup dosimeters outfitted with LR-115 Type II alpha detectors as stated by Mayya were used to determine the indoor inhalation dose rates. The analysis used the sum of the external and inhalation doses for the interior atmosphere [5].

Conclusion

Finding a potential link between the radiation exposure and the congenital deformity was done using conditional logistic regression (CLR) analysis. The data were interpreted using the evolved Odds Ratio (OR). Both the use of human subjects and the collecting of biological samples from the study participants were not involved in the investigation. To assess the risk of mental retardation/cleft lip/palate at various dose levels and account for the effects

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of gender and maternal age at delivery of the cases, the CLR analysis of mental retardation and cleft lip/palate was conducted. The SPSS programme was used to conduct conditional logistic regression analysis to ascertain the relationship between the analysed parameters.

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