

(2.79 expected), while 1 death was found in the 98 with intakes greater than 50 μCi (0.62 expected). Neither of these results is significant at the 5% level.

In contrast to these results, Adams and Brues (1980) found a statistically significant increase in breast cancer mortality and incidence at high intake levels. They examined the data for 1,180 radium dial workers who entered the industry before 1930, 779 of whom had been measured. In the measured cases of this cohort, 13 breast cancer deaths occurred (16.96 expected), while in the 401 unmeasured cases 23 deaths occurred (6.81 expected). When entry into the study was defined as occurring at the time of first measurement and the breast cancers diagnosed before first measurement were excluded, 11 deaths remained in 736 measured cases. Six of these deaths were in the group whose radium intake was greater than 50 μCi (1.04 expected); 5 deaths were in the group with intakes less than 50 μCi (7.8 expected).

Adams and Brues (1980) also examined the incidence of breast cancer in their measured cohort. They found 9 incident cases in the group exposed to more than 50 μCi (2.72 expected) and 16 incident cases in the group exposed to less than 50 μCi (20.68 expected). Both mortality and incidence data were said to be significant (chi-square p values < 0.001) for the group with intakes above 50 μCi .

Subsequently, Stebbings et al. (1984) published results that made the Adams and Brues (1980) result suspect. The Stebbings study differed from both earlier studies (Polednak et al. [1978] and Adams and Brues [1980]) in that it took into account the observation of Keane and Schlenker (1983) that the soft-tissue alpha-particle dose from ^{228}Ra at short times after radium intake was nearly six times that from ^{226}Ra . The previous two studies defined intake as the sum of the intakes of the two radium isotopes, but Stebbings et al. (1984) took the intake to be the sum of the μCi of ^{226}Ra and six times the μCi of ^{228}Ra . Further, they took for their study population all ascertained dial workers, not just those from employment and other lists.

Stebbing et al. (1984) found, as had Adams and Brues (1980), that the standard mortality ratios for breast cancer increased with increasing radium intake in the pre-1930 cohort. However, they also found an increase in the 1930-1949 cohort, even though the radium intakes in this period were much lower than in the pre-1930 era. Thus, the 1930-1949 cohort showed a significant increase in breast cancer deaths for an intake range that had fewer deaths than expected in the pre-1930 cohort. Next, Stebbings et al. found, when the study population was divided into three workplace locations, that more breast cancer deaths than expected were found in two locations: Orange, New Jersey, and Ottawa, Illinois. However, in Waterbury, Connecticut,