

Figure 5 - Map Credit:
[AtomicArchive.com](http://www.atomicarchive.com)

The structural damages incurred in both cities were the result of either the blast or pressure wave created from the blast, or fires. Primary fires resulted directly from the heat of the blast while secondary fires were initiated by the collapse of buildings containing equipment capable of producing fires (The Avalon Project at Yale Law School, 2006). A third type of fire occurred when primary and secondary fires spread to nearby areas or structures.

In the interactives portion of this section are two interactive diagrams of structural damage at Hiroshima and Nagasaki based on distance from the hypocenter. Embedded in the outlines are highlighted textual passages. Clicking on these passages will allow the user to view pertinent photos corresponding with the type of damage recorded at various distances from the hypocenters.

References

Atomic Archive (2006). *Atomic Bomb Damage of Nagasaki*. Retrieved November 2, 2006 from <http://www.atomicarchive.com/Maps/NagasakiMap.shtml>.

Hiroshima Peace Site (2006). *The Damage Done*. Retrieved November 2, 2006 from <http://www.pcf.city.hiroshima.jp/peacesite/English/Stage1/1-1E.html>.

Rain of Ruin: *The Atomic Decision Website (2006)*. Bombings. Retrieved November 2, 2006 from <http://library.thinkquest.org/05aug/01128/home.htm>.

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Component 4, Part 4 Human Health Effects of Radiation (Hiroshima and Nagasaki)

Radiation Dosages Received Per Distance From Hypocenters

The physiological effects to humans from the atomic bombings of Hiroshima and Nagasaki are directly related to the distance individuals were from the hypocenters of the bombs at the time of the attacks. Figure 1 is a graph comparing casualties based upon varying distances from the Hiroshima hypocenter.

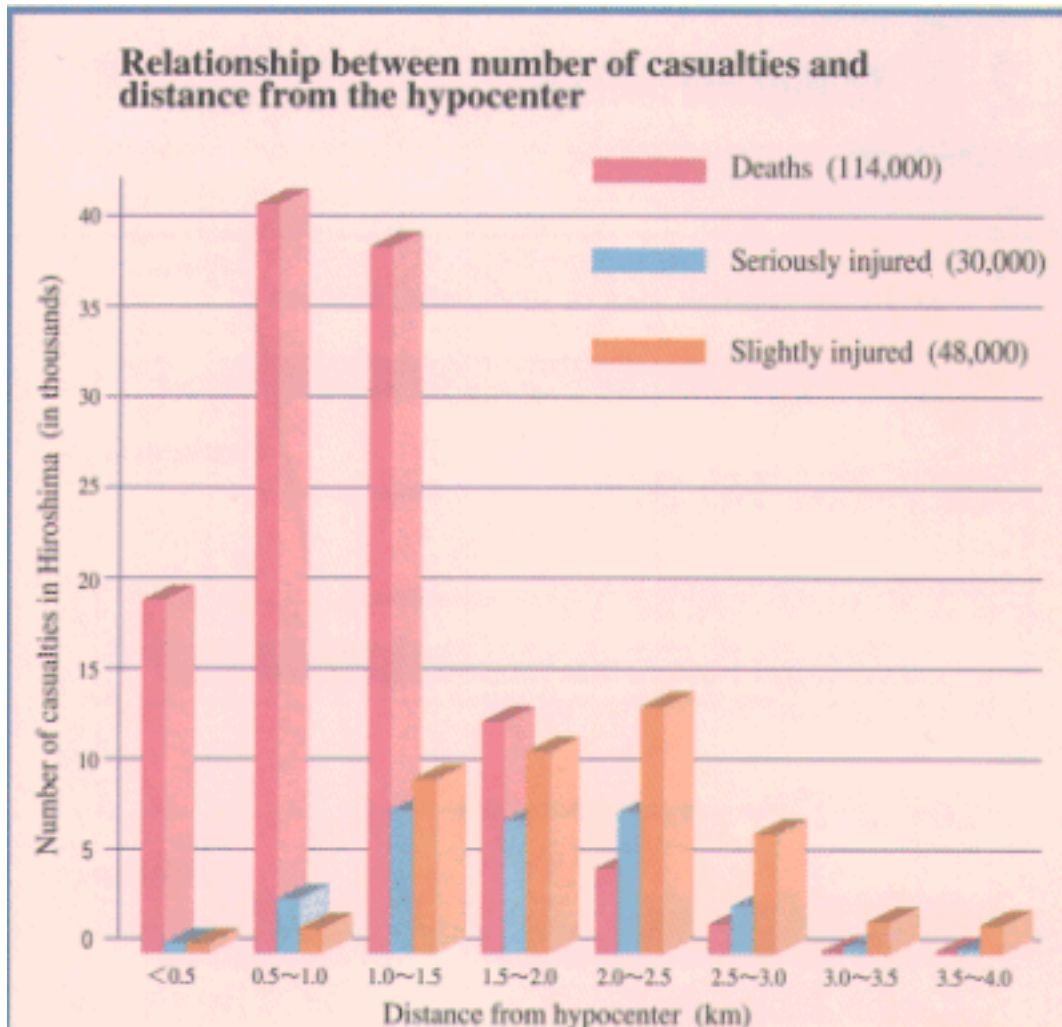


Figure 1 - Graphic Credit: *A-Bomb Radiation Effects Digest*

See also: [Hiroshima and the Aftermath of the A-Bomb](#)

Individuals located at or near the hypocenters of the explosions were subject to detrimental thermal and blast rays and received radiation doses incompatible with life (10 Sv or more). More than 90% of all individuals located at or near the hypocenters perished. Those receiving dosages around 3 Sv died within approximately 60 days; these individuals were located from 2.7 to 3.1 m distance from the hypocenters or were in their homes within 1 km of the hypocenters (RERF, 2006). People located beyond 2 km from the hypocenters received 0.1 Sv and effects at this point are not considered acute. At distances greater than 3 km from the hypocenters, radiation dosages approximated 0.002 Sv. This would be about the same amount of radiation an average person would be exposed to in a year.

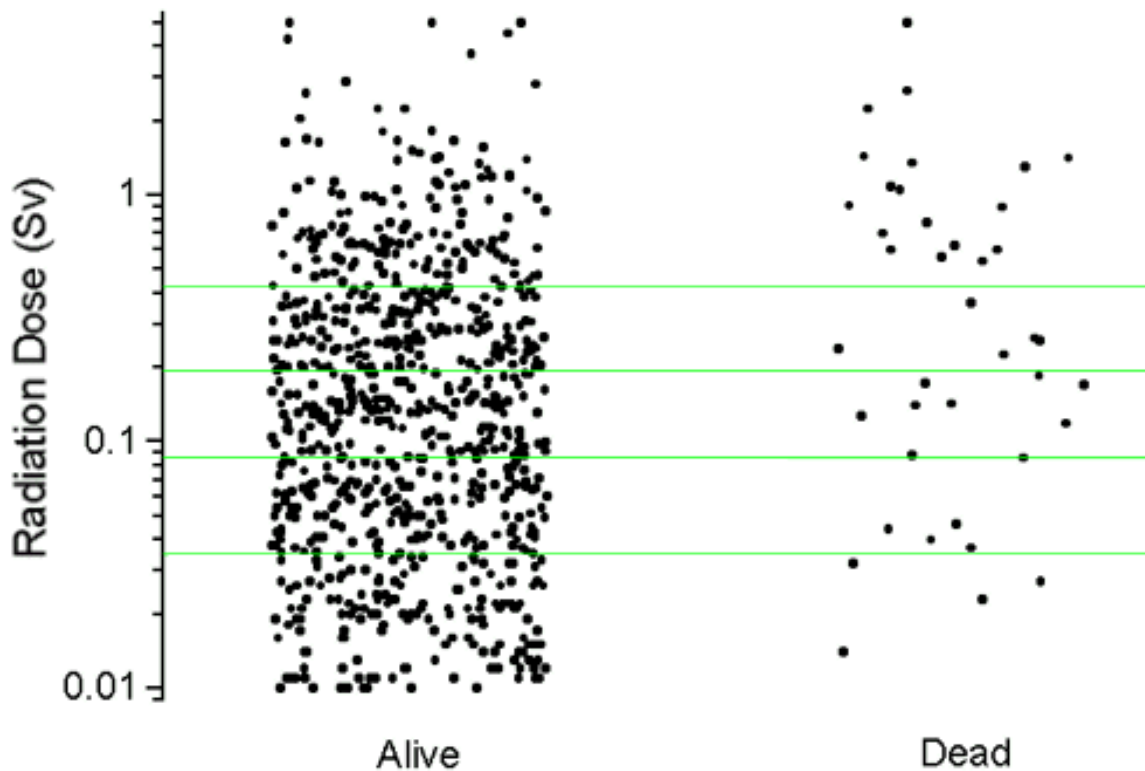


Figure 2 - Graphic Credit:

[Radiation Effects Research Foundation](http://www.ccohs.ca/oshanswers/phys_agents/ionizing.html)

Health Symptoms From Radiation Received Per Dosages

Table 1 provides information regarding the **early** physiological symptoms experienced per radiation dosage exposure (RERF, 2006). Note: Sv = **sievert**, a unit used to measure radiation dosage. For more information on radiation dosages, click the following link: http://www.ccohs.ca/oshanswers/phys_agents/ionizing.html. Late effects (occurring from several months to several years after the events) from exposure to radiation experienced by individuals present at the Hiroshima and Nagasaki bombings include excess cancer risks, especially leukemia (onset 5-10 years after exposure); an increased incidence of benign tumor formation; an increased occurrence of digestive, liver and respiratory diseases; remarkably high cholesterol levels; white blood cell chromosomal abnormalities; immunodeficiency; and early onset geriatric disorders (RERF, 2006). **Table 2** (RERF, 2006) provides information pertaining to the cancer deaths per dose range among atomic bomb victims over a 40 year period following the attacks.

Table 1: Physiological symptoms per radiation dosages

<u>Radiation Dosage Received (Sv)</u>	<u>Physiological Symptoms</u>
10 Sv or more	Immediate death
1 Sv	Vomiting, nausea, malaise, fatigue, headaches, loss of appetite, diarrhea, epilation (hair loss), anemia, bloody discharge, fever, lens opacity
0.5 Sv	Increased blood lymphocyte counts

Table 2: Cancer deaths between 1950 and 1990 among Life Span Study survivors with significant exposures.

Dose range	Number of cancer deaths	Estimated excess death	Attributable fraction
0.005-0.2 Sv	3391	63	2% (=100 x 63/3391)
0.2-0.5 Sv	646	76	12%
0.5-1 Sv	342	79	23%
>1 Sv	308	121	39%
All	4687	339	7%

Table Credit: [Radiation Effects Research Foundation](http://www.rerf.or.jp/)

References

A-Bomb WWW Museum (2006). *Introduction: About the A-Bomb*. Retrieved October 18, 2006 from: <http://www.csi.ad.jp/ABOMB/index.html>

Radiation Effects Research Foundation (2006). Retrieved October 19, 2006 from: <http://www.rerf.or.jp/>

Hiroshima and Nagasaki: Part 5 The Effects of Radiation on Cellular Processes

Of the four types of radiation emitted by the nuclear bombs deployed at Hiroshima and Nagasaki, gamma and neutron rays were the only types strong enough to reach ground and hurt people (see [Part 2](#)). The penetration of **ionizing radiation** into living human cells can result in cell alteration or death (Bertell, 1985). Figure 1 is a diagram depicting the process of ionization.