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論文タイトル：原爆被爆者の死亡率調査
第13報　固形がんおよびがん以外の疾患による死亡率:1950-1997年
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研究背景と目的

放射線影響研究所では、原爆放射線の健康影響を調べるために、約12万人の寿命調査集団を設定して、1950年から死亡率調査を行っている。

データ解析は定期的に行われており、1962年の第1報以来これまで合計13回報告がなされている。

本論文は2003年に発表された寿命調査第13報で、寿命調査第12報から調査期間を7年延長し、旧線量評価システム(DS86) を用いて、固形がん（注１参照）ならびにがん以外の疾患死亡率と原爆放射線との関連性の検討を行ったものである。

研究方法

寿命調査集団のうちで DS86 による個人線量が推定されている 86,572 人について、1950 年から 1997 年までの固形がんとがん以外の疾患による死亡について検討がなされた。47 年間の期間中、9,335 人が固形がんで、31,881 人ががん以外の疾患で死亡していた。がんについては、すべての固形がんを一つのグループとして、また15の特定のがん部位について、放射線に関連したリスク評価をおこなった。がん以外の疾患については、すべてのがん以外の疾患を一つのグループとして、また六つの疾患群（心疾患、脳卒中、呼吸器疾患、消化器疾患、感染症、その他の疾患）について、放射線に関連したリスク評価をおこなった。

研究結果（がん以外の疾患死亡率についてのみ解説）

① 寿命調査集団では、31,881 人の死亡のうち約 250 例が原爆放射線と関連していると考えられた。
② 線量反応（線量応答）曲線は「直線」か「下に凸の曲線」かの正確な判別は困難であった。
③ 結腸線量1 Sv 当たり約14%の割合で死亡率が増加すると推定された。(過剰相対リスク 0.14)（注２参照）
④ 約 0.5 Sv 未満の線量については有意な死亡率の増加はみられなかった。
⑤ 心疾患、脳卒中、呼吸器疾患、消化器疾患の疾患群で、放射線と関連して統計学的に有意な死亡率の増加がみられた。

注１：固形がん

固形がんとは、白血病などの血液や造血器のがんと異なり腫瘤を形作るがんをいう。

注２：リスク指標

過剰相対リスク：単位被曝線量あたりのリスク増加率（％で示すことも多い）

過剰絶対リスク：単位被曝線量あたりの罹患率増加の絶対値

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Studies of Mortality of Atomic Bomb Survivors. Report 13: Solid Cancer and Noncancer Disease Mortality: 1950–1997

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This continues the series of general reports on mortality in the cohort of atomic bomb survivors followed up by the Radiation Effects Research Foundation. This cohort includes 86,572 people with individual dose estimates, 60% of whom have doses of at least 5 mSv. We consider mortality for solid cancer and for noncancer diseases with 7 additional years of follow-up. There have been 9,335 deaths from solid cancer and 31,881 deaths from noncancer diseases during the 47-year follow-up. Of these, 19% of the solid cancer and 15% of the noncancer deaths occurred during the latest 7 years. We estimate that about 440 (5%) of the solid cancer deaths and 250 (0.8%) of the noncancer deaths were associated with the radiation exposure. The excess solid cancer risks appear to be linear in dose even for doses in the 0 to 150-mSv range. While excess rates for radiation-related cancers increase throughout the study period, a new finding is that relative risks decline with increasing attained age, as well as being highest for those exposed as children as noted previously. A useful representative value is that for those exposed at age 30 the solid cancer risk is elevated by 47% per sievert at age 70. There is no significant city difference in either the relative or absolute excess solid cancer risk. Site-specific analyses highlight the difficulties, and need for caution, in distinguishing between site-specific relative risks. These analyses also provide insight into the difficulties in interpretation and generalization of LSS estimates of age-at-exposure effects. The evidence for radiation effects on noncancer mortality remains strong, with risks elevated by about 14% per sievert during the last 30 years of follow-up. Statistically significant increases are seen for heart disease, stroke, digestive diseases, and respiratory diseases. The noncancer data are consistent with some non-linearity in the dose response owing to the substantial uncertainties in the data. There is no direct evidence of radiation effects for doses less than about 0.5 Sv. While there are no statistically significant variations in noncancer relative risks with age, age at exposure, or sex, the estimated effects are comparable to those seen for cancer. Lifetime risk summaries are used to examine uncertainties of the LSS noncancer disease findings.

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1. INTRODUCTION

This continues the series of periodic general reports on mortality in the Life Span Study (LSS) cohort of A-bomb survivors followed up by the Radiation Effects Research Foundation (RERF). The present report deals with cancer and noncancer mortality during the period from 1950 through 1997, updating with 7 additional years of follow-up results presented by Pierce *et al.* (*1*) and Shimizu *et al.* (*2*). The most recent comprehensive reports on LSS cancer incidence (*3, 4*) are based on follow-up through 1987. More recently, Pierce and Preston (*5*) used LSS solid cancer incidence data for the period from 1958 through 1994 in an assessment of low-dose risks. Since in recent years there has been little added information regarding the magnitude or age–time patterns of radiation-associated leukemia risks, and the LSS leukemia mortality and incidence data are similar, it is not considered in the current report but will be dealt with in cancer incidence reports to follow.

The LSS cohort includes a large proportion of atomic bomb survivors who were within 2.5 km of the hypocenters at the time of the bombings, together with a similar-sized age- and sex-matched sample of people who were between 3 and 10 km from the hypocenters where radiation doses were negligible. Individual radiation dose estimates are available for 85% of the cohort members who were within 3 km of the bombs and all of the more distant cohort members. The cohort also includes a sample of Hiroshima and Nagasaki residents who were not in the cities at the time of the bombings. As in most analyses of the LSS, this group was not used here. For most purposes, there is little change in the risk estimates if those beyond 3 km from the bombs are omitted from the analyses.

Earlier reports in this series have clearly demonstrated a radiation dose response for cancer and noncancer mortality