

Injuries and Fatalities in Apartment Building Fires

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ABSTRACT

Analysis of NFIRS statistics of the numbers, proportions and ratios of injuries and fatalities for bedrooms, kitchens, lounge rooms and other rooms in apartment buildings identifies factors influencing the probability of injury and death in apartment fires. Injuries and fatalities are compared primarily using the injury/fatality ratio (I/F ratio). Factors affecting fire outcomes available in the database include the room of fire origin, the age and sex of the casualties, the time of alarm, the ignition factor and the casualty location at time of ignition, condition before injury, activity at time of injury and condition preventing escape. There are wide variations in the proportions of casualties in various categories between the various room types. These appear likely to represent differences in the behaviour and the types of people involved in fires as casualties in the different rooms. There are differences between injury and fatality outcomes that also relate to the characteristics of the occupants and the uses of the rooms.

KEYWORDS: Fire, injuries, fatalities, human behaviour, statistics

INTRODUCTION

Design for fire safety in buildings requires knowledge of the effectiveness of fire safety components and measures and an understanding of the factors underlying the occurrence of casualties and damage. Previous papers [1,2] attempted to address these issues, by using NFIRS data [3] to estimate the effectiveness of some fire safety measures for a wide range of occupancies [1] and by investigating characteristics associated with injuries and fatalities in apartment buildings in the USA [2]. In [2] we concluded that:

- different factors are involved in injury and fatality outcomes in apartment fires and that they relate directly to characteristics and behaviour of occupants
- it is not appropriate to treat injuries and fatalities as though they are on one continuum from non-injury through injury to fatality

This analysis is now extended by examination of the numbers, proportions and ratios of injuries and fatalities for several fire locations, developing greater insights into factors influencing the probability of injury and death in apartment fires. It shows that, and to some extent how, the uses of the rooms and different occupant activities and behaviour in them influences fire occurrences and outcomes by utilising a little used resource, the records of those injured in fires. Comparison of fire and occupant characteristics from fires involving injuries with those involving fatalities enable the differences between them to be used to deduce differences in occupant characteristics and behaviour that may prove useful in education, design and regulation for fire safety. The information is also useful in modelling human behaviour in fires (as opposed to assuming the only human behaviour relevant to fire safety is evacuation response and speed as seen in most fire engineering design today).

METHODOLOGY

This paper primarily uses data from the NFIRS database which has files on fire incidents reported to contributing fire brigades and files on the casualties that occur in them. The casualty files contain data on the killed and injured (thus **casualties** = killed + injured). The NFIRS data used covers a ten year period between 1983 and 1993 (excluding 1986). It has 420,315 fires attended by fire brigades in apartment buildings in the USA that resulted in 28,635 injuries and 3111 fatalities. The **rate** per 1000 fires of fatalities was about 7 (from 6 fires), the rate of injuries 68 (from 47 fires) and the overall **ratio of injuries to fatalities** is 9.2.

This investigation is exploratory and at this stage has not involved multivariate analysis. Injuries and fatalities are compared primarily using the **injury/fatality ratio** (I/F ratio, or simply **I/F**). If the I/F ratio is:

- **very low**, say ≤ 1 , then fatalities make up $\geq 50\%$ of casualties, a high proportion
- **low**, say >1 but ≤ 5 , then fatalities make up $< 50\%$ but $\geq 17\%$ of casualties
- **medium**, say >5 but ≤ 15 , then fatalities make up $< 17\%$ but $\geq 6\%$ of casualties
- **high**, say >15 but ≤ 100 , then fatalities make up $< 6\%$ but $\geq 1\%$ of casualties
- **very high**, say >100 , then fatalities are $< 1\%$ of casualties, a low proportion

Provided there are a significant number of casualties for the category under consideration it is reasonable to infer that an I/F ratio that is very low means that the category is very dangerous (commonly results in fatalities) if occupants are present, whereas those with a very high I/F ratio represent categories that do not present great danger to occupants. This characterisation would be greatly improved if similar details for fires reported to the fire brigade that result in no casualties was available, but no data on the occupants are recorded in these cases. A further improvement would be similar data on fires not reported to the fire brigade (the great majority of fire starts) but such data does not exist. Much of the data is presented as rates to enable comparison of situations with different numbers of fires. **Rates** are always given on a per 1000 fires basis.

Some of the NFIRS fields may be thought of as representing **inputs** to the occurrence and effects of the fire, while others may be thought of as representing **outcomes**. Obvious outcomes, given a fire, are the number of people injured and killed, the proportion of fires in which casualties occur, the scale of casualties per fire and the cause and type of injury. Many inputs that it would be useful are not available. Those available include the area of fire origin, the age and sex of casualties, the time of alarm, ignition factor, and casualty location at time of ignition, condition before injury, activity at time of injury and condition preventing escape. A deficiency is data on people who do not become casualties – their characteristics and why they are uninjured would be valuable information.

RESULTS

Location of Fires (Area of Fire Origin)

Table 1 gives the number and proportion of fires by area of fire origin for the ten locations with the most fires. The remaining fires with known location are included in **all other**, and those with unknown or unclassified locations are grouped into **unknown**. Kitchens represent by far the most common area of fire origin, followed by bedrooms and lounge rooms. The remaining locations make up 31% of fires, but the biggest is just 3%.

In the remainder of the paper we examine in detail four locations: bedrooms, kitchens, lounge rooms and *other rooms*. The numbers and rates of **fires** with fatalities and injuries for these locations are given in Table 2 which shows that most fires have no **casualties** and that lounge room fires most frequently have casualties (11% have casualties), then bedrooms (9%), kitchens (4%) and *other rooms* just 3%.

Table 1 Location of Fires

Area of Fire Origin	Number of Fires	Proportion %	Number of Fires (Grouped)
Bedrooms	62440	14.9	62440
Kitchens	174831	41.6	174831
Lounge Rooms	35865	8.5	35865
Laundry	12742	3.0	147179
Hallway, corridor	11135	2.6	
Heating equip area	9026	2.1	
Lavatory, etc	8931	2.1	
Trash area	7516	1.8	
Closet	7453	1.8	
External wall	6974	1.7	
All other	66533	15.8	
Unknown	16869	4.0	
Total	420315		

There is great variation in the frequency of fires that result in **fatalities**: the rate of fires with fatalities varies between < 2 for kitchens and > 22 for lounge rooms. The variation in the frequency of fires that result in **injuries** is much lower. The resulting I/F ratios are 8, 24, 5 and 9 for bedrooms, kitchens, lounge rooms and *other rooms* respectively.

Table 2 Fatality and Injury Fires by Location (Rate is per 1000 fires)

Fire Type	No Injuries		Injuries		Total Fires
	Fires	Rate	Fires	Rate	
Bedrooms					
Fires with no fatalities	56838	910.3	4822	77.2	61660
Fires with fatalities	558	8.9	222	3.6	780
Total fires	57396		5044		62440
Kitchens					
Fires with no fatalities	167300	956.9	7226	41.3	174526
Fires with fatalities	210	1.2	95	0.5	305
Total fires	167510		7321		174831
Lounge Rooms					
Fires with no fatalities	32073	894.3	2997	83.6	35070
Fires with fatalities	547	15.3	248	6.9	795
Total fires	32620		3245		35865
Other Rooms					
Fires with no fatalities	142743	969.9	3896	26.5	146639
Fires with fatalities	327	2.2	213	1.4	540
Total fires	143070		4109		147179

There is great variation with location in all of these numbers confirming that fire location is important in determining ignition frequency and fire outcomes.

Age and Sex

The age and sex of casualties may influence their capabilities and behaviour. The proportion of injuries and fatalities by age group and sex is shown in Fig. 1 and the proportion of the 1990 USA population by age group is shown in Fig. 2 [4]. Comparison of Fig. 1 and 2 reveals that for certain locations and age groups fatalities and injuries are considerably out of proportion to the population. These variations are partly responsible for the variations in the I/F ratios with age group shown in Table 3.

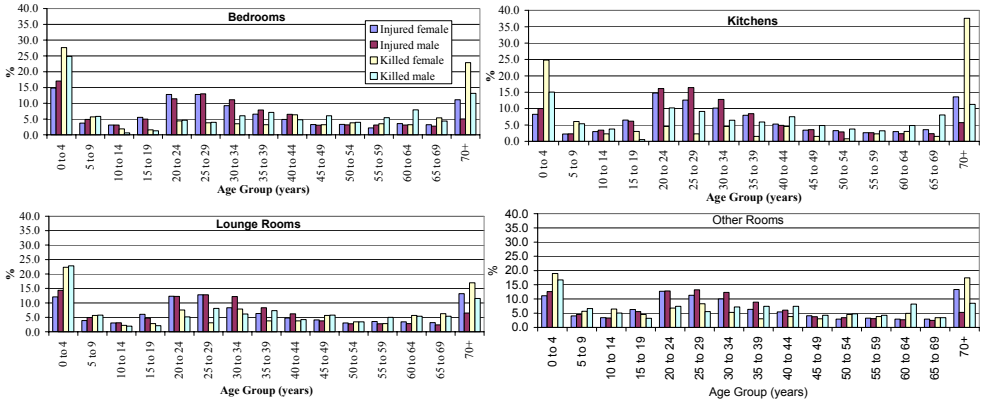


Figure 1 Proportion of Injuries and Fatalities by Age and Sex for Each Room Type

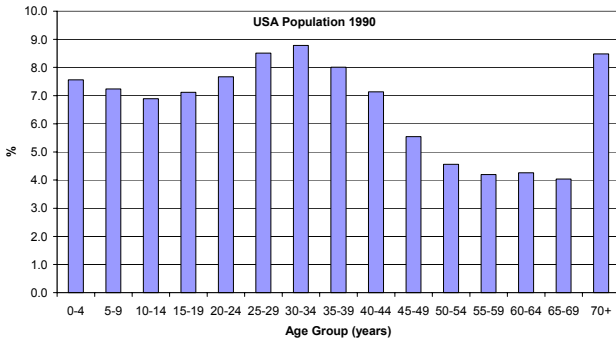


Figure 2 Proportion of 1990 USA Population by Age

From a comparison of Fig. 1 and 2 it is apparent that:

- the 0 – 4 year age group is greatly over represented for injuries and fatalities in bedrooms, and is generally over represented as casualties in other locations
- female fatalities in the 0 – 4 year age group are over represented by about 70% in kitchens only
- the 5 – 9 year age group is very under represented for injuries (all locations) and for fatalities in all locations but *other rooms*; the 10 – 14 years group is similar
- overall, males are over represented for fatalities (particularly in kitchens) but are generally not over represented for injuries
- females 70+ are over represented as fatalities in kitchens

Table 3 I/F Ratio by Age and Sex

Age Group	Bedrooms		Kitchens		Lounge Rooms		Other Rooms	
	Female	Male	Female	Male	Female	Male	Female	Male
0-4	5	4	9	13	3	3	5	6
5-9	14	32	37	17	8	7	5	5
10-14	29	26	60	217	12	10	12	13
15-19	24	16	91	30	10	11	16	13
20-24	28	21	155	34	24	7	12	18
25-29	22	12	62	38	6	9	17	13
30-34	18	7	147	27	10	5	19	9
35-39	6	9	32	12	7	7	13	6
40-44	9	3	63	14	4	3	12	7
45-49	6	5	10	8	4	4	6	5
50-54	7	5	120	15	5	4	6	5
55-59	5	4	32	16	7	2	8	5
60-64	10	3	27	9	4	2	5	2
65-69	5	4	66	6	3	2	8	5
70+	4	3	10	10	5	3	7	5

More detail is apparent in Fig. 1 but is not discussed here due to space limitations. Based on Table 3:

- no age group has a very low I/F ratio in any location
- in bedrooms and lounge rooms children 0 – 4 years of both sexes have a low I/F ratio as do males and females 40+ years (particularly males)
- the I/F ratio is high for ages 11 – 30 for bedrooms and kitchens
- generally the I/F ratio is higher for females than males
- the I/F ratio for females 70+ is medium (over representation of this group as fatalities in kitchens is not associated with a very high proportion of fatalities)
- there is great variation in the I/F ratios by age group but less variation by sex

Time of Alarm

Table 4 presents the proportions and rates of casualties and the I/F ratios by time of alarm and room type. The proportion of injuries varies most through the day for kitchens, less for lounge rooms and least for bedrooms and *other rooms*. The injury rate varies considerably with time, it is generally lower from 1 pm to 10 pm.

The proportions of fatalities vary less with time than injuries, generally being highest from 10 pm or 1 am through to 7 am but with significant variation. The fatality rates vary widely with time of alarm and room type, generally being highest from 1 am until 7 am and lowest in the afternoon and evening.

The I/F ratios are generally medium, but they are low for bedrooms, lounge rooms and *other rooms* late at night. Thus there are very significant variations in casualty proportions, casualty rates and I/F ratios with alarm time; room type affects these variations.

Ignition Factor

The field **ignition factor** in the NFIRS data often gives a good insight into the circumstances of ignition. Table 5 shows the eight most frequent entries for each room type ordered by injuries (but generally covering the most frequent fatality cases also).

Examination of Table 5 reveals that the most frequent entries for ignition factor vary considerably between the room types with **children playing** and **abandoned or discarded material** (includes cigarettes, cigars, etc) being predominant for both bedrooms and lounge rooms. For lounge rooms **abandoned or discarded material**, **falling asleep**, **incendiary** and **misuse of heat of ignition** have low I/F ratios.

Table 4 Proportions of Casualties and I/F Ratio by Time of Alarm and Room Type

Time	Injuries		Fatalities		I/F Ratio
	%	Rate	%	Rate	
Bedrooms					
7.01 am to 10 am	14.8	156	12.2	16	10
10.01 am to 1 pm	15.4	128	11.8	12	11
1.01 pm to 4 pm	11.4	99	9.2	10	10
4.01 pm to 7 pm	10.6	91	10.0	11	9
7.01 pm to 10 pm	13.0	107	8.2	8	13
10.01 pm to 1 am	13.8	123	17.1	19	7
1.01 am to 4 am	10.3	174	13.6	28	6
4.01 am to 7 am	10.7	150	17.9	31	5
Kitchens					
7.01 am to 10 am	8.3	57	8.1	2	25
10.01 am to 1 pm	13.3	48	14.0	2	23
1.01 pm to 4 pm	15.6	47	11.5	1	33
4.01 pm to 7 pm	19.7	45	9.0	1	54
7.01 pm to 10 pm	19.1	51	12.1	1	39
10.01 pm to 1 am	12.2	59	12.4	2	24
1.01 am to 4 am	6.1	76	15.2	8	10
4.01 am to 7 am	5.6	67	17.7	9	8
Lounge Rooms					
7.01 am to 10 am	15.7	219	13.6	35	6
10.01 am to 1 pm	11.9	148	9.7	23	7
1.01 pm to 4 pm	8.1	99	7.4	17	6
4.01 pm to 7 pm	9.3	100	7.9	16	6
7.01 pm to 10 pm	11.1	101	10.9	19	5
10.01 pm to 1 am	18.1	159	18.6	31	5
1.01 am to 4 am	13.0	222	16.9	54	4
4.01 am to 7 am	12.8	192	14.9	42	5
Other Rooms					
7.01 am to 10 am	10.8	55	8.9	5	10
10.01 am to 1 pm	11.2	40	7.5	3	13
1.01 pm to 4 pm	10.2	31	7.1	3	12
4.01 pm to 7 pm	12.3	33	6.6	2	16
7.01 pm to 10 pm	13.2	33	8.4	2	14
10.01 pm to 1 am	19.9	58	23.6	8	7
1.01 am to 4 am	11.5	68	20.5	14	5
4.01 am to 7 am	10.7	63	17.4	12	5

In the case of kitchens the predominant category for both injuries and fatalities is **unattended**. The second category for fatalities is **combustible too close to heat**, which (along with **abandoned or discarded material**) has medium I/F ratio. The predominant categories for *other rooms* are **incendiary** and **suspicious** with all I/F ratios medium except for **incendiary** which is low (perhaps indicating that in these fires homicide or

suicide was often the aim and possibly that arsonists are sometimes careless in handling flammable liquids and bring about their own accidental death).

Table 5 Casualty Proportions and I/F Ratio by Ignition Factor

Ignition Factor	% Injuries	% Fatalities	I/F Ratio
Bedrooms			
Children playing	29.0	21.6	12
Abandoned or discarded material	22.4	28.1	7
Falling asleep	10.1	16.5	6
Suspicious	6.8	6.5	9
Short circuit, etc	6.6	4.4	13
Incendiary	6.5	5.5	11
Combustible too close to heat	4.4	3.0	13
Misuse of heat of ignition	3.4	3.6	9
Kitchens			
Unattended	45.6	29.2	48
Falling asleep	8.6	8.8	30
Misuse of heat of ignition	7.7	5.6	42
Combustible too close to heat	7.1	15.2	14
Abandoned or discarded material	5.4	10.0	17
Short circuit, etc	2.8	3.2	27
Misuse material ignited	2.8	0.4	212
Part failure, leak, etc	2.3	1.6	43
Lounge Rooms			
Abandoned or discarded material	33.5	40.0	5
Children playing	15.9	13.0	7
Falling asleep	10.1	12.5	5
Incendiary	7.3	8.0	5
Suspicious	6.9	3.8	10
Short circuit, etc	5.1	2.2	13
Combustible too close to heat	4.7	3.8	7
Misuse of heat of ignition	3.1	6.8	3
Other Rooms			
Incendiary	24.5	38.1	6
Suspicious	21.0	23.0	9
Abandoned or discarded material	10.6	9.9	11
Children playing	9.6	6.6	15
Short circuit, etc	5.9	3.3	18
Combustible too close to heat	4.3	2.9	15
Other electrical failure	3.1	1.9	17
Part failure, leak, etc	2.9	1.6	18

Thus there is much variation between room types in the scenarios resulting in most casualties. Perhaps surprisingly (because sleep is frequently cited as a significant factor in design for fire safety) **falling asleep** is not pre-eminent in any of the room types.

Location at Ignition

The categories for **location at ignition** (Table 6) are ordered as in the database, reflecting a gradation from being very close to the fire to being far away when ignition occurred.

Examination of the I/F ratio in Table 6 shows a general gradation from low to high with increasing remoteness from the ignition location. The differential is small through the range of locations from **intimately involved** to **in building**, with a larger differential between **in building** and **off property**, except for kitchens. The I/F ratio is medium or high except as follows:

- it is **low** for **intimately involved** in bedrooms and for **intimately involved, in room** and **on storey** in lounge rooms
- it is **very high** for **off property** for all room types except lounge rooms

Table 6 Proportion of Casualties and I/F Ratio by Location at Ignition

Location at Ignition	% of Injured	% of Fatalities	I/F
Bedroom			
intimately involved	19.0	28.3	5
in room	27.8	35.8	6
on storey	25.8	21.8	9
in building	22.4	13.8	12
off property	5.1	0.3	143
Kitchen			
intimately involved	16.2	22.3	17
in room	35.9	20.6	40
on storey	28.4	37.1	18
in building	14.0	19.4	17
off property	5.5	0.6	198
Lounge Room			
intimately involved	13.4	22.6	3
in room	26.0	28.1	5
on storey	28.6	30.4	5
in building	25.9	17.3	7
off property	6.1	1.5	20
Other Room			
intimately involved	10.5	12.4	7
in room	17.0	16.2	9
on storey	21.3	24.3	7
in building	44.4	46.5	8
off property	6.8	0.5	104

The proportion of casualties **intimately involved** is highest (for both injuries and fatalities) for bedrooms and lowest for *other rooms*. At the other end of the scale there is little difference in the proportions for **off property** for all room types.

Considering the combined categories **intimately involved** and **in room** as representing occupants in the room of fire origin (RFO), the majority of the fatalities are in the RFO for bedrooms (64%) and lounge rooms (51%) but not for kitchens (43%) or *other rooms* (29%). There is less variation for injuries, from 52% for kitchens to 28% for *other rooms*.

Thus for room types apart from *other rooms* high proportions of casualties, particularly fatalities, are **in the RFO** at ignition and the I/F ratio is low or medium close to the ignition location.

Condition Before Injury

The proportions of casualties and I/F ratio are categorised by **condition before injury** in Table 7. There is a clear disparity in the table between **awake, unimpaired** and all other categories for the I/F ratio, with the I/F ratio being high for **awake, unimpaired** and lower for all other categories. **Awake, unimpaired** constitutes the highest proportion of injuries for all except lounge rooms, with kitchens at about 65% having the highest followed by *other rooms* at 56%. In contrast it constitutes a low proportion of fatalities for all room types except kitchens. **Asleep** is the other standout category, it represents a large proportion of casualties for all room types. Perhaps surprisingly it is highest for fatalities in other rooms (57%), followed by lounge rooms (54%), bedrooms (50%) and kitchens (40%).

Table 7 Casualties and I/F Ratio by Condition Before Injury

Condition Before Injury	% Injuries	% Fatalities	I/F Ratio
Bedrooms			
awake, unimpaired	46.1	13.0	33
asleep	38.8	50.3	7
bedridden, etc	1.6	6.6	2
impaired by drugs, etc	5.6	10.8	5
too young, old, etc	7.7	19.0	4
under restraint	0.1	0.4	4
Kitchens			
awake, unimpaired	65.2	28.8	67
asleep	24.4	40.2	18
bedridden, etc	1.4	3.9	10
impaired by drugs, etc	4.2	10.9	11
too young, old, etc	4.7	16.2	9
under restraint	0.1	0.0	
Lounge Rooms			
awake, unimpaired	36.8	12.9	17
asleep	50.9	53.7	6
bedridden, etc	1.6	6.4	2
impaired by drugs, etc	5.3	13.6	2
too young, old, etc	5.2	13.4	2
under restraint	0.1	0.0	
Other Rooms			
awake, unimpaired	56.0	19.8	32
asleep	34.7	57.2	7
bedridden, etc	1.5	3.8	4
impaired by drugs, etc	3.0	7.9	4
too young, old, etc	4.7	11.1	5
under restraint	0.1	0.3	4

Thus, **awake, unimpaired** has mostly injuries, few fatalities and high I/F ratios. **Asleep** has high proportions of injuries and fatalities but generally medium I/F ratios. The remaining categories generally have low proportions of casualties but low I/F ratios.

Activity at Time of Injury

Two categories of **activity at time of injury** stand out in terms of the I/F ratio (Table 8). **Fire control** has very high I/F ratios for all room types except kitchens for which it is high. It is also the case for **rescue attempt** for which it is high in all room types.

There is a reasonably consistent pattern in the I/F ratio for the other activities, with **unable to act** generally being the lowest ratio, but **sleeping, irrational action** and **escaping** being reasonably close. The I/F ratio for **sleeping** and **unable to act** are low in bedrooms and lounge rooms, as is **sleeping** in *other rooms*.

Table 8 Proportion of Casualties and I/F Ratio by Activity at Time of Injury

Activity At Time of Injury	% Injuries	% Fatalities	I/F Ratio
Bedrooms			
fire control	22.5	1.5	137
escaping	27.5	23.0	11
rescue attempt	11.6	1.5	70
irrational action	5.3	6.3	8
sleeping	26.4	48.9	5
unable to act	5.9	17.9	3
Kitchens			
fire control	47.3	6.5	223
escaping	15.3	26.9	17
rescue attempt	5.0	4.5	34
irrational action	5.3	6.5	25
sleeping	19.5	40.3	15
unable to act	6.2	14.9	13
Lounge Rooms			
fire control	14.5	1.9	47
escaping	36.4	28.2	8
rescue attempt	11.0	2.8	24
irrational action	4.0	3.5	7
sleeping	28.4	48.0	4
unable to act	5.1	15.1	2
Other Rooms			
fire control	20.5	1.8	113
escaping	40.8	44.5	9
rescue attempt	9.3	2.8	33
irrational action	5.0	5.7	9
sleeping	18.0	36.2	5
unable to act	5.4	8.7	6

Sleeping stands out from the other **activities at time of injury** for fatalities, accounting for almost half of them for bedrooms and lounge rooms, and over a third of them for kitchens and *other rooms*. **Escaping** is the largest single portion for *other rooms* (45%) but represents about a quarter of fatalities for the remaining room types.

In contrast to the proportions for fatalities, positive activities (**fire control, rescue attempt** and **escaping**) account for over 60% of injuries for all room types.

Unable to act represents a small proportion of injuries and a larger proportion of fatalities, almost certainly well out of proportion to the percentage of the general population represented.

Thus many occupants carry out positive activities after a fire is ignited, suffering some injuries but relatively few fatalities in doing so. Sleeping, unable to act and irrational action represent high risk activities (or perhaps lack of activity) with low I/F ratios.

Condition Preventing Escape

The field **condition preventing escape** provides great contrast between injured and killed occupants (Table 9). The category **nothing** stands out clearly from the others both in terms of the I/F ratio and the proportion of casualties. Thus, if there is no impediment to escape casualties are overwhelmingly injuries rather than fatalities.

Table 9 Proportions of Casualties and I/F Ratio by Condition Preventing Escape

Condition Preventing Escape	% Injuries	% Fatalities	I/F Ratio
Bedrooms			
clothing burning	2.2	5.7	4
fire before exit	9.1	20.9	5
incapacitated prior ignition	5.9	20.7	3
locked door, etc	1.2	2.6	5
no time, etc	7.6	22.8	4
too slow	6.5	11.2	6
nothing	67.5	16.1	45
Kitchens			
clothing burning	1.5	15.5	3
fire before exit	5.0	20.1	7
incapacitated prior ignition	5.3	8.4	18
locked door, etc	1.0	3.3	9
no time, etc	8.3	25.9	9
too slow	4.4	8.4	15
nothing	74.6	18.4	117
Lounge Rooms			
clothing burning	2.3	7.3	2
fire before exit	21.2	29.0	5
incapacitated prior ignition	6.1	17.7	2
locked door, etc	1.5	2.4	4
no time, etc	8.1	20.2	3
too slow	5.6	8.3	4
nothing	55.1	15.0	24
Other Rooms			
clothing burning	0.9	3.4	3
fire before exit	18.0	34.4	5
incapacitated prior ignition	2.4	9.4	3
locked door, etc	1.1	2.3	5
no time, etc	14.6	34.6	4
too slow	4.5	6.9	7
nothing	58.5	8.9	68

In proportion of fatalities two categories stand out, **fire before exit** (fire between casualty and exit) and **no time, etc** (no time to escape, explosion or fire progressed too rapidly). Both constitute significant proportions of fatalities for all room types. A third category, **incapacitated prior to ignition**, constitutes a significant proportion of fatalities for

bedrooms and lounge rooms. In all cases they represent much smaller proportions of the injuries.

For bedrooms, lounge rooms and *other rooms* the I/F ratio for all **condition preventing escape** categories except **nothing**, is predominantly low, and for kitchens is low for **clothing burning**. Thus with **nothing** preventing escape casualties are overwhelmingly injuries, and **clothing burning, incapacitated prior to ignition, fire before exit and no time, etc** constitute severe risk factors.

DISCUSSION AND CONCLUSION

Analysis and comparison of the numbers, proportions and I/F ratios for injured and killed occupants in different rooms in apartment buildings provides a means of adding to our understanding of the role of occupants in fires and in the occurrence of injuries and fatalities. There is a major deficiency in the data that is available: there is none for the people who become involved in fires but represent the vast majority of occupants, those who deal with the fire while it is small (so that the fire brigade is not called) or at the very least escape unharmed from fires to which the fire brigade is called.

There are wide variations in the proportions of casualties in various categories of the data between the various room types which appear likely to represent differences in the behaviour and capabilities of people involved in fires as casualties. Caution should be exercised in assuming cause and effect relationships and in drawing conclusions because of the limited range of data available.

The data indicates that different factors are involved in injury and fatality outcomes in bedrooms, kitchens, lounge rooms, and *other rooms*. Different occupants are predominant in their involvement as casualties in the different rooms. For example, elderly females are highly represented among injuries and fatalities in kitchens, while children under five are highly represented as fatalities in bedrooms and lounge rooms as outcomes of their playing with fire.

Differences between rooms can also be seen in the proportions of **activities at the time of injury**, with positive actions (fire control and rescue attempt) mostly leading to injury not death, and in the **condition preventing escape** with incapacitated prior to ignition, no time to escape and fire between the victim and the exit frequently causing death.

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