Al-Mustaqbal University
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# Biological Radiation hazards

## The eighth lecture

**Third Stage**

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## RISK ESTIMATES

A risk may be defined as the likelihood of injury or death from some hazard. The primary risk from radiography is radiation-induced cancer and, possibly, the potential to affect pregnancy outcomes.

The deterministic effects of high-dose radiation exposure are usually easy to observe and measure. The stochastic effects are also easy to observe, but it is nearly impossible to associate a particular late response with a previous radiation exposure.

Consequently, precise dose-response relationships are often not possible to formulate, and we therefore resort to **risk estimates**.

There are three types of risk estimates:

- Relative risk
- Excess risk
- Absolute risk

All of these represent different statements of risk and have different dimensions.

## Relative Risk (RR)

If one observes a large population for stochastic radiation effects without having any precise knowledge of the radiation dose to which they were exposed, then the concept of **relative risk** is used.

The relative risk is computed by comparing the number of persons in the exposed population showing a given stochastic effect with the number in an unexposed population who show the same stochastic effect.

**Relative risk = Observed cases / Expected cases**

- A relative risk of 1.0 indicates no risk at all.
- A relative risk of 1.5 indicates that the frequency of a late response is 50% higher in the irradiated population than in the Non-irradiated population.

## Excess Risk

Often, when an investigation of human radiation response reveals the induction of some stochastic effect the magnitude of the effect is reflected by the excess number of cases induced. Leukemia, for instance, is known to occur spontaneously in nonirradiated populations. If the leukemia incidence in an irradiated population exceeds that which is expected, then the difference between the observed number of cases and the expected number would be **excess risk**.

**Excess Risk = Observed cases- Expected cases**

The excess cases in this instance are assumed to be radiation induced. To determine the number of excess cases, one must be able to measure the observed number of cases in the irradiated population and compare this with the number that would have been expected on the basis of known population levels.

## Absolute Risk (AR)

Absolute risk represents the total number of persons with a specific disease affected by radiation exposure, or the rate of that disease in a given population over a given period of time (usually designated as “person-years”). AR is often expressed as the number of affected subjects per 104 person-years or 104 person-year-Gy (i.e., per 104 person-years per Gy). The absolute risk consists of units of cases/population/dose.

Whereas relative risk (RR) expresses the degree of excess risk, or strength of causation, AR describes the numbers of people affected and hence the public health impact in a population. For instance, the RR for leukemia is the highest among various late effects of radiation (RR approximately 5-6), but the total number of radiation-caused cases of leukemia in the Life Span Study (LSS) survivors is estimated to be only about 90-100. In contrast, the RR for solid cancers is much smaller (RR approximately 1.5), yet the total number of survivors who have developed such cancers due to bomb radiation is estimated to be about 850.