CHAPTER - 4

ANALYSIS OF CLOTHING BURN STATISTICS

4.1 INTRODUCTION

The term 'Textile Fire' denotes the fire in which a Textile product is the first to ignite. Among such fires the upholstery, mattresses and bedding are the main textile products responsible for fire accidents followed by curtains, carpets and clothing on a person. However, the clothing being worn shows the highest rate of deaths per fire. In most of such cases various clothing materials and garments including saree and supporting garments are involved in the fire accidents resulting the textile burn. The textiles burns are prime cause resulting in more deaths and injuries than any material. Fire injuries and death statistics are valuable not only for identifying the textile products contributing to such accidents but also for determining groups of individuals which are most apt to be involved in the fire related accidents. Identifying the recurring fire accidents variables that warrant public concern and developing consumer awareness programs focus on potential fire hazards or flammable textile products that present an unreasonable risk. Analysis of clothing related burn statistics is also helpful to the organizations forming standards while revising the standards and identifying textile products that present potential hazards to the consumers.

4.2 WORLD BURN STATISTICS

During the nineteen fifties, Bull[102] and his co-workers analysed the burn statistics for the Birmingham Burns Unit (and national burn statistics) and reported their findings in 1964. One of the their major conclusions from this study was that the ignition of clothing caused deep and large burn and that the dwelling fire accidents in which clothing catches fire, were the main causes of fatal burn injuries in 90% of the total textile related dwelling fires. Deaths caused as a result of a person falling in fires and conflagrations were also included whole reporting the textile-related dwelling fires. It was also recorded that the clothing fire fatalities in dwelling houses were significantly higher for females (70%) than that of males (30%).

Textile related burns statistics of the late nineteen sixties and early seventies produced by various organizations in the US have also been reviewed and the statistical data supports the above findings. Some of these conclusions are:

- While studying 166 patients of thermal injuries in 1954 cited that every third case resulted from the direct contact of clothing with an open fire. [103]
- In 1969, (Department of Health, Education and Welfare) reported 4900 cases of burns of which approximately 1200 were due to fabric ignition. Among these textile related burns 24% involved nightwear. Analysis of constituent material shows that Cotton was the major fibre type in 75% of the cases blends in 7%, nylon in 8% and other synthetics in 8% of the cases. [104]
- In 1969, National Burn Information Exchange also conducted a similar survey, which included 12000 cases of fire deaths; of these fabric was believed to be the cause or a contributing factor in 8000 incidences and in 4000 cases fabric was believed to be the sole cause of injury and death. [104]
- In 1970, The US Department of Commerce has analysed data from 800 cases investigated by the US Department of Health, Education & Welfare.[105] The reports shows that total 713 separate garments were ignited causing deaths of 76 persons and injury to 504. The children in age group below 5 years were injured particularly at high frequencies by burning of sleepwear.
- The study during the year 1975 revealed that of the 719 burn accidents studied, 160 were clothing-related incidents. Ignition sources were known in 134 cases and major sources of ignitions were open fires (17.9%), internal space combustion engines (17.2%), matches and lighters (11%).[106]
- NFPA estimated, the total number of fire deaths in U.S.A. in 1986 to 4770, which is 5% lower than that of in 1985 but higher than that in 1984.

- U.S. consumer product safety commission estimated 623000 residential fires in which 4240 civilians died due to Cigarettes. Cigars, pipes were involved in 49400 cases and 240 deaths were reported due to wearing apparels.[107]
- Burn statistics collected by Australian and New Zealand Burn Association in the late 1970s reveal that clothing was the primary agent ignited in flame burn cases for 25% children and 14% adults. For both children and adults, day clothes were involved four times as often as nightclothes.[83]
- H. Torey and A. Vickers[108] in 1976 analysed the frequency of the textile fabric products in USA. In 1087 cases of fire victims as ranked the product types in order of their most frequently involved type of clothing. Shirts trousers and underwear ranked higher than bedding and upholstered furniture in causing injury. Their results also show that most of the victims likely sustain deaths or serious injuries were those wearing loosely fitted garments like robes or housecoats, nightgowns, pajamas, etc
- The annual UK fire statistics has recorded the number of fatal and non-fatal casualties associated with clothing as the first ignited item. For instance, data for the year 1978 show that of the 733 total fire deaths in home, 361 were textile related and 66 were related to the clothing on the person, while the cause of death in the UK fire is more generally associated with inhalation of fire gases and those associated with clothing are predominantly burn-related.[107]
- Ministry of Home affairs, Government of India published data of fire accidents, fire related deaths and their causes the conclusions of the study are shown in Table 4.1.[109-112]
- In another report on fire accidents in Tamilnadu, one of the states in India, the loss of properties and human lives in the state for 20 years has been collected and analysed as shown in the Table 4.2.[133]

Table 4.1 Fire Related Data showing Accidental Death in India

Cause of Death	1995	1996	1997	1998
Crackers	623	470	393	368
Electrical Short Circuits	660	579	621	828
Gas Cylinder /Stove Bursts	5349	6203	7123	6833
Other Fire Accidents	16290	15397	17039	17869
Total Accidents	200887	20094	233903	258509

Table 4.2 Losses of Property/Human Lives due to Fire Accidents in Tamilnadu

Year	Number of Fire Accidents	Property (Rs in Lac)		Human lives	
		Loss	Saved	Loss	Saved
1985	8795	5.84	68.65	141	345
1986	8937	5.27	58.21	137	425
1987	10668	8.20	60.72	182	271
1988	10200	3.98	35.01	126	148
1989	10330	4.72	64.23	178	211
1990	10341	7.36	64.32	140	274
1991	12157	10.47	53.42	98	99
1992	12996	10.16	93.41	96	208
1993	14212	10.54	100.80	38	122
1994	11120	16.76	144.68	44	255
1995	12706	14.28	88.08	134	87
1996	12741	46.43	176.45	72	119
1997	13678	73.28	181.19	187	120
1998	15146	21.77	175.34	90	155
1999	16367	13.64	131.93	72	78
2000	16987	13.98	157.18	47	77
2001	17697	15.79	137.86	112	107
2002	18264	14.10	114.41	79	179
2003	16109	24.57	122.01	89	177

4.3 LOCATION OF FIRE ACCIDENTS

Reig A. *et al.*[114] while studying epidemiology and mortality of massive burns in 1994 reported that most of the burn accidents occur at home. Mabogynje[115] in their study in 1998, regarding burns in case of adults in Nigeria, reported that 55% of the burn accidents among women occurred in home environment. Kumar V. *et al.*[116] in 2001, concluded that, the largest number of victims (50%) sustained burns in kitchen, followed by living room (20%), kitchen cum living room (17%) and open space (13%). Arora and Amita[117] in 1977 in their study on treatment of 255 cases of burn injuries found that accidents occurred at home in 131 cases (58%) while 94 (42%) sustained burn injuries at their place of work.

Pegg S. P. *et al.*[118] studied accidental burn injuries of 411 patients, showed that 59.8% of the burn cases resulted from domestic or recreational accidents, 31.3% were industrial burns and the remaining 8.9% resulted from motor vehicle accidents. In 1978 in their study of 1228 females burns, Thomson N. *et al.*[119] found that 762 (62%) cases occurred at home, 212 (17.2%) at work place and 16 (1.4%) elsewhere and in 238 (19.4%) cases at unknown places. While studying the burn injuries in Jordan Muthaseb *et al.*[120] reported that the 80% of the accidents occurred at home, while those sustained at work constituted only 11% and rest elsewhere.

Robin A. C.[121] in 1984 also reported that much severe burn occurs in kitchen. Lynzdorf P.[122] in 1986 also reported that the great majority of burns in all age groups occurred in domestic premises (71%), whereas only two accidental burns found in bathroom and one found in road traffic. Darko D. F.[123] while analyzing the location of burn victims at the time of burn injury, found that home was the most common place for burns rather than place of work. In India Keswani M. H.[124] reported that 80% of the injuries occurs at home especially in kitchen.

4.4 CAUSES OF IGNITION

Analysis of flammability accidents in UK suggests that the smoking materials such as matches, cigarettes and lighters taken together (matches 14%+,

cigarettes 10%+, lighters 5%) are equally responsible for clothing fires. Another study reveals that naked flames from cookers (29%) and open flame fire heaters (23%) are the major sources of ignition. Candles were involved in 3% of the incidences and in 16% of cases the cause was unknown. Fire initiated by smoking materials is in general more likely to result in deaths than other fire. Smoking materials have always been reported as the overwhelming cause of ignition in fatal fires related to upholstered furniture, bedding and mattresses.

Nevertheless, cookers, heaters or fireplaces are also identified as major sources of ignition in clothing fires causing fatalities. Furthermore, the data on causes of textile fires indicate that most of these are due to the misuse of source of heat.[125]

According to Kumar *et al.*[116] the largest number of burn accidents in married women were due to kerosene stove 31%, wood cooking chula 26%, matchstick 22%, kerosene lamps15%, and others 6%.

4.5 GENDER OF CLOTHING FIRE VICTIMS

Since one-third of the clothing fire accidents initiates in the kitchen, females are involved in almost 75% (fatal and non-fatal) fire accidents. The main reason for higher levels of severe fatal accidents in the high-risk female group, is that they tend to take more domestic responsibilities and also because of the potentially loose fitting/flowing garments types associated with them. Literature suggests that approximately 40% of the dwelling fires happen in the kitchen, so if all females over the age of 20 are arbitrarily labeled "homemakers", with an added probability of females wearing loose fitting garments, the chances of them getting involved in a clothing related fire is significantly high.[106]

Agha and Benhamia[126] reported that there were nearly twice as many females as males (65:35) and female preponderance was exceptionally marked between the age group of 16 to 40 years. Sen and Banerjee[127] analysed 1000 cases of burns in SSKM hospital, Calcutta in 1981 and reported that 688

cases were pertaining to the age group of 11 to 50 years and of these 368 were females. Salesh *et al.*[128] while studying accidental burn deaths in case of Egyptian women of reproductive age between 15 to 49 years reported that out of 1691 deaths occurred in the three years due to various causes, 152 cases were due to burns and the burns are the third leading cause of the death.

4.6 TYPE OF CLOTHING INVOLVED

The study related to involvement of various types of garment in clothing fire incidences in case of UK reveal that more than 50% of the clothing fire incidences involve nightdresses followed by dressing gowns and pyjamas. Frequency of accidents caused by the ignition of nightdresses and dressing gowns taken together add up to the tune of 80 % greater than pajamas, which was only 21%. Moreover, 50% of fires involving pajamas are considered to cause by the ignition of bedding.

It has also been observed that burns involving the ignition of clothing (loose fitting garments in particular) usually prove to be more severe because of the intimate nature of the clothing textiles. Feller *et al.* [129] concluded in their study that the patients, burns associated with clothing ignition had a fourfold increase in mortality and a prolonged hospital stay (21 days longer) as compared to those patients whose clothing was not burned. Moreover, the body surface area involved in the clothing-related injuries was double greater than that for non-clothing related burns, and the area of full thickness injury was six times than that associated with non-clothing related burns.

Injury diagnosis associated with clothing items studied in Nebraska Burn Study has been reported by Laughlin *et al.*[106] wherein it is pointed out that the burnt area is less than 10% of the body surface in case of the close fitting and clinging garments, whereas it is greater than 10% in case of loose fitting and flowing garments. However, their findings with respect to involvement of garment in clothing-related fire incidences revealed that the clothing items like pants and shirts/blouse were involved in far more accidents than any other items. Belshaw and Jerram[22] also subjectively classified the garments involved in burns accidents, as the free flowing garments such as nightdress

and dressing gowns have higher risk of fatalities as compared to tight fitting garments.

Pressley[130] in another survey of burns accidents, based on accident victims treated at the Royal Children Hospital, Melbourne, Australia, reported 131 cases, out of which 56 cases were involved with flowing garments and 75 cases with fitting and clinging garments. Robinson. A. C.[131] in his study on serious burns sustained from wearing saree, particularly reported that severe burns occur due to ignition of loose fitting clothing; saree in Asian countries is more fatal. K. S. Bawa Bhalla[132] in his study regarding burn characteristics of fabric used in India reported that loose fittings garments, nightgowns, kurta etc. burn vigorously and with large flames whereas tight fitting garments are difficult to burn. Dense fabrics such as 'khadi,' burn slower than thin cotton saree. Loose fitting garments with thin fabrics such as saree and the nightgown were found to be much more hazardous than tight fitting garments with thick fabric, such as jeans with shirt and 'khadi' kurta with pajamas.[133]

4.7 AGE GROUP OF CLOTHING FIRE VICTIM

Previous studies have indicated that the children and those individuals above 65 years aged were more likely to suffer more severe burn injuries.[102-125] The most unexpected and unfortunate finding of the study revealed that large number of teenagers suffers serious injuries in clothing fires, which are often disfiguring, and require long hospital treatments. Clothing fire fatalities for the age group of 21-65 years are lowest (8%), however, their proportion rises sharply for minor accidents. Thus, adults appear to be more able to deal with fire situations and putting out the flames once the clothing catches fire.

Sen and Banerjee[127] analysed 1000 cases of burns and found that 688 cases were aged in group of 11-50 years, 274 were children below 10 years and remaining 38 were above 50 years of age. Higher severity of injuries and increased number of deaths in the extreme age groups can be attributed to their lower dexterity and inability to prevent accidents or removing themselves from situations of serious injury when the accidents occur. Moreover, children became victims of panic rather than attempting to put the flames out.

4.8 RECENT STUDY ON BURN VICTIMS

To frame an experimental layout of the study in question, an extensive survey of recent burn victims was carried out by us, to study the burn injury patients in burn units of hospitals in Mumbai, Akola and Yavatmal. The studies of total 360 cases show that 112 were males and 248 were females representing 30% and 70% respectively (Fig. 4.1). This is in accordance with earlier findings of various studies carried out in general. The various types of textile materials involved in the clothing of the burn victim was also analysed in all these cases.

Fig. 4.2 shows the type of material used in the garments involved in case of burn injury victims. The study disclosed the facts that in majority of 148 cases (42%), cotton material was found in the garment, followed by polyester in 80 cases (22%), and polyester:cotton blend accounted for 52 cases (14%). Nylon was found in 33 cases (9%), Silks was found in 28 cases (8%), wool in 11 cases (3%) and in 8 cases (2%) polyester:viscose blend was found.

It can be seen from Fig. 4.3 that highest number of victims is in the age group of 21-30 years, followed by 31-40 age group, 11-20 age group, and 41-50 age group. Numbers of burn cases in the age group of 51-60 and above are considerably low, whereas cases in the age group below 10 are least.

The Fig. 4.4 indicates that maximum accidents occurred in case of the use of polyester material for the age group of 40-45 years. Similarly, for cotton in the age group of 25-30, nylon for age group of 40-45, wool for age group of 40-45, silk for age group of 15-20, polyester:cotton blend for age group of 30-35 and polyester:viscose blend for 40-45 age group.

The Fig. 4.5 shows that cotton gives highest burn percentage in the age group of 25-30 years, polyester for age group of 40-45, silk for 15-20 age group, polyester:cotton blend for 25-30 age group, polyester viscose blend for age group of 40-45 and wool for a age group of 35-45 years.

The Fig. 4.6 shows that maximum 71% accidents occur at kitchen, followed by other places i.e. home-13%, shops-7%, office-3%, outdoors-3%, bakery-2% and 1% in industry.

The Fig. 4.7 shows the proportion of source/fuel involved in the accidental cases i.e. kerosene 31%, gas 29% (LPG), followed by ovens 11%, electricity 11%, boiler 8 %, water 5%, electric stove 2% and chemicals 1%. It may be noted that kerosene and gas stove accounts for about 60 % cases as most of the fire accidents occurred at kitchen while cooking etc. The Fig. 4.8 shows that due to saree 48% females are victimized followed by nightly 23%, Punjabi dresses 23% and skirts 11%. The Fig. 4.9 shows that shirts are for 60% burn cases in case of males, followed by kurta in 20% cases, jeans/T-shirts in 15 % and boiler suits in 5% cases.

The Fig 4.10a to Fig 4.10n shows the burn victims of fire accidents taken during the recent survey carried out on 360 burn victims, at different burn units. The Fig.4.10a and Fig.4.10j show the 2^{nd} and 3^{rd} degree burn injuries on the posterior trunk, chest, upper arms, and lower arms neck covering almost 50 % of TBSA. Fig.4.10b, Fig.4.10d, Fig.4.10f, Fig.4.10g and Fig.4.10k show 2nd and 3^{rd} degree burn injuries damaging epidermis, dermis and hypodermis in some portion of trunk, chest, arms, side upper thighs, interior thighs, lower legs covering almost 60 % of TBSA. Fig.4.10c, Fig.4.10e and Fig.4.10o shows disfigurement of female body due to 2^{nd} and 3^{rd} degree burns due to cotton saree and it supporting garments. Fig.4.10i shows 3^{rd} degree burns on almost 80 % of TBSA, where all the skin tissues like epidermis, dermis and hypodermis is completely burnt and converted into char. Fig.4.10h shows permanent disfigurement of female with 2^{nd} and 3^{rd} degree burns due to cotton saree and polyester blouse as it supporting garments, the victims were operated 4 times. Fig.4.10n shows a recovered burn victim having 2^{nd} degree burn injuries on upper portion of trunk and breast, after three operations and transplantation.

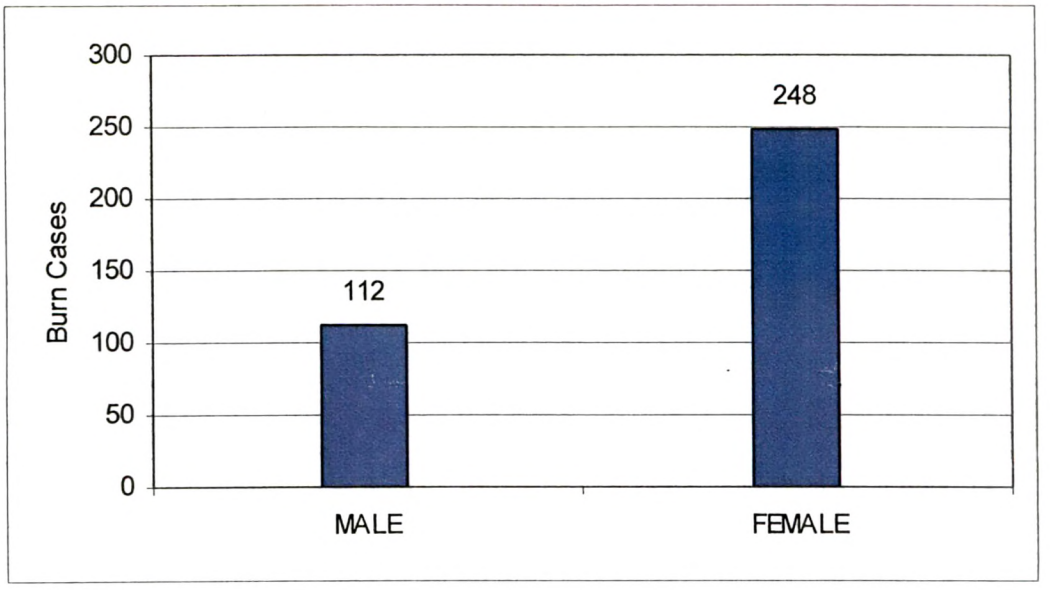

Fig. 4.1 Number of male and female among the burn victims

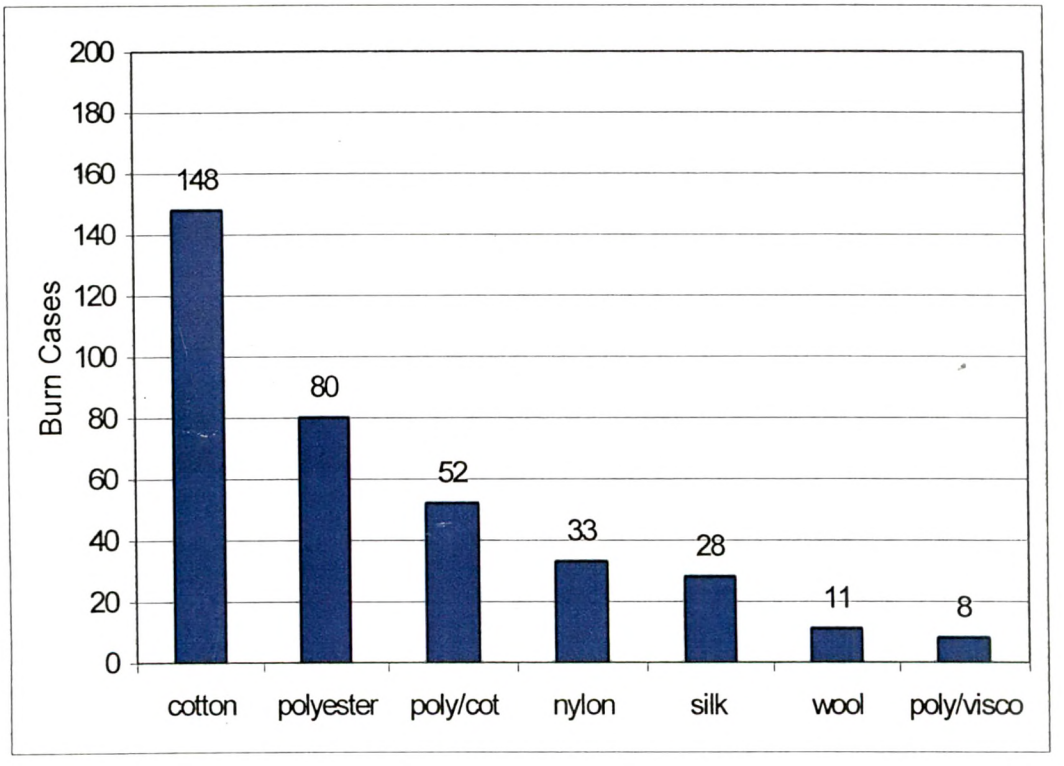

Fig. 4.2 Number of burn cases according to material of clothing

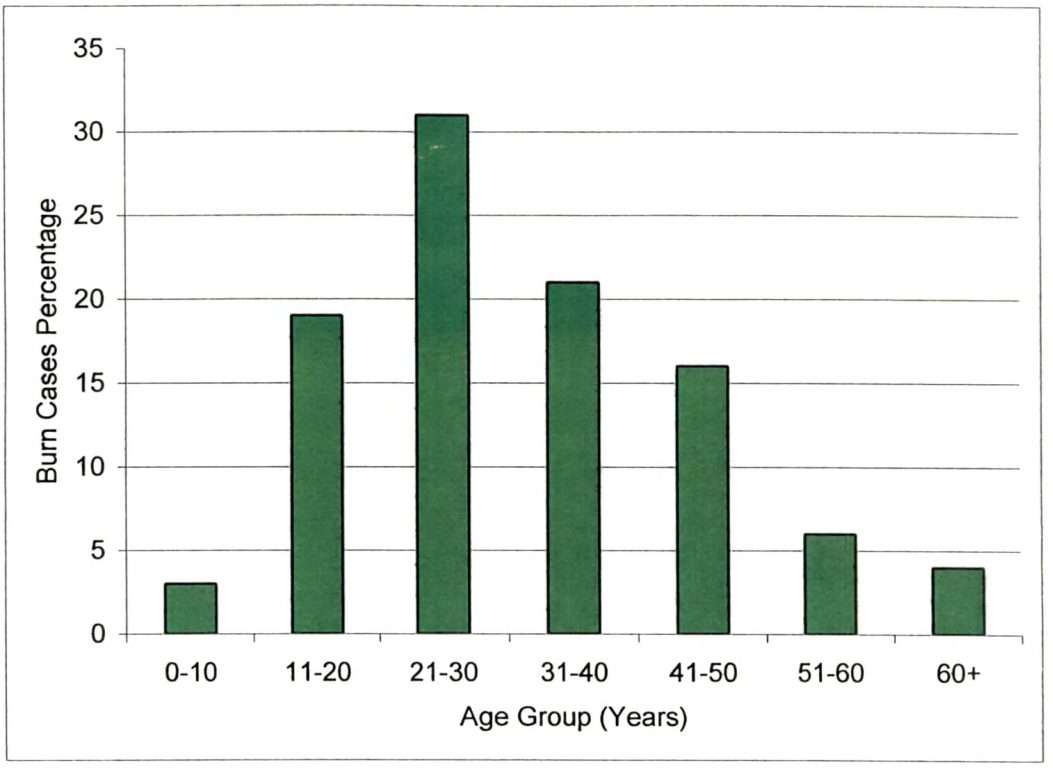

Fig. 4.3 Number of burn cases occurred in various age group

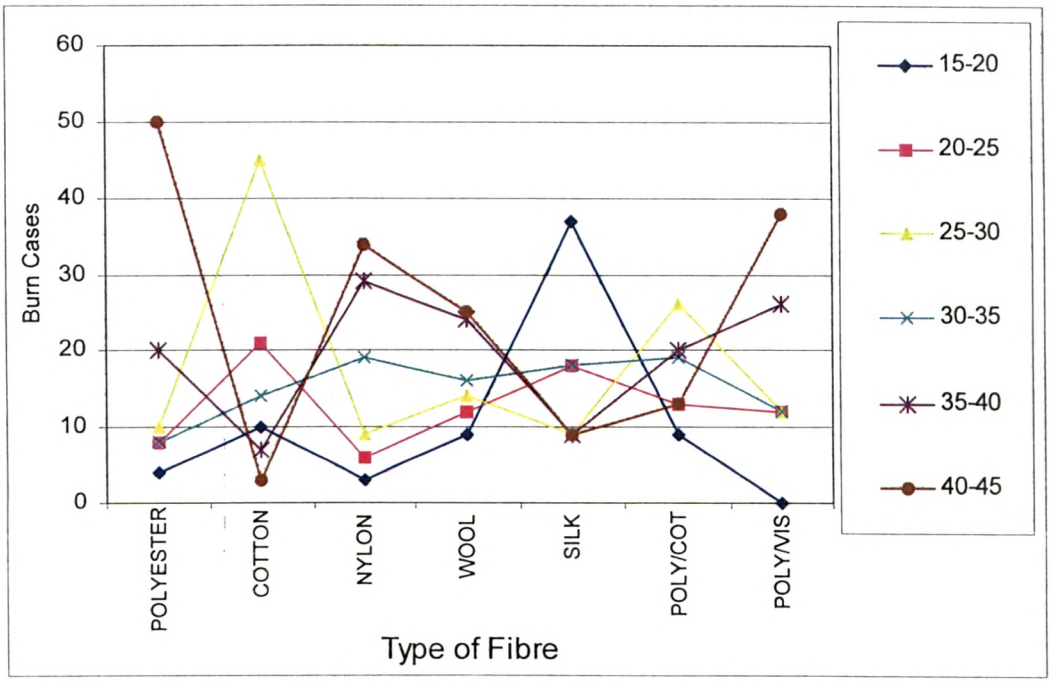

Fig. 4.4 Number of burn cases of fibres in clothing and age group

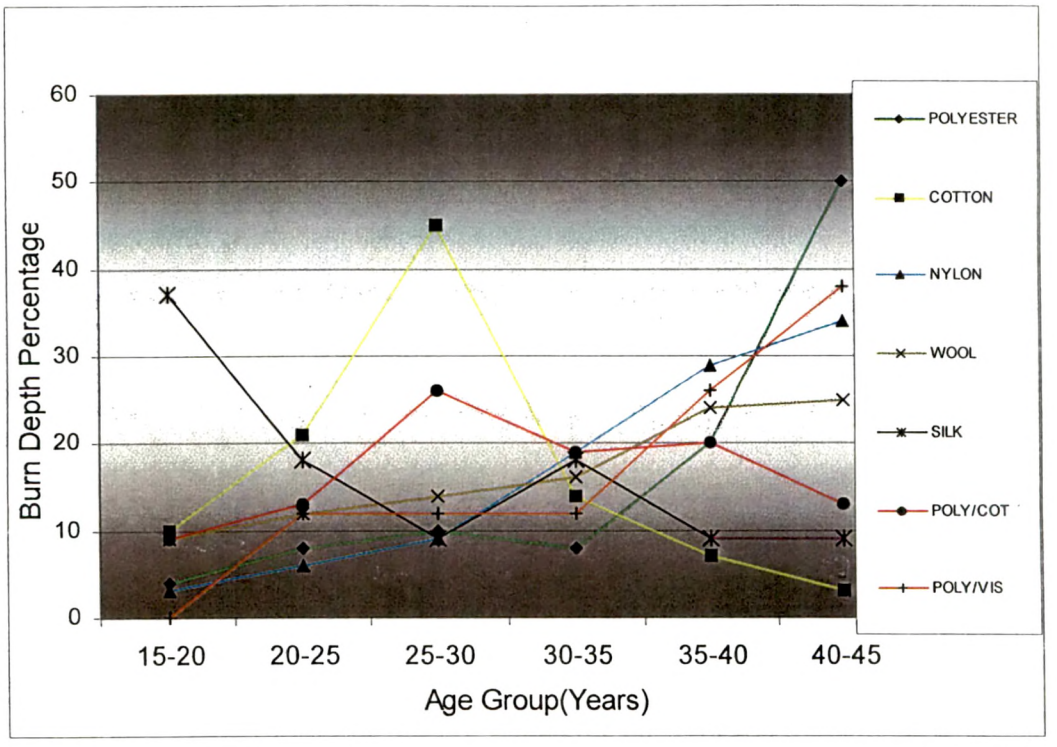

Fig. 4.5 Burn depth percentage of victims involving various fibres in different age group

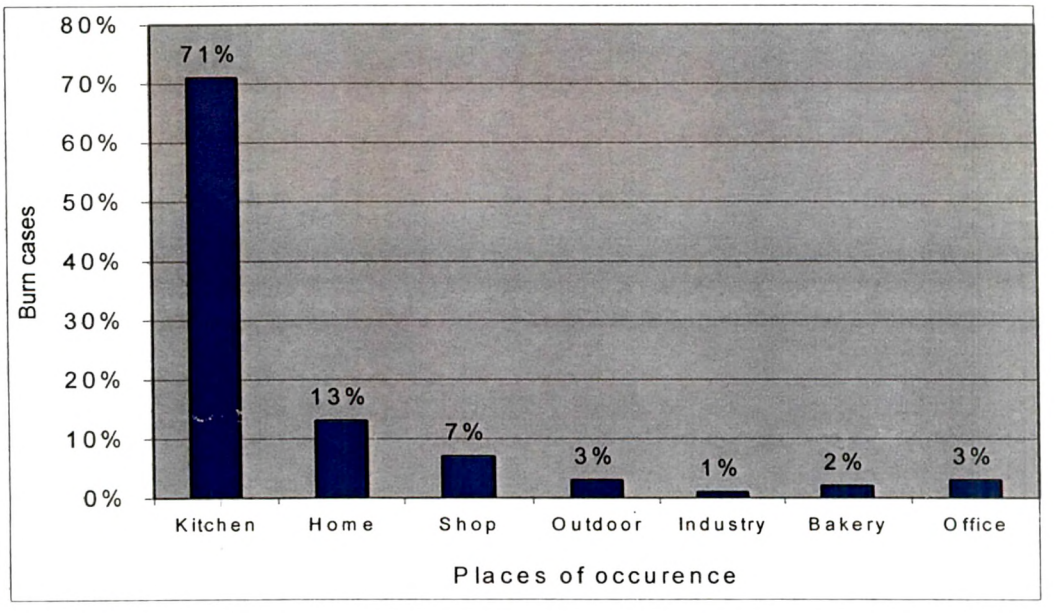

Fig. 4.6 Proportion of burn cases according to places of burn accident occurrence

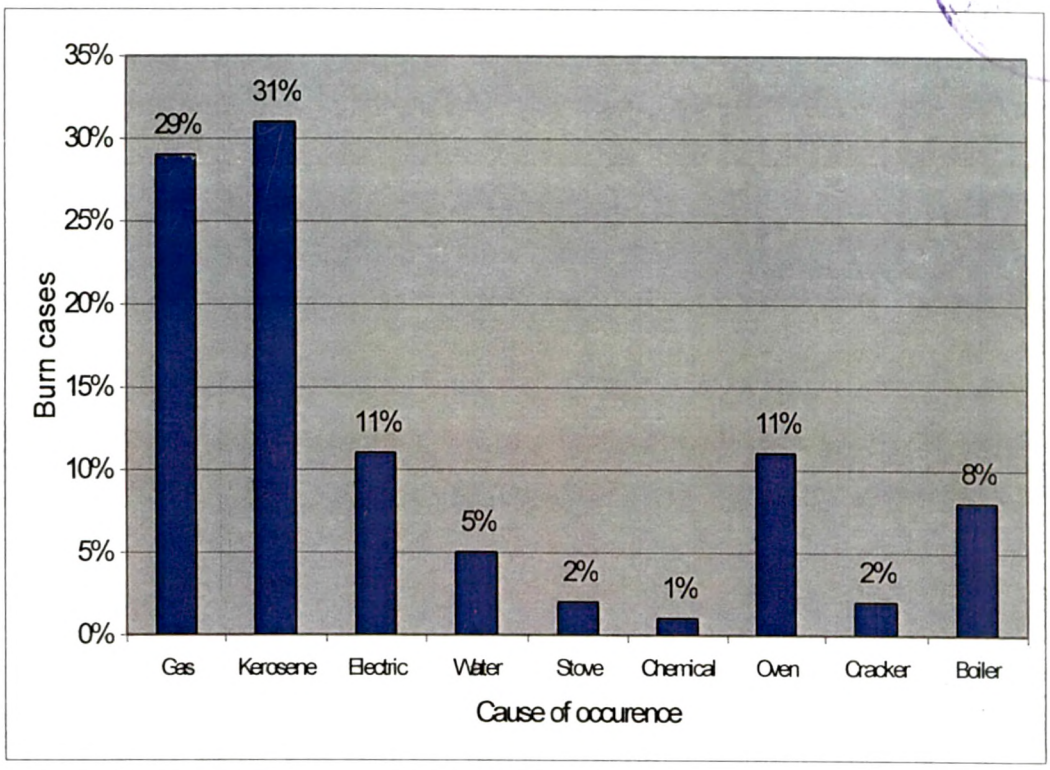

Fig. 4.7 Proportion of burn cases for various causes of their occurrence

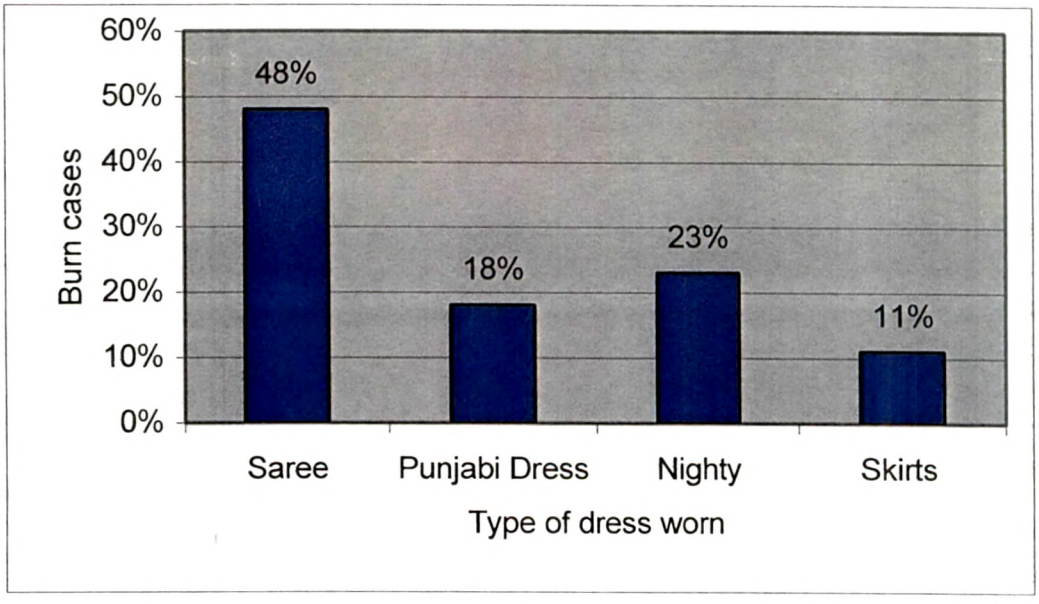

Fig. 4.8 Proportion of burn cases according to type of dress worn by female

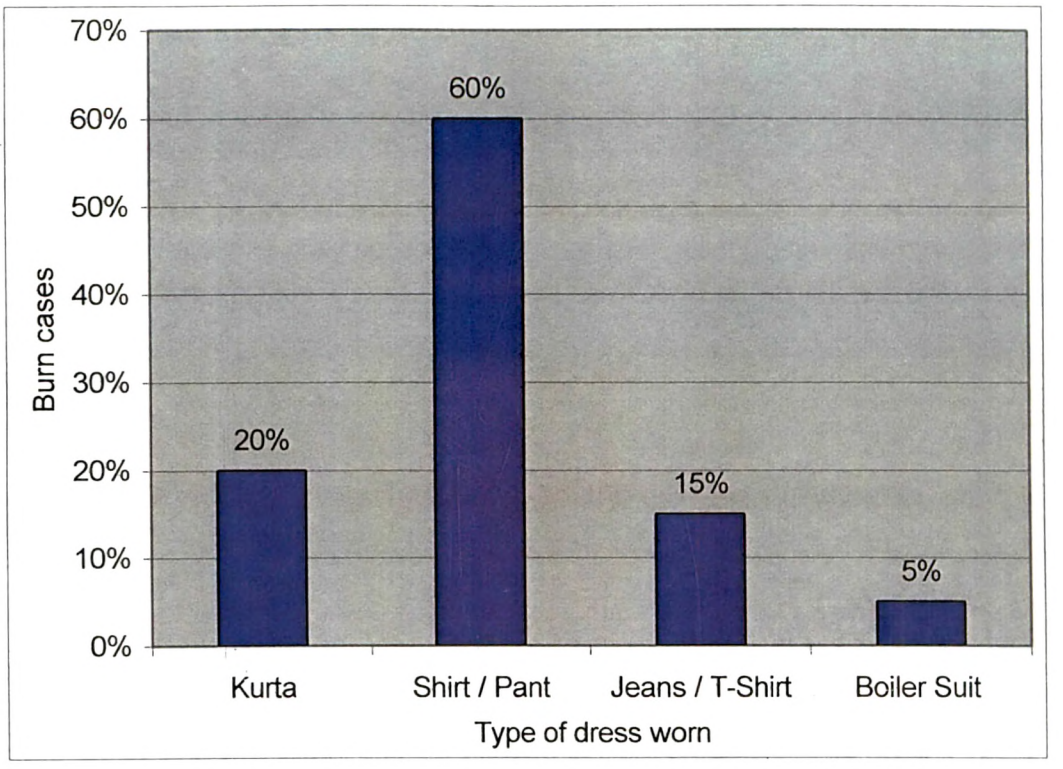

Fig. 4.9 Proportion of burn cases according to the type of dress worn by males

Fig.4.10a

Fig.4.10b

Fig.4.10c

Fig.4.10d

Fig.4.10e

Fig.4.10f

Fig.4.10g

Fig.4.10h

Fig.4.10i

Fig.4.10j

Fig.4.10k

Fig.4.10l

Fig.4.10m

Fig.4.10n

Fig.4.10i

Fig.4.10j