وفيات الحروق المنزلية في بابل:
دراسة 266 حالة وفاة بالحروق، 1986 - 1994

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الملخص

خلفية البحث وهدفه: تشكل الوفيات الناجمة عن الحروق المنزلية مشكلة صحية عامة في كافة أرجاء العالم، بالاضافة الى االنعكاساتها الاقتصادية والقضائية. حيث تحتل وفيات الحروق المرتبة الخامسة في اسباب الوفيات الطارئة في الولايات المتحدة الامريكية والثالثة في روسيا والرابعة في بقية انحاء العالم.. أما الانعكاسات القضائية، فقد وجد انه حوالي 10% من حالات متلازمة الطفل المعنى تضمنت استخدام النار. هذا بالاضافة إلى أن بعض المجرمين يعمدون الى استخدام النار للتخلص من ضحاياهم بهدف اخفاء الفعل الجرمي. ان الهدف من هذه الدراسة هو وصف وبائية الوفيات الناجمة عن الحروق المنزلية في محافظة بابل لمعرفة معدلات وقوعها والعوامل المؤهبة لها واسبابها ودرجة تفشيها بين مختلف الفئات العمرية ومقارنة ذلك ببقية اقطار العالم.

مواد البحث وطرائقه: شملت الدراسة 266 حالة وفاة بسبب الحروق الحرارية حصلت خلال الفترة من 1986 الى 1994. من خلال جمع المعطيات الخاصة بكل حالة ودراسة السجلات الموجودة في دائرة الطب العدلي و التقارير التشريحة الخاصة بكل حالة، تم تثبيت كافة المعطيات المتعلقة بالعمر والجنس ووقت الوفات وشهر الوفاة. بالاضافة الى تحديد درجة الحرق و مساحته والاضرار الخارجية والداخلية التي سببها. بعد ذلك قمنا بتحليل هذه المعطيات احصائيا لايجاد الروابط بينها.

النتائج: خلال الفترة من 1986 الى 1994 تم تشريح 266 حالة وفاة ناتجة عن حرق حراري وتضمنت اشخاصا من مختلف الاعمار ومن كلا الجنسين ومن مختلف الطبقات الاجتماعية. بلغ معدل وقوع الوفيات بسبب الحروق الحرارية 3.5 وفاة الكل 100,000 نسمة سنوياً. كان أعلى معدل لها بين الفئات العمرية اليافعة، اي اقل من 30 سنة. وكان معدل وقوعها عند الاناث اعلى منه عند الذكور. في حوالى 60% من الحالات كانت الحروق من الرجة الثانية وإن الحالات التي زادت نسبة الحروق فيها عن 80% تجاوزت 50% من مجموع الحالات. أما العوامل المؤهبة فكان من اهمها عاملي الجهل والاهمال. كان السبب الرئسي للوفيات هو التأثير المباشر للحروق على الجسم، وكان 95 % من حالات وفيات الحروق عارضيا.

الاستنتاج: إن معدل وقوع الوفيات بسبب الحروق في محافظة بابل يعتبر عال جداً إذاً ما قورن مع بقية بلدان العالم. كان اعلى معدل لوقوع هذه الوفيات عند الاعمار اليافعة. وكان اكثرشيوعا عند النساء مقارنة بالرجال. أعلى معدل لوقوع الوفيات كان خلال اشهر السنة الاكثر برودة. السبب الرئيس للوفيات كان التاثير المباشر للحرق على الجلد والاحشاء الداخلية.

الكلمات المفتاحية: وفيات، حروق منزلية، وبائية، الاسباب.

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Residential Fire-related Deaths in Babel: a study of 266 fire-related deaths, 1986-1994

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Abstract

Background: Thermal deaths or fire-related deaths constitute a major public health problem worldwide, in addition to its economic and medicolegal impacts. Deaths due to fire accidents represented the fifth leading cause of accidental deaths in USA, the third in Russia, and the forth worldwide. As to it economic impact, it has been estimated that the dollar loss in millions due to fire deaths in USA was $11,307 in 2006. The medicolegal impacts of fire-related injuries are very important, it has been reported that in USA, about 10% of the cases of child abuse involved burns. In addition, criminals sometimes use fire for disposal of their victims to hide evidences that may lead to their criminal acts. The aim of this study was to describe the epidemiology of residential fire-related deaths among the population of Babel governorate to identify the risk factors, the causes of these deaths, and to compare results with those obtained in other countries of the world.

Material and Methods: The study included 266 residential fire-deaths in Babel from 1986 to 1994. The data were obtained from autopsy records for all deaths that have been autopsied in the Medicolegal Office in Babel. The sex, age, causes of deaths, the risk factors, the extent of burns, and the degree of burns were determined for each case. Statistical analysis of these date were done and the correlations between various factors were studied.

Results: From 1986-1994, 266 cases for residential fire-related deaths were received and autopsied at the Medicolegal Office in Babel. The incidence rate of fire-related deaths in Babel was 3.5 per 100,000. The highest rates of these deaths occurred in the younger age group (<30 years). About more than half of deaths occurred between October and March. There was a female preponderance. The most common predisposing factors were ignorance and carelessness. About 60% of burns were of the second degree, and 50% of the cases were having burns with percent exceeding 80%. The most common cause of death was the direct effect of the dry heat on the body. The nature of fire deaths was accidental in 95% of the cases.

Conclusions: The incidence rate of fire-related deaths in Babel is one of the highest rates in the world. These deaths occurred predominantly in the youngest age groups and the incidence was higher among females than males. The highest rate occurred in the coldest months of the year. Most of deaths were due to direct effect of dry heat on the skin and the internal organs.

Key words: Deaths, residential fire, epidemiology, causes.

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Introduction:

Heat injuries, also called burns, may be defined as the localized or generalized, internal or external lesions produced by exposure to high temperature. Fire-related deaths constitute a major public health problem worldwide, in addition to its economic and medicolegal impacts. It has been reported that deaths due to fire accidents represented the fifth leading cause of accidental deaths in USA, the third in Russia, and the forth worldwide (1, 2, 3). In the United Kingdom, more than 47 fire-related injuries occur every day (4). It has been reported that the direct dollar loss in millions due to fire deaths in USA has significantly increased from $8.585 in 1996 to $11,307 in 2006 (4). The medicolegal impacts of fire-related injuries are very important. In USA it has been reported that about 10% of the cases of child abuse were reported to involve burns. In addition, criminals sometimes use fire for disposal of their victims to hide evidences for their criminal acts (5).

Patho-physiology of burns: Skin is the largest organ of the body that serves multiple functions that are essential to the survival of the organism. These functions, such as thermal regulation, barrier against infections, and sensation may become compromised by the presence of a burn (4). The soft tissue is burned when it is exposed to a temperature above 44-46C (4, 6). The extent of damage caused will depend upon the applied temperature, the nature of tissue exposed to temperature, and t he duration of exposure.

The temperature/time relationship is important since, it has been found that the lowest temperature that would cause damage is 44C and it requires more than five hours to cause a burn (6). However, if the temperature is above 60C, only three seconds are needed to cause burn (5). A thermal burn causes coagulation of the soft tissues. When the marginal areas of the burn become perfuse, there will be formation of free radicals and ROS that lead to vasodilatation and increased vascular permeability. This will cause fluid loss, as well as, increasing plasma viscosity and micro-thrombi formation. Burns may cause hyper-metabolic state manifested by fever, increased metabolic rate, increased minute ventilation, increased cardiac output, decreased after-load, increased gluconeogenesis resistant to glucose perfusion, and increased skeletal and visceral catabolism (4).

The extent of tissue damage is the function of time and temperature (6). The vast majority of dry burns are due to high temperatures acting for a shorter time (5). In dry heat burns, if the time is extended beyond that needed for initial burning, the tissue may be charred, carbonized or completely destroyed as in cremation (9, 10, 11). The out come of a burn depends on two factors: 1) its severity, which is measured by the degree of burn, and 2) the surface area of the skin involved, which is traditionally estimated by the surgical "Rule of Nines" (12, 13, 5, 6).

Classification of the severity of burns:

There are two systems of classifying the severity of the burns, the first was adapted by Dupuytren, which consists of six degrees, the second is adapted by Wilson and consists of three degrees (5, 6). Though both classifications are arbitrary, they are useful to denote the severity of both burns and scalds. The six-degree classification is more detailed and useful in forensic pathology practice and will be adapted in our study. The three-degree classification is useful mainly for surgical purposes (13).

First degree burns involve only the epidermis. Second degree burns involve the deeper layers of the epidermis down to stratum spinosum, saving the basal layer. Third degree burns involve the entire thickness of the epidermis including the basal layer. These burns usually heal by second intention with formation of scar tissue associated with contracture, if the affected area is large. Forth degree burns. They are full-thickness burns that involve both the epidermis and dermis. These burns are usually due to dry heat because; tissue loss caused by scalds rarely exceeds the third degree. Healing takes place by scarring (11, 13). Fifth degree burns. These burns involve the skin and subcutaneous tissues and are usually due to dry heat (9).Sixth degree burns. They are charred burns, which extends deeper to involve muscles, bones, and internal organs. These burns are almost always due to dry heat (9).

The eextent of burns is measured by the surface area of the skin involved by the thermal injury. The area of the skin involved by the burn is estimated by the "Rule of Nines", which is useful for prognostic purposes, though for the pathologist a more precise anatomical description of the area burned is essential for autopsy report (5). A superficial widespread burn is more dangerous than a deeper localized one. When the percentage of the burn exceeds
30%, the burn is said to be dangerous (5, 6, 11, 12, 13). If it exceeds 60%, the burn is said to be lethal and incompatible with life. Older people can die at considerably lower percentages than this, while children are more resistant (1). The interposition of clothing may have two opposite effects; it may protect the underlying skin from the hot liquid, but it may also hold the hot liquid in contact with the skin for longer time, especially if the fabric is absorbent (5, 6, 8, 13).

Gross appearance of burns at autopsy: There are wide ranges of damage produce by heat varying from just reddening over a wide area to almost total cremation. If there is no charring or leathery coagulation, ante-mortem burns will be reddened and blistered (5, 6, 11, 13). Most ante-mortem blisters have a bright red base when burst and an erythematous areola (6, 5, 13). The whole of burned area may form one large blister or be a coalescence of blisters, which usually collapse at autopsy (9).

When the burns are more sever the skin becomes stiff, yellow-brown, and leathery. The hair may be singed or completely burnt away in sever burns. Beneath burns of any degree, the deeper tissue may be affected; especially muscles which become pale, brownish and part-cooked (5, 6, 12, 13). Where heat has been intense and continuous, all soft tissues down to bone may be consumed and the bone may be blackened (7). Where a substantial heat has reached the body, muscle contractures are common. This phenomenon is due to dehydration of the muscles and protein denaturation (5, 11, 13). The flexor muscles are bulkier and stronger than extensors and as a result the body will assume general flexion position, the so-called boxer's or pugilistic attitude (5, 13). Charred burns constitute one of the most difficult problems that the forensic pathologists might face, because it is important from legal point of view in these cases to decide whether the death is due to the burn it self or other causes (7, 12). This in turn implies that the pathologist must decide whether the burn is vital (ante-mortem) or postmortem.

The aims of this study are: 1) To describe the epidemiology of fire-related deaths in Babel regarding its incidence rate, distribution by age, sex, years, and months; 2) To determine the degree and percent of the burn and their relation to the causes of deaths. 3) To compare our results with those obtained in other countries of the world. This study is the first in Babel and the data included in it had not previously been reported by other authorities in Babel governorate or in Iraq.

Patients and Methods:

This study comprises two combined studies: a four-year retrospective study of fire-related deaths that had been autopsied in medico-legal office in Babel governorate, which extended from 1986 to 1989; and a five-year prospective study, which extended from 1990 to 1994 included. The studied sample included victims of both sexes, various age groups, and different socioeconomic statuses. The study was done according to the following steps:

1. Data regarding age, sex, type of burn, year of autopsy, month, and circumstance surrounding death were taken from the available records for each case, and put on special forma prepared for the purpose of this study.
2. Then, each case was subjected to full autopsy by an expert anatomo-pathologist and the gross autopsy findings, regarding percentage of the burn, degree of the burn, and internal lesions involving body organs, were registered on special forma.
3. Specimens from various organs of the body where taken from each case and sent for microscopic and laboratory examination.
4. Samples of blood were taken from the cases in which the death had occurred rapidly and the cadaver was severely burned. These samples were sent for investigating carbon monoxide, poisons, or drugs.
5. Cases distribution was done according to the years of the study, months of death, age of the

victim, sex of the victim, degree of the burn, percentage of the burn, and the causes of death.

6. The data obtained where analyzed by the usual statistical methods.

Results:

A total number of 266 cases of residential fire-related deaths were received in the forensic medicine units in Babel during the period from 1986 to 1994; this constituted about 6.5% of the total number of accidental deaths that had been received during this period. The place of death was the residence for all cases in our study. The incidence per year (table 1) shows that there is a three-fold increment in the number of fire-related deaths when the year 1986 is compared with the year 1994. Incidence per month shows two peaks, one in the coldest months of the year and the other in the hottest months (table 3). The incidence per 100,000 populations is 3.5 per year. The mean number of deaths was 29.5 cases per year.

The age incidence (table 2) shows that about 65% of the cases occurred in the age group 1-30 years. The peak incidence was at the age of 1-20 years with approximately half of the deaths occurred in this age group. The sex incidence (Table 1) shows female preponderance; 144 cases were females (54.1%) and 122 cases were males (45.9%). The majority of victims were house-wives. Distribution of cases according to the degree of the burn (Table 4) shows that the majority of burns have fallen in the second-degree, about 42.45%; followed by the first degree. Distribution of burns according to their percent (Table 6) shows that in 44.5% of cases the percentage of the burn exceeds 80%, and in bout 26% of cases the percentage was above 50%. This means that about 70.5% of the cases had had a lethal burn.

Distribution of deaths according to the cause (Table 5) shows that the main cause of death is the direct effect of the burn on the body, about 60.98% of the total number of cases, followed by deaths due to complications within the burn, which comprises 23.42% , and then deaths due to complications outside the burn, which constitutes 15.6%. When we studied the circumstances that surrounded the deaths, we found that nearly all cases were accidental, except 3 suicidal cases and one criminal, in which the victim was burnt after, had been killed by strangulation.

Table 1: Incidence per year and sex

Year	Total	Male	Female	Percent
1986	17	6	11	6.20
1987	11	5	6	4.10
1988	14	10	4	5.20
1989	19	12	7	7.10
1990	29	14	15	11.20
1991	44	22	22	14.70
1992	42	12	30	15.60
1993	45	21	24	16.95
1994	45	20	25	16.95
Total	266	=122 %45.9	=144 %54.1	100

Table 2: Incidence per age

Age group	Total number	Percent
10-1	57	21.42
20-11	64	24.06
30-21	58	21.80
40-31	41	15.41
50-41	21	7.89
60-51	14	5.26
70-61	6	2.25
80-71	1	0.37
90-81	3	1.12
.-90>	1	0.37
Total	266	99.95

Table3: Distribution per month

Month	Number	Percent
January	28	10.52
February	27	10.55
March	22	8.27
April	17	6.39
May	14	5.46
June	28	10.52
July	22	8.38
August	19	7.14
September	20	7.19
October	18	7.12
November	22	8.37
December	29	10.90
Total	266	100

Table 4: Distribution of deaths according to the degree of the burns

Degree	Total No.	Percent %
First	139	28.74
Second	203	42.45
Third	108	22.25
Forth	30	5.3
Fifth	5	0.8
Sixth	3	0.5
Total	475	100

Table 5: distribution by cause of death

Cause of death	Number of deaths	Percent
Burn it self	147	60.98
Complication in the burn	62	23.42
Complications out side the burn	57	15.60
Total	266	100

Table 6: distribution of deaths according to the percentage of the burn and the cause of death for the years 1990-1994 only

Percent of burn and cause	Less than 20%	More than 20% less than 50%	More than 50% less than 80%	0	Total	Percent
The burn it Self	0	5	30	90	125	60.98%
Complications within the burn	1	16	14	11	42	23.41%
Complications out side the burn	1	7	16	8	32	15.60%
Total	2	28	60	119	199	100

Discussion:

Incidence per 100,000: Fire-related deaths in Babel represented approximately 6.5% of all autopsy cases received at the Medicolegal Office in Babel (14). In Germany, the fire-related deaths represented approximately 6% of all autopsy cases (15). In USA, the fire-related deaths represented 3.4% of all accidental deaths in the year 2002 (1, 2, 3, 4).

The results of our study have shown that the incidence of fire-related deaths in Babel was about 3.5 deaths per 100,000 of population per year. This rate is considered high when compared with USA and western countries. Findings released by the World Fire Statistics in 2007 showed that the fire-related death rate in the Unites States of America was 1.39 deaths per 100,000 in the years 2002-2004; in Finland and Hungary the fire related deaths were 2.08 and 2.10 per 100,000, respectively (4). The countries with the lowest rate include Singapore (0.08/ 100,000) and Switzerland (0.51/100000). The rate in Russia was astonishingly high, which is 13 deaths per 100,000 (16) , which is approximately ten times greater than in USA and Europe and four times greater than in Babel.

Incidence per year: Our study has shown that the incidence of fire-related deaths per year showed an increment by three-fold during the period of the study (table 1). This finding is in contrast with those reported from USA and Russia, which indicate a decrease in the number of fire-related deaths from 1997 to 2006 (4, 16). The reason for that is the embargo circumstances that Iraq had been subjected to during this period, i.e., 1990-1994. During that period most families in Iraq were obliged to make bread in the houses by using old fashion gas-ovens, which lack the least safety measure. This makes persons using these ovens at higher risk for burns. This phenomenon can also explain the high incidence of burns among females in our study, because females are the family members who are responsible for preparing bread and cocking.

Incidence per month: Our study has shown that about 55% of fire-related deaths occurred between October and March, which are the coldest months of the year (table 2 and figures 2A and 2B). The same results have been reported by

two studies in Alabama and New Jersey (17, 18). Our study showed that all fire-related deaths occurred at residence, McGowan and Barillo (17, 18) reported that the highest number of fire-related deaths occurred at residence.

Incidence per age and **sex:** Our study has shown that the highest number of fire-related deaths occurred in the young age group (from 1 to 30 years), which represented 65% of all fire-related deaths. The peak incidence was at the age 11-20 years. This finding has also been reported by other studies on the same subject. In a retrospective study on fire-related deaths between the years 1985 and 1991 in New Jersey (USA), Barillo, et al (17) reported that fire victims under the age of 11 years or over the age of 70 years constituted 22.1 percent of the state population. Nearly, similar results have been reported by McGwin, et al from Alabama (USA). Our study has shown that about 23% of the victims were under the age of 11 years or above the age of 70 years. Another study from the state of Dallas (19) reported that 40% of fire-related deaths in children resulted from fire play, especially those occurred in apartments and mobile homes. The most important predisposing factor in children is fire play. It has been found that 84% of the fireplay related injuries were from children playing with matches or lighter (19). This high incidence of fire-related death in young children was attributed to the nature of child's behavior in relation to fire play (19).

In people older than 18 years age, alcohol and cigarette smoking are two important predisposing factors (18). It has been reported that more than half the victims aged 18 years and over had been drinking alcoholic beverages before the fire accident. Alcohol intoxication is an important predisposing factor in fire deaths, and it may do this by: increasing the likelihood of fire, impairing the ability of the victim to escape, and depressing the Central Nervous System (20). It has also been reported that more than half of the deaths resulted from cigarette-ignited fires (21). Our study has shown that the incidence of fire-related deaths among females is higher than

males. This finding is in contrast with other studies, which reported higher incidence among males (4, 17, 18, 19). These differences can be explained on the bases of the differences in lifestyles; in our country the social habits make women in contact with fire more frequently than men, especially residential fires, because women is responsible for preparing food for the family, in addition our people especially in rural areas prefer house made bread.

Causes of death after fire injuries: Our study shows that the most common cause of fire injury was dry heat and the commonest circumstance surrounding the accidents was carelessness. The results of our study shows that about 60.98% of fire related deaths were due to the direct effect of fire on the body. In a study from Germany (15) that had been carried on 115 unselected autopsy cases of death from fire, it has been found that in 100 cases the cause of death was due to the direct effect of heat; 23 cases died during initial medical care or clinical treatment due to respiratory arrest as a result of smoke poisoning or delayed shock caused by direct effect of fire on the skin. In the remaining 77 cases, the death occurred immediately at the scene of the fatal event. Death after exposure to heat may result from one of the following mechanisms (4, 5, 6, 13):

1. Direct effect of heat on the body. When the heat is dry and resulted in extensive and deep burn, death may occur: a) immediately, as a result of substantial damage to the brain, heart, or other vital internal organs. Immediate death can also be the result of direct thermal damage to the air passages, causing scorch of tongue, pharynx, epiglottis, and marked pulmonary edema (4, 5), b. rapidly within one or two hours as a result of neurogenic shock resulting from widespread stimulation of the sensory nerve ending through out the body, especially in second- and third-degree burns, c) within few hours after extensive burns as a result of hypovolemic shock resulting from extensive loss of body fluids and plasma through the broken skin, d) within two days as a result of the liberation of abnormal toxic protenaceous substances within the burnt area and their subsequent absorption in the blood.

2. Direct complications. This usually results from direct infection of the burn by many types of pathogenic bacteria, especially gram negative bacteria, with subsequent bacteremia or septicemia and septic shock (13).

3. Indirect complications. These include lobar pneumonia, generalized infections, and bleeding from curling ulcers, which usually develops ten days after extensive burns.

The medico-legal importance of fire-related deaths: Damage to the tissues arising from application of heat is commonly encountered in forensic pathology and sometimes provides a challenging problem in distinction between ante-mortem and post-mortem burning, which may have serious criminal aspects. However, it can be difficult or impossible to tell how much a burn is ante-mortem or post-mortem, because the presence of reddening and blistering can not always be depended on as criteria for vital burns (5, 4, 11, 13). When criminals dispose their victim by burning their cadavers, the burns are very severe and charred because they try to hid any evidence as to the real cause of death (5). Charred burns constitute one of the most difficult problems that the forensic pathologists might face, because it is important from legal point of view, in these cases, to decide whether the death is due to the burn it self or other causes (7, 12). This in turn implies that the pathologist must decide whether the burn is vital (ante-mortem) or postmortem. In our study, only 4 cases of the fire-related death were suspicious; 3 cases were females and their families claimed a suicide attempt, the forth case was an old man who was living alone, in which the body was nearly cremated. After autopsy we discovered that he had been fatally strangulated before fire. There are certain criteria on which the pathologist may relay to make his decision as to the vitality of a burn: These include:

A) Redness of the skin, which is not always a reliable indicator, because the exposed skin surface may be reddened in both ante-mortem and postmortem burns. The classical distinction of red flair or "vital reaction" is unsafe as an index of infliction before death, because it has been reported by some authors that an extensive red flair was seen in undoubted post-mortem burn

after attempts at disposal of a fatally strangulated victim by fire (4, 5, 9, 10, 11, 13).

B) Blistering of the skin. Blisters that form in second degree burns can be used as indicators for ante-mortem deaths. The ante-mortem blisters is said to be tense, the base is usually red, and the skin surrounding it is red. However, these sings can not be depended on absolutely. Another point of distinction is that: the blisters formed in life contain more protein and chloride (4, 5, 9, 10, 11, 13).

C) Presence of carbon monoxide in the circulating blood. This proves that the victim was still alive when the fire is in progress, but necessarily indicates that any burns were ante-mortem. On the other hand, it should be indicated that not all persons alive during a fire accumulate carboxyhemoglobin in their blood (22, 23, 24).

D) Presence of carbon particles in the air passages. The dense black smoke that is liberated during combustion of objects, such as furniture and carpets, usually contains carbon particles that become deposited in the various levels of air way passages. These carbon particles are indicators of ante-mortem inhalation, and are almost as useful as carbon monoxide. Histological demonstration of soot in the more peripheral bronchi, as far as the terminal bronchioles, is absolute proof of respiratory function. The carbon is usually mixed with mucus on the tracheal and bronchial lining epithelium (4, 5, 11, 13, 22, 23).

E) Swallowed soot. Presence of soot and mucus in the stomach is an evidence of ante-mortem burns, which indicate that the victim was alive during the smoky phase of fire (4, 5, 22, 23).

Relation of burn's extent to the cause of death: The extent of a burn is estimated by its surface area relative to the total surface area of the skin and this is measured by the "Rule of Nines". Mortality and morbidity in burns accidents has been directly related to the percentage of burn. It has been reported that burns less than 30% and more 20% are considered dangerous, while those above 50% are considered incompatible with life (5, 13). The results of our study showed that the cause of death in 125 cases was the direct effect of the fire, and in approximately 95% of these cases the burn was above 50% of the total surface area of the body. In those who died due to complications within the burns or out side it, showed less extensive burn compared to those who died as a result of direct effect of burns in addition, they had been hospitalized for long period of time after the fire accident.

The degree of burns: Regarding the degree of burn, our study showed that approximately 42.45% of cases have second-degree, 28% first-degree, and 22% third-degree burn. Since it is possible to find more than one degree of burn in the same case and it is difficult to calculate the surface areas of each degree precisely, the degree of the burn has no prognostic value regarding mortality. For example a third degree burns or even a charred burn of less than 0.5% carries a better prognosis than a first degree burn involving 70% of the surface area of the body. The degree of burn is important as to the outcome of burns after healing, because burns of second degree and more usually heal by fibrous tissue and scar formation (4, 5, 6).

Conclusions: Residential fire-related deaths occurred predominantly in the young ages, and the incidence was higher among females than males. The highest rate was in the coldest months of the year. Most of deaths were due to direct effect of dry heat on the skin and the internal organs.

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