REVIEW OF LITERATURE
HISTORY

Accidents are older than history. The natural hazards, must have participated in the evolution of man. Dangers were the agents of natural selection (Gibson, 1961). Some of the ancient cave paintings provide evidence for this.

"Act of God", "Luck", "Chance" etc., were some of the culturally acceptable explanations of accidents for a long time. To many people they still are, though these terms are now less applicable to diseases than before.

Coming to more recent times, often it was dramatic misfortunes that attracted the attention of the people. For example, the Michigan Forest fires in 1882 got the American Red Cross interested in accidents. Similarly by 1903 the American Medical Association was conscious of the burn and other mishaps. Accidental poisoning was recognised by 1910 when Lye used to be a common house hold article in USA (Gordon, 1962).

The first organised movement in Great Britain against accidents was the formation of the society first council, now known as the Royal Society for prevention of accidents, London in 1916 (Editorial, 1966).

With the publication of series of reports by the medical research committee (Later Medical Research Council), Industrial Health Research Board, Great
Britain, between 1919 and 1937, the concept of accident pronners caught the imagination of all and research in accident took a new turn towards the study of personality.

The advent of automobiles introduced a new element. In 1924, the U.S. Government called for a conference on street and highway safety. Rightly they discussed accidents in home, industry and other places too, as case of diseases the community responsibility of accidents was first with medical profession. Role of the public health department was first pointed out by Earlie Brown of Kansasa who called accident a killer and emphasized the nature of its specific causation and mentioned practical and reasonable measures of prevention.

The ancient literatures refers to accidents. For instance the Bible (Knox, 1963) mentioned that Absolom got caught by the tangled branches of a great oak tree while riding fast on a mule underneath. The ancient Egyptian book of etiquette "Percepts of Anii" warned that consuming too much of beer was conductive to accidents (WHO, 1966).

The epidemiological approach to accidents was first tried during the second world war for prevention of trench foot (Gordon, 1949).

In 1955 the Swedish Government drew attention the World Health Assembly to accidents, specially among children in Europe. Neatherland also referred the matter to the Executive Board. As a result came out

Currently the world Health Organisation and various national Governments specially in the developed countries are spending vast sums on accident research. Pursuit is going on in various directions by physicians, engineers, social scientists, psychologists etc.

A major epidemiological revolution in Western Europe since the second world war, has been reversal of the rates of infectious diseases and accidents as a cause of death.

In 1946, in England and Wales deaths due to infectious diseases of all types were twice as those due to accidents (28,000 and 14,000 respectively). Five years later the two were equal and by 1966 deaths from infectious diseases were less than one quarter of those due to accidents (4,400 and 19,000). Both domestic and road accidents deaths have increased during this period. The main change has been a reduction of mortality from infectious diseases but accident figures have increased by nearly 30 percent during last fifteen years (Bhanjekar, 1971).

Accident represent a major epidemic of non communicable disease in the present century. In developed and many developing countries road traffic accidents are now main cause of death and disability, particularly in young adults. World statistics are incomplete but are sufficient to give an out line of this
man-made twentieth century epidemic.

Since India became independent, there has been a tremendous development in industry, construction of new road and increase in heavy and high speed traffic. Farming has been completely mechanised in certain states over the years. This change in the country's complexion has led to a marked increase in accidents on roads, in factories and on farms. Accidents can be classified as follows:

1. Road accidents: Road accidents are the most common important regarding mortality and morbidity.
2. Farm accidents.
3. Industrial accidents.
   a. Organised industries i.e. factories.
   b. Unorganised industries i.e. small scale cottage industries (Agarwal, ND, 1985).
   c. Domestic accidents and
4. Rail accidents and diastery.

NATIONAL AND INTERNATIONAL LEVEL

Accidents on Indian roads seem to be mounting in same proportion at the increase in number of vehicles. In 1960, there were 38,818 recorded accidents which took a total of 4,491 lives. The vehicle population then was about 6.5 lakhs (Agarwal, ND, 1985).

Accidents between 1946 and 1956 rose by 15 percent while the increase in population was only five percent (in Great Britain). The increase among accidents
was particularly in domestic and transport accidents while occupational accidents have declined (Bull, 1961).

There were only 2 motor vehicle accident deaths in Great Britain in 1898 while in USA only one person died in 1899. But in 1957 there were 102,532 deaths in automobile accidents in 47 member countries the WHO alone (WHO, 1962).

According to WHO (1965), the annual deaths due to traffic accidents have more than doubled in 10 years in many countries. Similar trends are reported from several developing countries.

Ibrahim (1966) stated in weekly newspaper that in India during seven years immediately preceding Dec. 31, 1964, the motor vehicle accident rose by 151 percent while the automobiles and the population increase was only 96 and 17 percent respectively. On the basis of deaths per 1,000 vehicles India is already in second highest position amongst the countries of the world.

There has been a 10 percent rise in the accidental deaths among American men of the working ages, between 1961 and 1964 (Statistical Bulletin, 1967).

Accidents are now one of leading cause of death in Western countries. Total number of death due to accident in USA exceeded one million (actual 1038430) in Great Britain-40988, in Japan-40447, West Germany-35295, in France-32955, Italy-23171, Mexico-19831, Poland-11838, Canada-10569 (Seal SC, 1964).
Number of accidental deaths in India by causes during 1983-1985.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Natural Causes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Lightning</td>
<td>1884</td>
<td>1406</td>
<td>1381</td>
</tr>
<tr>
<td>2.</td>
<td>Heat stroke</td>
<td>630</td>
<td>503</td>
<td>533</td>
</tr>
<tr>
<td>3.</td>
<td>Floods</td>
<td>849</td>
<td>774</td>
<td>565</td>
</tr>
<tr>
<td>4.</td>
<td>Cold and exposure</td>
<td>428</td>
<td>361</td>
<td>361</td>
</tr>
<tr>
<td>5.</td>
<td>Land slide</td>
<td>576</td>
<td>506</td>
<td>588</td>
</tr>
<tr>
<td>6.</td>
<td>Cyclones</td>
<td>131</td>
<td>691</td>
<td>502</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>4498</td>
<td>4241</td>
<td>3930</td>
</tr>
<tr>
<td>B.</td>
<td>Other Causes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Firearm</td>
<td>1478</td>
<td>1796</td>
<td>1860</td>
</tr>
<tr>
<td>2.</td>
<td>By explosion</td>
<td>398</td>
<td>438</td>
<td>391</td>
</tr>
<tr>
<td>3.</td>
<td>House collapse</td>
<td>1501</td>
<td>1220</td>
<td>1341</td>
</tr>
<tr>
<td>4.</td>
<td>On road</td>
<td>23375</td>
<td>29375</td>
<td>29831</td>
</tr>
<tr>
<td>5.</td>
<td>Bus factories</td>
<td>688</td>
<td>666</td>
<td>585</td>
</tr>
<tr>
<td>6.</td>
<td>Railways</td>
<td>13124</td>
<td>12735</td>
<td>13307</td>
</tr>
<tr>
<td>7.</td>
<td>Air crash</td>
<td>56</td>
<td>52</td>
<td>85</td>
</tr>
<tr>
<td>8.</td>
<td>Fire</td>
<td>15372</td>
<td>15741</td>
<td>16667</td>
</tr>
<tr>
<td>9.</td>
<td>By poisoning</td>
<td>5736</td>
<td>6735</td>
<td>8560</td>
</tr>
<tr>
<td>10.</td>
<td>Animal biting/killing</td>
<td>4946</td>
<td>4767</td>
<td>4867</td>
</tr>
<tr>
<td>11.</td>
<td>Drowning</td>
<td>23217</td>
<td>22729</td>
<td>21592</td>
</tr>
<tr>
<td>12.</td>
<td>Miscellaneous</td>
<td>34187</td>
<td>34133</td>
<td>36641</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>124078</td>
<td>130387</td>
<td>135727</td>
</tr>
</tbody>
</table>
The records in Calcutta city hospitals show that in 1963 a total of 10835 cases of accidents were treated of which 864 proved fatal. Death toll increased to 961 in 1964. In that city road accidents increased from 3678 in 1955 to 5085 in 1964, i.e. 40 percent rise in 10 years. The road casualties in Calcutta during 1963 and 1964 against total accidents recorded in hospitals are given below:

<table>
<thead>
<tr>
<th>Year</th>
<th>Fatal</th>
<th>Total No.of road injuries</th>
<th>No.of accidents</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>228</td>
<td>4292</td>
<td>11516</td>
<td>16036</td>
</tr>
<tr>
<td>1964</td>
<td>245</td>
<td>4549</td>
<td>11487</td>
<td>16281</td>
</tr>
<tr>
<td>Increase/decrease</td>
<td>+17</td>
<td>+257</td>
<td>- 29</td>
<td>+ 245</td>
</tr>
</tbody>
</table>

In India, accidents are definitely on the increase. Between 1957 and 1979 accidents increased by 461 percent while in same period the increase in population was 156 percent and increase in the number of vehicles was 1677 percent. In absolute number 40000 people were killed in road accidents in 1986, as against 24600 in 1980. India has a fatality rate in road accidents that is 20 times that of developed countries (Park, 1989).

Different types of accidents cause clinically similar injuries, but from epidemiological point of view of causation and prevention, accidents are classified into following broad groups.
A ROAD TRAFFIC ACCIDENTS

In many countries motor vehicle accidents rank first among the all fatal accidents. There are almost 300,000 deaths from road accidents annually in the world and the fatal casualties number up to 10 million. In addition every death there are as many as 30 to 40 minor injuries and 10 to 15 serious injuries requiring long period of expensive care, nursing and treatment (WHO, 1981).

In USA (1957) deaths at all ages from road traffic accidents (38,702) exceeded these due to all infectious and communicable diseases (WHO, 1961).

In India, accidents have increased from 72,000 in 1965 to 1,07,000 in 1968 while number of death increased from 8392 in 1965 to 12555 in 1968. Eight persons get killed per 1000 vehicles in India whereas in Britain, France, West Germany, Italy and USA the death figure per thousand vehicle is only one (Park, 1981).

According to Leo A. Kaprio about 2,50,000 people or more are killed on the roads of the world each year. In 1974, 50,000 people died in the USA as a result of road traffic accidents. In three countries of Europe, Italy, and the U.K. nearly 35000 were killed in road accidents. In 1973 there were over seven million injured in road accidents throughout the world. Among those who died 90,000 were first hospitalised for period upto 30 days. Two million motor vehicles on India's roads its people

It is estimated that 11142 road accidents were reported in Tamil Nadu, during 1970. In these, 1039 persons were killed and 9,370 injured. It is rather shocking that the total number of accidents in Tamil Nadu during 1976 was 11655 (Christopher Daniel, 1973).

India had one of the highest road accident rate in the world. One out of 42 vehicles in the country met with accident in 1986. In US and Europe the average is one in every 100 vehicles. In 1986, 40,000 people were killed in road accidents as against 24,600 in 1980. The number of people injured in road accidents doubled in past six years, touching 1.75 lakh in 1986 (Park JE, 1979).

B. DOMESTIC ACCIDENTS

In developed countries like UK and USA, there has been marked increase in road and domestic accidents over the past ten years. More than one third of the accidental deaths in England and Wales occur in and around home, another one third occur on roads and about seven percent in industries (Bull, 1965)

"Accident in home as causes of injury and death are of increasing importance, accounting for about half of the accidental deaths and equivalent in public healthy terms of a major epidemic. Yet in most countries both the medical professional and the general public are slow to recognise the fact" (WHO, 1966).

Domestic accidents are frequent cause of death
or disability at the extreme of life they account for about 75 percent of injuries to people over 65 in the industrialised countries (Park JK, 1989).

Jockett (1965) showed proportionate contribution of all accidental deaths of domestic accidents at three periods (1951, 1956 and 1960) in England and Wales.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total deaths</th>
<th>Total accidental deaths</th>
<th>Total domestic accidental deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>549380</td>
<td>15105</td>
<td>4964</td>
</tr>
<tr>
<td>1956</td>
<td>521331</td>
<td>16407</td>
<td>5916</td>
</tr>
<tr>
<td>1960</td>
<td>526268</td>
<td>17720</td>
<td>6008</td>
</tr>
</tbody>
</table>

There was decline by the 26 percent in the number of total accidents amongst children in England and Wales between 1951 and 1956 (England and Wales, Ministry of Health, 1957). Significant domestic accident rates declining slowly in western countries. Domestic accident death rate has declined quite rapidly perhaps as much as 50 percent in twenty five years in USA.

Each year in Great Britain 6000 people die as a result of accidents in the home, 100,000 are admitted to hospital and some 1 million receive treatment from their general practitioner.

In period of six month in 1977, 30097 domestic accidents were recorded in 20 hospitals in England and Wales. The types of the accidents were as given below.
<table>
<thead>
<tr>
<th>Type of injury</th>
<th>No. of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>10609</td>
<td>34.4</td>
</tr>
<tr>
<td>Fracture/dislocation</td>
<td>3738</td>
<td>12.1</td>
</tr>
<tr>
<td>Contusions</td>
<td>3296</td>
<td>10.4</td>
</tr>
<tr>
<td>Sprains</td>
<td>2747</td>
<td>8.9</td>
</tr>
<tr>
<td>Burn</td>
<td>1100</td>
<td>3.6</td>
</tr>
<tr>
<td>Scald</td>
<td>1011</td>
<td>3.6</td>
</tr>
<tr>
<td>Wound from painted object</td>
<td>810</td>
<td>2.6</td>
</tr>
<tr>
<td>Inhalation/ingestion</td>
<td>789</td>
<td>2.6</td>
</tr>
<tr>
<td>Foreign body in an orifice in eye</td>
<td>753</td>
<td>2.4</td>
</tr>
<tr>
<td>Concussion</td>
<td>356</td>
<td>1.2</td>
</tr>
<tr>
<td>Splinters</td>
<td>248</td>
<td>0.8</td>
</tr>
<tr>
<td>Poisoning</td>
<td>57</td>
<td>0.2</td>
</tr>
<tr>
<td>Electric shock</td>
<td>17</td>
<td>0.1</td>
</tr>
</tbody>
</table>

(Symposium on epidemiology of accident trauma and resulting disabilities. Strasbourg, 1981)

Mittal et al (1972) reported total of 375 cases during course of study. Most common cause in domestic accident was due to fall (38.9 percent) followed by burn (24.3 percent).

Ghosh et al (1972) reported a total of 8205 accidents in which home accidents, Agriculture construction and blast accidents were 2204, 1948, 1556 and 111 respectively.

Gill et al (1977) reported that the highest number of accident were due to domestic accidents 41 (37.5%) while road accidents were 30(37.5%) and school accidents were 2(2.5 percent).
OCCUPATIONAL ACCIDENTS

Bell (1965) estimated that more than 15 million minor injuries and one third of a million serious injuries occurred in industries of England and Wales per year. The frequency rate of injuries in India in 1982 was 0.05 and 16.25 in fatal and non-fatal respectively (India Labour Yearbook, 1963).

Brockington reported that over a third of the total spells off work of all the working population in England was due to accident.

The enormous amount of lifting, carrying and moving of raw materials, price of parts and product of factories is responsible for many accidents. More than 38,000 (27 percent) of all accidents occurred in this way in 1958. In 1932, corresponding figure was 24,000 (23 percent) of all accidents.

In 1958, seven thousand accidents due to the transport (excluding rail) in and about factories i.e. power trucks, stackers and so forth which since the end of World War increased many fold. The accidents in the factories from this cause have more than doubled in the 10 years since 1948 (Bramley and Harker).

In developed countries because of industrialization new hazards have been introduced not only at work and during transportation but also in homes. The American Medical Association estimated that in 1957 there were 2,50,000 toxic or potentially toxic product in the
consumer market (Verhelst and Cann, 1960). Another example is the common ratory cutter used in the kitchen (WHO, 1966).

The changes due to industrialization which have occurred in developed countries in some fifty years are increasing much faster in developing countries. The socio-cultural change which results in recent migrants from an agricultural to industrial milieu has important implication in accident causation.

However, by better planning design, training etc. the occupational death rates have declined in the west. In USA, these rates for 1961 were only half of 1937 rate (Baetjer, 1966).

In Great Britain about one third each of total industrial accidents occur in factories and in works of building construction. A further one-fifth occur in transport services (Bhajekar AB, 1971).

Every year almost a thousand workers die and another 250,000 are injured, some of them receiving permanent disability. Industrial accidents in India in West Bengal, industrial accidents rose 20 percent in four years from 1974 to 1978. In 1979, Maharashtra alone accounted for 93,000 injured and 155 dead in industrial mishaps (Mankekar Kamala, 1981).

Every year, two lakhs workers are injured in factories in India. About 450 of them are killed and many are disabled and crippled for life. This is
considered very modest estimate as large number of minor
accidents are not reported (Brig. Chaddha, 1978).

A study carried out by Gill et al (1978) data
of 80 cases of accident were analysed in which factory
school and railway total accidents were 6(7.5%), 2(2.5%),
and 1(1.25%) respectively.

Agarwal et al (1981) showed that large number
of accidents occur in the factories. The number of
accidents are reported employees state insurance corpo-
ration for Punjab was 5623 in 1980 and 6051 in 1981.

**Railway Accident**: Park (1989) showed daily
over 11,000 trains carry over on crone passenger through
out the country. With increase number of trains and
passengers, the increase in number of accidents and
casualties resulting there form is not expected. In
1981, there were 12,408 deaths as against 7133 deaths
in 1987. The main factor is involved in railway
accident is human failure.

3. **RANK OF ACCIDENTS**

Accident constitute variable epidemic. They
rank now third in order among the leading causes of
death and responsible for approximately ten percent of
all deaths in developed countries. They are also the
chief cause of death among person age 10-24 years
between 12 and 65 percent deaths.
Accident as a proportion of all causes of death among person aged 10-24 years.

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>1978</td>
<td>12.3</td>
</tr>
<tr>
<td>Thailand</td>
<td>1980</td>
<td>19.9</td>
</tr>
<tr>
<td>Singapore</td>
<td>1981</td>
<td>25.2</td>
</tr>
<tr>
<td>Japan</td>
<td>1980</td>
<td>36.0</td>
</tr>
<tr>
<td>England and Wales</td>
<td>1980</td>
<td>45.9</td>
</tr>
<tr>
<td>France</td>
<td>1978</td>
<td>54.6</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>1978</td>
<td>54.5</td>
</tr>
<tr>
<td>Australia</td>
<td>1980</td>
<td>63.3</td>
</tr>
</tbody>
</table>

India has one of the highest road accident rate in the world. One out of every 42 vehicle in the country met with an accident in 1986. In USA and Europe average is on in every hundred vehicles.

3. INCIDENCE

As in some case of diseases, the incidence of accident is difficult to findout. However, a few surveys such as the one done in USA by department of Health education and welfare, in Scotland by Mac Queen (1960) and in Ludhiyana, Punjab, by Gordon et al (1962) have thrown some light on the incidence.

In USA, the national healthy surveys conducted between 1958 and 1961 covered injuries also. However, this included non accidental injuries too. They considered only injuries which resulted in one or more days of restricted activity or medical attendance. The
incidence of injuries was estimated to be 255 per 1000 population during the period of 1959 to 1961 (Baeker, 1965).

The Shore Committee (1946) had reported 54174 accidents in the industries of which 9,111 were serious and the other minor.

According to Gupta (1962) on average 22 persons in factories, mines, railways and docks, were being injured per hours in 1958 in India.

Gordon et al (1962) conducted a survey of traumatic accidents in four villages of Ludhiyana, district, Punjab, India. They considered only those injuries which produced a disability for at least one day. The incidence observed was 115.6 per thousand with 4.3 percent permanent crippling.

A study conducted by Ghosh et al (1972), 8205 accidents were recorded for four year period from 1967 to 1971 in eight districts of Himachal Pradesh which had population 2970981 at that time. They observed agricultural accidents 30.88 percent and construction work, mainly road building 24.66 percent are two important areas where large number of accidents occur in Himachal Pradesh. Accidents occurring at home, agricultural field and construction site put to gether are responsible for 90.51 percent of total accidents.

One fourth (25.50 percent) of all accidents in motor vehicle accidents corresponding figure for USA in 42.2 percent. Himachal Pradesh is having very high motor
vehicle accident in comparison to other part of India. Accident due to fall were 11.07 percent.

In study of industrial workers at Lucknow it was found that 23.5 percent workers had one or more accidents in one year and 92.9 percent of the accidents occurred while working in the factory. The average number of accidents per worker of those who met some accident was 1.3 and per 100 employee it was 31. The number of working class lost per accident was 7 and per hundred employees was 220 (Zaidi, 1965).

India is one of the country which has highest road accident rate in the world. One accident out of every forty two vehicles in 1986, while in US and Europe, the average is one in every hundred vehicles (Park JE, 1989).

MORTALITY

Accident is a leading cause of death for forty member countries of the World Health Organisation in both the hemispheres. Mortality mainly affects young people (WHO, 1967a and b).

According to WHO (1966b) over 100,000 persons are killed annually in road accidents exceed those from all communicable diseases. Lancet in a leading article (Editorial, 1963) has pointed out that accidents at home are responsible for even more deaths than by motor vehicles.
In USA, accidents is the first cause of death for ages between 1 and 36 years. Males under 20 years constitute 40 percent of all deaths from accidents and for male of 15 to 24 years accident mortality exceeds deaths from all causes combined (DHEW- PHS, 1960).

In Japan the leading cause of deaths from non transport accidents is fires and explosions, closely followed by falls, 21 percent due to drowning and 16 percent due to poisoning (WHO, 1965a).

Accidents accounted for 5 percent of all deaths in United Kingdom. In non transport accident mortality, poisoning contributes 22 percent.

In Ceylon 24 percent of the non transport accidental deaths are due to drowning, 20 percent fires and over 10 percent each bites and stings and falls (WHO, 1965d). In Tehran drowning is the chief cause of death from non transport accidents. Falls and blow from object closely follow it. Fires accounted for 18 percent, poisoning and electricity also account for 4 and 3 percent in this group respectively (WHO, 1965a).

The Bshore Committee (1946) reported 323 fatal accidents in the industries. According to Gupta (1961) the fatal accidents in Indian factories mines and railways have despite fluctuations between generally on the increase. The death rate per 1000 workers in factories was 0.09 in 1947 and 0.12 in 1958.

The Rajasthan state has reported that in 1960 there were 22 motor vehicle (19 in males and 3 in females).
and 464 other accidents (males-298, females-166) and in 1961 corresponding figures were 21 (15 and 6) and 436 (267 and 169). The data for 1961 represent 22% of all the deaths in the state (WHO, 1966).

In Nagpur, fires account for 37 percent, drowning 19 percent, falls 5 percent and poisoning 3 percent of the non transport accidental deaths (WHO, 1965a).

Gordon et al (1962) give 63.3 per 100,000 as the death rate from accidents for 11 Ludhiyana villages. They consider it high for a area without automobiles, factories or electricity.

Mittal BN et al (1972) reported 375 domestic accidental injuries during course of study at Allahabad. Incidence rate was 29 per thousand persons per year.

In 1974 there were an estimated 250,000 deaths in two million traffic accidents, for each death there are several hundred non fatal accidents and many be ten percent or more permanent disabilities (Park JE, 1989).

Gunaratne (1979) quoted statistics to illustrate the similarity in data on accidents in developed and developing countries. While three of four percent of deaths in India were accounted by natural causes such as lighting flood, land slide, exposure to cold and cyclones, nearly 22 percent accidental death were due to drowning, 12.9 percent due to traffic accidents, ten percent due to train accidents and eight percent due to poisoning. On average 1,000 deaths occurred every day on the road world wide.
MORBIDITY

Like incidence, this is also difficult to assess. The human cost, chronic handicap, deformity, pain, grief, separation, family disruption, economic loss etc, are all affects of accidents.

According to DHEW-PHS (1960), out of nearly 47 million injured in 1958, 11 million incurred in bed disabling injury. Intern of days they estimated that each year the injuries result in 124 million days of restricted activity, 114 million days of bed disability and 107 million work loss days. Gordon et al (1962) found that in 11 Punjab villages there were for very fatal accident, 7.9 non fatal ones with varying degree of crippling and 183 with disability for one day or longer.

Economic cost is difficult to calculate. According to American Medical Association and National Safety Council the wage loss (1,550,000,000 dollars) medical expenses (150,000,000 dollars), property damage (1850,000,000 dollars) and insurance (1,750,000,000 dollars) adding upto colossal sums are spent on road accidents alone (WHO, 1962a).

Backet (WHO, 1965) adds that for every fatal domestic accident there are 150 significant non fatal ones (with disability for one or more days or involving medical care), 550 more with disability for less than 24 hours and 3,500 without disability.
Economic loss due to accidents in USA is estimated at 5.3 billion dollars annually. In 1957 motor vehicle accidents alone caused about 4,21,100 man years loss at ages 20-29 years compared to about 98,00 due to diseases of heart (WHO, 1962).

The estimated cost of domestic accidents in U.K. is above pound 500 million annually (Editorial, 1963) and for industrial injuries pounds 70 million (Featherstone, 1964).

Industrial accidents in 1958 in India, 91.86 percent resulted in temporary disablement, 5.86 percent in permanent disability and 2.28 percent were fatal (Bhajekar et al, 1971).

According to time (1966) the cost of wage losses, medical and insurance expenses totalled dollar 18 billion USA, in 1965 from accidents involving 104,000 persons killed, 10.5 million disabled and 52.5 million injured.

Huge sums of money are paid by Employees State Insurance Corporation as compensation for industrial accidents in India every year (Zaidi, 1969).

5. AGE/SEX

Children especially boys have more accidents with low death rate and elderly persons have low incidence with high death rate (WHO, 1966a).

Domestic and pedestrian accidents are commoner
in extreme of age, while collision type of motor vehicle and occupational accidents are more found in young adults (Bull, 1961).

King (1955) observed that in rural accidents maximum incidence was observed in 15 to 20 years age group and minimum in 31 to 35 years with tendency to rise again thereafter.

CHILDREN

Poisoning is common in young children with peak at 2 years (Craig and Farner, 1953 and Jacobziner, 1959).

Burn is also common in children under 5 years. It is common in India where cooking is mostly done on the floor or ground (Fowler, 1956 and WHO, 1965a).

Children under 7 years have more accidents than older children (Gupta, 1961).

Gordon et al (1962) found that children below 15 years had the highest accident rate in Ludhiyana (Though severity was greater in older persons) School going children showed high incidence of 41.25% of all accidents (Gill et al, 1978).

adolescent and young adult

From his study of about 35,000 accidents over 19 years Schulzinger (1956) found that the peak was at 21 years, within the range of 17 to 28 years.

Out of 21,587 casualties and fatal accident
records analysed by Gharpure et al (1952a and b). The age group of 10-35 years was found to be most affected.

**DRIVERS**

Males under 30 especially between 18 and 23 years contributed heavily to the accidents than those beyond. Young adults and teen age drivers are also found to be involved in a disproportionately large number of single vehicle accidents (Mc Farland and Moor, 1957).

But case control study on automobile accidents in New York by Mc Carrol and Haddon (1962) did not find any evidence to support the widely accepted view that young drivers cause more of fatal accidents.

**INDUSTRIAL WORKERS**

Bhajekar et al (1971) reported accidental injuries, among Bombay port trust employees 70 percent of injured workers were below the age of 40 years.

**ADULT AND MIDDLE AGED AND POSTMIDDLE AGED**

Mc Farland (1958a) stated that for drivers past middle age due to impaired efficiency of senses and slower reaction time the rate tends to increase though many of them compensate by slower driving, less driving at hight etc.

According to norman (WHO, 1962) adult and middle aged drivers, have lower accident rates. Lowest is between 50 and 60 years.
But in the case of pedestrians, Haddon et al (1961) found that age increases the risk of accident as well as death when involved. Falls as cause of death assumes greater importance after 34 years. By 55 to 64 years of age, it accounts for a sixth of accidental mortality. Similarly fires and machinery accidents recorded a rising mortality with advancing age among men. At ages 45 to 64 years fires was the third and machinery the fourth cause of accidental deaths.

Ghosh et al (1971) showed that the age group between 15 to 44 years which is main working group of population is responsible for 56.5 percent of the accidental cases.

ELDERLY PERSONS

Older persons have more fall due to poorer sensory and motor functions. In USA more than 75 percent of those killed by falls are 65 years and over (DHHS-PHS, 1960).

The elderly present the chief problem. In a study relating to accidents to distance walked those aged 5 and over had three times the accident rate of the 30-39 age groups (the 'safest' group) and 20 times fatal accidents.

According to WHO (1962 and 1966b) dangerous age for all classes of road users is above 65 years and 15-25 years. Agate J, (1966) states that 75 percent fatal home accidents involved persons above 65 years
and that 50 percent are above 75 years age. In 9 out of 10 fall fatalities the victim is elderly.

**SEX**

Men are more susceptible to accidents at all ages except the very young and very old. And they are also more vulnerable to fatal accidents (WHO, 1966a).

In over all incidence males predominate except falls handling objects and non motor transport (Collins, 1944).

Schalzinger (1956) observed that males have significantly higher incidence than females (except the 1st year) specially repeated accidents. However, in USA women of the low income group have more accidents than men (DHEW-PHS, 1960).

In USA more than 213 of all accidents occur in males except falls. And in the occupational category it is almost exclusive (Mc Iver, 1961).


Fire accounts for 35 percent of non transport accident mortality in females in Ceylon while fall from tree cause 21 percent deaths for males from non transport causes in Ceylon. These are also related to occupation (WHO, 1965a).
In Bombay, out of the 21,587 non fatal and 1,848 fatal accidents, the cases records of which were analysed by Gharpure et al (1959), females formed only 10 and 5 percent respectively.

According to WHO (1965a) in Nagpur, among non transport accident mortality, women are more susceptible to burn and scalds (25 and 40 percent respectively) than men (3 and 19 percent). But males have more accidental deaths from falls (12 percent) and drowning (28 percent) than females (4 and 13 percent respectively).

CHILDREN

Among children pedestrians risk for boys is more than in girls (WHO, 1962a). Rao (1966) found that in his series of 91 burns in Delhi (hospital) that the sex ratio was 2 : 1.

Gill et al (1970) reported highest accident rate for both sexes was 51.25 percent amongst children of school going age.

ADOLESCENT

Girls have fewer accidents and are among the best risks on the road (Backett, 1959). Normal (WHO, 1962) says that girls except under 1 years are 5 times less susceptible.

ADULTS

The general excesses of males in road fatalities has its peak in the young adult where the
sex ratio is 10 : 1 (Backett, 1959).

Lauer (1952) says that apart from being the major contributor in road accident male drivers also take 5 years before improving their accident record. Females on the contrary show improvement from the start. But according to Mc Farland and Moor (1960), it is difficult to say whether females are safer drivers or not because of disproportionate amount of driving between the two sexes.

Women have less accident than men doing comparative jobs. In a study by physiological and industrial hygiene section of All India Institute of Hygiene and Public Health, Calcutta, the ratio was 5:24 for reportable accidents in 1946 in Bengal (Sabnis and Rao, 1961).

But investigation into 93 percent of the fatally injured motor vehicle drivers in New York showed that they were all males (Mc Carrol and Haddon, 1962).

Ghosh et al (1971) reported highest number of accidents in Home (34-97 percent) in which males (33.52 percent) and females (86.94 percent).

**ELDERLY PERSONS**

Over 65 years more females die from falls (Gordon, 1949). In USA nearly 315 of the fatal falls were in women of 65 years and over. In non fatal variety the retired females had twice as many accidents as males (DHEW-PHS, 1960).
Agarwal et al (1985), in Punjab, increasing loss of limbs is being reported as result of thresher accidents. In year 1976, as many as 294 cases were reported from Punjab. In year 1980, three hundred one cases were reported. Many cases must have remained unrecorded. Most of these accidents were due to use of improper threshers without safeguards.

A study from Ceylon (WHO, 1960) showed that high percentage of local accidents (21 percent) among the males which were due to fall from the trees, since one important occupation of male population is toddy tapping and picking of coconuts.

7. EFFECT OF ALCOHOL, DRUGS

The association between alcohol and accidents was known to ancient Egyptians (1,500 B.C.). One of the main danger of alcohol is that of accident on the road, at work and in the home. Beyond, 0.03 percent blood alcohol concentration, which may be considered normal, the chance of accident increases in geometrical progression. Roughly each rise of blood alcohol by 2 percent doubles the risk.

DRIVERS

Bjerver and Goldberg (1950) conducted experiment on expert drivers accustomed to moderate amount of alcohol and found that with 0.4 to 0.6 percent blood alcohol
According to Agate (1966) above 65 years 3 percent of all males and 4.8 percent of all females die from accidents. Fall is twice as common in females as males.

6. OCCUPATION

Occupation plays a significant role in the prevalence of accidents. Those working in mines, airways, railways, marine transport, factories, industries, workshops, machine, shops jetties etc. run a much greater risk than others. Similarly motor drivers, house builders, mountaineers, Army field operators, motorist cyclist and those enjoyed in various constructional work (like bridges, tunnels) loading and unloading, cutting woods, plucking fruits etc. also largely exposed to accident (Seal et al, 1961).

Death for persons engaged in mining, quarrying oils and gas wells were about 170/100,000 compared to 50 of those in agriculture and construction in U.S. in 1947 (Gordon, 1949).

For house keeping, females had a disproportionately higher accident rate of 22.5 percent compared to only three percent in males (DHEW-PHS, 1959).

Gordon et al (1962) found that the accident pattern was closely related to farm activity in the mainly agriculture community of Ludhiyana villages.
driving ability was reduced by 25 to 30 percent. According to them the threshold level of impairment was 0.035 to 0.09 percent in blood for expert drivers moderately accustomed to alcohol.

It has been shown many times that the drinking driver is particularly prone to accidents (e.g. Freimuth et al, 1958).

In Perth, Australia, Prearson (1957) found that of 218 fatal road accidents victims, 86 (39.4 percent) had an alcohol concentration, 100 mg/dl of blood or more and 53 (24.3 percent) had 200 mg/dl or more.

Banciu et al (1957) in Romania, 457 drivers examined with presumptive evidence of alcohol consumption of whom 128 drivers were involved in accidents.

Loomis and West (1958) used a stimulator and showed that there is direct relationship between blood alcohol concentration and impairment of functions.

The likelihood of accident rises even with relatively low levels of alcohol, and at higher levels the chance increases sharply (McFarland and Moore, 1957 and McFarland, 1958b).

Implication of alcohol has come from several countries like Australia, Canada, Germany, Italy, Scandinavia, South Africa, U.K., observed in blood alcohol concentrations of even 0.03 percent which is considerably below the legally accepted level of intoxication in U.S.A.
Using the "Miles driving Trainer" Drew et al (1958) found that low blood alcohol concentration of 20 to 30 mg/dl affects timing of controlled movements. At 30 mg percent there was 16 percent deterioration.

Some controlled studies carried out in Sweden showed that scores obtained by a group of expert drivers were poorer by 25 to 35 percent after alcohol consumption to the level of 0.04 to 0.06 percent. Some showed increased errors with as little as 0.032 percent. Individual variations are common. An insight into the quality of performance was lost first. In turn it deteriorated the standard of performance. As alcohol is eliminated slowly from nervous tissues, the effect may last for 14 to 18 hours or even more (Mc Farland, 1958).

Haddon et al (1959) concluded that alcohol is casual factor in more than 50 percent of the single motor vehicle fatal accidents studied by them.

A study of private motor vehicle accidents by airway by Barmac and Payne (1961) showed that pre-accident drinking was present in 69.5 percent of the cases. Driving after drinking was 12 times commoner in cases than controls. Abuser of alcohol and excessive drinkers were over-represented in the case series.

Cohen et al (1958) studied the effect of alcohol on experienced drivers with safe records and nil to moderate drinking habits. Results showed that alcohol
increased the percentage of risk takers. With increasing alcohol intake their performance deteriorated progressively. They concluded that even small doses (smaller than 0.5 mg percent considered safe by National safety Council, USA or 80 mg per 100 ml of blood considered safe limit by British Medical Journal, U.K. produced impairment of judgement and driving skill while creating false confidence. Such people are more dangerous than heavily drunken who are usually unable to drive.

Schmidt and Smart (Canada) (1959) found that the alcoholic drivers were involved in a significantly large number of accident per year and per mile driven.

Haddon and Bradess (1959) showed study of 83 drivers killed in single vehicle accidents, involving neither other vehicles nor pedestrians revealed that 41 (49 percent) had blood alcohol level of 150 mg per 100 ml or more at death and further 17 (20%) had level 50 to 150 mg/100 ml.

According to WHO (1966) alcohol is involved in half of at total driver accidents and in one third of the fatal pedestrian accidents.

Hypnototic, sedative and tranquillizers to be preserved with caution for drivers. The side effect of antihistaminics vary considerably. Miller (1957) suggested that patients taking these drugs should not drive until they have established by trial that they not experience significant side effect.
Nevertheless an investigation by the Food and Drug Administration of the United States uncovered a "dopring" which was illegally selling the Amphetamine sulphate tablet as "benny pills", "Copilots" or "Stay-awake pills" to the truck industry in 1953-55. Fatigue and depression normally followed by initial stimulation.

Miller (1957) suggested that if dose of Amphetamine does not exceed 10 mg, a driver may be permitted to prolong driving for a period of not more than two hours, the drug should not be repeated on the same day.

Various tests were conducted to study the effect of tranquillizers on skill of driving. Three tranquillizers (a barbiturate, a benzodiazepine and a phenothiazine) impaired performance in male series of tests. But the volunteers were unaware of any impairment (B.M.J., 1979). Using a pharmacological methods, an American study of drugs in living and fatally injured drivers suggested that stimulants increased the risk of fatal accidents 14 times and sedatives and antihistamines five times but tranquillizers not et al (Glauz and Blackburn, 1975).

The transport and road research laboratory's survey in Berkshire also looked at drug use. Eighty seven of the 2211 drivers at a fault were considered to have been impaired by a drug other than alcohol (non admitted to drug abuse). Thirty one of these who had taken a drug had also been drinking, and in 14(12 percent) of these accidents where alcohol was thought to have been
a major factor, the drivers had also taken drugs including monoamine oxidase inhibitors and other psychotropic drugs (Storie V.J., B.M.J., 1978).

Harvard (1976) has discussed the effect of main types of drugs and medicines and the precautions that should be taken on medical aspect of fitness to drivers. He emphasized the dangers of exceeding the prescribed dose or taking combination of drugs especially if one is alcohol and driving first few days of treatment when the effect may be most noticeable.

PEDESTRIANS

Haddon et al (1962) stated that studies in Illinois and Canada showed that elevated blood alcohol levels may be more frequent in pedestrians than drivers. A controlled study of the characteristics of adult pedestrians fatally injured in Manhattan showed that like drivers, the ability of pedestrians to negotiate the city traffic without mishap was deteriorated even in low concentration (10 to 90 mg percent) of alcohol. Another observation was that increasing age with little alcohol and middle age with much alcohol separately carried greater risk of fatal involvement.

Gerber (1954) measured the blood alcohol concentration in 1755 victims of fatal road traffic accidents, all were over 15 years of age and died within 12 hours of accident, of these victims, 49 percent had measurable
amount of alcohol in their blood (19 percent with 200 mg alcohol or more per 100 ml, 6 percent with 50 to 190 mg, 100 ml, 4 percent with 40 mg/dl or less). Three fourths of the victims were pedestrians, 49 percent of whom also had alcohol in their blood.

IN INDUSTRY

A french study on industrial workers showed that accident victims had higher percentage of alcohol than controls (WHO, 1966a).

AT HOME

The correlation between domestic accidents and drinking is yet to be studied. But is believed by experts that alcohol is related to domestic accidents too (WHO, 1966d).

8. EFFECT OF VEHICLE (TYPE)

In United Kingdom (1958) only 7481(2.5%) of 299767 casualties in road accidents were considered by the police at the scene of accident to be due to defect in brakes, tires and steering.

In the National vehicle safety checkup programme in the United State in 1959 (National Safety Council, 1960) one out of five passengers cars and one out of four trucks checked were found to be need of maintenance attention for safe driving. Lights and Brakes two factors of great importance for safety, were principal item needing attention on both passenger cars and trucks.
In study of vehicular defects in eleven states of United States (National Safety Council, 1960), about two out of five vehicles tested, were found unsafe, among individual states, four had vehicle rejections exceeding 50 percent, and the highest was 72 percent. Head lights led the list, being defective on 24 percent of all vehicles. In order of frequency defective brakes—17 percent, rear light—15 percent, steering—10 percent, glass—5 percent, and tires—one percent.

According to National Safety Council (1960) in United States 7.2 percent of drivers involved in accidents were considered to have visual obstruction on the vehicle (e.g. rain, snow, or wind shield, other wind shield obstruction load on vehicle), in the United Kingdom (Great Britain, Ministry of Transport and Civil Aviation, 1959a) only 64 of 299767 road casualties were considered to be due to the cause.

Driver of modern vehicle sits in an atmosphere which may be fairly completely sealed from the out side air. Although several ventilation aids are available, he may not use them. The resulting warm and comfortable condition may induce drowsiness. Defective exhaust escape of dangerous fumes into interior of the vehicle.

Pedestrians obviously come from encounter with motor vehicles. The legs are the chief sites of injury,
though impact with the bumper, but the head in case of life threatening injuries - which are more often caused by striking the vehicle, especially with the wind screen than the ground (Ashton, Paddor and Mackay, 1977).

Harris (1977) pointed out that energy absorbing materials and 'collapse' features can lessen the impacts. Solutions clearly must be incorporated in vehicle design as matter of urgency (B.M.J., 1979).

For motor cycle riders the main cause of death is also head injury, but severe injuries to chest and abdomen are common. A feature of motor cycle fatalities is both the multiplicity and the great severity of trauma sustained. For surviving motor cycle riders injuries to the extremities occur with great frequency, those to the legs often cause significant long term disabilities.

A feature of motor cycle casualties in industrialized countries in particular is a very significant proportion of survivors with serious brain damage. Rehabilitation prospects for those casualties are poor and cost of health care in extremely high.

For bicycle riders head injuries predominate amongst both fatal casualties and survivors. Lower limb injuries are fairly frequent, and a specific problem of foot injuries to child cyclist from spokes has been identified.

For car occupant, in fatal cases both head and chest injuries are of almost equal importance, among
survivors lower limb injuries are a frequent cause of disabilities. The use of seat belts by car occupants reduces the risk of all types of injuries. Among car occupants who are injured, the use of seat belt changes the anatomical distribution of injuries and also, for collision of equivalent impact severity, reduces markedly the risk of specific injuries. For unbelted occupants ejection is still identified as an important mechanism of injuries, although it has been reduced with introduction of anti-burst lock designs in car doors.

For occupant of light vans, pattern of injury vary significantly from those of car occupants. Ejection is more important mechanism of injury, lower leg injuries occur more frequently.

For occupants of truck, injuries differ substantially from those of car occupant. Severe injuries to the lower leg are particularly prominent amongst serious casualties, chest and head injuries are relatively less frequent. Fatal injuries are strongly associated with massive intrusion of car structure or with ejection of the occupants (WHO, 1979, Europe).

9. EXPERIENCE OF DRIVER

Farmer and Chamber (1939) showed that experience reduces accident rate, though it does not affect accident proneness.
Study of a single vehicle accident and drivers indicated that susceptibility of younger drivers may be due to inexperience. A study of personal injury accidents in Great Britain also supported the view that inexperience is a major factor in teenage accidents (Mc Farland and Moore, 1960).

Rastogi (1962) observed that increasing experience reduced the accident rate among industrial workers in Kanpur.

According to Norman (WHO, 1962) adult and middle age drivers have lower accident rate. Lowest is between 50 to 60 years of age.

Mc Farland (1958a) stated that for drivers of past middle age due to impaired efficiency of senses and slower reaction time the rate of accidents tends to increase, though many of them compensate by slower driving, less driving at night etc.

Drivers who have not been trained properly fails to react correctly in emergencies, though they are able to drive in normal conditions (Thorley, 1961).

Ignorance, lack of education and inexperience are also causes of accidents (Sabnis and Gupta, 1961).