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FOREIGN POLICY IN FOCUS

Nuclear War in South Asia

By Matthew McKinzie, Zia Mian, M.V. Ramana, and A.H. Nayyar

There is a history of war in South Asia. India and Pakistan fought in 1948, 1965, 1971, and 1999. There is good evidence that in no case was there the expectation of a war on the scale and of the kind that ensued. Rather, war followed misadventure, driven by profound errors of policy, political and military judgement, and public sentiment. Nuclear weapons do nothing to lessen such possibilities. There is even reason to believe they may make them worse in South Asia. One lesson of the 1999 Kargil war is that Pakistan saw its newly acquired nuclear weapons as a shield from behind which it could fuel and stoke the conflict in Kashmir, safe from any possible Indian retaliation. During this war, nuclear threats were made publicly by leaders on both sides. It took international intervention to stop the slide to a larger, more destructive war.

Pakistan's leaders have made it clear they are prepared to use nuclear weapons first in any conflict; they hope this threat will prevent war, and in the event of war they fear being overwhelmed by India's conventional military superiority. While India has offered an agreement for no-first use of nuclear weapons, its armed forces seem prepared to try to destroy Pakistan's nuclear capability before it is used, and seek their own capability to launch a nuclear attack if they believe that enemy nuclear missiles are armed and ready for launch. Pakistan, in turn, may seek to preempt such a situation by using its nuclear weapons even earlier in a conflict rather than risk losing them.

When it comes to picking targets for nuclear weapons there are really only two options. One option is to indiscriminately destroy cities in the hope of either forcing an end to hostilities or eliciting unconditional surrender. The second option is to try to use nuclear weapons to destroy military command structures and war-fighting capabilities. Pakistan cannot hope to prevail in a drawn-out war and its leaders have made clear they intend to follow the first option. Should India seek to try the second option and attack only military targets, the results may not be that different from deliberately using nuclear weapons against cities. This is because nearly all of Pakistan's significant military centers are located either in or close to cities. For instance, Karachi, Hyderabad, Bahawalpur, Multan, Lahore, Gujranwala, Rawalpindi, Peshawar, and Quetta are all army corps headquarters. Islamabad has the air force and naval headquarters. These are obvious targets. Nuclear weapons cause destruction over such large distances that even if nuclear weapons were targeted specifically at military installations the cities would not escape.

EARLY WARNING

The destructive power of nuclear weapons means the nuclear superpowers live in perpetual fear of a surprise attack. These fears are worsened by the deployment of ballistic missiles, which reduce the time it would take to mount a nuclear attack. During the cold war, the superpowers addressed their fears by building complex early warning systems that would let each of them know they were about to be attacked and give them time to launch their nuclear weapons before they were destroyed. These systems also sought to limit the possibility of a war starting by accident or miscalculation by creating time during which policymakers and military planners could make decisions using real information about what was actually happening rather than responding simply on the basis of fear about what might happen.

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The U.S. and the Soviet Union, now Russia, relied on satellites and early warning radar systems to give them information within about one and a half minutes of the possible launch of a missile. They took about two and a half minutes to work out what was happening from this information. Advisers could be called and a threat determined a few minutes after this. In other words within about six or seven minutes, it was possible to decide if a nuclear attack may have started. Since the missiles would have taken about 25 minutes to travel from the U.S. to the Soviet Union or in the other direction, there was still time for a final confirmation that the missiles were real. There was even time left to find out if there had been an accidental launch of the missiles, and to decide what to do.

The Failures of Early Warning

The United States has invested enormous financial and technical resources in setting up its early warning system. It has tried hard, but without success, to make it fool-proof. There is no real history of all the failures. It is known, however, that between 1977 and 1984 there were over 20,000 false alarms of a missile attack on America. Over 1,000 of these were considered serious enough for bombers and missiles to be placed on alert.

Some of these incidents give terrifying insights into how easily even the most carefully designed and technologically advanced warning systems can go wrong. Two instances will suffice. In November 1979, the U.S. missile warning system showed that a massive attack had suddenly been launched. A nuclear alert was declared. There was no attack. There were no missiles. The warning was due to a computer that had been used to test the warning system to see how it would behave if there were an attack. Somebody had forgotten to turn off the computer after the exercise.

A second example was even more dramatic. In June 1980, the early warning systems showed that two missiles had been launched toward America. This was followed by signals that there were more missiles following the first two. The situation was considered to be sufficiently serious that the President's special airplane was prepared for take-off. Again there was no attack, nor any missiles. The reasons for the mistaken signals, and interpretations, were eventually traced to a computer chip that was not working properly.

The repeated failures of the U.S. early warning system led at one time to an official inquiry, which reported that the system "had been mismanaged... by the Air Force, the Joint Chiefs of Staff, and the Department of Defense." In other words, every institution assigned to make sure the system worked had failed in its task.

It was not just the U.S. early warning system that had problems. While there is little information yet on how the Soviet Union managed its nuclear weapons warning systems, there is at least one example from recent years that suggests it may not have worked any better than the U.S. system. On January 25, 1995, a Norwegian rocket was launched to take scientific measurements. The Norwegian government had told the Russian government in advance that this would happen. Nevertheless, when the rocket was picked up by Russian radar it was treated as a possible missile attack. It seems a warning was sent to the Russian defense minister's headquarters, the Russian military leadership, and to the commanders of Russian missiles that an attack may be underway. A message was then sent to Boris Yeltsin, the Russian President, and an emergency conference called with nuclear commanders over the telephone. Boris Yeltsin has confirmed that such an emergency conference did take place.

South Asia

There is some evidence that early warning systems in South Asia are limited in their scope and capabilities. For instance, in August 1998 the United States launched a major cruise missile attack against Afghanistan from its ships in the Arabian Sea. To reach the targets, scores of missiles flew long distances over Pakistan. Concerned about the possibility that Pakistan may detect these missiles and misinterpret the evidence as indicating that they were coming from India, the United States sent a very senior general to Pakistan in advance of the attack. His job was apparently to reassure Pakistan that it was not the target. It seems that Pakistan did not even detect the missiles.

Even if Pakistan and India had the technology for early warning, and even if it worked reliably, they could not use it against each other—geography has made sure of that. Instead of the twenty-five minutes or so warning time that the U.S. and the Soviet Union had, it would take an Indian Prithvi missile somewhere between three and five minutes to reach almost anywhere in Pakistan. It would take Pakistan's Ghauri missile about five minutes to reach Delhi. An early warning system could give a warning of what was happening, advisers could be called, and then time would run out. There would be no time to decide whether the warning was real, or a mistake. The decision on how to respond, including possible nuclear retaliation, would have to be made regardless.

The Effects of Nuclear Weapons

Approximately 5,000 kilometers east of New Delhi and 55 years ago two nuclear weapons were used by the United States to kill over 190,000 people in Japan. Agonizing deaths took place for approximately a month after the explosions—indeed deaths continued for weeks after Japan surrendered. The impacts on that country and the world from these atomic bombings have been enormous, and continue to the present. Can one predict the effects of the use of nuclear weapons against cities in India or Pakistan today? In some ways "yes" and in many important ways "no."

The effects of a nuclear weapon explosion are so immense and so different from those of conventional weapons that it is useful to present, as a case study, a familiar hypothetical "target." The nuclear weapon used by the United States to attack Hiroshima had a yield equivalent to 15 thousand tons of TNT and was detonated at 580 meters above the surface of the earth. This yield is comparable to the yields of the nuclear weapons that India and Pakistan claimed they tested in May 1998. We describe therefore the effects of a single explosion of a Hiroshima-sized nuclear bomb at an elevation of 600 meters over Bombay (Mumbai), India. The consequences of such an explosion for any other large, densely populated, South Asian city would be similar.

The short-term effects of a nuclear explosion—those that occur within the first few weeks—can be classified as either prompt or delayed effects. In addition, there are long-term effects, primarily related to radiation from fallout, that can develop over years.

Prompt Effects

Any person or object exposed to the explosion would first experience an extremely intense flash of heat and light, brighter than a thousand suns. Even looking at the flash could cause blindness. For 1.6-3.2 kilometers around the point of explosion (the epicenter, or ground zero), everything that could burn—wood, paper, clothes, vegetation, and all other combustible materials—would catch fire.

Exposure to neutron and gamma radiation, resulting from the nuclear reactions responsible for the explosion, would occur almost simultaneously. Radiation exposure could lead to a variety of symptoms such as nausea, bloody diarrhea, and hemorrhages within a few days (other consequences of radiation could appear years later). These health effects are often fatal and include leukemia, thyroid cancer, breast cancer, and lung cancer, as well as non-fatal diseases such as birth defects, cataracts, mental retardation in young children, keloids, and others.

The third effect is the shock or blast wave, which would result in a forceful blow to any person or object in its path. The winds accompanying the shock wave would reach velocities of more than 110 kilometers per hour to a distance of 2.4 kilometers or more. The shock wave would destroy everything within a circle with a radius of 1.1 kilometers.

Up to 1.7 kilometers from the point of explosion, all houses not built with concrete would be destroyed. Many of the buildings in Bombay, especially older ones, are either badly designed or constructed with raw materials that are of poor quality (such as adulterated cement or improperly baked bricks). Every year several hundred buildings collapse by themselves, especially during the rainy season. Faced with the shock wave and these hurricane-force winds, buildings may collapse at significantly greater distances than those estimated here.

Delayed Effects

A few minutes after the explosion, the delayed effects would begin. The first of these is the firestorm that would result from the coalescing of individual fires started by the initial flash of light and heat. In the case of a Hiroshima-sized explosion over a city like Bombay, the radius of the region set on fire would be 1.7 to 2 kilometers. Due to the large area of the fire, the fire zone would act as a huge pump, sucking in air from the surrounding areas and driving heated air upwards. This pumping action would create winds with velocities as high as 50-80 kilometers/hour. The temperature in the fire zone would reach several hundred degrees, making it almost certain that there would be no survivors. Furthermore, fire-fighting would be almost impossible due to the combination of hurricane-force winds, thick smoke, the destruction of water mains and tanks by the shock wave, and the presence of debris from the blast blocking roads and access routes.

Other factors would lead to the probability of small explosions in the fire region and, therefore, to a greater chance that people would be injured as well as burned. In Bombay, for example, many houses contain gas cylinders (containing liquid petroleum gas) that are used for cooking. These are known to explode when exposed to fires. In addition, compared to cities in Japan and Germany during World War II, Bombay and other modern cities have much greater concentrations of motorized vehicles such as cars, scooters, and buses that use petroleum-based fuels. The corresponding storage and dispensing facilities for such highly inflammable and explosive fuels would only increase the numbers of casualties.

The second delayed effect is radioactive fallout. When a nuclear bomb explodes at low altitudes, a large amount of material is vaporized and carried aloft into the mushroom cloud. This material then mixes with the fireball's radioactive materials, which results in a cloud of highly radioactive dust. This radioactive fallout can travel large distances on the winds created by the explosion, as well as in the atmosphere, before ultimately falling back to earth. If, instead of assuming that the weapon is detonated at a height of 600 meters, we assume that the explosion happens at the surface with a wind velocity of 25 kilometers per hour, the area subject to levels of fallout that have a high likelihood of being fatal would be about 25-100 square kilometers. The wind direction during the period that the fallout is aloft (which could be fluctuating) would determine which areas would be subject to these levels of radioactivity. The regions subject to high levels of fallout would have high levels of casualties and radiation sickness. Further, Bombay, being close to the sea, has high levels of water vapor in the atmosphere. Water droplets would likely condense around radioactive particles and descend as rain, as was the case in Hiroshima and Nagasaki.

Even people who live in areas subject to lower levels of radiation, unless they are immediately evacuated, would be susceptible to radiation sickness. Given the large population of Bombay, the public panic that would follow a nuclear attack, and the likely damage to all forms of transportation infrastructure, such as train stations and tracks, roads, petrol stations, dockyards, airports, etc., evacuation of survivors would be nearly impossible.

Casualty Estimates

The most recent Indian census data (from 1991) gives the population of Greater Bombay as 9,910,000; if the neighboring town of Thane is also included, the population is 12,572,000. Since the decadal growth rate for Bombay during the decade preceding this census was 20.21%, these numbers may understate the current population significantly. Furthermore, there is also some evidence of undercounting in the 1991 census. The average population density of Bombay is about 23,000 people per square kilometer. There are regions, however, where the population density exceeds 100,000 people per square kilometer.

Since a nuclear explosion and its effects are complicated physical phenomena, with different types of effects occurring around the same time, it is impossible to predict numbers of casualties or injuries accurately. There are three ways to estimate the number of casualties from prompt effects. All of these are based on empirical data from Hiroshima when the casualties were expressed as a function of different variables—radius, overpressure, and thermal fluence, respectively. Using these three models and assuming the above population densities, we can calculate that there will be somewhere between 150,000 and 800,000 deaths in Bombay within a few weeks of the explosion. These would be the result from just the blast and fire effects of a Hiroshima-sized) nuclear weapon, and assuming that fallout effects are negligible (assumptions that lead to a very conservative casualty estimate).

For comparison, in the case of a weapon exploding at ground level, the areas damaged by fire and blast are somewhat less but radioactive fallout would be a more significant cause of deaths and sickness. Assuming that all the fallout is deposited in inhabited areas (and assuming they have a population density of 23,000, the average for Bombay) the number of people dying of all causes could be as high as 350,000 to 400,000 for a 15-kiloton weapon. Many more people would be subject to lower doses of radiation, which in the case of already sick people, the old, and the young, could well be lethal in the absence of medical care.

The above numbers include only the "prompt" casualties, those who are injured or die right away or within a few weeks of the explosion. Many more people will certainly die from long term effects, especially radiation-related causes. Studies involving survivors of the atomic bombing of Hiroshima and Nagasaki reveal that the mortality rates for all diseases, leukemia, and malignancies other than leukemia, are all significantly higher than among people not exposed to radiation. Increases in the cancer rates of survivors of an atomic bombing of Bombay may be comparable to, if not greater than, those among Hiroshima and Nagasaki survivors.

There are a number of other reasons to believe that the casualty numbers cited above would be an underestimate in a city like Bombay. First, the assumed population densities are lower than the actual densities. Apart from undercounting and variations among regions, a substantial number of people come in every day from places as far away as Pune (four hours by train) to work in Bombay. The census does not take such commuters into account. Since an attack from the air is quite likely to take place during the day in order to maximize visibility, many commuters will also be killed or injured. Second, casualties from fallout have not been included in the estimates. Since fallout, even if present only in small quantities, can spread out to large regions and cause local hot spots, this is an important omission. Third, conservative figures for blast damage and regions affected by fire have been deliberately chosen. The actual areas are likely to be higher, implying a greater number of casualties.

There is another significant uncertainty in the estimates offered here, one that is likely to increase the casualties. There are a large number of industrial facilities in Bombay and its vicinity. India's highest concentration of chemical plants is in the Trans-Thane creek area, which has more than 2,000 factories. Central Bombay is home to several mills, which could cause additional fires and explosions, and which could spread toxic substances. The Union Carbide accident in Bhopal is an example of the kinds of effects that are possible due to escape of toxic chemicals. In addition to chemical industries, the largest nuclear laboratory in India—the Bhabha Atomic Research Center—is in Trombay, just outside Bombay. A nuclear explosion in the vicinity of either reactor at the Center or near the reprocessing plant or the facilities storing radioactive waste and/or spent fuel could lead to the release of large amounts of radioactivity in addition to the quantities resulting from the explosion itself. This would increase the amounts of fallout significantly.

Hospitals and medical care in an overcrowded city such as Bombay are limited to begin with, and facilities within the affected area would be destroyed or damaged during the attack. The injured would be unlikely to find medical treatment.

Table 1: Estimated nuclear casualties for each of 10 large Indian and Pakistani cities

City	*Total Pop. within 5km Ground Zero*	*Killed*	*Severely Injured*	*Slightly Injured*
India				
Bangalore	3,077,937	314,000	175,000	411,000
Bombay	3,143,284	477,000	229,000	477,000
Calcutta	3,520,344	357,000	198,000	466,000
Madras	3,252,628	364,000	196,000	449,000
New Delhi	1,638,744	176,000	94,000	218,000
Pakistan				
Faisalabad	2,376,478	336,000	174,000	374,000
Islamabad	798,583	154,000	67,000	130,000
Karachi	1,962,458	240,000	127,000	283,000
Lahore	2,682,092	258,000	150,000	354,000
Rawalpindi	1,589,828	184,000	97,000	221,000

The Effects of Nuclear War

We have described in some detail the effect of the use of one relatively small nuclear weapon on a large South Asian city. It is hard to imagine that if this dreadful event were ever to take place as the result of an attack there would be no response from the other side. Both Pakistan and India have sufficient nuclear weapons and the missiles and aircraft to destroy several, perhaps many, of the other's cities.

To illustrate the terrible consequences of a large-scale nuclear war in South Asia, we estimate the numbers of deaths and injuries from nuclear attacks on ten major Indian and Pakistani cities. To arrive at consistent estimates for all of these cities we use a different, simpler, methodology than was used earlier for the detailed case study of the consequences of a nuclear attack on Bombay. We transpose onto each city the characteristics and consequences of the August 6, 1945 Hiroshima bombing with its mass fires, radiation sicknesses, severe burns, deaths in buildings collapsed by the shock wave, hurricane-force winds propelling missiles through the air, and blindness.

This historical data from Hiroshima on the fraction of the population killed and injured in concentric, five-hundred-meter-wide rings out to a distance of five kilometers from the explosion is applied to a database that gives population distribution information for each of ten cities in South Asia. The "LandScan" world population database was used for these calculations. It uses the best available census information and assigns them to grid cells of roughly 1 km by 1 km size by creating a probability distribution based on factors such proximity to roads, environmental characteristics such as climate and terrain slope, and nighttime lights as seen by satellites.

Table 1 below shows (to the nearest thousand) the numbers of dead, severely injured, and slightly injured persons after a nuclear attack on each of ten large South Asian cities. A total of 2.9 million deaths is predicted for these cities in India and Pakistan with an additional 1.5 million severely injured.

It should be appreciated that this exercise of predicting the casualties from nuclear attacks on cities in India and Pakistan based on the historical record at Hiroshima just scratches the surface of what would play out if nuclear weapons were used. There is also the loss of key social and physical networks that make daily life possible: families and neighborhoods would be devastated, factories, shops, electricity, and water systems demolished; hospitals, schools, and other government offices destroyed. The flood of refugees would carry the physical effects far beyond the cities.

The ultimate impact on both societies would extend well beyond the bombed areas in highly unpredictable ways. Nuclear attacks would provoke profound and enduring responses from citizens of India and Pakistan and of the world. Nothing would ever be the same again.