

# **Analysis on Fatalities' Characteristics of Residential Fires**

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## **1. INTRODUCTION**

Every Year, a half of structure fires occur in residential buildings, and three fourths of fire deaths caused by structure fires are due to residential fires in Japan. Moreover, Japan is facing the problem of the rapid aging of society which is expected to continue to a stage where one fourth of total population will be 65 or older at the beginning of the 21st century. Since almost a half of the total fire deaths are 65 or older, the rapid aging of Japanese society would cause increasing number of fire deaths in the coming near future. Considering these facts, much more concern than ever has addressed the residential fire problem in this decade from the viewpoint of fire deaths reduction in Japan.

The purpose of this study is to analyze the characteristics of fatalities due to residential fires for examining appropriate residential fire protection measures in terms of life safety especially for the people with disabilities like aged people.

## **2. SOURCE OF FIRE DEATHS DATA BASE USED IN THIS STUDY**

Every fire death as well as every fire incident is reported systematically in an unified format from municipal fire departments to Fire Defense Agency. The data base of fire deaths used here contains the information of the fire deaths that occur in single-family dwellings, and multiple-family dwellings for five years from 1983 to 1987. However, the fire deaths caused by such fires as incendiary fires and suicide fires are excluded from analysis here, because this kind of problem should be treated with from other viewpoints such as a crime or a social problem. The total number of residential fire deaths analyzed here is 3,629.

The information in a fire death report includes the building features of an origin house or an apartment, the data of a fire profile such as a cause, the first item ignited, extent of fire spread etc., and the fatality's characteristics such as age, sex, physical and mental conditions at a fire including incapacitation due to alcohol.

## **3. RESULTS OF ANALYSIS**

### **3.1 Life Loss Risk by Structure Type**

Table 1 shows the comparison of life loss risk by structure type of residential buildings. Six structure types here are determined by combining three construction types such as fire resistive construction, fire proof wooden construction, and ordinary wooden construction, and two housing types such as a single-family dwelling and a multiple-family dwelling.

As can be seen in Table 1, the number of fire deaths per year per million units of a corresponding structure type changes mainly according to the change of construction type rather than that of housing type. Therefore, if characteristics of a fatality himself ( or herself ) is omitted from consideration in analysis, fire severity such as an extent and/or rapidity of fire spread is naturally considered to be a dominant factor that affects life loss risk in a residential fire.

### 3.2 Life Loss Risk by Fatality's Characteristics

The items concerning fatality's physical functions obtained from a fire death report are age, whether one suffers from sickness or not, whether one is handicapped or not, and whether one is bedridden or not. Likewise, the items concerning a level of one's consciousness awakening in terms of fire detection are whether one is sober or not, and whether one is awake or asleep. Using these items, the relation between life loss risk and fatality's characteristics is analyzed hereafter.

#### (1) Age

Figure 1 shows a histogram of the proportion of fire deaths by three age groups as 65 or older, 5 or younger, and 6 to 64. As shown in Figure 1, almost a half ( 47.8 % ) of the total fatalities are 65 or older. By the way, Table 2 gives us another aspect of life loss risk among four groups as 65 or older, 75 or older, handicapped, and bedridden. In terms of the death rate ( the number of fire deaths per year per 100,000 persons ), the aged who are 65 or older have 4.5 times as high risk as average, and the aged who are 75 or older have 8 times higher risk than average. Handicapped persons, who are given a certificate by government, have almost as same risk as the aged who are 65 or older. However, the most noticeable fact is that bedridden persons, 82 % of whom are 65 or older, have indeed 41 times as high risk as average.

From this fact, the most difficult condition is considered to be the case of a bedridden person among the groups categorized as the people with disabilities. Although such two characteristics of fatalities as aged and bedridden overlap each other, a substantial feature of physical functions like bedridden should be given priority to categorize high risk groups.

#### (2) Physical Functions

The conditions of physical functions can be sorted out into such seven categories as shown in Figure 2 based on the items in a fire death report. Figure 2 shows a histogram of the proportion of fire deaths by these seven category groups. In order to think of a strategy of fire deaths reduction program, it is a considerably important fact that the total percentages of the six groups that have some handicap at any rate in terms of escaping ability reach almost 70 %. This fact tells us that occurrence of fire death depends not only on severity of a fire itself but also largely on conditions of occupants' physical functions. Therefore, besides fire control measures, we should notice improvement of environmental conditions of disabled persons and the elderly as well as emergency assistance by their family or neighbors for reducing fire deaths.

### (3) The Level Of Consciousness Awakening

With combination of two items of drinking status and awakening status, the levels of consciousness awakening of fatalities can be sorted out into such five category groups as shown in Figure 3. From the histogram of the proportion of fire deaths by these five groups, about a half ( 53.1 % ) of the total number of fatalities come under such status as drunk or asleep. Figure 4 shows the breakdown by three age groups as described in Figure 1 for each level group of consciousness awakening. In the cases of drunk status to some extent, the proportion of the age group "6 to 64" is over 65 %. On the other hand, the proportion of elderly group "65 or older" exceeds that of "6 to 64" in the cases of sober status.

### (4) Presence of Others at a Fire

Presence of others, i.e. whether one is staying alone or not at a fire, is also a very important item as an environmental condition of fatalities especially for the people who need help to move. The status of staying alone here includes being left alone temporarily and living separately from one's family in the same site as well as living alone.

Figure 5 shows a histogram of the proportion of fire deaths by presence of others at a fire. A half ( 50.8 % ) of the total fire deaths correspond to the status of staying alone at a fire in any case. Although the living alone case has the most proportion ( 24.8 % ) among the cases of staying alone at a fire, the case of being left alone temporarily has a quite large proportion ( 20.9% ). The number of fire deaths in this case could increase in the future, because there is an increasing tendency for elderly persons to be left alone during daytime, since more and more women go out to work in recent Japan. In either case of staying alone at a fire, emergency help by neighbors and emergency communication system for that are needed for disabled persons to be rescued.

### 3.3 Fire Deaths Incidence by Time of Day

For each of three items such as age grouping, whether one is bedridden or not, and presence of others at a fire, fire deaths incidence by every two hours in a day is illustrated respectively in Figure 6 through Figure 8. The distribution pattern of each category in these figures can be clearly identified as "more in daytime" type and "more in night-time" type. Namely, as to the categories of the aged, infants, bedridden persons, and being left alone temporarily, fire deaths tend to occur much more during daytime than during night-time. In contrast to above categories, as to "6 to 64" year age group, persons who are not bedridden, and living alone, fire deaths incidence during night-time is considerably higher than that during daytime.

#### 4. Concluding Remarks

Considering fire deaths incidence by time of day described above, residential fire deaths can be grouped as "the Disaster-Vulnerable people & Daytime Fire" pattern and "Non Disaster-Vulnerable people & Night-time Fire" pattern. Table 3 gives a summary of the distinctive features of these two typical fire death patterns.

The former pattern can be described typically as the case that a person, who needs help to move, encountered a fire alone and resulted in a fire death while other family member(s) went out for work or shopping. On the other hand, the latter pattern could be the probable case that a person, who has normal physical functions, died in a fire mainly due to delay of detection while he was drunk or asleep at night.

Towards the goal of the reduction of fire deaths, "the Disaster-Vulnerable people & Daytime Fire" pattern is more important than "Non Disaster-Vulnerable people & Night-time Fire" pattern, because the death rate as well as the number of deaths in the former pattern is quite high and further the population of such a high risk group corresponding to this pattern is increasing rapidly in Japan.

This kind of pattern classification of fire deaths makes it easy to understand how fire protection measures, such as a smoke detector, home sprinkler system, and emergency communication system, would be appropriate for a specified target group like the aged, the handicapped, or the persons who tend to be left alone during daytime. In addition, based on statistics on the proportion of fire death patterns and the population of corresponding target high risk groups, estimation of effect of a specified fire protection measure would be possible.

Table 1 The Number of Residential Fire Deaths by Structure Type

Structure type ( Housing type / Construction type )	The number of fire deaths per year per million units of house by structure type
Single-family / wooden	35.1
Single-family / fire proof wooden	10.2
Single-family / fire rated reinforced concrete	5.1
Multiple-family / wooden	33.4
Multiple-family / fire proof wooden	17.1
Multiple-family / fire rated reinforced concrete	6.0
Total of above	21.3

Table 2 Comparison of Residential Fire Death Rate among High Risk Group

Category of high risk group	The number of residential fire deaths per year per 100,000 persons	Ratio of fire death rate to the average ( 1.0 ) of total population
The Bedridden ( 65 <math>\leq</math> )	24.6	41.0
The handicapped*	3.0	5.0
The Aged (a) ( 65 <math>\leq</math> )	2.7	4.5
The Aged (b) ( 75 <math>\leq</math> )	4.8	8.0
Total Population	0.6	1.0

\* Handicapped : The people who are given a certificate by government

Table 3 Two Typical Fire Death Patterns Derived from Study of Fire Deaths Incidence by Time of Day

Fire Death Pattern	Distinctive Features of Fires
Disaster-Vulnerable* people & Daytime Fire	<ul style="list-style-type: none"> <li>* Victims are people who are disabled, elderly, or infant.</li> <li>* There are relatively few victims who are drunk or asleep.</li> <li>* There are many such cases that victims are left alone at a fire during other family members' absence.</li> <li>* For this pattern, home sprinkler system and/or neighbor's assistance is needed.</li> </ul>
Non Disaster-Vulnerable people & Night-time Fire	<ul style="list-style-type: none"> <li>* Most of victims are people who are 6 to 64 years old and with normal physical functions.</li> <li>* There are many victims who are drunk or asleep.</li> <li>* Many cases of living alone as well as staying with other family members at a fire come under this pattern</li> <li>* For this pattern, efficient fire detection system would save many lives.</li> </ul>

\* Disaster-Vulnerable : The people who are vulnerable to disaster

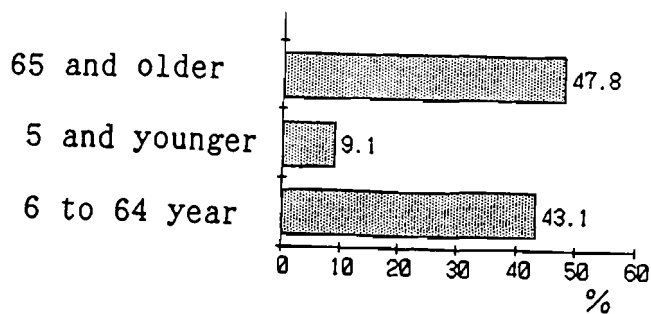


Figure 1 Proportion of Residential Fire Deaths by Age Classification

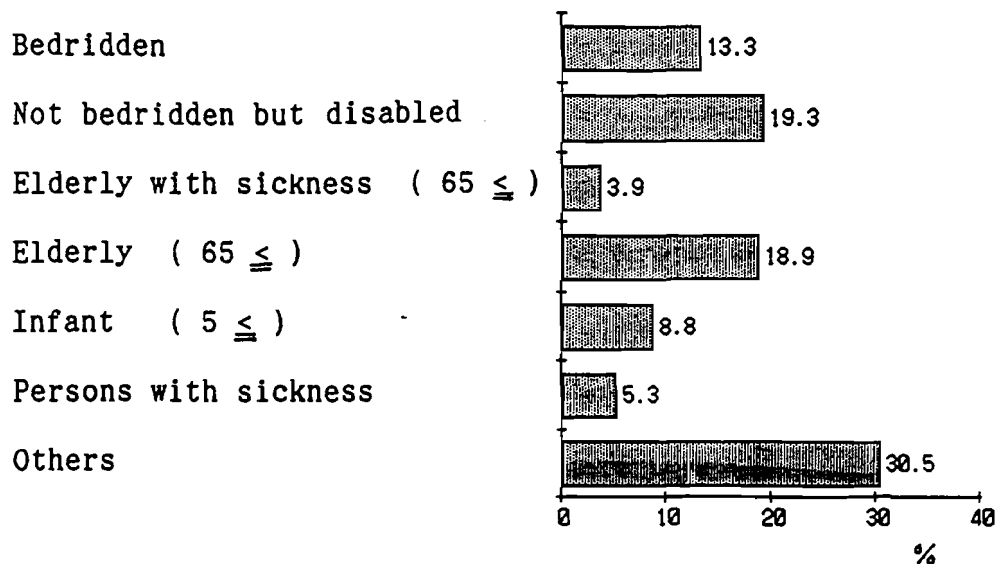


Figure 2 Proportion of Residential Fire Deaths by Conditions of Physical Functions

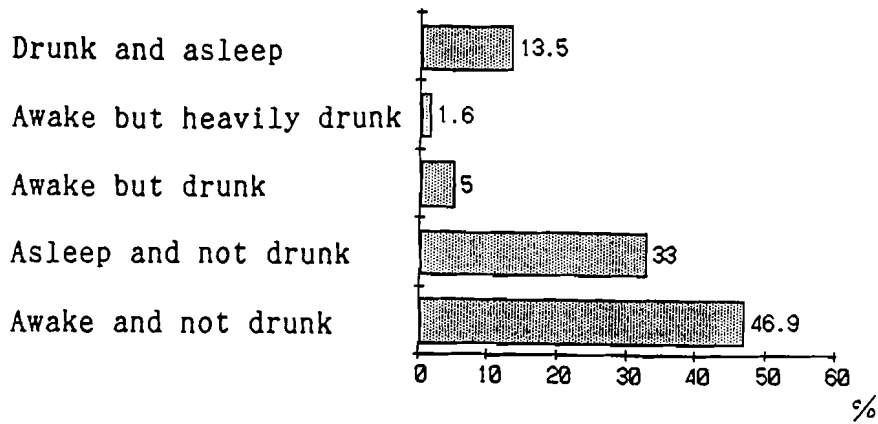


Figure 3 Proportion of Residential Fire Deaths by Levels of Consciousness Awakening at a Fire

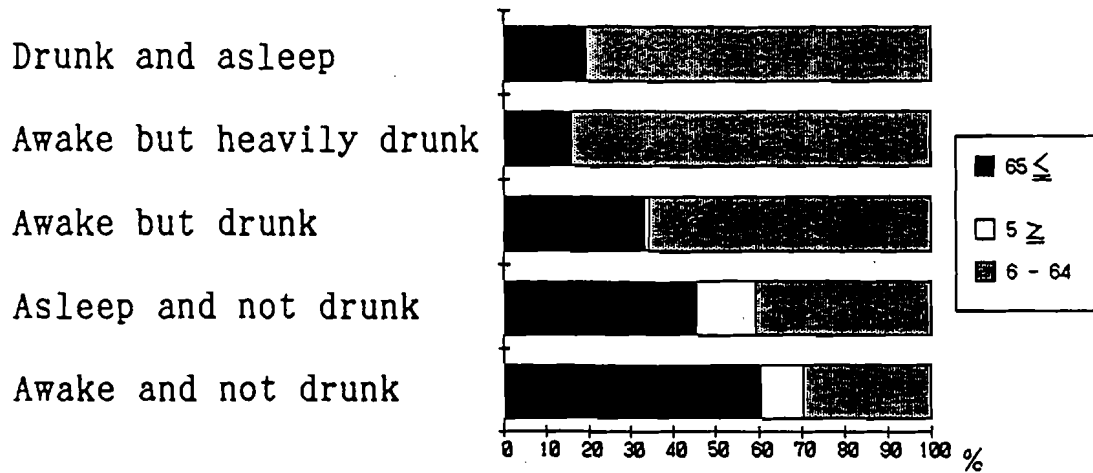


Figure 4 Breakdown by Age Classifications in Each Category of Levels of Consciousness Awakening at a Fire

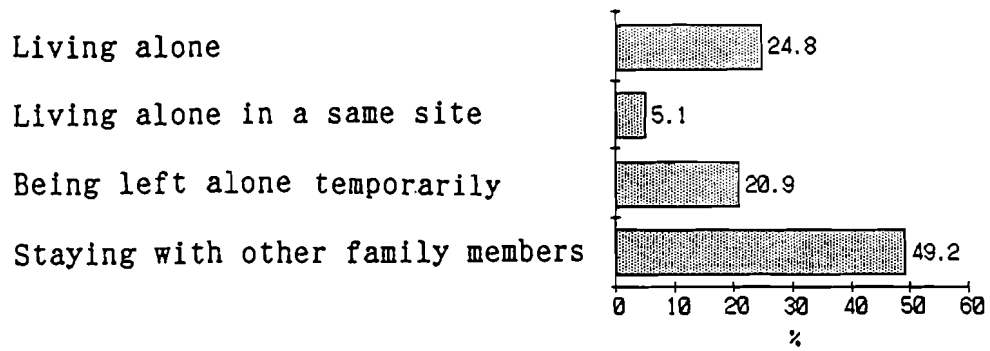


Figure 5 Proportion of Residential Fire Deaths by Presence of Others at a Fire



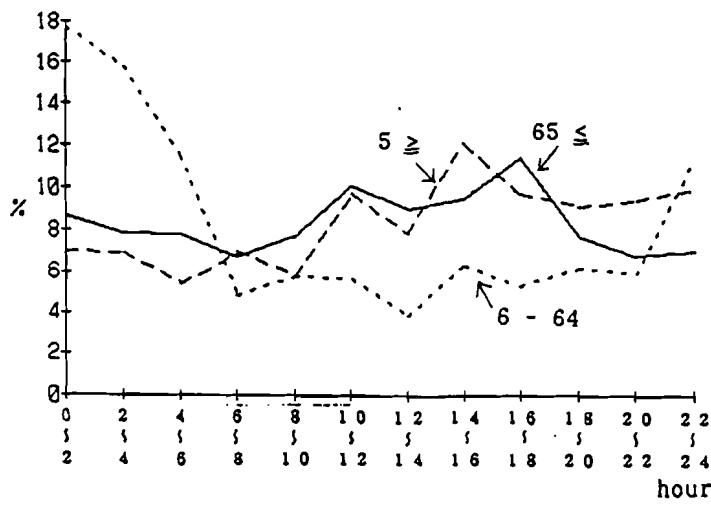


Figure 6 Fire Deaths Incidence by Time of Day for Each Category of Age Classification

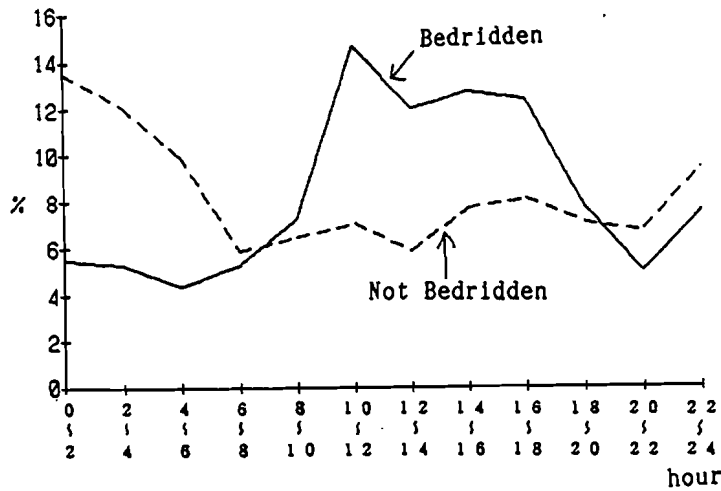


Figure 7 Fire Deaths Incidence by Time of Day for Each Category of the Bedridden and the Not Bedridden

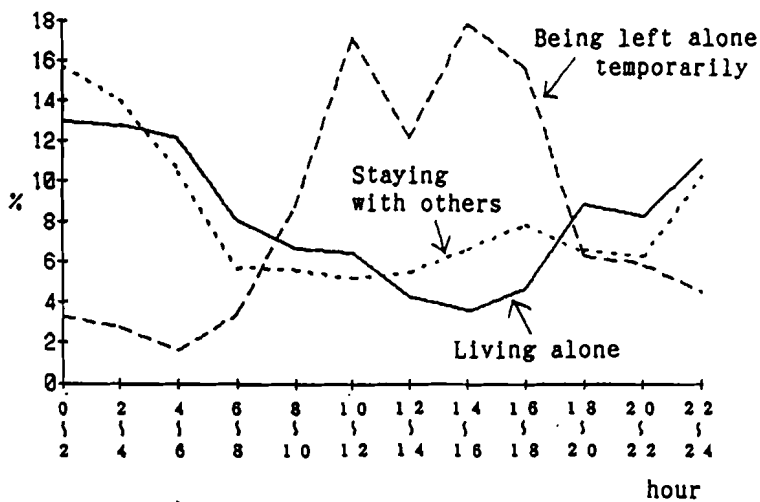


Figure 8 Fire Deaths Incidence by Time of Day for Each Category of Presence of Others at a Fire