

# THE MAJOR STRATEGIES OF FIRE PREVENTION ON RESIDENTIAL FIRE IN TAIPEI

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## ABSTRACT

Records from Taipei City Fire Department show that age and gender of the victims, type of housing, the location of the fire, source of ignition, hour range and residential fire deaths are all related to how and why residential fires occurred in Taipei City. With aids of the prevention strategy on residential fire which includes safety precaution, arson prevention and reinforcement on rescue training and the employment of fire rescue decision-making system, we are able to build hierarchy of prevention strategy to reduce the probability of residential fires, injury and deaths.

**KEYWORDS:** Residential fire, Fire prevention, Arson prevention

## INTRODUCTION

By analyzing the records of source of ignition, location of fires, number and age distribution of the deceased, number of wounded victims, hour range, amount of money loss, and the strategies of fire prevention have been developed by many counties and cities respectively to reduce the threats of fires to human lives and their properties<sup>1-10</sup>. The outcome of the analysis shows that residential fire remains the major type among all fire incidents and is the main reason causing unintentional fire deaths. For example, the majority of fire deaths of the United States, 75% of the total, are caused by residential fires<sup>3</sup>. In London, 78% of unintentional fire deaths are caused by residential fires<sup>5</sup>.

Taipei is a capital city with a population of 2.7 million people. In recent years, Taipei city government has taken an active role in conducting fire prevention strategies to reduce the number of fire and death. The four focal points of fire prevention work are: conducting fire prevention promotion, executing arson prevention work, strengthening the rescue training in residential fire and employing emergency rescue decision-making system.

Table 1 summarizes the number of building fires, number of residential fires and number of fire deaths from 1999 to 2006. Table 2 lists the number of fatal fires and number of deaths recorded in TCFD from 2003 to 2006 by purpose of property. Table 1 indicates that in recent years, the number of building fires, number of residential fires and number of fire deaths all decreased significantly in Taipei City. However, the number of residential fires to the number of building fire incidents remains approximately 75%. Table 2 shows that the accumulated number of fire deaths from 2003 to 2006 is 33, while the accumulated number of deaths in residential fire is 27. Among the 27 fire deaths, 78% has resulted from unintentional residential fires. From these two Tables, we could conclude that TCFD has taken effective fire prevention strategies and measures to control the residential fires and fatalities.

In this paper, the risk factors of residential fires in Taipei City are derived from the analysis of various characteristics of fire deaths. Therefore, the hierarchy of fire prevention strategies could be developed. Some of the on-going projects, including the residential fire prevention strategies for the elderly, on-campus and community fire prevention promotion campaign, improvement on how citizens use fire and appliances safely, automobile and motorcycle arson prevention, improvement on how grille are installed, are also outlined.

**TABLE 1.** Building fires, residential fires, and fire deaths recorded in TCFD, 1999-2005

Year	Number of incident building fires	Number of residential fires(% of building fires)	Number of fire deaths
1999	547	432 (79%)	19
2000	496	352 (71%)	13
2001	533	415 (78%)	10
2002	460	339 (74%)	12
2003	355	271 (76%)	11
2004	377	293 (78%)	9
2005	297	233 (78%)	5
2006	-	-	2

**TABLE 2.** Number of fatal fires and deaths recorded in TCFD, 2003-2006 by the purpose of the property

Property type	Number of fatal fires	Number of fire deaths
Residential-dwellings	21	27
Car-park	4	4
Others	2	2
All	27	33

## THE CHARACTERISTICS OF FATAL RESIDENTIAL FIRES

### Causes of Residential Fire Deaths

Table 3 provides a breakdown of number of deaths by sources of ignition in unintentional and deliberate residential fires from 2003 to 2006 in Taipei city. The number of the deceased in unintentional fire incidents accounted for 78% of the total. Discarded cigarettes accounted for 41% among all ignition sources, followed by electrical faults and defects of 29%. This result accords with the findings in worldwide and 46% of the fatal unintentional fires had cigarette, tobacco and cigar as source of ignition in London<sup>5</sup>.

Table 4 shows that the major cause of death in residential fires is smoke inhalation accounting for 52% of the total fatalities, which shares common result with statistics in the other papers<sup>2,3,5,10</sup>. It suggested that the smoke inhalation damaged far more seriously to human lives than burns caused by fire and heat.

### Age and Gender of Victim

Table 5 provides a breakdown of the number of fire deaths and pmp per year by age and gender in Taipei City from 2003 to 2006. Table 5 shows that roughly 70% of the deceased who suffered from the residential fire are male. Male also accounted for 100% of the deceased for the age group over 60. The pmp per year and number of deaths increased significantly by age. By looking into the original fire investigation report, we could attribute these findings to the following two reasons:

- (1) Health condition: Among the male victims in residential fire, most of them had histories of drinking and smoking. This could cause poor health condition leading to less capability of alertness and sheltering compared to the female.

- (2) Lifestyle: Most of the older male victims smoke in the bedrooms, which caused the fire fatalities in the bedrooms. In contrast, the female have better housekeeping habit and are more careful with the cooking and household appliances. As a result, the probability of fire fatalities is normally lower.

**TABLE 3.** Fatal residential fires and recorded in the TCFD, 2003~2006 by cause of fire

Cause of fatal dwelling fire	Number of fatal fires	% of fires	Number of fire deaths	% of fire deaths
Unintentional	16	76	21	78
Discarded Cigarette	6	28	11	41
Electrical faults and defects	8	38	8	29
Careless construction	1	5	1	4
Candles	1	5	1	4
Deliberate	5	24	6	22
Suicide	3	14	3	11
Arson	2	10	3	11
All fatal residential fires	21	100	27	100

**TABLE 4.** Unintentional residential fire deaths by cause of death

Cause of death	Number of fatal fires	% of fires
Smoke inhalation	11	52
Burns	6	29
Death from fall	4	19
All fatal residential fires	21	100

**TABLE 5.** Residential fire deaths by age group, gender of victim, and annual death rate (pmp per year\*)

Age group (years)	Male			Female			All		
	Number of fire deaths	% of fire deaths	pmp per year	Number of fire deaths	% of fire deaths	pmp per year	Number of fire deaths	% of fire deaths	pmp per year
00-09	0	0	0.0	1	4	1.9	1	4	0.9
10-19	1	4	1.4	2	7	3.2	3	11	2.3
20-39	3	11	2.0	2	7	1.2	5	19	1.6
40-59	6	22	3.9	3	11	1.7	9	33	2.8
60-79	7	26	11.3	0	0	0.0	7	26	5.4
80+	2	7	13.1	0	0	0.0	2	7	7.1
Total	19	70	4.9	8	30	2.0	27	100	2.6

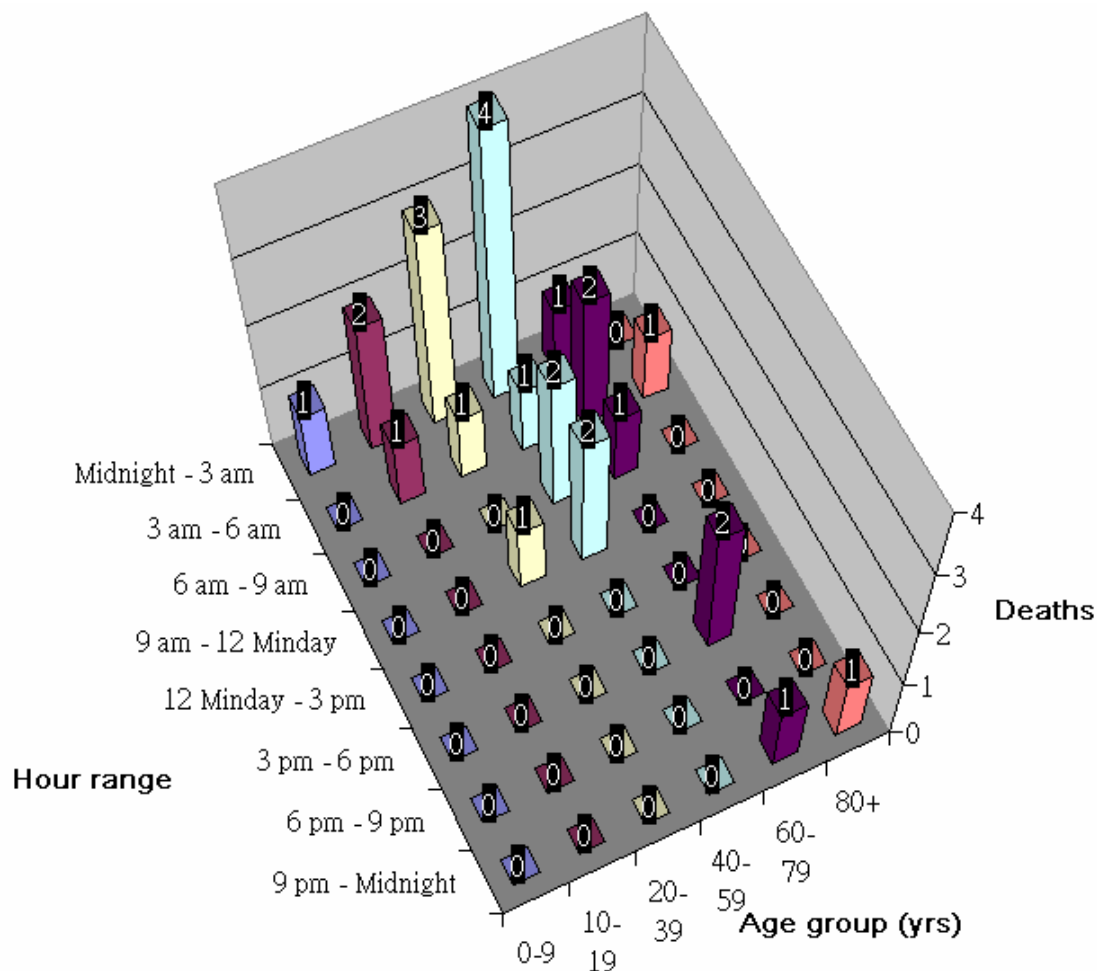
\*Based on TCFD data: 2003-2006 and using the 4 year average for annualized figures.

Table 6 lists out the percentage of death grouped by age and pmp per year in NFIRS, London and Taipei. The numerical result suggests that the percentages of death in three different geographic areas are rather close. It should be noted that NFIRS was based on adults in 2002. 66% of residential fire fatalities reported to NFIRS is for adults between 18 and 64, 34% was for adults above 65 years old. Both Table 5 and Table 6 show that pmp per year increases by age. In Taipei city, pmp per year for age group over 60 is much lower than that of London. This could be attributed to the cultural difference that many of the people over 60 years old in Taipei city live with their children, which could reduce the likelihood of fire fatalities and damages.

According to the records, the number of dwelling fire deaths did not follow a periodical cycle over the course of the year in Taipei City. However, in terms of the time of the day when fire deaths occurred, 70% occurred between midnight and 6 am as shown in Fig.1.

**TABLE 6.** Fire casualties by age group

Age group	NFIRS <sup>11</sup> percent	London <sup>5</sup>		Taipei	
		percent	pmp per year	percent	pmp per year
00-60(18-64)	(66)	58	3.86	67	2.03
60+(65+)	(34)	42	26.1	33	5.73



**FIGURE 1.** Dwelling fire deaths by hours range and age group of victims

## MAJOR STRATEGIES TO PREVENT RESIDENTIAL FIRE

### Advocate of Fire Prevention

#### Fire prevention for regular houses and the elders who live alone

TCFD has launched a series of fire prevention campaign for housing which has not been equipped with fire alarm system, especially for houses where the elders live alone, dormitory for singles and students, and houses for rent. TCFD also retains so-called “Fire safety Feng-Shui master” who are professional evaluators for fire safety to assist Taipei city citizens plan their residential fire safety. Their major tasks are outlined as follows:

- (1) Conduct preliminary analysis on residential fire prevention
- (2) Plan escape and sheltering for housing and dormitory
- (3) Improve the behaviors of fire usage and household appliances
- (4) Promote the installation of individual fire alarm system
- (5) Improve the installation of grille

Through fire prevention campaign, TCFD is able to build up database of high-risk housing which helps rescue planning or before fire occurs.

#### Fire prevention promotion for campus and communities

In addition to the annual large-scale fire prevention promotion campaign to the public, TCFD also sends officials to schools of all levels including cram schools, public places and communities to educate fire safety. Fire safety education includes get-to-know the fires, how to use fire safely, how to use fire extinguishers and how to operate the escape facilities.

#### The opening of Fire Safety Museum

In order to educate the citizens of Taiwan in disaster preparation, TCFD founded the Fire Safety Museum in July 1995. Advanced and entertaining facilities like computers and simulators have been utilized to help visitors understand the disasters such as earthquakes, storms, floods and fires; more importantly, what to do in case these disasters happens. The major facilities in the Fire Safety Museum includes safety training classroom for children, video presentation section, fire prevention at home, fire extinguish training area, smoke exposure area, demonstration area for fire evacuation at home (window area), fire prevention device education, fire prevention technology and etc.

Table 7 is the statistics in fire prevention dissemination during 2005 and 2006, which shows that approximately 400,000 citizens have received fire prevention dissemination every year. For cities like Taipei with a 2.7 million population, the penetration is so high that it should be very helpful in preventing fires from occurring, fire fighting in the very beginning and follow-up fire escape and sheltering.

**TABLE 7.** Statistics in fire prevention dissemination

Year	On-campus promotion		Visits by Feng-Shui master	Community promotion	Fire safety museum			
	No. of campaign	No. of participants			No. of campaign	No. of participants		
2005	2,073	176,983	39,646	131,676	4,168	61,408	1,530	71,046
2006.01 ~2006.09	1,225	114,764	24,599	80,610	2,853	56,281	1,103	62,760

### **Fire prevention promotion over the internet**

Internet has become very popular in the households of Taipei city. On its official homepage, TCFD has designed an interacting section which educates the citizens in knowing the characteristics of various locations and disasters to prevent possible damages. In this section, locations such as fields of business, factories, homes, natural disasters, escape, fire extinguish, firework damage, fire safety diagnosis, gas usage safety, electricity usage safety, and multi-media interacting education for fire prevention are included.

### **Promotion on Arson Prevention**

In recent years, there were increasing arson incidents in Taiwan. There are many reasons behind the arson incidents. In order to effectively prevent arson from happening, Taipei City government has created a dedicated homepage for arson impeachment recently. In the hope of the aid from the public, arson can be effectively reduced. The major focus on important sections such as automobiles, motorcycles, fields of business, homes, communities, and public places are as follows:

#### **Arson prevention for transportation vehicles**

- (1) Park in the open and light spaces.
- (2) It is more important that the vehicles are completely shut down, windows and doors are closed than having vehicles locked up.
- (3) Install alarm system.
- (4) Strengthen the street illumination.
- (5) Recycle of scrape vehicles.

#### **Arson prevention for fields of business**

- (1) Restrict entrance and exit, and always keep emergency exit clean and unlocked.
- (2) The owner or manager of the business should constantly remind the employees of the alertness to the arson, and the employees should report to the manager immediately in case the customers act unusually.
- (3) Only authorized staff or managers are allowed to enter the storage rooms, warehouse and other restricted areas.
- (4) Install nighttime illumination facilities equipped with self-control switch after work.
- (5) Carry on firefighting rehearsal on a periodical basis. Prevention plans should be made to meet specific characteristics of different locations. Fire prevention management system must be implemented. Self-defense, training and marshalling should be strengthened.
- (6) In case of fire, warnings and on-time broadcast should be made to the customers. Guidance of escape and fire extinguishment should be given to customers as well. Timely report to the police (dial 119 in Taiwan) is also necessary.

#### **Arson prevention for homes**

- (1) Always keep the doors and windows locked, sufficient light should be shed to the homes. In order to have more time to escape, the gate to the stairways should be shut during the sleep time to prevent smoke and heat from spreading through the rest of the building.
- (2) In order to prevent flamed paper or clothes from brimming over, metal or inflammable material should be used for mailbox.
- (3) Every home should have an emergency responding plan, and special attention should be paid to multi-direction exits.
- (4) Burglar-proof measures should be taken to prevent break-in arson.
- (5) Install fire extinguishers or tools which could put out fires.
- (6) Condo residents should be accustomed to close the public corridors door at all times. Devices like automatic door close should be installed if necessary.

#### **Arson prevention for communities and public places**

- (1) Video recording facilities should be activated for 24-hour monitoring. Tape reload, maintenance and repairs should be done on a regular basis.

- (2) Patrol should be intensified for empty houses or places with insufficient lighting.
- (3) Volunteer citizens and community patrol team should follow the command of the police to increase the “density energy of patrol”.
- (4) Fire extinguishers or tools which could put out fires should be fitted, and make sure that everyone in the community knows how to use them.
- (5) Special attention and console should be given to those who ever commit suicide through arson.

### **Rescue Training and Employment of Decision Making System**

In recent years, TCFD has conducted commanding and rescue training programs for different places/buildings which could cause massive damage, injury and difficult to escape and seek shelters. These places include conjunction buildings, building cluster with insufficient source of water, basement workplaces, high buildings over 20 stories, welfare institutes for the disabled, sanatoriums for the aged, hospitals, subway stations, underground shops, mechanical parking towers, department stores, shopping malls and etc.

Fire fighters and emergency medical technicians are to receive on-going courses of training including ALS (advanced life support) to enhance the quality of rescue and nursing care before the injured arrive at the hospital and decrease the responding time when fire and other emergency incidents happen.

Although there are ambulances in hospitals, health centers and fire departments in Taiwan, fire fighting government authority is the one who actually gives first-aid treatment to the injured at the scenes of disaster and escort them to the hospital before the hospital emergency rooms take over. In order to integrate the functions of acceptance, dispatching and control, TCFD has expanded its disaster prevention decision-making system such as GIS (Geography Information System) with input of on-the-spot disaster information. Using this system, TCFD can dispatch optimal resources, workforce, machinery and equipment according to the scale of the disasters.

### **CONCLUSION**

Taipei City Government has made tremendous efforts in promoting fire prevention, arson prevention, rescue training and regulation revision in recent years, which has reduced the number of residential fire and death significantly as we can see from the statistics. From 2003 to 2006, the pmp per year in residential fires in Taipei City is around 2.6, and the pmp of the elderly above 60 years old is three times the number under age of 60. What needs to be noted is that the victims over age of 60 from unintentional residential fires are all male and account for 33% of the total number of fire deaths. These death victims all have habits of smoking and drinking. Discarded cigarette is the major source of ignition, followed by electrical fault and defects. Around 70% of unintentional residential fires occur between 12 a.m. to 6 a.m.

In addition to continuous promotion on fire prevention education in campus and communities, automobile and motorcycle arson prevention, enhancement of the rescue training and employment of emergency rescue decision-making systems, Taipei City also plan to roll out the following work in the next years:

1. The elders who live alone should be on the priority list. Keep close contacts with those who have been equipped with SOS signaling system and provide most efficient and effective rescue and help.
2. The booklet of the fire prevention promotion should accommodate Vietnam, Indonesia, and Thai languages as more and more foreign workers and maids are employed in the families and workplaces.
3. Residential smoke detectors are to be installed and fire rescue/escape plan be promoted in the families, especially for those who have elderly members and infants.

4. Improve the cooperation mechanism between Taipei City and central government, Taipei City Government, other city governments, Taipei City disaster rescue department and private sectors (such as sanatorium, field of business, condominium, and hospitals). Available resources and fire prevention efforts from both the government and private sectors can be allocated to help diminish the happening of fire disaster and the losses to human lives and property.

## REFERENCES

1. Z. Guicheng, H.L. Andy, C.L. Hoe, and C. Michael, "Fire Safety among the Elderly in Western Australia", Fire Safety J., 41, 57-61, 2006.
2. A.M. Hasofer and I. Thomas, "Analysis of Fatalities and Injuries in Building Fires Statistics", Fire Safety J., 41, 2-14, 2006.
3. USFA, Fire and the Older Adult. Department of Homeland Security, United States Fire Administration - National Fire Data Center, January 2006.
4. J.A. Gulaid, J.J. Sacks and R.W. Sattin, "Deaths from Residential Fires among Older People, United States, 1984", J. Am Geriatr Soc., 37, 331-334, 1989.
5. P.G. Holborn, P.F. Nolan and J. Golt, "An Analysis of Fatal Unintentional Dwelling Fires Investigated by London Fire Brigade between 1996 and 2000", Fire Safety J., 38, 1-42, 2003.
6. P. Brennan, "Victims and Survivors in Fatal Residential Building", Fire Mater., 23, 305-310, 1999.
7. K.S. Fawaz, "Fires Related Incidents in Jordan (1996-2004)", Fire Safety J., 41, 370-376, 2006.
8. A.T. Elder, T. Squires and A. Busuttill, "Fire Fatalities in Elderly People", Age Ageing, 25, 214-216, 1996.
9. T. Rosenberg, "Statistics for Fire Prevention in Sweden", Fire Safety J., 1999; 33:283-294.
10. L. Peter, G. Markil and S. Svend, "Fatal Residential Fire Accidents in the Municipality of Copenhagen, 1991-1996", Prev. Med., 27,444-451, 1998.
11. Department of Homeland Security, Fire and the Older Adult, United States Fire Administration - National Fire Data Center, January 2006.