
GAZİ ÜNİVERSİTESİ
Gazi
1926

FIRE STATISTICS IN COMPARISON WITHIN ISTANBUL (TURKEY), LONDON (ENGLAND) AND NEW YORK CITY (UNITED STATES OF AMERICA) CONTEXT

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
GAZİ UNIVERSITY

BY

Cemre BİNGÖL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
ARCHITECTURE

APRIL 2023

ETHICAL STATEMENT

I hereby declare that in this thesis study I prepared in accordance with thesis writing rules of Gazi University Graduate School of Natural and Applied Sciences;

- All data, information and documents presented in this thesis have been obtained within the scope of academic rules and ethical conduct,
- All information, documents, assessments and results have been presented in accordance with scientific ethical conduct and moral rules,
- All material used in this thesis that are not original to this work have been fully cited and referenced,
- No change has been made in the data used,
- The work presented in this thesis is original,

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Cemre BİNGÖL

26/04/2023

YANGIN İSTATİSTİKLERİNİN İSTANBUL (TÜRKİYE), LONDRA (İNGİLTERE) VE NEW YORK CITY (AMERİKA) KAPSAMINDA KARŞILAŞTIRMALI OLARAK İNCELEMESİ

(Yüksek Lisans Tezi)

Cemre BİNGÖL

GAZİ ÜNİVERSİTESİ
FEN BİLİMLERİ ENSTİTÜSÜ

Nisan 2023

ÖZET

Yüzyıllar boyunca şehirler, ülkelerin ekonomik, bilimsel, kültürel ve idari merkezleri olarak gelişmiştir. Ancak gelişmiş kentler her zaman sorunlarla karşı karşıya kalmıştır. Büyük şehirlerin en önemli sorunlarından biri can ve mal güvenliğidir. Belediyelerin polis, itfaiye ve acil durum hizmetleri gibi bu tür olaylarla ilgilenen özel hizmetleri bulunmaktadır. Fakat, istatistiksel verileri kullanarak çözüm aramak amacıyla olayların verilerini kaydedecek yeterli sayıda bölüm de olmalıdır. İstatistik bölümü, olayların nedenlerini ortaya çıkararak çözüm arayışını kolaylaştırmalıdır. Bu bağlamda, bu tezin amacı yangın istatistikleri konusuna dikkat çekmektir. Yangın önlemleri konusunda ilerleme kaydedilmiş olmasına rağmen yangınlar nedeniyle can ve mal kaybı tehlikesi devam etmektedir. Bu nedenle İstanbul'un (Türkiye) yangın istatistikleri incelenmiş, Londra (İngiltere) ile New York (Amerika Birleşik Devletleri) yangın istatistikleri ile karşılaştırılmıştır. Karşılaştırma, 2016 yılından 2020 yılına kadar olan 5 yıllık dönemi kapsamaktadır. İstatistiksel analizler yangın sorununu detaylı bir şekilde ele alarak binalara odaklanmıştır. Vurgulanan konular arasında yangın sorununun önemi, yangınların nedenleri ve nerede meydana geldikleri yer almaktadır. Bu çalışma ile İstanbul'da yangınların ve yangınlar nedeniyle meydana gelen yaralanmaların arttığı ortaya konulmuştur. New York City ve Londra'da ise yangın sayılarında azalma görülmektedir. Yangınlar, New York City ve İstanbul'da daha çok yapılı çevrede, Londra'da ise açık alanlarda meydana gelmiştir. İstanbul'da daha fazla sayıda bina yangını konut olmayan binalarda ve Londra'da konut binalarında meydana gelmiştir. Türkiye'deki en kapsamlı yangın istatistikleri İstanbul İtfaiyesi tarafından tutuluyor olmasına rağmen, Londra ile karşılaştırıldığında istatistiklerin detaylı şekilde tutulmasına ve yayınlanmasına ilişkin gelişim gösterilmesi gerekliliği görülmüştür. Geliştirilebilir ve yangın olaylarına ilişkin çeşitli bilgileri içeren ulusal bir veri havuzunun oluşturulması, istatistiksel çalışmaların yapılmasını ve yangın güvenliği önlemlerinin artırılmasını sağlayacaktır.

Bilim Kodu : 80103
Anahtar Kelimeler : Yangın İstatistikleri, İstanbul, Londra, New York City
Sayfa Adedi : 125
Danışman : Prof. Dr. Füsun DEMİREL

FIRE STATISTICS IN COMPARISON WITHIN ISTANBUL (TURKEY), LONDON (ENGLAND) AND NEW YORK CITY (UNITED STATES OF AMERICA) CONTEXT

(M. Sc. Thesis)

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GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

April 2023

ABSTRACT

Over the centuries, cities evolved as economic, scientific, cultural, and administrative centers of the countries. However, evolved cities have always confronted some problems. One of the most important problems of large cities is the safety of life and property. The municipalities have special services that deal with such incidents such as police, fire departments, emergency services, etc. However, there should be an adequate number of departments that will record the data of incidents for the purpose of searching for solutions by using statistics. The department of statistics should facilitate the search for solutions by revealing the causes of the incidents. In this context, the aim of this thesis is to take attention to the subject of fire statistics. Many advances in fire prevention have been made, however, the danger of loss of life and property from fires continues. For this reason, the statistics of fires in Istanbul (Turkey) were examined and compared with the fire statistics of other cities such as London (England) and New York City (United States of America). The comparison covers the 5-year period from 2016 to 2020. Statistical analyses addressed detailly the fire problem and focused on buildings. Emphasized topics include the importance of the fire problem, the causes of fires, and where they occur. With this study, it was revealed that the fires and injuries that occurred due to fires increased in Istanbul. However, in New York City and London, there is a decrease in fires. Fires occurred mostly in the built environment in New York City and Istanbul, and open areas of London. The greater number of building fires in Istanbul occurred in the non-residential built environment, and in residential buildings of London. Even though the most comprehensive fire statistics in Turkey were accomplished by the Istanbul Fire Department, it was observed that there was a need for development in the collection of data regarding detailing and publication of statistics when compared to London. Developing a national data pool that can be improved and contains various information about fire incidents will provide statistical studies to be accomplished and fire safety precautions to be increased.

Science Code : 80103
Key Words : Fire Statistics, İstanbul, London, New York City
Page Number : 125
Supervisor : Prof. Dr. Füsun DEMİREL

ACKNOWLEDGEMENT

First and foremost, I would like to express my most sincere thanks to my supervisor, Prof. Dr. Füsun DEMİREL, for her guidance, and encouragement to complete this thesis. She had valuable contributions to my education, and I am glad to be her student. I would also like to thank İstanbul Fire Department to share the fire data of İstanbul for this thesis. Lastly this study would have been very difficult to complete without the endless and unconditional love, encouragement, and support of my parents Mustafa and Dilek BİNGÖL, my dogs Oskar and Toprak, and my cat Cimcime. I have always considered myself lucky to be a member of my family and owe them who I am along with everything that I achieved.

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SYMBOLS AND ABBREVIATIONS

The symbols and abbreviations used in this study are presented below with their explanations.

Symbols	Explanations
°C	Centigrade
°F	Fahrenheit

Abbreviations	Explanations
CTIF	International Association of Fire and Rescue Services
FDNY	Fire Department of the New York City
FRS	Fire and Rescue Services
ILD	Incident Level Datasets
IRS	Incident Recording System
LFB	London Fire Brigade
NFDC	National Fire Data Center
NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
USFA	United States Fire Administration

1. INTRODUCTION

Burning is a physical event that can be called an exothermic reaction that usually occurs when the substance comes together with the oxygen and heat source and turns into the form of heat and light (Şengöz, 2018). A controlled burning does not create a problem, but when it is uncontrollable, it is called fire and becomes a situation that causes serious problems for both living beings and the environment we live in. Damages caused by fires by humans or of natural origin depend on the predetermination of risks.

Fires have always been a threat to human and building safety. Fire causes deaths and huge amounts of capital because of property loss around the world each year. Especially with the increase of multi-story buildings in urban areas, the concept of fire has become a very important problem in ensuring the safety of life and property (Bingöl and Demirel, 2022). All academics and practitioners face increasing challenges in how to solve all these complex fire safety issues. In order to investigate and define the problems of fires and their causes, it is essential to gather statistics covering a period of several years. More detailed research must be carried out to provide more usable data. When fires and their damages are known in advance, it is possible to create and develop systems, tools, and mechanisms to intervene (Bekem, Çavuş, and Demirel, 2011).

This study will address the statistics of fire in different cities. It is essential to have accurate data that are current and organized for fire precautions and setting rules for fire prevention in order to be prepared for possible fire incidents or to minimize the loss of property and life during fires. This is extremely important to raise awareness of people, to use technological equipment for the detection of risks, and to develop more advanced systems.

Defining the problem

Fire safety is always a major concern in buildings. During fires, the prime objective is life safety although property protection is also important. For improving fire safety in buildings, data of fire incidents are collected in many cities. Information from fire data makes it possible to help with the generation of strategies for fire protection and

prevention. The study will show that existing data is not structured for systematic fire prevention. It is difficult to access data on fires over a long period of years.

The objective of Turkey's Regulation on Fire Protection is clarified in article 1 as appointing the procedures and rules for pre-fire and post-fire measures to be taken, organizations, training, and inspections to minimize the fires that can be occurred during the design, construction, operation, maintenance processes of any structures, buildings, and facilities and to extinguish a fire to minimize loss of life and property (Binaların Yangından Korunması Hakkında Yönetmelik, 2007). Despite these regulations put into practice, fires occur almost every day in both workplaces and living areas revealing that there are some deficiencies in regulations. The deficiency can be summarized as this regulation does not contain any information about statistics of fire hazards.

Purpose of the study

In many countries, there are lots of research and solution-oriented studies on national or international fire statistics, however, there are only a few studies in our country with a focus on research. Detailed studies on fire safety in buildings have been carried out with master and doctoral thesis studies, but there is no comprehensive study on fire incidents statistics.

The aim of the study is to gather and analyze data on various numbers of causes of fires in different cities in order to guide to what extent existing data could be used as a baseline to improve fire prevention at a global level with the prime objective of reducing human life loss from fire and secondly protecting the asset property. To reduce the number of fires, it is required to improve fire statistics, education, leadership, methodologies, and tools for systematic fire prevention. It is clear that a data bank is needed to reduce fires which are an important danger in terms of life and property safety. With this database, a lot of information can be obtained in detail.

Scope of the study and limitations

A statistical study on fires in buildings in New York City (United States of America), Istanbul (Turkey), and London (England) was carried out in this thesis. This statistical

study was created from the fire incidents that were reported to the fire departments. It must be noted that not all fire incidents are reported to fire departments. In other words, it does not contain information about the fires that were not reported and were extinguished by the people at the scene.

For the United States of America, data will be used from 'National Fire Incident Reporting System (NFIRS)'. It should be noted that NFIRS is a voluntary system. Different states of the USA have different reporting requirements and practices. This means data from NFIRS may be susceptible to systematic biases (U.S. Fire Administration, 2017a:1).

For London, data will be used from the source 'London Datastore' (London Datastore, 2021). It should be noted that the dashboard on this datastore is dynamic. This means data from past years can be changed if any new information is found. To prevent inconsistency in statistics, instead of the dynamic dashboard, a publication about fire statistics of London Fire Brigade is used for preparing graphics and statistics.

For England, data will be used from the source 'GOV.UK' (GOV.UK, 2021). Data is provided by The Home Office, however digital publications and excel files are shared on the government's web page. Where an error has occurred with the statistical data, live excel tables, and other accompanying releases are updated with a correction notice. Consequently, the date of accessing the fire data source that have been used for this thesis is specified in references.

For Turkey, there is no information about fire statistics that is shared with the public. For this reason, the author of this thesis couldn't access the data.

Methodology

According to Turkey's regulation on fire protection, which was created based on European norms, article 5, when this regulation has not adequate norms about the project, it is recommended to use European Standards by designers (Binaların Yangından Korunması Hakkında Yönetmelik, 2007). As Turkey's norms recommended European Standards, it is convenient to choose England for comparison. England uses Building Regulations for fire protection in buildings. Also, the United States of America was chosen for its deep-rooted

past on this issue. National Fire Protection Association (NFPA) first started its work in 1913 based on schools, theaters, shops, and factories (Şimşek, 2013).

The analyses use data for fire from London Datastore for London (London Datastore, 2021). For England, for producing tables and graphics, data is taken from United Kingdom's official website GOV.UK (GOV.UK, 2021). For United States of America, data is received from the annual results of National Fire Protection Association (NFPA Applied Research, 2021:2-23).

Data from New York City Fire Department for between the years 2013 and 2018 (New York City Fire Department, 2022) and no. 20 CTIF report for between years 2009-2012 (Brushlinsky, Ahrens, Sokolov, and Wagner, 2015), no. 15 CTIF report for between years 2004-2008 (Brushlinsky, Hall, Sokolov, and Wagner, 2010), no. 11 CTIF report for 2003 (Brushlinsky, Hall, Sokolov, and Wagner, 2006) are used in the fire data analysis of New York City. The primary source of fire data for Istanbul is Istanbul Fire Department (İstanbul Büyükşehir Belediyesi İtfaiye Daire Başkanlığı, 2022).

Population numbers are received from United States Census Bureau for the United States (United States Census Bureau, 2020) and from New York State Department of Health for New York City (New York State Department of Health, 2019). Data for the population are received from London Datastore for London (London Datastore, 2021a). For England, data for the population are received from Office for National Statistics (Office for National Statistics, 2021). Population numbers of Istanbul are received from Turkish Statistical Institute (Turkish Statistical Institute, 2021).

Fatality and injury numbers are received from the annual results of National Fire Protection Association (NFPA Applied Research, 2021:2-23) for United States of America and for New York City, data of injuries is received from no. 26 CTIF report (Brushlinsky, Ahrens, Sokolov, and Wagner, 2021), no. 24 CTIF report (Brushlinsky, Ahrens, Sokolov, and Wagner, 2019), no. 22 CTIF report (Brushlinsky, Ahrens, Sokolov, and Wagner, 2017), and no. 18 CTIF report (Brushlinsky, Hall, Sokolov, and Wagner, 2013). Death and non-fatal casualty numbers for England are taken from United Kingdom's official website GOV.UK (GOV.UK, 2021) and for London, data is taken from London Datastore for London (London Datastore, 2021). Fatality and injury numbers of Istanbul are received

from Istanbul Fire Department (İstanbul Büyükşehir Belediyesi İtfaiye Daire Başkanlığı, 2022).

Coherence is a term that was used to create a common language for this thesis. Data of all countries are released using the calendar year except England. Although London's data is published with the calendar year, England's fire incident reports are shared with the financial year. The financial year starts that year's month of April and ended in next year's month of March. However, for making comparisons, the data is converted to a calendar year by the author.

In the chapter of 'Findings and Conclusion', the data from countries and cities will be compared. In the case of, the data starting from different years for countries and cities, the comparison will be made for common years. If data is not available for a section for 3 countries, a comparison will be made between 2 countries.

Structure of the thesis

This thesis deals with fire statistics in different cities and is consisting of four chapters. In the first chapter, introduction indicates the problem and why it has been chosen to be studied. It also contains the aim of the study, limitations and scope of the study, and methodology. The structure of the thesis is also introduced in this chapter.

The second chapter; Literature Review is about statistics of fire, causes of fire, and buildings. In this part of the study, other studies conducted abroad on the subject were examined. For every topic, both national and international academic publications are determined. Tabulation differs for thesis and other types of studies.

The third chapter explains the causes of fires. This section, it is aimed to define the most common fire reasons to form general knowledge and share preventative measures for each type of cause.

The fourth chapter forms the statistics through tables and figures through obtained data with detail examined. The fire incidents and the reasons for starting and related records are analyzed in this section.

The last chapter includes the findings and conclusion of the study by aggregating these data, a general view of our country in this matter is presented.

2. LITERATURE REVIEW

In this part of the thesis, a literature review on causes of fire, fire statistics, and fire safety of buildings has been conducted. Studies based on national fire statistics are an important part of fire safety in buildings.

One of the studies about fire statistics was conducted by Demirel et al. (2011) based on the number of fires that occurred in Turkey between 1988 and 2008. The increasing annual number of fires during the period under study was associated with population and energy use. It was found that the number of fires increased with increasing population and energy use. Demirel also shared information on the details of the statistical data and emphasized the importance of keeping details such as gender, age, and causes of death by examining the loss of life in fires. It is also stated in research that, in Turkey, only Istanbul Metropolitan Municipality has been keeping detailed fire reports since 2007 (Bekem, Çavuş and Demirel, 2011).

The fires that took place in Giresun between 2011 and 2016 were analyzed by Bekem Kara (2017) and it was stated that 36% of the fires were caused by electric and 43% were extinguished at the initial stage. It was stated in the article that most fires in Giresun province occurred in residential buildings and most fires in residential buildings occurred in concrete type buildings (Bekem Kara, 2017).

In another study, Kılıç (2018) stated that the number of actual fires plays an important role in improving fire services. It was also shared that the General Directorate of Civil Defense in Turkey used to collect fire data from provincial fire departments every year and create annual reports (Kılıç, 2018).

Bakırcı et al. (2019) compared the statistics of fires that occurred in Istanbul between 2008-2018 with the fire statistics of the USA, China and EU countries and identified the differences in data types. They stated that the current data type is not sufficient when compared to other countries. (Bakırcı, Karatop, and Bayındır, 2019).

2.1. Research within the Scope of Causes of Fires

Literature review of academic studies (national thesis studies) conducted in the universities of our country within the scope of causes of fire are shown in Table 2.1.

Table 2.1. National thesis studies within the scope of causes of fires

No	Author/Authors	Years	Publisher	Title
1	Mehmet Cem Şengöz	2018	Süleyman Demirel University	Elektrik Nedenli Yangınların Araştırılması ve FMEA Yöntemi ile Risk Analizi (doctorate thesis)
2	Fatih Nurtaş	2016	Gedik University	Plastik Enjeksiyonla Üretimde Yangın Riskleri ve Yangın Güvenliği (master's thesis)
3	Mehmet Cem Şengöz	2011	Süleyman Demirel University	Meskenlerdeki Elektrik Tesisatlarından Kaynaklanan Yangınların İncelenmesi ve Yangın Risk Analizlerinin Yapılması (master's thesis)
4	Oğuz Karakuş	2010	Ankara University	Ankara'da Çıkan Yangınların Kundaklama Açısından Değerlendirilmesi (doctorate thesis)

Literature review of national thesis studies within the scope of causes of fires is followed by national studies within the scope of causes of fires other than a doctorate thesis and master's thesis are shown in Table 2.2.

Table 2.2. National studies within the scope of causes of fires

No	Author/Authors	Years	Publisher	Title
1	Füsun Demirel, Özlem Baytemür	2020	Yangın ve Güvenlik Dergisi	Hastane Yangınlarının Nedenleri ve Geçmişte Yaşanmış Hastane Yangınları
2	İlknur Bekem Kara, Cuma Kara	2018	Mühendislik ve Mimarlık Çalışmaları	Bina Yangınları ve Maddi Zararın İncelenmesi Üzerine Bir Çalışma: Gümüşhane İli Örneği
3	Abdurrahman Kılıç	2018	Yangın ve Güvenlik Dergisi	Gelişmiş Ülkelerde ve Türkiye'de Yangın Nedenleri
4	İlknur Bekem Kara	2018	Doğal Afetler ve Çevre Dergisi	2013-2017 Yılları Arasında Artvin İl Merkezinde Meydana Gelen Bina Yangınlarının İncelenmesi
5	Mehmet Cem Şengöz, Mustafa Merdan	2017	5th International Symposium on Innovative Technologies in Engineering and Science	Elektrik Nedenli Yangınların İncelenmesi ve FMEA (Failure Mode and Effects Analysis) Yönteminin Uygulanması (İstanbul Örneği)
6	Mehmet Cem Şengöz, Mustafa Merdan	2017	9. İşçi Sağlığı ve İş Güvenliği Kongresi	Risk Analizi ve Saha Kontrolleri Açısından Elektrik Nedenli Yangınların İncelenmesi (Ankara Örneği)
7	Saadet Nurullah Güleç	2013	Elektrik Mühendisliği Dergisi	Yangınlar ve Elektrik Kontağı
8	Abdurrahman Kılıç	2012	Yangın ve Güvenlik Dergisi	Otel Yangınları ve Sebepleri
9	Saadet Alkış	2002	Adli Bilimler Dergisi	Otomobil Yangınlarının İncelenmesi

Literature review of national studies within the scope of causes of fires is followed by international studies within the scope of causes of fires other than a doctorate thesis and master's thesis are shown in Table 2.3.

Table 2.3. International studies within the scope of causes of fires

No	Author/Authors	Years	Publisher	Title
1	Kanchan Chowdhury	2014	Journal of Clinical Anesthesia	Fires in Indian Hospitals: Root Cause Analysis and Recommendations for Their Prevention
2	Andrea Camia, Tracy Durrant, Jesus San-Miguel-Ayanz	2013	Publications Office of the European Union	Harmonized classification scheme of fire causes in the EU adopted for the European Fire Database of EFFIS
3	Ali Asgary, Alireza Ghaffari, Jason Levy	2010	Fire Safety Journal	Spatial and Temporal Analyses of Structural Fire Incidents and Their Causes: A Case of Toronto, Canada
4	John J. Shea	2010	Fire and Material	Identifying Causes for Certain Types of Electrically Initiated Fires in Residential Circuits
5	Shen-Wen Chien, Guan-Yuan Wu	2008	Fire Safety Journal	The Strategies of Fire Prevention on Residential Fire in Taipei
6	P. G. Holborn, P. F. Nolan, J. Golt	2003	Fire Safety Journal	An Analysis of Fatal Unintentional Dwelling Fires Investigated by London Fire Brigade Between 1996 and 2000
7	Vytenis Babrauskas	2002	The Journal of the International Association of Arson Investigators	How do Electrical Wiring Faults Lead to Structure Ignitions?

2.2. Research within the Scope of Fire Statistics

Literature review of academic studies within the scope of fire statistics (national studies other than a doctorate thesis and master's thesis) are shown in Table 2.4.

Table 2.4. National studies within the scope of fire statistics

No	Author/Authors	Years	Publisher	Title
1	Erhan Bakırcı, Buket Karatop, Sümeyye Bayındır	2019	Doğal Afetler ve Çevre Dergisi	Yangın Stratejilerinin Oluşturulması İçin İstatistik Veri Türlerinin Türkiye (İstanbul İli Örneğinde) ve Seçilmiş Ülkeler ile Karşılaştırılması
2	Abdurrahman Kılıç	2018	Yangın ve Güvenlik Dergisi	Gelişmiş Ülkelerde ve Türkiye'de Yangın İstatistikleri
3	İlknur Bekem Kara	2017	Karadeniz Fen Bilimleri Dergisi	Giresun İli Yangın İstatistiklerinin İncelenmesi (2011-2016)
4	İlknur Bekem, Murat Çavuş, Füsun Demirel	2011	TÜYAK	Türkiye Ölçeğinde Yangın İstatistikleri Üzerine Bir Araştırma

Literature review of academic studies within the scope of fire statistics, international studies other than a doctorate thesis and master's thesis are shown in Table 2.5.

Table 2.5. International studies within the scope of fire statistics

No	Author/Authors	Years	Publisher	Title
1	Marcus Runefors, Nils Johansson, Patrick Van Hees	2017	Fire Safety Journal	The Effectiveness of Specific Fire Prevention Measures for Different Population Groups
2	Yaping He, Laurence A. F. Park	2017	Fire Safety Journal	A Statistical Analysis of Occurrence and Association Between Structural Fire Hazards in Heritage Housing
3	Fawaz K. Sweis	2006	Fire Safety Journal	Fires and Related Incidents in Jordan (1996–2004)
4	A. M. Hasofer, I. Thomas	2006	Fire Safety Journal	Analysis of Fatalities and Injuries in Building Fire Statistics

Table 2.5. (continues) International studies within the scope of fire statistics

No	Author/Authors	Years	Publisher	Title
5	Yang Lizhong, Zhou Xiaodong, Deng Zhihua, Fan Weicheng, Wang Qing'an	2002	Fire Safety Journal	Fire Situation and Fire Characteristic Analysis Based on Fire Statistics of China
6	Tommy Rosenberg	1999	Fire Safety Journal	Statistics for Fire Prevention in Sweden

2.3. Research within the Scope of Fire Safety of Buildings

Literature review of national thesis studies conducted in the universities of our country within the scope of fire safety of buildings are shown in Table 2.6.

Table 2.6. National thesis studies within the scope of fire safety of buildings

No	Author/Authors	Years	Publisher	Title
1	Merve Güneş	2020	Konya Technical University	Öğrenci Barınma Hizmeti Veren Binalarda Yangın Güvenlik Önlemleri (master's thesis)
2	Resime Nur Yıldırım	2020	Gazi University	Havalimanı Yolcu Terminallerinde Pasif Yangın Güvenlik Önlemleri Analizi ve Performans Kriterlerinin Oluşturulması (master's thesis)
3	Halenur Kutsal	2019	Konya Technical University	Okul Öncesi Eğitim Yapılarında Pasif Yangın Güvenlik Önlemleri (master's thesis)
4	İrem Dokur	2019	Dokuz Eylül University	Eğitim Amaçlı Binalarda Yangın Tehlikesinin Risk Analizi (master's thesis)
5	Özlem Baytemür	2019	Gazi University	Hastanelerde Yangın Güvenlik Önlemlerine İlişkin Performans Kriterlerinin Oluşturulması ve Bir Örneklem (master's thesis)
6	Erdal Çavuş	2019	İstanbul Rumeli University	Hastanelerde Yangın Güvenliği ve Yangından Korunma Planlaması (master's thesis)

Table 2.6. (continues) National thesis studies within the scope of fire safety of buildings

No	Author/Authors	Years	Publisher	Title
7	Furkan Eruçar	2018	İstanbul Technical University	Fonksiyon Değişikliğine Uğramış Hastane Yapılarında Alınan Yangın Güvenlik Önlemlerinin İncelenmesi (master's thesis)
8	Pınar Özayan	2018	Çankaya University	İş Güvenliği Kapsamında Öğrenci Yurtlarında Yangın Güvenlik Önlemlerinin İncelenmesi ve Bir Örneklem (master's thesis)
9	Gül Işık Kurtoğlu Doğan	2016	Gedik University	Bir Akıllı Kamu Binasının Yangın Güvenliği Bakımından İncelenmesi (master's thesis)
10	Abdurrahman İnce	2016	Üsküdar University	Hastanelerde Yangın Güvenliği ve Tahliye Gerekleri Üzerine Bir İrdeleme (master's thesis)
11	Zuhal Şimşek	2013	Uludağ University	Sağlık Yapılarında Yangın Güvenliğinin ve Duman Kontrolünün Sağlanmasına İlişkin Modelleme Yöntemi (doctorate thesis)
12	Yasin Alkış	2013	Bahçeşehir University	Taşınmaz Kültür Varlıkları Niteliğindeki Kamu Yapılarında Yangın Güvenliği; Galatasaray Üniversitesi ve Haydarpaşa Garı Yangınları (master's thesis)
13	Pınar Sunar	2010	Mimar Sinan Fine Arts University	Otellerde Yangın Güvenlik Önlemleri ve Tasarıma Etkilerinin Mekansal Kontrol Listeleri Üzerinden Analizi (master's thesis)
14	Fatma Sevindi	2006	Gazi University	Yangınla İlgili Mevzuatlar Çerçevesinde Toplanma Amaçlı Yapılarda Kaçış Yollarının Analizi ve Bir Örnek Çalışma (master's thesis)

Literature review of national thesis studies within the scope of fire safety of buildings is followed by academic studies conducted in the universities of other countries within the scope of buildings are shown in Table 2.7.

Table 2.7. International thesis studies within the scope of fire safety of buildings

No	Author/Authors	Years	Publisher	Title
1	Zhengrong Chen	2008	Carleton University	Design Fires for Motels and Hotels (master's thesis)
2	Wu Hoi Hung	2007	The Hong Kong Polytechnic University	A Critical Study on the Fire Safety for Big Hotels in Hong Kong (doctorate thesis)

Literature review of academic studies within the scope of fire safety of buildings (national studies other than a doctorate thesis and master's thesis) are shown in Table 2.8.

Table 2.8. National studies within the scope of fire safety of buildings

No	Author/Authors	Years	Publisher	Title
1	Sedat Altındaş	2016	Yapı ve Yalıtım Teknolojileri Dergisi	Hastanelerde Pasif Yangın Önlemleri
2	Gökhan Balık, Kazım Beceren	2015	TÜYAK	Hastane Binalarının Tasarımında Yangın Güvenliği
3	Zuhal Şimşek, Filiz Şenkal Sezer, Nilüfer Akıncıtürk	2015	Tesisat Mühendisliği Dergisi	Sağlık Yapılarında Yangın Güvenliği: Bursa Örneği
4	Seçkin Özcan	2015	TÜYAK	Kreşlerdeki Yangın Güvenlik Kriterlerinin Değerlendirilmesi
5	Füsun Demirel, Tuba Tunç Kurt, Özlem Hoçanlı	2014	Beykent Üniversitesi Fen ve Mühendislik Bilimleri Dergisi	Bir Üniversiteye Ait Derslik Bloğunun ‘’Binaların Yangından Korunması Hakkında Yönetmelik’’ Bağlamında İrdelenmesi
6	Füsun Demirel, Hüseyin Başdemir, İsmail İşeri	2013	TÜYAK	Bir Hastane Projesi ve Türkiye Yangından Korunma Yönetmeliği'ne Uygunluk Analizi

Table 2.8. (continues) National studies within the scope of fire safety of buildings

No	Author/Authors	Years	Publisher	Title
7	Füsun Demirel, Hüseyin Başdemir, İsmail İşeri	2012	Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi	Yangın Güvenlik Önlemleri Bağlamında Bir Hastane Projesi ve Ulusal Yangın Mevzuatına Uygunluk Analizi
8	Zuhal Şimşek, Recep Yamankaradeniz, Nilüfer Akıncıtürk	2009	TÜYAK	Hastane Yapılarında Yangın Güvenliği ve Denetimde Güncel Gelişmelerin İrdelenmesi
9	Füsun Demirel, Zeynep Günaydın Konur	2006	Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi	Ulusal ve Uluslararası Mevzuatlar Çerçevesinde Otellerde Kaçış Yollarının Analizi ve Bir Örneklem

Literature review of academic studies within the scope of fire safety of buildings (international studies other than a doctorate and master's thesis) are shown in Table 2.9.

Table 2.9. International studies within the scope of fire safety of buildings

No	Author/Authors	Years	Publisher	Title
1	Tseng Wei-Wen, Pan Kuo-Hsiung, Hsu Che-Ming	2011	Physics Engineering	Performance-Based Fire Safety Design for Existing Small-Scale Hospitals
2	Mohammad A. Hassanain	2009	Structural Survey	Approaches to Qualitative Fire Safety Risk Assessment in Hotel Facilities
3	Leslie R. Richardson	2007	Fire and Materials	Fire Losses in Selected Property Classifications of Non-Residential, Commercial and Residential Wood Buildings. Part 1: Hotels/Motels and Care Homes for Aged
4	Mohammad A. Hassanain, Mohammed Saif	2006	Architectural Science Review	A Systematic Approach for Fire Safety Audits in Health-Care Facilities

Table 2.9. (continues) International studies within the scope of fire safety of buildings

No	Author/Authors	Years	Publisher	Title
5	Mohammad A. Hassanain, Mohammed Abdul Hafeez	2005	Structural Survey	Fire Safety Evaluation of Restaurant Facilities

3. GENERAL KNOWLEDGE ABOUT CAUSES OF FIRE

Combustion is an exothermic chain reaction of flammable substances under certain conditions with the help of an ignition source with oxygen or other oxidizing gases. The increased heat at the end of the reaction allows the combustion to continue more vigorously. This physicochemical event continues its activities in a continuous cycle. If there is enough fuel in the environment, it spreads rapidly. All fuels must reach the gas form and meet with oxygen before combustion starts. The fuel diffuses through the air as a gas and forms a fast-burning mixture. When this mixture reaches the ambient ignition temperature, it ignites and begins to burn. A sparking electricity leak, a cigarette butt, a slight flame are external factors that accelerate ignition. All materials used in the building are fuel, which is a link in the combustion chain. As the speed of the chain reactions forming the combustion event increases, the severity of the fire also increases (Şimşek, 2013).

Unpredictable or unexpected heat sources cause a fire in the presence of air and flammable material. Reasons such as cigarette, lightning, friction, mechanical arc, heat source, arcs in electrical systems can be sufficient for the fire to start (Şengöz, 2018).

With the development of technology, people's daily lives have become easier, while the living space has been enriched with organic materials. This has caused a serious increase in the number of flammable and combustible materials that can cause a fire (Bakırcı, Karatop, and Bayındır, 2019).

The information on the causes of fires is of paramount importance to support the environmental and civil protection policies and also create appropriate prevention measures.

Countries use their national schemes for classifying fire causes. In this thesis, Turkey’s causes of fires scheme which is adopted from Istanbul Fire Department was used. This scheme considered the following categories of fire causes: the electrical cause, smoking, willfully/intentionally started by man, self-ignition, chimney fires, hot work, fireplace, lightning, children carelessness, other known causes, and unknown causes.

3.1. Electrical Cause

Fires caused by electrical failure or malfunction involve some form of arcing, which results from an unintentional discharge of electricity between conductors. Given enough time and level of current, arc faults can produce heat to ignite a fire. Arc faults may originate from any electrical fixture or equipment. Aging electrical systems in older buildings can be a source of arc faults, either through normal wear and tear or since the systems cannot be able to accommodate the greater demands of modern appliances (Campbell, 2019).

Vytenis Babrauskas stated that electrically caused fires are one of the most important dangers in the ignition of buildings (Babrauskas, 2002). Arcs that occurred due to various reasons in the transmission, distribution, and consumption of electricity energy cause explosions and even fires. When these fires occurred both in living areas and workplaces, they cause material damage, injuries, and loss of life. To give a specific example for this issue, on 22 January 2013, the roof of the historical building of Galatasaray University in Istanbul was burned due to the overheated electrical cables of the elevator (Şengöz, 2018).

Figure 3.1. A fire caused by electricity (Campbell, 2019)

Short circuits in electrical devices that are attached to the sockets all the time, overheating of the lamps, and fires in ventilation devices are considered electrical causes. Dust

accumulating in the installations of motorized devices and lack of maintenance is another reason (Kılıç, 2012).

Damage to the electrical insulation due to various reasons, overheating of the lines due to weak fuses, patching, lack of transmission in the lines due to loosening connections, the explosion of bulbs to an area with flammable materials, faulty grounding or not being done at all can be given as examples (Karakuş, 2010).

The occurrence of arcs ignites easily combustible objects, and the ignition of gases from overheated insulators by arcs can cause a fire to start. The aging of cables used in installations is also among the causes of electrical fires (Şengöz, 2018).

To reduce the electrically caused fires there are several precautions as,

• With the completion of the building project, no changes should be made on the electrical installation,
• Electrical installations should be reviewed regularly by experts,
• Devices, interrupt energy of systems when an arc fault occurs, which is developed to prevent fires caused by electricity can be used as protection, especially in industrial facilities,
• Another method for minimizing or eliminating the danger of electrical fires is an effective risk analysis study which contains the control process in electrical installations and determination of the hazards that lead to fires with checklists (Güleç, 2013).

3.2. Smoking

In NFIRS, smoking materials include cigarettes, cigars, pipes, and undetermined smoking material. While the contents are not specified, most presumably are lit tobacco products (Ahrens, 2019)

The fire of a burning cigarette creates a possible fire hazard has a temperature of 330-400 ˚C. It can burn for 15-20 minutes by itself. Although the ash around the fire decreases the possibility, it can cause a fire after a while when it encounters easily flammable materials

such as cotton, paper, sawdust. In fires caused by cigarette butts, carbonization on the floor, such as seats or on the floor and very close surroundings and blackening and soot stains on the mirrors and glass as a sign of burning for a long time (1-4 hours) are seen (Karakuş, 2010).

This chapter also includes the fires caused by the match which used for lighting the cigarette and thrown away by the smoker, but not cases where a match or cigarette uses to set an arson fire. Throwing cigarettes and matches into the garbage cans or out of the balcony without putting them out causes fires. When the causes of the fire were investigated in Turkey, it was seen that the most important factor was smoking. In this context, it is thought that the number of fires will decrease with the awareness of the public (Bekem, Çavuş, and Demirel, 2011).

3.3. Willfully/Intentionally Started by Man

Intentional fires are caused by the deliberate misuse of a heat source. Various definitions are made on what arson is. It can be defined as knowingly and willingly starting a fire to damage a structure. Some people cause loss of life and property by deliberately burning personal or government buildings and facilities for various purposes and gains.

It will be seen that there are countless reasons that drive people to arson as,

• Caused by behavioral disorders, in this group, there are people with abnormal behavior or mental illness. It is seen in the research that such people who participated in the arson incidents enjoyed the fire they started as a result of a psychological impulse.
• Due to special criminal cases, people who have committed other crimes besides arson should be recruited to this group. The main purpose for such people to start fires is theft, murder, suicide, breaking and entering, destroying records, and similar crimes they have committed to cover up. These crimes can be committed individually or within the scope of the activities of an organized group. Fires that are set for diversionary tactics are included in this category.
• For benefit, the common characteristic of all arsonists in this group is that they have done the arson to gain a benefit. This group also includes those who try to defraud

insurance companies by arson in return for wages or by setting their own property on fire. The common reason for arson made for profit is economic profit.

• Caused by revenge, conflict, grudge, and jealousy, the discussions of lovers and family discussions are the biggest contribution to this group. Personal revenge can be explained as retaliation for grievance, argument, personal affront, or any events perceived by the offender.

• Caused by vandalism (malicious damage), vandals start fires for fun there is no other reason. Many fires in vacant buildings are caused by vandals. They also start fires in abandoned cars, garbage cans, and elsewhere. Mischievous fire settings which intended to result in damage can be occurred due to willful and malicious mischief or peer group pressure. (Karakuş, 2010).

Table 3.1. Intentional structure fires in the USA by heat source, 2014–2018 annual averages (Campbell, 2021a)

Heat Source	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage
Lighter	16 420	150	520	$327 000 000
Match	11 520	60	90	$86 000 000
Unclassified heat source	5050	30	30	$47 000 000
Flame or torch used for lightning	3380	30	50	$80 000 000
Hot ember or ash	2500	-	20	$12 000 000
Unclassified hot or smoldering object	2290	10	10	$18 000 000
Incendiary device	1730	40	30	$50 000 000
Smoking materials	1460	-	20	$24 000 000
The heat from a direct flame or convection currents	1240	20	40	$19 000 000
Radiated or conducted heat from operating equipment	1170	10	20	$12 000 000

Table 3.1. (continues) Intentional structure fires in the USA by heat source, 2014–2018 annual averages (Campbell, 2021a)

Heat Source	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage
Multiple heat sources, including multiple ignitions	1140	30	30	$55 000 000
Unclassified heat from powered equipment	1130	-	20	$18 000 000
Other known heat sources	3230	20	70	$67 000 000
TOTAL	52 260	400	950	$815 000 000

Fires caused by one or more persons intentionally directly damage the life or property of a person or persons are considered sabotage. The United States of America ranks first in sabotage in the world. Approximately 500000 sabotage incidents have taken place in the years between 1992-2002 (Alkış, 2002). Heat sources of sabotage can be lighter, match, flame, torch, hot ember, ash, smoldering object, incendiary device, smoking materials, equipment, and others.

Figure 3.2. Damage to a property in Grovelands Road caused by a fire that was suspected to be arson on 15 December 2021 (The Guardian, 2021)

3.4. Self-Ignition (Spontaneous Combustion)

‘Self-heating’ is the occurrence of a rise in temperature in a material. In certain circumstances the temperature rise turns to combustion; this is a ‘self-ignition’ or ‘spontaneous ignition’. The materials concerned about self–ignition are hay, grains, oilseeds, vegetable, animal fibers, green waste piles, and compost.

Spontaneous combustion occurs when combustible material is heated to its ignition temperature. Generally, the accumulation of heat to ignition occurs when the material is closely together or in a pile preventing the heat being generated from escaping.

The possibility of self-combustion is greater if the surrounding air is dry and warm. Heating the material can start the oxidation reaction that leads to spontaneous combustion or can hasten ignition by adding more heat to the combustible material (South Australian Metropolitan Fire Service, 2021).

Table 3.2. Ignition temperatures of some building materials (Egan, 1978:4)

Material	Ignition Temperature (˚C)	Ignition Temperature (˚F)
Asphalt	485	905
Cotton Batting	232	450
Gasoline	260 to 454	500 to 850
Oil, cottonseed	343	650
Paper, newsprint (cuts)	232	450
Polystyrene	482 to 510	900 to 950
Polyvinyl chloride (rigid)	427 to 482	800 to 900
Wood (sawdust and shavings)	204 to 260	400 to 500
Wood (fir, oak, pine, etc.)	232 to 260	450 to 500

Ignition temperature is the minimum temperature for material that must be heated in air to start self-sustained combustion. Ignition temperatures in the above table are approximate.

Since ignition varies with moisture content, duration of exposure to heat, shape, and other factors. However, data from the table indicates that building materials can be easily ignited in fully developed fires where temperatures are higher than 538˚C (Egan, 1978:4).

3.5. Chimney Fire

Fireplaces and wood stoves usually contain wood-fuel fires for the purpose of providing heat. Chimneys expel the by-products of the combustion that include smoke, assorted minerals, unburned wood particles, gases, hydrocarbon, etc. As these substances leave the wood stove or fireplace and flow up into the chimney that is relatively cooler, condensation occurs. The residue that sticks to the walls of the chimney is called creosote which is a brown or black residue. All forms of creosote are highly combustible.

A common cause of chimney fires is the ignition of creosote. If it builds up in sufficient quantities, and the temperature is high enough for combustion, the result could be a chimney fire. For chimney-based fires, soot accumulated in the kitchen aspirator and chimneys ignites and creates a potential fire hazard, chimney fires can easily turn into roof fires and roof fires into building fires. (Bekem, Çavuş, and Demirel, 2011).

The ignition of the debris, greasy wastes, and industrial wastes in the chimneys brings about the fire event. Chimney fires can be caused by,

• Unseasoned wood or restricted air supply encourages the accumulation of creosote,
• The chimneys are not built properly,
• Common chimneys are preferred to save space,
• Not built over external walls,
• The chimney can be too inclined,
• Cracks can be in the chimney,
• The formation of hard corners that will cause internal gas output,
• Chimney cleaning and control are not done,
• Burning chimneys for cleaning purposes (Bekem Kara, 2017).

3.6. Hot Work

Careless welding is another cause leading to fire mostly during construction and renovation. For mechanical and electrical installations in buildings and certain steel or metal framework constructions for structures and window installation, these works contain lots of welding work. The careless attitude of the workers during welding work will leave lots of lighted or high temperatures on the construction site. If not cleaned or removed properly, this soot can be a fire source (Hoi Hung, 2006).

Special procedures are required when hot work is to be performed in a confined space. Sparks from welding work can cause a fire. Environmental safety should be taken beforehand while welding. Most hot work incidents happen because of the ignition of combustible materials near the activity. For example, all lint and dust on the welding equipment interior or surface should be regularly and properly removed.

Renovation projects such as the removal of old escalators in the lobby to create an atrium, intense welding will be needed same as in the upgrade project on installation of a new air handling unit. The sparks can be lighted the dust and lint accumulated inside the equipment. These are examples of poor welding techniques, inefficient maintenance and cleaning processes implemented on the welding equipment (Hoi Hung, 2006).

Figure 3.3. Sparkles from welding machines (Oyewole, Parasram, Shroff, and Banks, 2017)

Common sources of ignition during hot work contain open flames, friction, electrical, hot surfaces and bearings, welding or heated gases. To prevent fires caused by hot work, there are some precautions like,

• Avoid hot work and consider alternative methods,
• Before hot work actions, perform a hazard assessment that identifies the scope of the work, potential dangers, and methods of hazard control,
• Conduct gas monitoring in the work area using a combustible gas detector,
• In work areas where flammable gases and liquids are stored, drain all equipment and piping before welding is conducted. When welding on or in the vicinity of storage tanks and containers, control all surrounding tanks or near spaces for the presence of flammables,
• A trained fire watch must remain at the work site for a minimum of 30 minutes after hot work has stopped for monitoring the site (Oyewole, Parasram, Shroff, and Banks, 2017).

3.7. Fireplace

Fires involving fireplaces follow a clear seasonal pattern and are common during the cold weather months. Failure to clean equipment is the leading factor contributing to fires involving heating equipment. Clearances around fireplaces must remain unobstructed (Campbell, 2021). Because fires in which a heat source is close to combustible materials are more likely to spread beyond the origin place of fire.

To prevent fires caused by fireplaces, there are some precautions like,

• Anything that is capable of burning should be kept at least three feet away from the heating source, whether it can be a furnace, wood stove, fireplace, or space heater,
• Keep a metal or glass screen in front of the fireplace to stop embers from flying into the room,
• Ashes must be cool before putting them in a metal container.

Figure 3.4. Fireplace with a sturdy screen (Campbell, 2021)

3.8. Lightning

Lightning strikes can cause fires because they serve as an ignition source by directly striking an object. It can occur in various ways, for example, lightning strikes can cause fires far from the place where it strikes by traveling in electric cables.

A lightning rod or lightning conductor protects structures from lightning fires, which is a tool aiming to transfer the electrical charge in the air to the ground. Lightning is the primary factor in wildland fires. Peak seasons for lightning fires vary by region, like weather patterns in general (Rosenberg, 1999).

Figure 3.5. Two houses in flames after being hit by lightning in Andover, Hampshire on 24 July 2021 (The Telegraph, 2021)

3.9. Children Carelessness

This chapter can be explained as unintentionally set by people (under legal age) making fire for playing games or entertainment. The difference between deliberate and this chapter is that the fire is initially voluntarily set, however, not in order to damage.

Children start to play with fire for various reasons, ranging from natural curiosity, boredom, or peer pressure. Children under five are mostly curious about flames. Often the behavior of fire setting begins as a natural exploration of the unknown. If child firesetters are not given guidance by their parents and teachers, they repeat their dangerous behavior.

Children are one of the highest risk groups for initiating dwelling fires. For instance, at home, children may play with fire using lighters, matches, or other ignitable. There are fire safety precautions that adults can follow to decrease the risk of fires caused by playing with fire. These include:

• Store lighters and matches out of the reach of children,
• Never use matches and lighters as a source of amusement for children because they may imitate such behavior
• Never leave children alone in the house where there is a burning candle or cooker on, even for short periods of time (Campbell, 2021b).

Figure 3.6. Children play with fire (London Fire Brigade, 2022)

3.10. Other Known Causes

The title of ‘Other Known Causes’ covers the causes of fires which are known and determined by fire departments but cannot be included in the other classification titles.

3.11. Unknown Causes

The fire field is one of the most difficult areas for research and investigation. Because of the destruction of the fire itself, the evidence is mostly corrupted or destroyed at the fire site during its extinguishment and control by the firefighters. There are difficulties in determining the cause of the fire because of the control and safety of the scene, the interest shown by the public and the press, and the fire may cover large areas. Considering these negative factors, it should not be surprising that firefighters are not successful in fire investigation and determining the cause of the fire (Karakuş, 2010).

This title can be summarized shortly as the cause of the fire has not been determined exactly, but there are no factors that will cause the fire to break out spontaneously. Unknown causes of fires result in unreliable statistics (Rosenberg,1999). Unknown causes are of the highest concern for the quality of data. The number of unknown causes is often larger than some of the important categories. When the numbers of unknown entries are large, the accuracy of the data is skeptical. (U.S. Fire Administration, 2017:22).

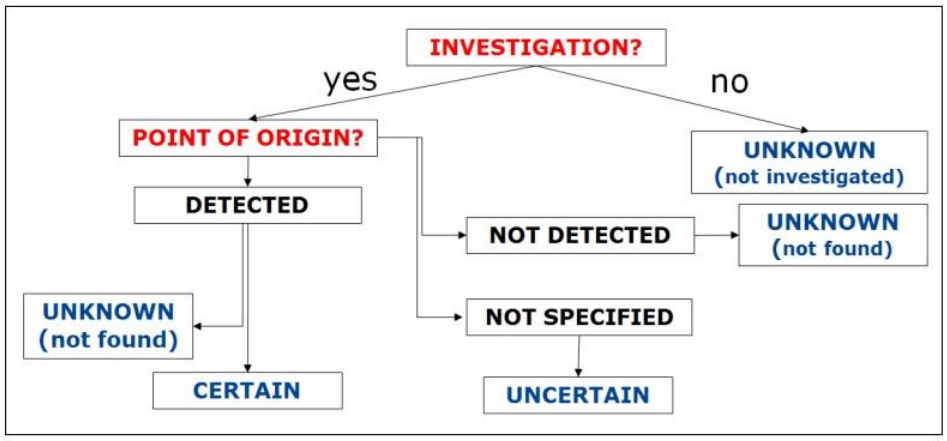


Figure 3.7. Key to the level of certainty of fire causes identification (Camia, Durrant, and San-Miguel-Ayanz, 2013:8)

According to the figure above which illustrates an example key to assess the level of certainty in the identification of the causes of fires to be reported in the fire database. If the ignition point is not detected, the cause of the fire is to be reported as unknown. If the ignition point couldn’t be specified remaining vaguely identified while different elements from the investigation support some assumptions about the cause, then the fire should be reported as uncertain.

4. FIRE STATISTICS IN BUILDINGS

In previous chapters, the causes of fire have been studied to introduce fire statistics. Statistics of fires occurring in a country play an important role in regulations on the future of fire services. Knowing the number of fires and why; guides in the design of fire precautions, in the deployment of fire stations, in determining the teams and their equipment. Therefore, fire statistics are given importance and one of the most important units of the fire brigades of developed countries is the statistical evaluation unit.

The fire problem varies from continent to continent and country to country because of variations in climate, education, demographics, socioeconomic status, and other factors. The aim of this chapter is to put forward a comparison of the scope of fire statistics in Turkey with the example of Istanbul with the fire statistics of the United States of America (New York City) and England (London). In this section, statistics are prepared for countries, cities, and buildings that are existed in cities. Line charts are used for tracking smaller changes over long periods of time. On the other hand, column charts are created for determining massive changes over long or short periods of time. Bar charts are prepared for comparing things between different types. Pie and donut charts are created to present the whole of a matter. The area chart is used for making comparisons of more than two different categories. Lastly, tables are prepared for providing detailed information.

For both countries and cities, the following charts are prepared. The number of fires is introduced with a column chart to show annual distribution. The number of fires in relation to the number of inhabitants is shown in a table due to demonstrate the population number. Total fires per 1000 inhabitants are introduced with a line chart to make a visual comparison. The number of fatalities and injuries is introduced with a line chart to produce another related chart for revealing another perspective to the same issue. Fatality and injury numbers per 1000 fires are introduced with a line chart to support the previous chart from a different point of view. Fires by property categories are introduced with a table to provide detailed data for calculating averages. Distribution of the 5-year averages of fires by property categories is introduced with a pie chart for creating a visual comparison. Lastly, chimney fires are analyzed with a bar chart for annual distribution.

For cities, the following charts are prepared to present building fires. Distribution of buildings fires as dwellings and other buildings is introduced with a 3-B column chart. Distribution of other building fires by property type is introduced with a table to provide detailed information about every type. The 5-year averages of fires that happened in other buildings by property type are introduced with a donut chart for making an understandable summary of the previous chart.

Specifically for Istanbul, the distribution of total fires by causes of fires is introduced with a table for sharing detailed information on the national fire problem. The 5-year averages of causes of all fires are introduced with a pie chart to demonstrate the importance of causes. For specifically London, distribution of fires by motive is introduced with an area chart for being an example for national publications on fire statistics. Other building fires by causes of fires is introduced with table to produce another chart for making a comparison. Lastly, the distribution of 5-year averages of causes of other building fires is analyzed with a pie chart for demonstrating an example in which details statistics should have.

Statistics is a method that deals with the collection, organization, and interpretation of numerical facts. In other words, it is a science that includes the principles of collecting data for a specific purpose, summarizing the data with tables and graphs, interpreting the results, explaining the degree of confidence in the results, generalizing the results obtained, researching the relations between the samples, and helping all branches of science. Moreover, it represents numerical facts that are systematically collected (Bakırcı, Karatop, and Bayındır, 2019).

4.1. International Fire Statistics

There is a variation from country to country in how statistics are obtained and recorded. Due to the lack of consistency, deficiencies occur in the evaluation of statistics. However, reliable current fire statistics and annual reports are published by CTIF (Comité Technique International de prevention et d'extinction de Feu) worldwide. CTIF is also known as International Association of Fire and Rescue Services. CTIF was founded in 1900 in Paris for promoting and encouraging cooperation among firefighters and other

experts in fire and rescue services throughout the world. CTIF creates world fire statistics by publishing annual reports from 80 different countries and 90 capital cities.

The main products of CTIF are reports, fire statistics, results of surveys, etc. The publication of CTIF is named “World Fire Statistics”. All statistical data about fire incidents presented in the CTIF reports were obtained from responses to the requests of the Fire Statistics Center. However, some of the data are received from published official statistical reports of various countries (CTIF - International Association of Fire and Rescue Services, 2022). Furthermore, the publication proposes standard reporting forms to enable direct comparison of all statistical bulletins.

Table 4.1. Questionnaire table from the annual report of CTIF (Brushlinsky, Ahrens, Sokolov, and Wagner, 2021)

Statistical data	Name of country	Name of capital city
Year		
Population		
Area (square kilometer)		
Total number of calls a year:		
-fires		
-rescue, technical aid		
-medical aid		
-false calls		
-other calls		
Total number of fires:		
structure - residential with chimneys		
structure - all other buildings		
-vehicles		
-forests		
-grass, bushes…		

Table 4.1. (continues) Questionnaire table from the annual report of CTIF (Brushlinsky, Ahrens, Sokolov, and Wagner, 2021)

-rubbish		
-other fires		
Number of fire deaths:		
structure - residential with chimneys		
structure - all other buildings		
-vehicle		
-other		
Number of fire injuries:		
structure - residential with chimneys		
structure - all other buildings		
-vehicle		
-other		
Number of firefighter deaths		
Number of firefighter injuries		
Number of all firefighters:		
-professionals (full time)		
-part time		
-volunteers		
Number of female firefighters:		
-professionals (full time)		
-part time		
-volunteers		
Number of young (junior) firefighters:		
Number of fire stations		
Number of engines (pumps)		

Table 4.1. (continues) Questionnaire table from the annual report of CTIF (Brushlinsky, Ahrens, Sokolov, and Wagner, 2021)

Number of ladders and hydraulic lifts		
Number of other fire automobile		

Since every country uses its national schemes, harmonization and also detailed cross-country comparisons are difficult. The above table is created for this purpose by CTIF. The need for a new scheme, harmonized across countries, to be compared in the publication of World Fire Statistics, has been identified to improve the information level and the common knowledge on the fires in the World. World Fire Statistics report includes statistics on fire incident numbers and rates, deaths and injuries caused by fires, and firefighter deaths and injuries. The report also includes statistics on numbers of non-fire incidents, by type of incident, and values and rates of firefighters, stations, and fire service apparatus.

Common indicators of fire statistics in the countries of the World in 2019

№	Country	Population, thous.inh.	Number of				Average number:					
			calls	fires	fire deaths	fire injuries	per 1000 inh.:		fire deaths per:		fire injuries per:	
							calls	fires	100000 inh.	100 fires	100000 inh.	100 fires
1	USA	328 240	37 272 000	1 291 500	3 704	16 600	113,6	3,9	1,1	0,3	5,1	1,3
2	Russia	146 781	1 161 581	471 426	8 559	9 461	7,9	3,2	5,8	1,8	6,4	2,0
3	Japan	126 167	8 786 855	37 683	1 486	5 865	69,6	0,3	1,2	3,9	4,6	15,6
4	Egypt	100 075	-	50 662	252	1 203	-	0,5	0,3	0,5	1,2	2,4
5	Vietnam	95 990	-	3 790	85	126	-	0,0	0,1	2,2	0,1	3,3
6	France	66 628	4 819 900	316 100	261	1 289	72,3	4,7	0,4	0,1	1,9	0,4
7	Great Britain	64 903	705 924	222 511	317	8 750	10,9	3,4	0,5	0,1	13,5	3,9
8	Republic of Korea	51 629	-	40 030	284	2 219	-	0,8	0,6	0,7	4,3	5,5
9	Myanmar	51 466	-	2 155	79	226	-	0,0	0,2	3,7	0,4	10,5
10	Ukraine	42 029	269 160	96 812	1 909	1 523	6,4	2,3	4,5	2,0	3,6	1,6
11	Poland	38 411	512 514	153 520	508	3 782	13,3	4,0	1,3	0,3	9,8	2,5
12	Kazachstan	18 611	63 727	13 850	323	978	3,4	0,7	1,7	2,3	5,3	7,1
13	Netherlands	17 282	143 500	38 900	22	-	8,3	2,3	0,1	0,1	-	-
14	Greece	10 788	72 545	27 784	21	36	6,7	2,6	0,2	0,1	0,3	0,1
15	Jordan	10 659	769 780	36 650	52	10 902	72,2	3,4	0,5	0,1	102,3	29,7
16	Czech Republic	10 650	2 298 681	18 813	128	1 388	215,8	1,8	1,2	0,7	13,0	7,4
17	Sweden	10 328	128 044	26 445	78	882	7,7	2,0	1,1	0,3	8,5	3,3
18	Hungary	9 772	79 922	20 913	113	758	8,2	2,1	1,2	0,5	7,8	3,6
19	Belarus	9 408	81 590	6 100	489	444	8,7	0,6	5,2	8,0	4,7	7,3
20	Austria	8 859	278 672	43 370	-	-	31,5	4,9	-	-	-	-
21	Switzerland	8 500	70 939	12 935	-	-	8,3	1,5	-	-	-	-
22	Bulgaria	7 050	68 610	42 141	134	293	-	6,0	1,9	0,3	4,2	0,7
23	Singapore	5 612	194 330	2 862	1	142	34,6	0,5	0,0	0,0	2,5	5,0
24	Slovakia	5 458	123 484	9 602	45	343	22,6	1,8	0,8	0,5	6,3	3,6
25	Ireland	4 920	120 024	20 756	16	-	24,4	4,2	0,3	0,1	-	-
26	New Zealand	4 748	83 359	23 258	33	-	17,6	4,9	0,7	0,1	-	-
27	Croatia	4 058	31 393	14 980	30	166	7,7	3,7	0,7	0,2	4,1	1,1
28	Mongolia	3 296	1 357 294	4 209	54	68	411,8	1,3	1,6	1,3	2,1	1,6
29	Lithuania	2 794	30 666	11 509	70	164	11,0	4,1	2,5	0,6	5,9	1,4
30	Slovenia	2 095	153 758	4 427	13	209	73,4	2,1	0,6	0,3	10,0	4,7
31	Latvia	1 920	20 749	10 095	76	279	-	5,3	4,0	0,8	14,5	2,8
32	Estonia	1 329	26 076	4 675	43	113	19,6	3,5	3,2	0,9	8,5	2,4
33	Brunei	430	-	2 053	1	8	-	4,8	0,2	0,0	1,9	0,4
34	Liechtenstein	39	-	49	1	-	-	1,3	2,6	2,0	-	-
Total		**1 270 925**	**59 725 077**	**3 082 565**	**19 187**	**68 217**	**47,0**	**2,4**	**1,5**	**0,6**	**5,4**	**2,2**

Figure 4.1. An example of a table from the annual report of CTIF about common indicators of fire statistics (Brushlinsky, Ahrens, Sokolov, and Wagner, 2021)

Figure 4.1 is an example of a table from the CTIF report. The table shows that in 34 countries, representing nearly 1,3 billion inhabitants which make 17% of the World's population, approximately 60 million calls (47 calls per 1000 inhabitants), 3 million fires that makes 5% of all emergency calls, 2,4 fires per 1000 inhabitants, 19,1 thousand civilian deaths caused by fire, and 68,2 thousand civilian fire injuries.

4.1.1. Fire statistics in the United States of America

The NFPA (National Fire Protection Association) has surveyed the public fire department to measure the annual fire experience of the United States since 1977. This survey of US fire departments allowed the NFPA to produce estimates of the national fire problem, as measured by the number of fires attended by local fire departments and the deaths, injuries, and property losses.

The National Fire Data Center (NFDC) of the U.S. Fire Administration (USFA) periodically publishes "Fire in the United States," which is the statistical outcome of the fires in the U.S. With the NFIRS (National Fire Incident Reporting System). In the reporting forms of fire data for the USA; data is kept with information such as injured or dead civilians and firefighters in the fire, where the fire started, how the fire started, identifying the building, the person's mood, the reasons that may cause the injury, which department went to the fire area, the moment of notification of the fire, the moment of arrival. In case of incompleteness, the reports are corrected again or cancelled (U.S. Fire Administration, 2017:1, 9).

NFIRS is a voluntary reporting standard that fire departments in every state use to uniformly report on the full range of their activities, from fire to emergency medical services to natural disasters and severe weather. NFIRS data is used for many purposes by many organizations. Fire departments participate in the National Fire Incident Reporting System (NFIRS) and send information from departments to the U.S. Fire Administration. The U.S. Consumer Product Safety Commission uses NFIRS data to identify materials and products that can cause fires. They also enhance safety tips to include in their publications. The National Highway Traffic Safety Administration uses NFIRS data to identify fire risks in vehicles. NFPA uses NFIRS information in many of its analyses (U.S. Fire Administration, 2017a:9).

Benefits of NFIRS cover both fire departments and United States of America. First of all, fire departments can use NFIRS to document the full range of department activity, track apparatus, casualty information, and justify budgets with statistical data and summary. Furthermore, departments can use the data to focus on measuring program performance and predicting future issues. USFA uses the data to analyze the nation's fire problem, identify the focus for research efforts, and lastly, make recommendations for national codes and standards (U.S. Fire Administration, 2021:5).

U.S. Fire Administration annual statistical reports explore aspects of the U.S. fire problem. Basically, based on data collected through USFA's NFIRS, reports briefly address the specific fire or fire-related problem, highlight crucial findings, and suggest other resources to consider for further information.

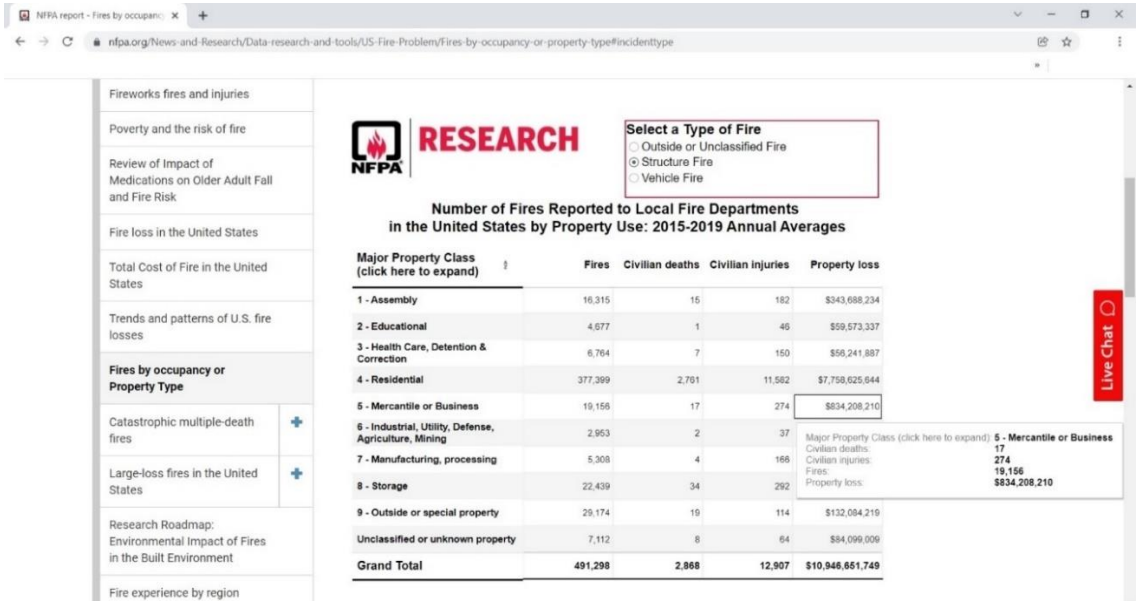


Figure 4.2. National Fire Protection Association's official web page (National Fire Protection Association, 2022)

The above tool (figure 4.2) is presented by NFPA to introduce the number of fires reported to local fire departments in the United States by property use between the years 2015 and 2019 with annual averages. It is possible to use this tool to find the estimated average number of fires, civilian deaths and injuries, and direct property damage resulting from fire incidents per year for reported fire incidents to local U.S. fire departments during the five-year period of 2015-2019.

After selecting the incident type in the red box; for accessing more detail, the user must click "Major property class" and then click the “+” that appears immediately below. Three types of incidents are presented with this tool, and these are structure fires, vehicle fires, and outside or unclassified fire.

Structure fires can be defined as any fire that occurred in a building or other structure. Even if the structure was not damaged. Vehicles include highway-type vehicles which are cars, recreational vehicles, trucks, buses, and motorcycles. Also, aircraft, rail vehicles, boats, or water vehicles are considered as vehicles as well as industrial, agricultural, home, garden, and construction vehicles. Outside and other fires category include fires that are not structure or vehicle fire. This category includes outside grass, crop or other vegetation fires, brush, forest, trash fires, and unclassified fires.

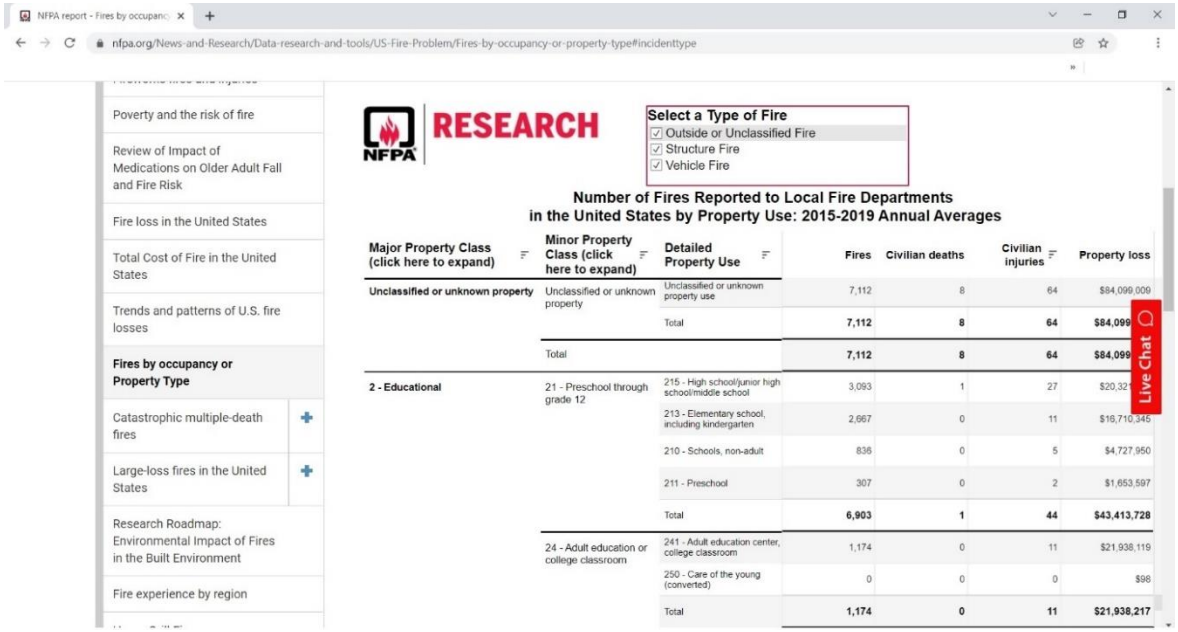


Figure 4.3. NFPA’s dynamic tool for fire incident data (National Fire Protection Association, 2022)

Figure 4.3 is an example of the usage of the NFPA tool. In the example, all types of fires are selected. Furthermore, to provide more information about incidents, minor property class, and detailed property use are also added to the tool.

For structure fires, there are 10 headlines such as assembly, educational, health care, residential, business, industrial, manufacturing, storage, special property, and unclassified

or unknown property. For every headline, there are many subheadings. For instance, educational headline contains daycare, preschool, adult education, and unclassified or unknown type public educational property. Additionally, every type of minor property class has information about detailed property use.

The data for statistics are received from National Fire Protection Association's publication of 'Fire Loss in the United States: Trend Tables' which is published in September 2021 (NFPA Applied Research, 2021:2-23). Fires that were reported to state or federal firefighting organizations, handled by industrial fire brigades, or not reported are not captured in the publication.

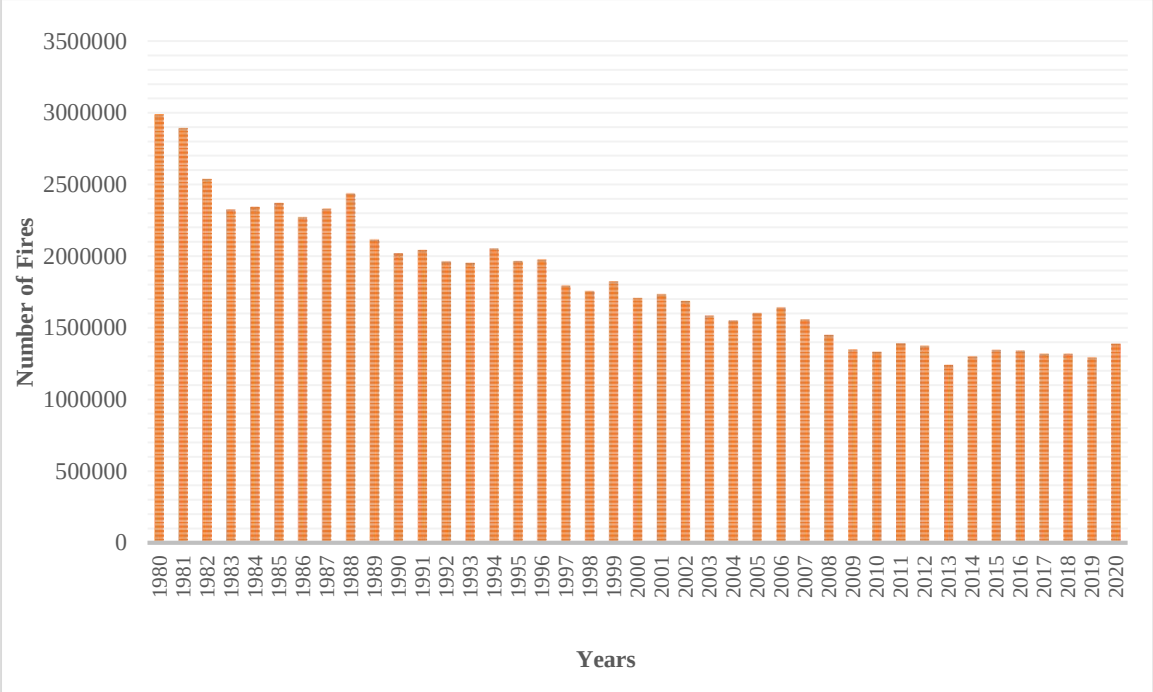


Figure 4.4. Annual distribution of the number of fires in the United States (1980-2020)

The total number of fires in the United States from 1980 to 2020 is 74465500. The distribution of these fires by calendar year is shown in the Figure. When the figure is examined; it is seen that most fires occurred in 1980 with 2988000 and the least fires occurred in 2013 with 1240000 in the years between 1980 and 2020.

Although the number of total fires is increased greatly in the year 1988 and slightly in 1985, 1994, 1999, 2006, and 2011, there is an overall decline in the number of fires that

occurred from 1980 to 2020. In this context, it is thought that the number of fires decreases depending on advanced research and codes applied.

Table 4.2. The number of fires in relation to the number of inhabitants in United States of America (1980-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2020	1 388 500	332 639 102	4,17
2019	1 291 500	328 239 523	3,93
2018	1 318 500	326 687 501	4,03
2017	1 319 500	324 985 539	4,06
2016	1 342 000	322 941 311	4,15
2015	1 345 500	320 635 163	4,19
2014	1 298 000	318 301 008	4,07
2013	1 240 000	315 993 715	3,92
2012	1 375 000	313 830 990	4,38
2011	1 389 500	311 556 874	4,45
2010	1 331 500	309 321 666	4,30
2009	1 348 500	306 771 529	4,39
2008	1 451 500	304 093 966	4,77
2007	1 557 500	301 231 207	5,17
2006	1 642 500	298 379 912	5,50
2005	1 602 000	295 516 599	5,42
2004	1 550 500	292 805 298	5,29
2003	1 584 500	290 107 933	5,46
2002	1 687 500	287 625 193	5,86
2001	1 734 500	284 968 955	6,08
2000	1 708 000	282 162 411	6,05

Table 4.2. (continues) The number of fires in relation to the number of inhabitants in United States of America (1980-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
1999	1 823 000	279 040 168	6,53
1998	1 755 500	275 854 104	6,36
1997	1 795 000	272 646 925	6,58
1996	1 975 000	269 394 284	7,33
1995	1 965 500	266 278 393	7,38
1994	2 054 500	263 125 821	7,80
1993	1 952 500	259 918 588	7,51
1992	1 964 500	256 514 224	7,65
1991	2 041 500	252 980 941	8,06
1990	2 019 000	249 622 814	8,08
1989	2 115 000	246 819 230	8,56
1988	2 436 500	244 498 982	9,96
1987	2 330 000	242 288 918	9,61
1986	2 271 500	240 132 887	9,45
1985	2 371 000	237 923 795	9,96
1984	2 343 000	235 824 902	9,93
1983	2 326 500	233 791 994	9,95
1982	2 538 000	231 664 458	10,95
1981	2 893 500	229 465 714	12,60
1980	2 988 000	227 224 681	13,14

For the above table, population numbers are received from United States Census Bureau (United States Census Bureau, 2020). United States population data are based on official estimates and projections. All population projections and estimates are for the resident population.

The United States population for the year 2020 shown in the International Database may not match the official population components for the U.S. due to differences in how they are displayed (calendar year versus midyear-to-midyear estimates). Therefore, the United States population estimates may not match due to differences in the timing of their release.

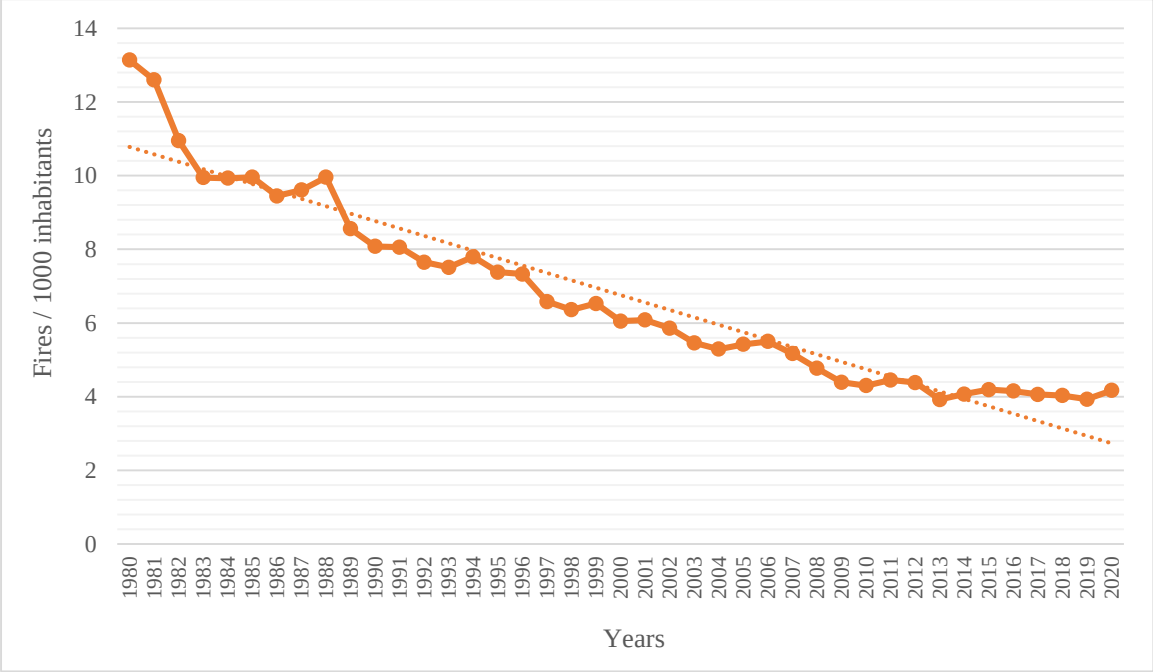


Figure 4.5. Annual distribution of fires in United States of America per 1000 inhabitants (1980-2020)

When the populations of each year are compared with the total number of fires, it is seen that the number of fires per 1000 inhabitants decreased significantly during the period 1980-2020, and then the trend of decreasing levelled out. Although, between the years 1980 and 2020, United States of America has the least population in 1980, the same year with a population of nearly 227 million accounts for the ratio of 13,14 fires per 1000 inhabitants.

The year 2020 with a population of nearly 333 million accounts for the ratio of 4,17. In 2013, since the number of total fires accounted for the lowest at all, the ratio is also lowest with 3,92. In addition, it is seen on the table that although the population increases every year in the United States, the total number of fires decreases.

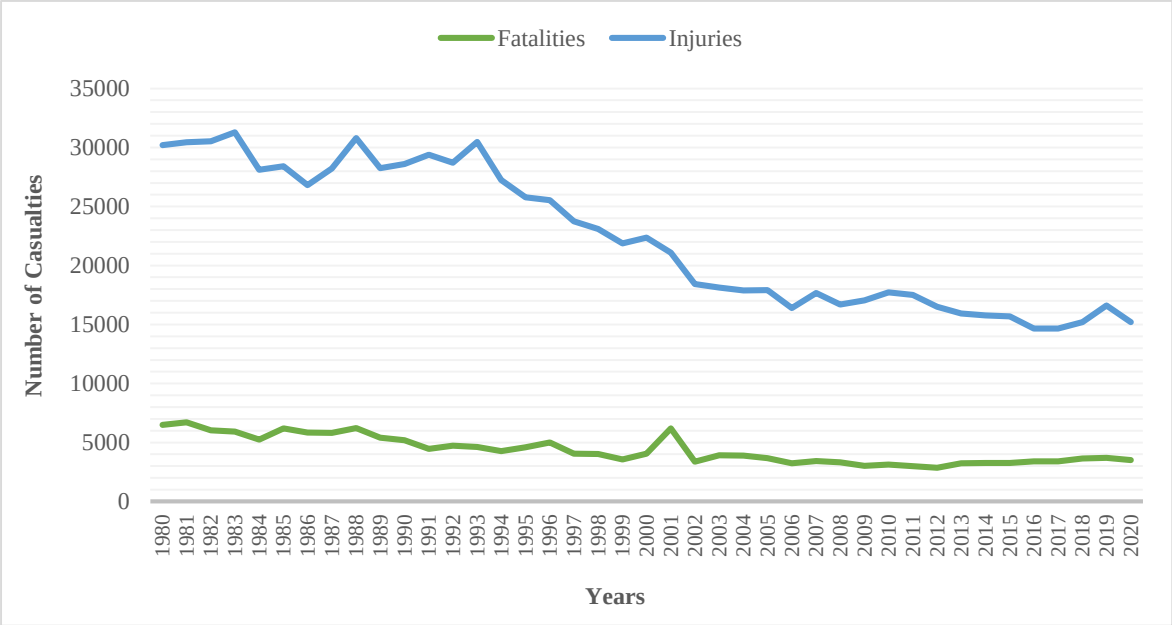


Figure 4.6. Annual distribution of numbers of fatalities and injuries caused by fires in United States of America (1980-2020)

The total number of fatalities caused by fires between the years 1980 and 2020 is 178925. The 41-year average is determined as 4364. On the other hand, between 2016 and 2020, the 5-year average is 3528. When the figure is examined, it is seen that most fatalities occurred in 1981 with 6700 and the least fatalities occurred in 2012 with 2855. Although fatality numbers are increased in the years 1981, 1985, 1988, 1992, 1996, 2001, 2007, and 2016, there is an overall decline in fatalities.

Between the years 1980 and 2020, 916610 injuries happened due to fires that occurred in United States of America. The 41-year average is determined as 22356. On the other hand, between 2016 and 2020, the 5- year average is 15264. Since there is a decline in averages, it is a possible indication of a decline in the number of non-fatal casualties.

When the figure is examined, it is seen that most injuries happened in the year 1983 with 31275 and the least injuries happened in 2016 with 14650. Although injuries that are caused by fires are increased in 1983, 1988, 1993, 2000, 2010, and 2019, it is thought that this decline in both injuries and fatalities was caused by decreasing numbers in total fires, developed fire codes, and research on fire issues.

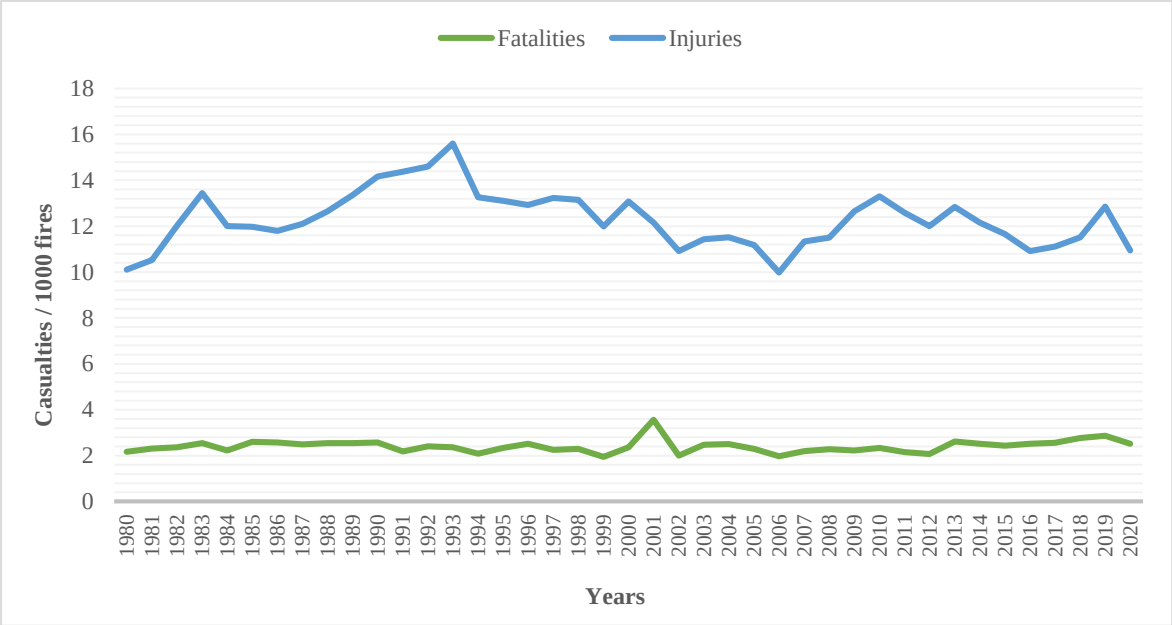


Figure 4.7. Annual distribution of fatalities and injuries occurred in United States of America per 1000 fires (1980-2020)

As seen in the previous figure, it is possible to say that there is a decline in the number of deaths and injuries. However, this figure provides another perspective to the same issue. The number of fatalities per 1000 fires between the years 1980 and 2020 has an increasing pattern.

When the figure is examined, it is seen that most fatalities occurred in 2001 with 3,57 per 1000 fires and the least fatalities occurred in 1999 with 1,95. Since, on 11 September 2001, The World Trade Center fire occurred with the number of 2666 fire-related fatalities, it is very predictable that most fatalities per 1000 fires happened in 2001 (National Fire Protection Association, 2021). Although fatality numbers per 1000 fires are decreased in the years 1984, 1991, 1994, 1999, 2002, 2006, and 2012, there is a slight increase in fatalities in contrast to the previous figure.

When the figure is examined, it is seen that most injuries per 1000 fires happened in the year 1993 with 15,6 and the least injuries per 1000 fires happened in 2006 with 9,98. Although injuries that are caused by fires are decreased in 1986, 1996, 1999, 2002, 2006, and 2016, there is a slight increase in the number of injuries per 1000 fires, as opposed to the decrease in the number of injuries in the previous figure.

Table 4.3. Annual distribution of fires in United States of America by property categories (2016-2020)

Year	Total fires	Building fires	Vehicle Fires	Outdoor Fires
2020	1 388 500	490 500	209 500	688 500
2019	1 291 500	481 500	223 000	587 000
2018	1 318 500	499 000	212 500	607 000
2017	1 319 500	499 000	197 500	623 000
2016	1 342 000	475 500	204 000	662 500

In the publication of USFA, fires are categorized as structure fires, vehicle fires, and outdoor fires. In general, any fire that occurs in a structure is considered a building fire, even if no damage was done to the structure itself. Structure fires are divided into two categories as home structure fires and non-home structure fires. Home structure fires have subheadings like apartment or multi-family housing structures and one- and two-family home structures.

Vehicle fires cover highway vehicles and other vehicles. Highway vehicles include cars, motorcycles, trucks, recreational vehicles in transit, buses, and other vehicles intended for roadway use. The term highway is used for describing the type of vehicle, not the location of the fire. Other vehicles are trains, boats, farm vehicles, construction vehicles, ships, and aircraft. Outdoor fires include brush, grass, rubbish including dumpsters, outside storage, crops, timber, all other fires, and wildland.

The table explains building fires in terms of property categories annually between the years 2016-2020. Although in 2020 total fires are at the highest number with 1388500, the 5-year average is determined as 1332000. On the other hand, the least number of fires occurred in the U.S. in 2019 with 1291500. The number of fires is below the 5-year average in the years 2017, 2018, and 2019 with respectively 1319500, 1318500, and 1291500.

The headline of buildings includes home structure and non-home structure fires. The 5-year average of this headline is determined as 489100. Between 2016 and 2020, the

number of building fires reaches the highest point with 499000 in 2017 and 2018. The 5-year average of building fires is above the number of fires that occurred in the years 2016 and 2019.

The vehicle property category constitutes the smallest percentile among total fires in United States of America between the years 2016 and 2020. In 2019, the number of fires is at the highest level with 223000. Its 5-year average is determined as 209300. Fires that occurred in 2016 and 2027 are below average with respectively 204000 and 197500.

Between 2016 and 2020, the number of outdoor fires reaches the highest point in 2020 with 688500 and the least outdoor fires occurred in the year 2019. Since the 5-year average of this headline is 633600, in 2017, 2018, and 2019 the number of fires is below average with respectively 623000, 607000, and 587000.

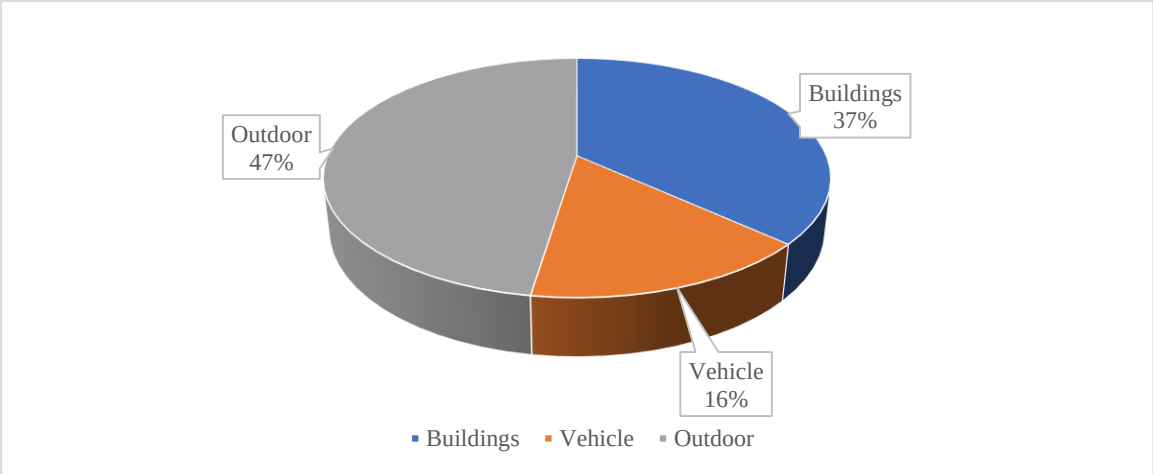


Figure 4.8. Distribution of the 5-year average of fires that occurred in United States of America by property categories (2016-2020)

To focus on building fires, property categories among total fires are reviewed. From 2016 to 2020, every year, outdoor fires make up the vast majority of total fires with a 5-year average of 633600. Secondly, building fires are following outdoor fires in total fires which has a 5-year average of 1332000. For building fires, the average of five years is determined as 489100. Lastly, vehicle fires have the least percentile among other categories with a five-year average of 209300. Consequently, buildings and outdoors are places where most of the fires occurred in United States of America.

4.1.2. Fire statistics in New York City

The Fire Department of the New York City (FDNY) is the largest fire department in the United States of America and its inception is in 1865. The FDNY's main objective is to provide fire protection, emergency medical care, and other critical public safety services to visitors and residents in the five boroughs. The Fire Department also works to educate the public about fire, disaster preparedness, life safety along with enforcing public safety codes.

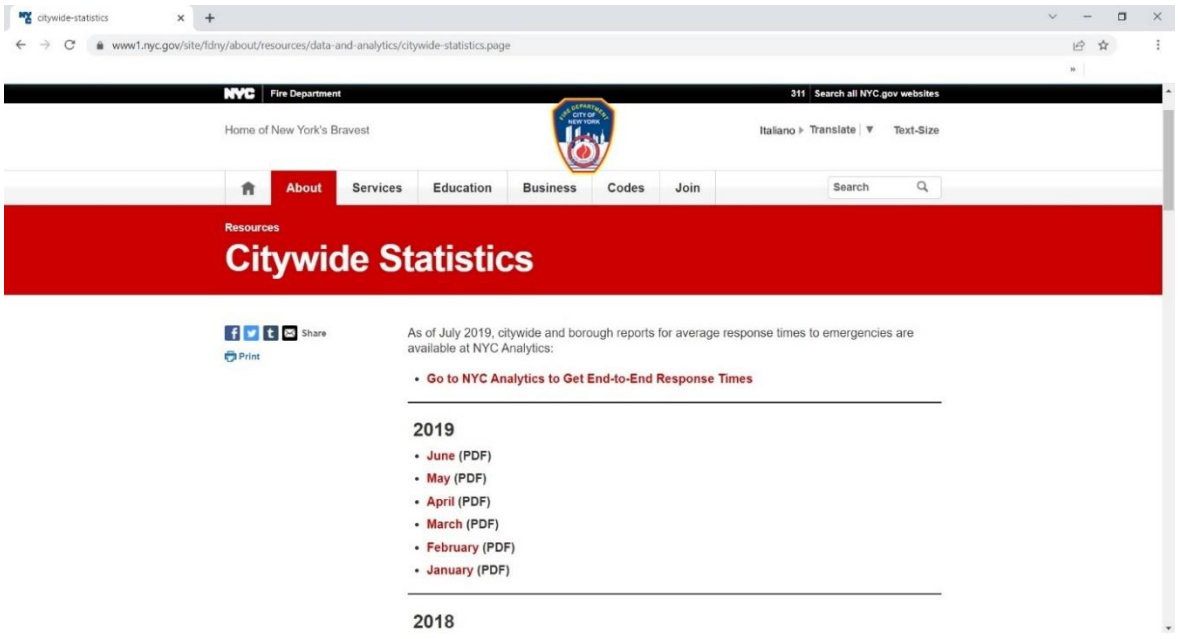


Figure 4.9. New York City Fire Department's official web page (New York City Fire Department, 2022)

On the web page of New York City Fire Department, it is possible to access citywide fire data. However, citywide statistics were published monthly from January 2013 to June 2019. Differing from other countries, New York City like United States of America publishes fire data after a very long time. On the date February 14, 2022, the author can only access the data until June 2019. Although the statistics are published lately with the public, it also should cover all past year's statistical data too. But the data user can only access fire numbers from January 2013.

№	City	Population, thous. inh.	Number of fires					Average:	
			2015	2016	2017	2018	2019	per year	per 1000 inh.
1	Delhi	18 000	27 089	30 285	29 423	31 264	-	29 515	1,6
2	Tokyo	13 921	4 433	3 982	4 205	3 973	4 120	4 143	0,3
3	Moscow	12 600	6 034	5 516	5 101	4 874	9 687	6 242	0,5
4	Lima	9 900	4 937	5 499	5 153	5 914	-	5 376	0,5
5	Seoul	9 674	-	-	-	6 368	5 881	6 125	0,6
6	Cairo	9 294	-	-	-	-	7 114	7 114	0,8
7	Ho Chi Minh	8 993	539	1 960	-	342	342	796	0,1
8	London	8 961	20 923	20 388	19 863	19 675	17 993	19 768	2,2
9	New York City	8 550	45 476	41 225	42 423	40 783	-	42 477	5,0
10	Hanoi	8 053	149	831	-	563	864	602	0,1
11	Tehran	8 000	-	-	27 209	-	-	27 209	3,4
12	Hong Kong	7 440	34 320	38 112	33 934	33 463	34 000	34 766	4,7
13	Paris	6 773	-	13 776	14 480	13 524	-	13 927	2,1
14	St. Petersburg	5 380	3 135	3 089	3 050	2 932	11 006	4 642	0,9
15	Alexandria	4 388	-	-	-	-	3 516	3 516	0,8
16	Berlin	3 769	7 165	7 230	6 909	7 570	6 688	7 112	1,9
17	Dubai	3 331	-	-	-	-	329	329	0,1
18	Madrid	3 166	-	7 030	6 085	-	-	6 558	2,1
19	Athens	3 074	-	-	-	4 448	4 950	4 699	1,5
20	Kiev	2 951	6 038	4 615	5 262	6 101	5 878	5 579	1,9
21	Roma	2 806	14 135	-	24 596	-	-	19 366	6,9
22	Osaka	2 752	-	849	-	741	-	795	0,3
23	Taipei	2 650	103	165	-	2 163	1 590	1 005	0,4
24	Haiphong	2 028	54	-	-	119	119	97	0,0
25	Minsk	2 021	388	335	304	270	305	320	0,2
26	Bucharest	1 944	1 660	1 470	1 540	-	-	1 557	0,8
27	Vienna	1 897	10 040	10 740	10 622	10 685	11 255	10 668	5,6
28	Hamburg	1 787	11 424	11 702	-	-	-	11 563	6,5
29	Warsaw	1 777	4 903	-	4 903	4 484	4 454	4 686	2,6
30	Budapest	1 752	2 819	2 569	2 994	2 558	1 853	2 559	1,5
31	Almaty	1 700	709	696	-	-	-	703	0,4
32	Ulan-Bator	1 540	3 249	2 474	2 266	-	2 871	2 715	1,8
33	Kyoto	1 472	-	256	-	249	-	253	0,2
34	Muscat	1 421	1 036	1 204	1 296	1 398	1 330	1 253	0,9
35	Milan	1 350	10 195	-	11 220	-	-	10 708	7,9
36	Prague	1 309	2 387	2 025	1 974	2 226	1 998	2 122	1,6
37	Sofia	1 242	3 305	3 385	1 140	3 488	4 222	3 108	2,5
38	Dublin	1 186	-	10 763	-	11 204	9 150	10 372	8,7
39	Da Nang	1 134	29	-	-	245	245	173	0,2
40	Nur-Sultan	1 130	870	811	699	650	717	749	0,7
41	Yerevan	1 068	2 602	1 842	1 956	-	-	2 133	2,0
42	Cologne	1 017	1 891	1 938	-	-	-	1 915	1,9
43	Stockholm	974	1 626	-	1 894	1 829	1 750	1 775	1,8
44	Naples	972	10 681	-	14 549	-	-	12 615	13,0
45	Turin	890	8 631	-	11 959	-	-	10 295	11,6
46	Zagreb	804	1 289	1 187	1 590	1 218	1 483	1 353	1,7
47	Frankfurt Main	732	1 634	1 470	-	-	-	1 552	2,1
48	Genova	700	1 920	-	-	-	-	1 920	2,7
49	Kishinev	681	320	-	-	-	-	320	0,5
50	Palermo	676	6 288	-	7 435	-	-	6 862	10,2
51	Helsinki	643	871	945	887	912	-	904	1,4
52	Riga	633	2 691	2 378	2 298	-	2 271	2 410	3,8
53	Copenhagen	616	-	-	1 605	1 550	-	1 578	2,6
54	Vilnius	532	1 459	1 532	1 350	-	1 481	1 456	2,7
55	Tallinn	437	1 515	1 369	1 181	1 284	1 049	1 280	2,9
56	Ljubljana	295	930	-	-	1 099	1 179	1 069	3,6
Total		**202 786**	**271 892**	**245 643**	**313 355**	**230 166**	**161 690**	**244 549**	**1,2**

Figure 4.10. Trends in fires in the cities of the World (2015-2019) from the World Fire Statistics published by CTIF (Brushlinsky, Ahrens, Sokolov, and Wagner, 2021)

The table belongs to the World Fire Statistics which is published by CTIF in the year 2021. Since CTIF collects the fire data from cities, it is possible to double-check that New York City's delayed publication causes some missing information for comparisons. On the other hand, London publishes and shares the data of the year in the next year's month of June. As a result, it can be revealed that the fire department should give due importance to statistical publications.

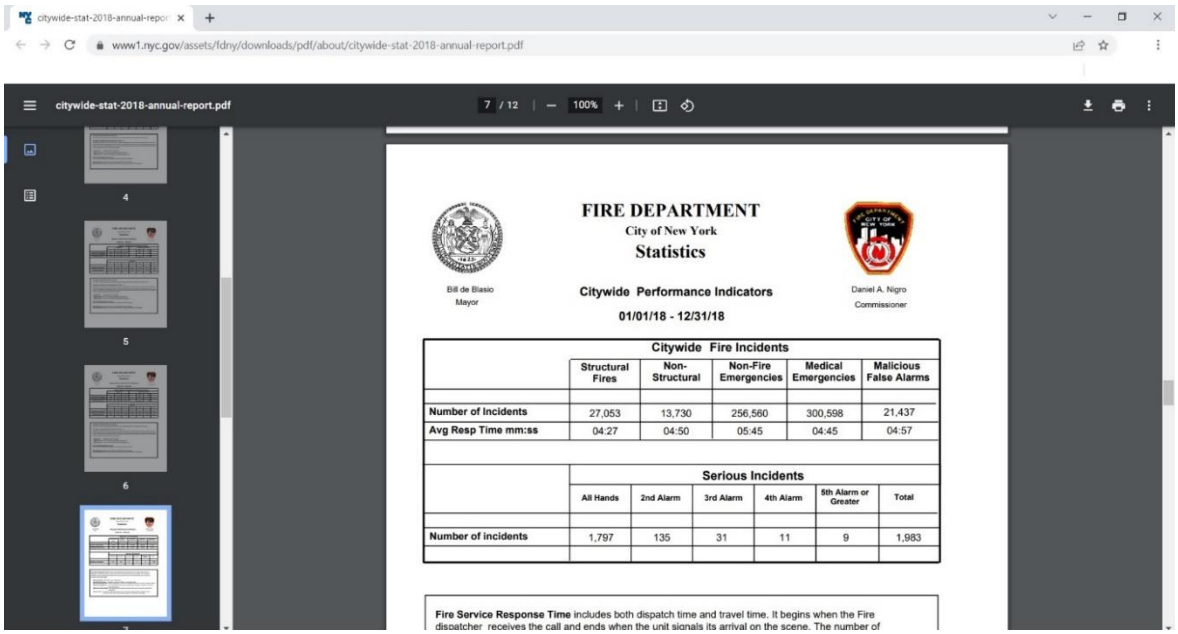


Figure 4.11. New York City Fire Department's statistics published on the official web page (New York City Fire Department, 2022)

Each publication includes statistics of citywide performance indicators and performance indicators for the five districts. With these publications, the user of the data can access numbers of structural fires, non-structural fires, non-fire emergencies, medical emergencies, and malicious false alarms with average response times in minutes and seconds for each category. Fire Service Average Response Time covers both dispatch time and travel time. The timing begins when the call is received and ends when the unit arrives on the scene. On the other hand, the publication shares outdoor and vehicle fires under one headline which is called non-structural fires.

The data between the years 2013 and 2018 are received from New York City Fire Department's official web page for statistics (New York City Fire Department, 2022). The data for the year 2003 is received from the publication of CTIF (Brushlinsky, Hall,

Sokolov, and Wagner, 2006). Between 2004 and 2008, the fire numbers are taken from CTIF's World Fire Statistics (Brushlinsky, Hall, Sokolov, and Wagner, 2010). For the years 2009, 2010, 2011, and 2012, the fire numbers are received from another publication of CTIF (Brushlinsky, Ahrens, Sokolov, and Wagner, 2015). To verify the accuracy of data that is received from CTIF, fire numbers from New York City Fire Department between the years 2013 and 2018 are compared with the number of fires that is published in World Fire Statistics. When the data is matched, the author considered the rest of the data from CTIF as accurate and reliable. Population numbers between 2003 and 2018 are received from New York State Department of Health (New York State Department of Health, 2019).

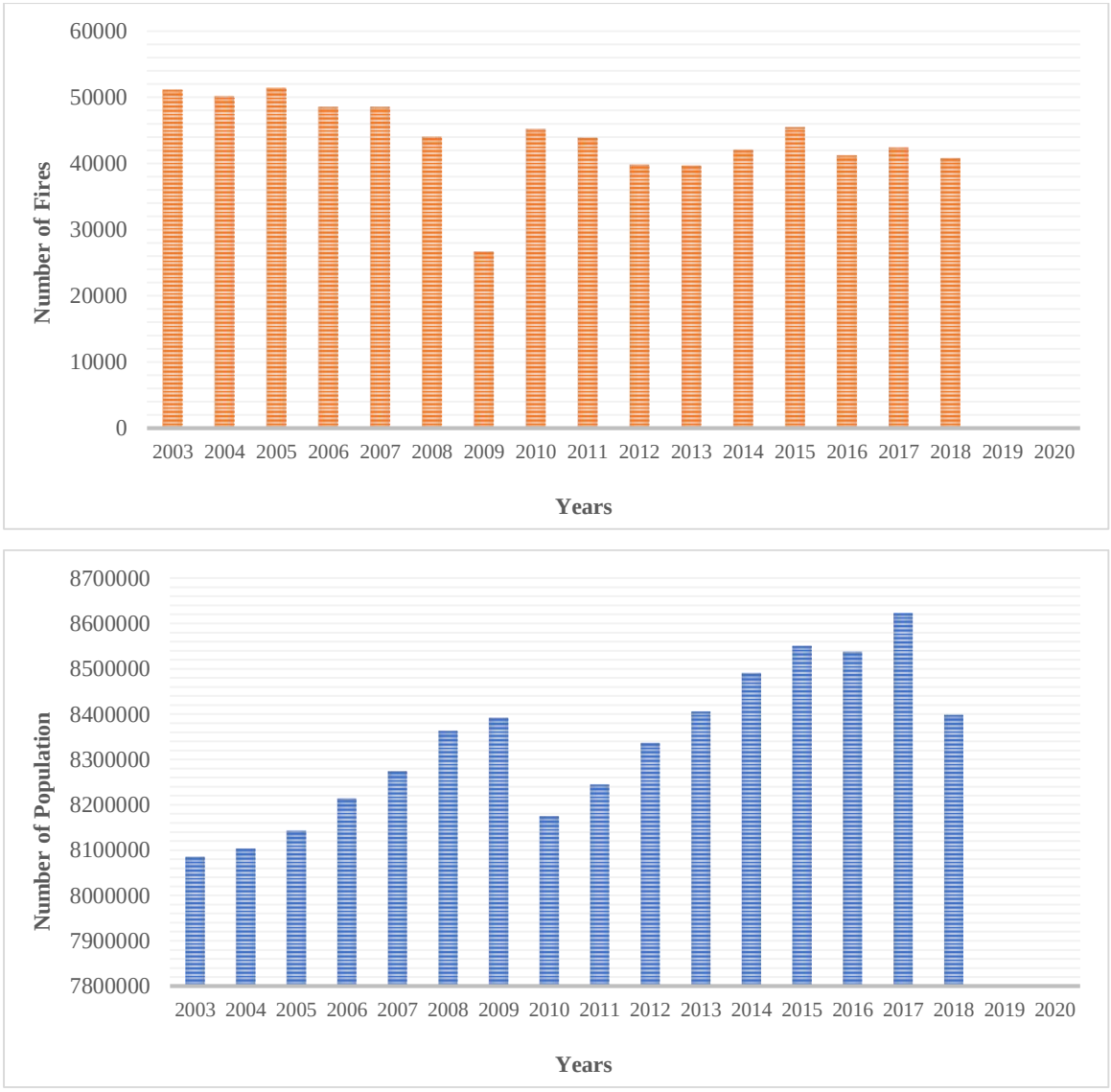


Figure 4.12. Annual distribution of the number of fires and population in New York City (2003-2018)

The total number of fires in New York City from 2003 to 2018 is 700986. The distribution of these fires by year is shown in the Figure. When the figure is examined; it is seen that most fires occurred in 2005 with 51395 and the least fires occurred in 2009 with 26666 in the years between 2003 and 2018. Although the number of total fires is increased in the years 2005, 2010, 2015, and 2017, there is an overall decline in the number of fires that occurred from 2003 to 2018. In this context, it is thought that the number of fires decreases depending on advanced research and codes applied thanks to detailly kept records. On the other hand, the statistical analysis also points to unreliable data as the increase or decrease model is broken by incorrect data. In the year 2009, only 26666 fires happened in New York City however it seems unreliable data. Because it is very different from the current pattern of decrease.

Table 4.4. The number of fires in relation to the number of inhabitants in New York City (2003-2018)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2018	40 783	8 398 748	4,85
2017	42 423	8 622 698	4,91
2016	41 225	8 537 673	4,82
2015	45 476	8 550 405	5,31
2014	42 043	8 491 079	4,95
2013	39 665	8 405 837	4,71
2012	39 834	8 336 697	4,77
2011	43 894	8 244 910	5,32
2010	45 214	8 175 133	5,53
2009	26 666	8 391 881	3,17
2008	44 054	8 363 710	5,26
2007	48 520	8 274 527	5,86
2006	48 519	8 214 426	5,90
2005	51 395	8 143 197	6,31

Table 4.4. (continues) The number of fires in relation to the number of inhabitants in New York City (2003-2018)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2004	50 155	8 104 079	6,18
2003	51 120	8 085 742	6,32

When the populations of each year are compared with the total number of fires, it is seen that the number of fires per 1000 inhabitants decreased slightly during the period 2003-2018. Although, between the years 2003 and 2018, New York City has the least population in 2003, the same year with a population of nearly 8 million accounts for the ratio of 6,32 fires per 1000 inhabitants. On the other hand, the year 2009 with a population of nearly 8,4 million accounts for the lowest ratio with 3,17. In addition, it is seen on the table that although the population increases in New York City, the total number of fires decreases.

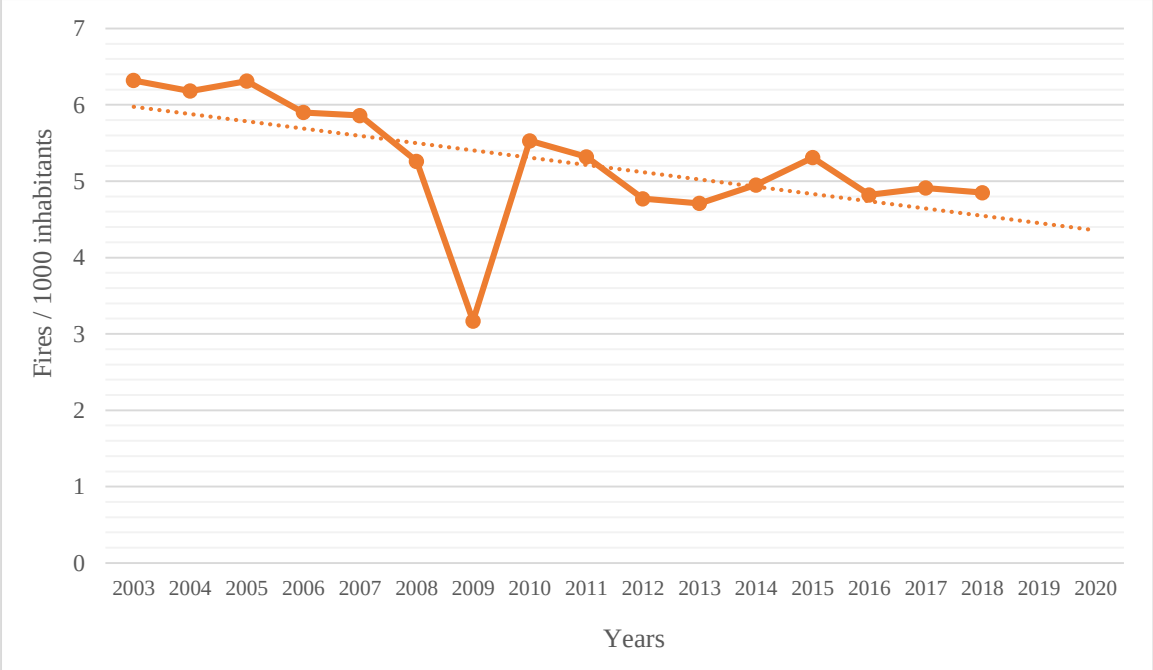


Figure 4.13. Annual distribution of fires in New York City per 1000 inhabitants (2003-2018)

The most fires occurred in 2005 and as a result of it, 6,31 fires happened per 1000 inhabitants. The year 2003 with a population of nearly 8 million accounts for the highest ratio, 6,32 fires per 1000 inhabitants. On the other hand, the year 2009 with a population

of nearly 8,4 million accounts for the lowest ratio with 3,17 since the lowest fire numbers occurred in the same year. Furthermore, it is observed that although the population increases in New York City, the total number of fires decreases. Since the fire numbers of the years 2019 and 2020 are not available, it is possible to make inferences from the figure that the decreasing trend will continue in these years too.

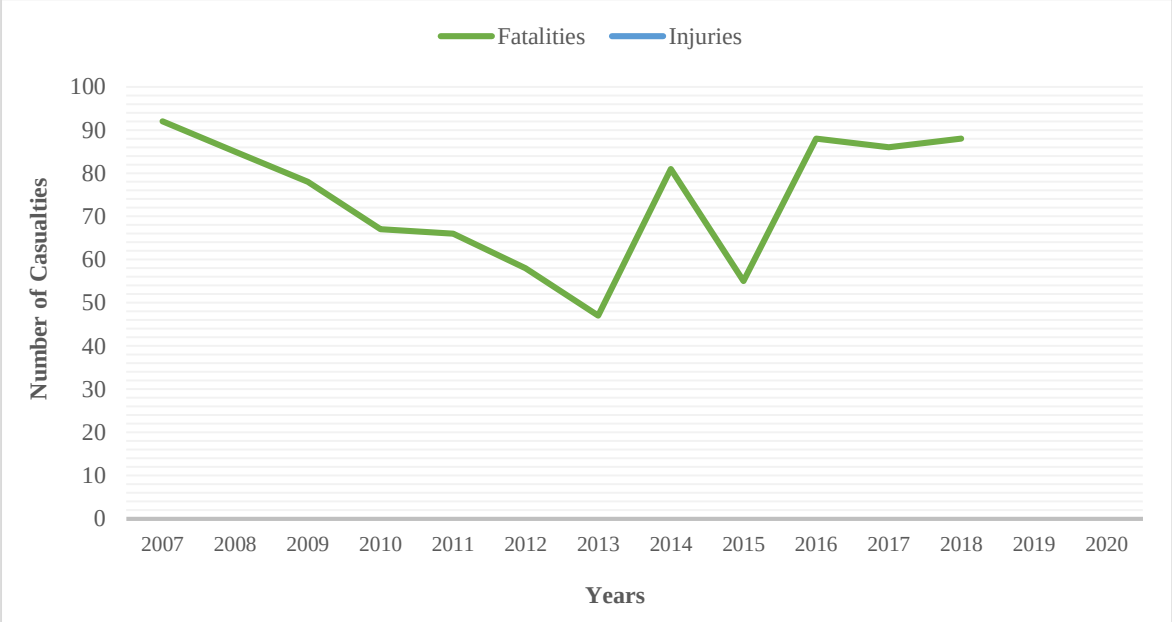


Figure 4.14. Annual distribution of numbers of fatalities and injuries caused by fires in New York City (2007-2018)

For this figure, the data on fatalities are received from the publication of CTIF. However, data on injuries are absent in the publication. From 2015 to 2018, fatality data is obtained from Report 26 (Brushlinsky, Ahrens, Sokolov, and Wagner, 2021), from 2013 to 2017, data is obtained from Report 24 (Brushlinsky, Ahrens, Sokolov, and Wagner, 2019), from 2011 to 2012, data is received from Report 22 (Brushlinsky, Ahrens, Sokolov, and Wagner, 2017), from 2007 to 2010, data is received from Report 18 (Brushlinsky, Hall, Sokolov, and Wagner, 2013).

The total number of fatalities caused by fires between the years 2007 and 2018 is 891. The 12-year average is determined as 74. Between the years 2016 and 2018, the 3-year average is determined as 87. When the figure is examined, it is seen that most fatalities occurred in 2007 with 92 and the least fatalities occurred in 2013 with 47.

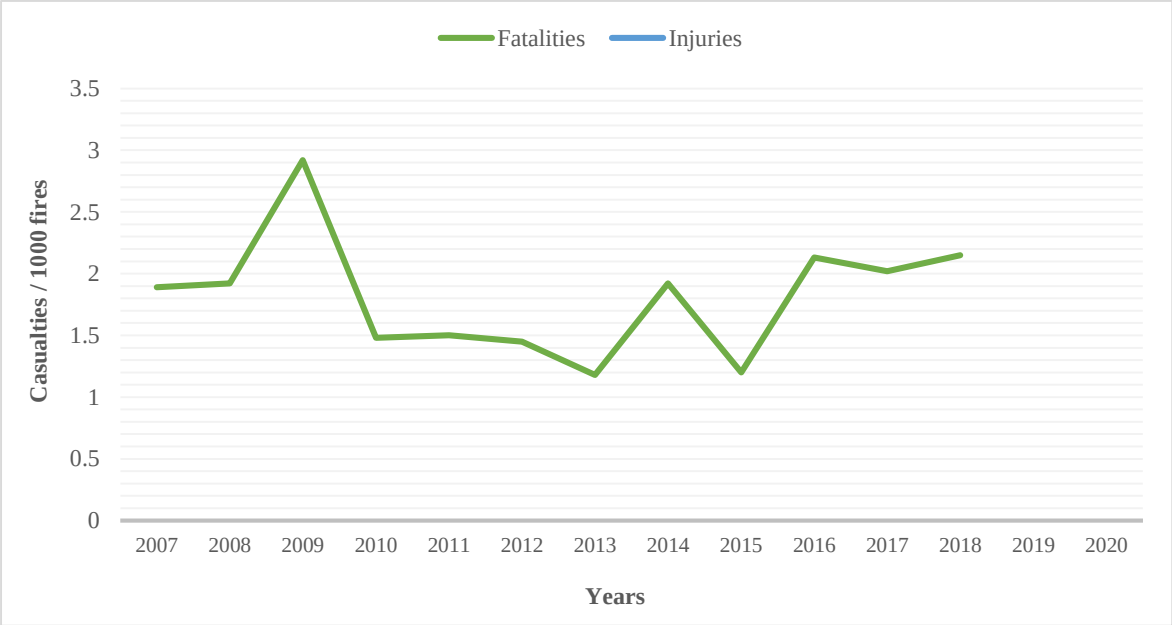


Figure 4.15. Annual distribution of fatalities and injuries occurred in New York City per 1000 fires (2007-2018)

When the figure is examined, between the years 2007 and 2018, it is seen that most fatalities occurred in 2009 with 2,92 per 1000 fires and the least fatalities occurred in 2013 with 1,18. Although fatality numbers per 1000 fires are decreased in the years 2010, 2013, and 2015, there is a slight increase in fatalities.

Table 4.5. Annual distribution of fires in New York City by property categories (2016-2018)

Year	Total fires	Building fires	Non- structural (vehicle and outdoor) fires
2020	-	-	-
2019	-	-	-
2018	40 783	27 053	13 730
2017	42 423	26 484	15 939
2016	41 225	26 491	14 734

In the fire report of New York City Fire Department, fire data is published under two headlines as structural and non-structural fires. Non-structural fires cover both outdoor and vehicle fires. The above table explains building fires in terms of property categories annually between the years 2016-2018 for New York City. Although in 2017 total fires

are at the highest number with 42423, the 3-year average is determined as 41477. On the other hand, the least number of fires occurred in New York City in the year 2018 with 40783. The number of fires is below the 3-year average in the years 2016 and 2018.

Building headline has the 3- year average of 26676 between the years 2016 and 2018. In 2018, building fires are at the highest number with 27053. In 2017, 26484 fires occurred in New York City. It is the lowest number and under the average. In addition, fires that occurred in 2016 are below average.

The non-structural category includes vehicles and outdoor fires. This category constitutes the smallest percentile among total fires between 2016 and 2018. In 2017, the number of fires is at the highest level with 15939. Its 3-year average is determined as 14801. Fires that occurred in 2016 and 2018 are below average with respectively 14734 and 13370.

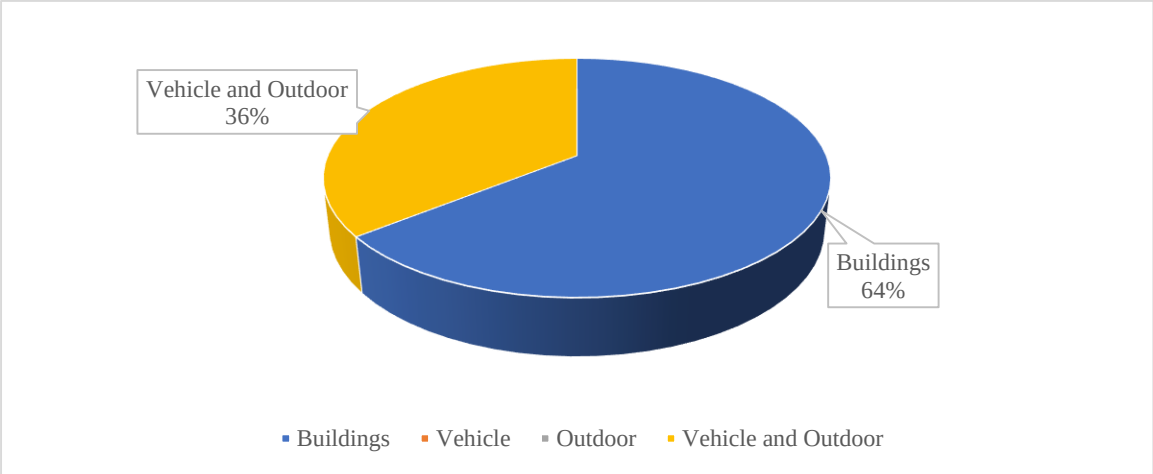


Figure 4.16. Distribution of the 3-year average of fires that occurred in New York City by property categories (2016-2018)

To focus on building fires, property categories among total fires are reviewed. From 2016 to 2018, every year, building fires make up the vast majority of total fires with a 3-year average of 26676. Lastly, vehicle and outdoor fires are following building fires in total fires which has a 3-year average of 41477. For vehicle and outdoor fires, the average of three years is determined as 14801. Consequently, buildings are places where most of the fires occurred in New York City.

4.1.3. Fire statistics in buildings in New York City

The fire statistical data needed for comparison within the context of fire statistics in buildings for New York City could not be reached by the author of this thesis.

4.1.4. Fire statistics in England

The Home Office collects detailed information on all types of incidents attended by Fire and Rescue Services (FRSs) which are the local service providing emergency cover. The Home Office has responsibility for fire services in England. Detailed statistics are released to the public on fires, fire-related fatalities, and casualties attended by fire and rescue services across England.

The data of fire incidents is provided via the IRS (Incident Recording System) which is a website managed by the Home Office and was introduced in April 2009. It collects detailed information on all types of incidents attended by FRSs, for example, fires, road traffic collisions, and false alarms. Data is collected in real-time as firefighters arrive at the incident scenes and enter information into the IRS. Some information can be updated continuously as investigations proceed and new information is found. Data is published by the Home Office in aggregate form on a quarterly and annually (as a financial year). The IRS data is used to create seven publications per year (GOV.UK, 2020).

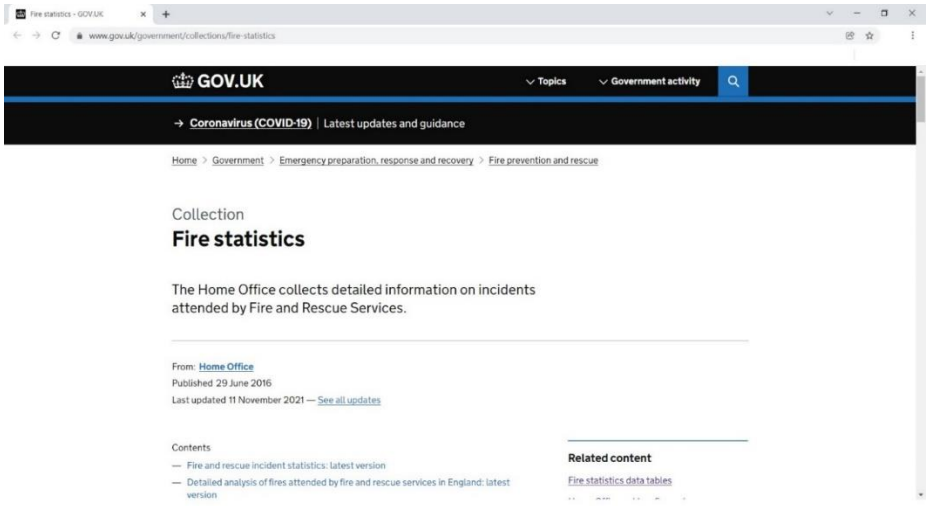


Figure 4.17. United Kingdom’s official web page (GOV.UK, 2021)

On the web page, data is released with publications and xlsx format. On this website, information can be found about fire and rescue incident statistics, and this presents trends in fires, fire-related fatalities and casualties, false alarms, and non-fire incidents attended by fire crews. Detailed analysis of fires attended by fire and rescue services in England is also presented and contains detailed statistics on fires, fire-related fatalities, and non-fatal casualties, including analyses of the causes of fires and smoke alarms operation.

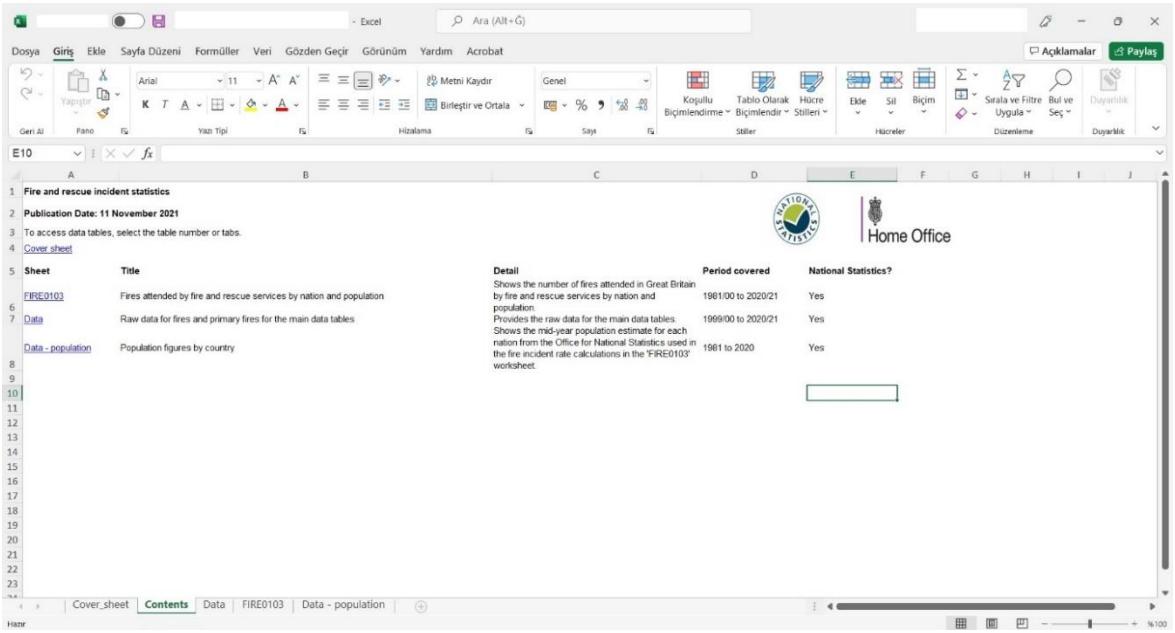


Figure 4.18. The Home Office's incident reports database published in xlsx format (GOV.UK, 2021a)

The web page (figure 4.18) introduces incident level datasets (ILD) to enable users to run their own more detailed analyses. Every Excel file presents only one category. Since incidents are categorized into 11 types in England, it can be said that files are very detailed. Every file has a cover sheet that introduces publication time, the responsible statistician with contact information, and future update date. Furthermore, it also contains a content page that gives information about the period covered and the topic of each sheet in the file. Rest of the sheets in the excel file shares data about the specific category.

For producing tables and graphics, data is taken from United Kingdom's official website. Data is received from the latest statistics, published by the Home Office on 11 November 2021 and it is stated by the Home Office that the data are consistent with records that reached the IRS (Incident Recording System) by 27 September 2021 (GOV.UK, 2021a).

It should be noted that the Home Office publishes fire incidents reports under financial years. For making comparisons between countries, the publication of Fire Statistics Table 0102: Incidents attended by fire and rescue services in England, by incident type and fire and rescue authority, quarterly which has detailed information about all quarters in a financial year is converted to calendar year by author.

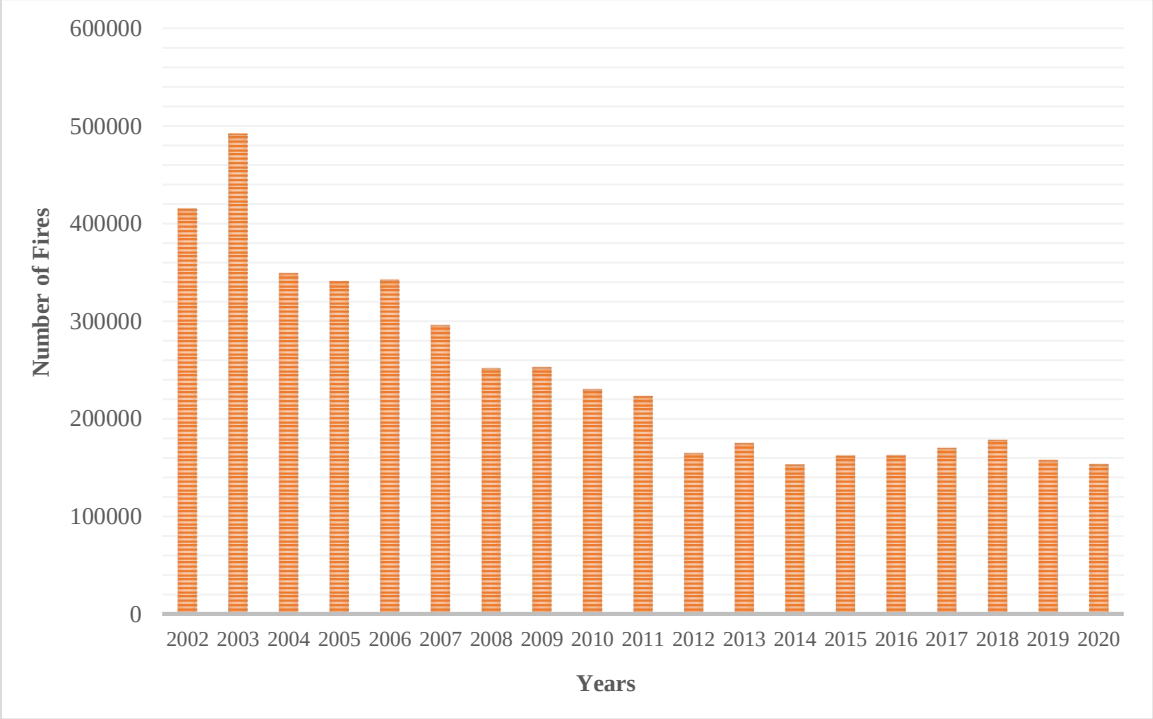


Figure 4.19. Annual distribution of the number of fires in England by calendar year (2002-2020)

Total fires attended by the fire crew include primary fires, secondary fires, and chimney fires. Primary fires are defined as fires occurred in a (non-derelict) building, outdoor structure, or vehicle.

The total number of fires in England from 2002 to 2020 is 4671928. The distribution of these fires by calendar year is shown in the Figure. When the figure is examined; it is seen that most fires occurred in 2003 with 492344 and the least fires occurred in 2014 with 153136 in the years between 2002 and 2020. Although the number of total fires is increased greatly in the year 2003 and slightly in 2006, 2009, 2013, 2015, and 2018, there is an overall decline in the number of fires that occurred from 2002 to 2020. In this context, it is thought that the number of fires decreases depending on advanced research and codes applied.

Table 4.6. The number of fires in relation to the number of inhabitants in England (2002-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2020	153 348	56 550 000	2,71
2019	157 583	56 287 000	2,79
2018	178 221	55 977 200	3,18
2017	170 056	55 619 400	3,05
2016	162 519	55 268 100	2,94
2015	162 321	54 786 300	2,96
2014	153 136	54 316 600	2,81
2013	174 914	53 865 800	3,24
2012	164 808	53 493 700	3,08
2011	223 430	53 107 200	4,20
2010	230 108	52 642 500	4,37
2009	252 646	52 196 400	4,84
2008	251 939	51 815 900	4,86
2007	296 173	51 381 100	5,76
2006	342 514	50 965 200	6,72
2005	340 955	50 606 000	6,73
2004	349 371	50 194 600	6,96
2003	492 344	49 925 500	9,86
2002	415 542	49 679 300	8,36

For table 4.6, population numbers are received from Office for National Statistics (Office for National Statistics, 2021). When the populations of each year are compared with the total number of fires, it is seen that the number of fires per 1000 inhabitants decreased significantly during the period 2002-2020, and then the trend of decreasing levelled out. Although, between the years 2002 and 2020, England has the least population in 2002, the

same year with a population of nearly 50 million accounts for the ratio of 8,36 fires per 1000 inhabitants. On the other hand, the year 2020 with a population of nearly 57 million accounts for the lowest ratio with 2,71. In 2003, since the number of total fires accounted for the highest at all, the ratio is also highest with 9,86. In addition, it is seen on the table that although the population increases every year in England, the total number of fires decreases. To illustrate, in 2020 London's population accounted for the highest with nearly 57 million. This is the most number for inhabitants in England, but also the least fire occurred and the rate of inhabitant to fire that occurred is the lowest.

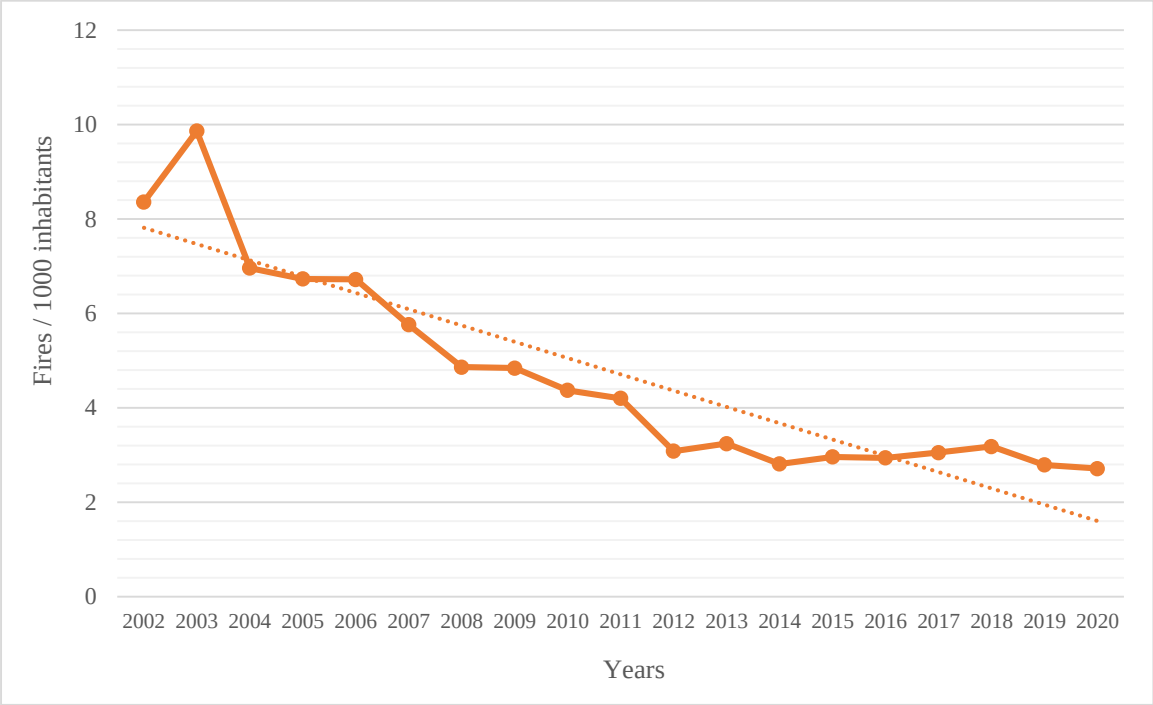


Figure 4.20. Annual distribution of fires in England per 1000 inhabitants (2002-2020)

Consequently, advanced data collecting is one of the primary factors that lead to diminishing ratios. For example, before 1 April 2009 fire incident statistics were based on the FDR1 paper form. This approach means the fire statistics for before this date can be less robust. Since data can be unreliable, prevention which should be defined by statistical analysis can be profitless. Since this date, the statistics are based on an online collection tool which is the Incident Recording System (IRS). From 2012 it is possible to observe a great decline. Between the years 2009 and 2012, the adaption of the new system occurred and its positive effects on fire incidents are started to be seen after the 3-year term.

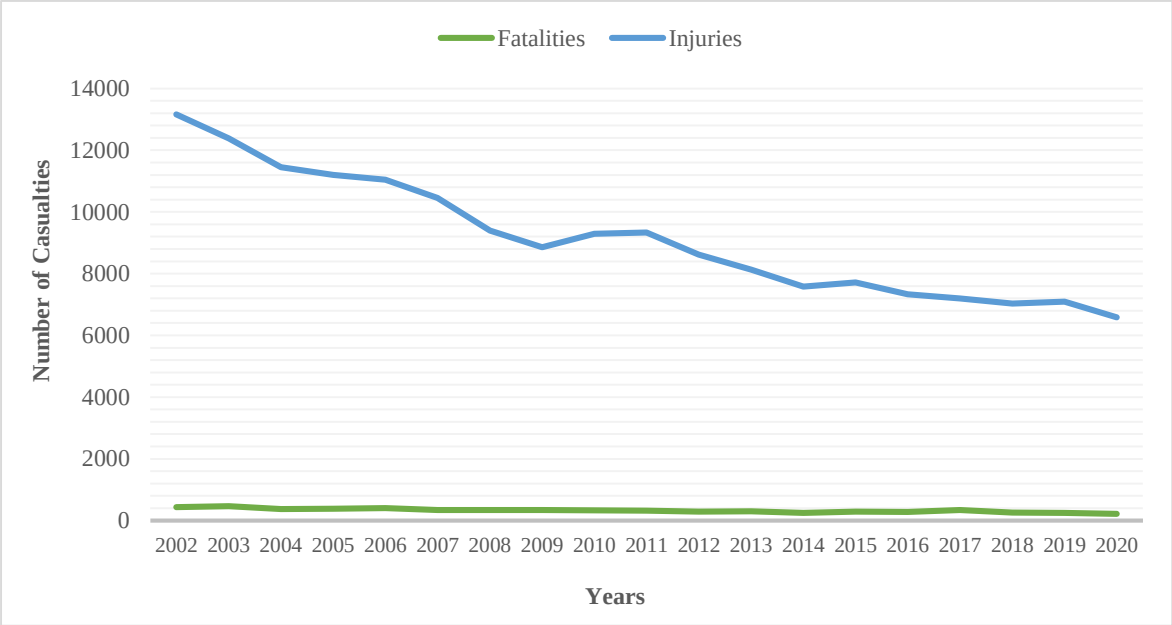


Figure 4.21. Annual distribution of numbers of fatalities and injuries caused by fires in England (2002-2020)

For making comparisons between countries, the publication of Fire Statistics Table 0502: Fatalities and non-fatal casualties by fire and rescue authority and location group, England, which has detailed information about fatalities and casualties for quarters in a financial year are converted to calendar year by author. In the non-fatal casualties, the severity of the injury is defined as hospital severe, hospital slight, first aid, and precautionary checks.

The total number of fatalities caused by fires between the years 2002 and 2020 is 6207. The 19-year average is determined as 327. On the other hand, between 2016 and 2020, the 5-year average is 270. When the figure is examined, it is seen that most fatalities occurred in 2003 with 468 and the least fatalities occurred in 2020 with 220. Although fatality numbers are increased in the years 2003, 2006, 2009, 2013, and 2017, there is an overall decline in fatalities.

Between the years 2002 and 2020, 173 836 injuries happened due to fires that occurred in England. The 19-year average is determined as 9149. On the other hand, between 2016 and 2020, the 5- year average is 7047. Since there is a decline in averages, it is a possible indication of a decline in the number of non-fatal casualties.

When the figure is examined, it is seen that most injuries happened in the year 2002 with 13160 and the least injuries happened in 2020 with 6583. Although injuries that are caused by fires are increased in 2011 and 2015, it is thought that this decline in both injuries and fatalities was caused by decreasing numbers in total fires, developed fire codes, and research on fire issues.

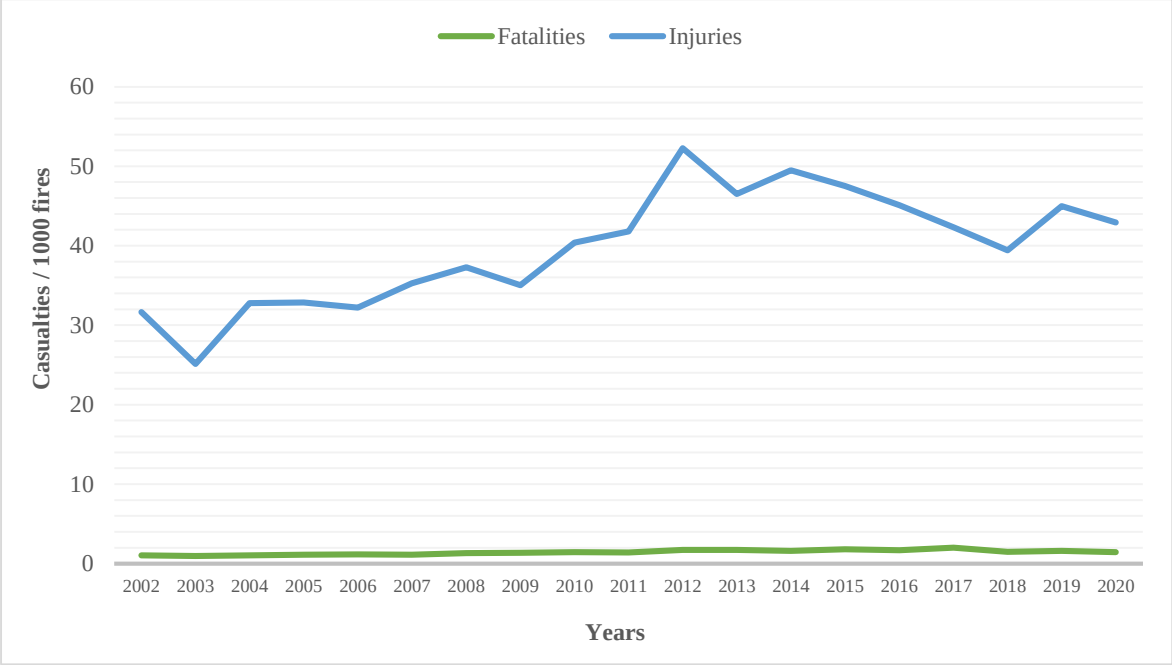


Figure 4.22. Annual distribution of fatalities and injuries occurred in England per 1000 fires (2002-2020)

For making a comparison between countries, fatality and injury numbers are reviewed in relation to total fire numbers in the same year. Before this analysis, fire numbers are reviewed in relation to population numbers, however, for this one, analysis in relation to population numbers can be misleading. Since people are injured or dead due to the fires, it will be logical to review casualty numbers in relation to total fire numbers.

As seen in the figure 4.21, it is possible to say that there is a decline in the number of deaths and injuries. However, this figure provides another perspective to the same issue. The number of fatalities per 1000 fires between the years 2002 and 2020 has an increasing pattern.

When the figure is examined, it is seen that most fatalities occurred in 2017 with 2,01 per 1000 fires and the least fatalities occurred in 2003 with 0,95. Since, on 14 June 2017, The

Grenfell Tower fire occurred with the number of 72 fire-related fatalities, it is very predictable that most fatalities per 1000 fires happened in 2017. Although fatality numbers per 1000 fires are decreased in the years 2003, 2007, 2011, 2014, and 2020, there is a slight increase in fatalities in contrast to the previous figure. When the figure is examined, it is seen that most injuries per 1000 fires happened in the year 2012 with 52,27 and the least injuries per 1000 fires happened in 2003 with 25,14. Although injuries that are caused by fires are decreased in 2003, 2009, 2013, and 2018, there is an increase in the number of injuries per 1000 fires, as opposed to the decrease in the number of injuries in the figure 4.21.

Table 4.7. Annual distribution of fires in England by property categories (2016-2020)

Year	Total fires	Building fires	Vehicle Fires	Outdoor Fires
2020	153 348	43 372	18 250	91 726
2019	157 583	46 173	20 817	90 593
2018	178 221	48 773	21 833	107 615
2017	170 056	50 301	23 025	96 730
2016	162 519	51 633	23 197	87 689

The table 4.7 explains building fires in terms of property categories annually between the years 2016-2020. In general, it is possible to see an overall decline in total fires. Although in 2018 total fires are at the highest number with 178221, the 5-year average is determined as 164345. On the other hand, the least number of fires occurred in England in 2020 with 153348. The number of fires is below the 5-year average in the years 2016, 2019, and 2020 with respectively 162519, 157583, and 153348.

The headline of buildings includes dwelling fires, other building fires, and chimney fires. The 5-year average of this headline is determined as 48050. Between 2016 and 2020, the number of building fires reaches the highest point with 51633 in 2016. In 2019 and 2020, the trend of decreasing is leveled out with respectively 46173 and 43372.

The vehicle property category constitutes the smallest percentile among total fires in England between the years 2016 and 2020. In 2016, the number of fires is at the highest

level with 23197. Its 5-year average is determined as 21424. Fires that occurred in 2019 and 2020 are below average with respectively 20817 and 18250.

Outdoor covers other outdoor fires headline which is one of the sub-categories of primary fires and secondary fires. Between 2016 and 2020, the number of outdoor fires reaches the highest point in 2018 with 107615. Since the 5-year average of this headline is 94871, in 2016, 2019, and 2020 the number of fires is below average with respectively 87689, 90593, and 91726.

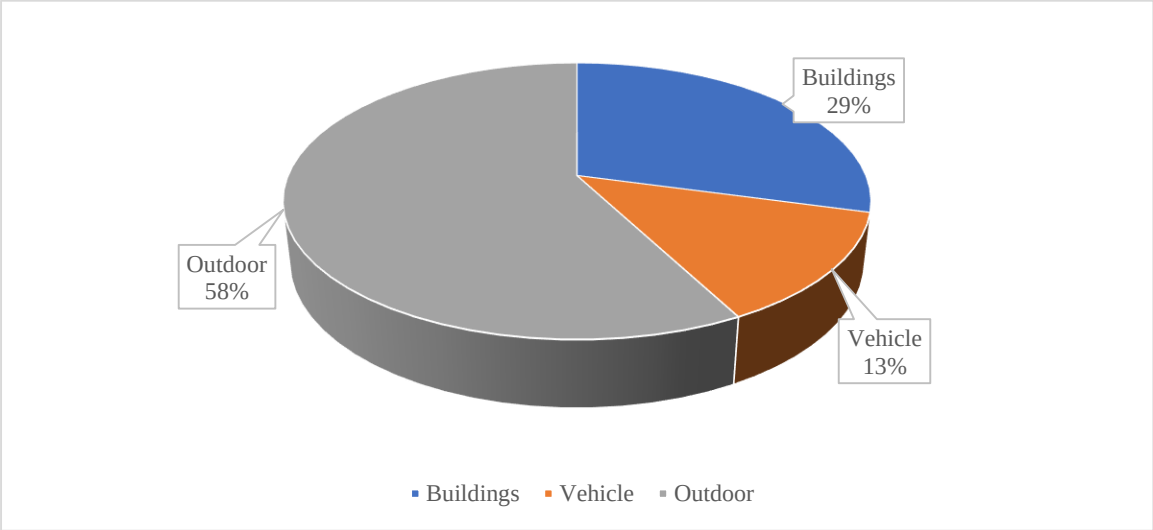


Figure 4.23. Distribution of the 5-year average of fires that occurred in England by property categories (2016-2020)

To focus on building fires, property categories among total fires are reviewed. From 2016 to 2020, every year, outdoor fires make up the vast majority of total fires with a 5-year average of 94871. Secondly, building fires are following outdoor fires in total fires which has a 5-year average of 164345.

For building fires, the average of five years is determined as 48050. Lastly, vehicle fires have the least percentile among other categories with a five-year average of 21424 and a constant decrease every year. Consequently, buildings and outdoors are places where most of the fire occurred.

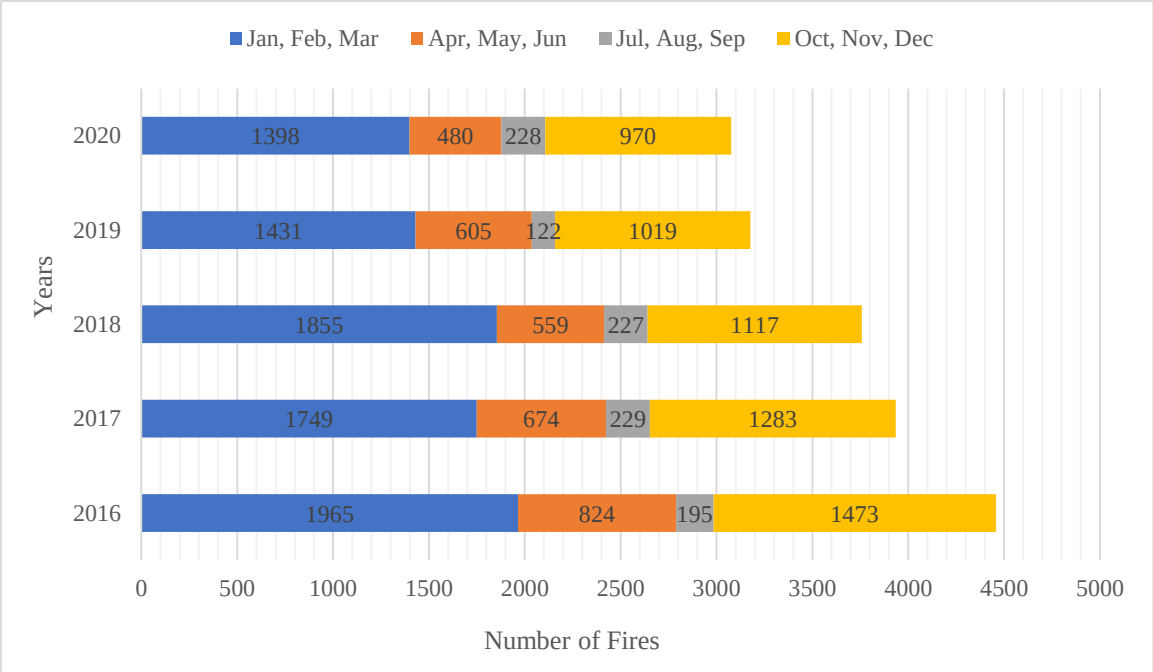


Figure 4.24. Annual distribution of chimney fires in England by quarters (2016-2020)

Between 2016 and 2020, the most chimney fires have occurred in the year 2016 with 4457. In 2020, only 3076 chimney fires happened, and this is the lowest number between 2016 and 2020. The 5-year average of chimney fires is determined as 3681. Fires in 2019 and 2020 are below average with respectively 3177 and 3076. As seen on the table, there is an overall decline in chimney fires.

The above figure represents chimney fires by quarters. In the publication of the Home Office, chimney fires data are given in 3-months periods. As seen on the table, every year's months of August, July, and September, the number of chimney fires is at the lowest point. However, every year's months of January, February, and March have the highest numbers between the years 2016 and 2020. The quarter of January, February, and March is followed by the quarter of October, November, and December, and then the quarter of April, May, and June in case of the number of chimney fires. Hereby, it is possible to say that although chimney fires decrease every year, the density changes due to weather conditions. In cold weather, chimney fires occur more than in the summer.

Thanks to statistics, regarding fires that increase seasonally, warnings are made to the public through fire departments in European countries, and they are asked to take precautions and be careful (Şengöz, 2018).

4.1.5. Fire statistics in London

London Fire Brigade (LFB) incident reports are published worldwide. Their official website publishes a dataset that contains every detail of fires that occurred in London since January 2009. Information about fires is provided for when and where the fire happened, and the type of incident dealt with. On their website, there is a dashboard that allows everyone to interact with this data and drill down to Ward or Postcode level.

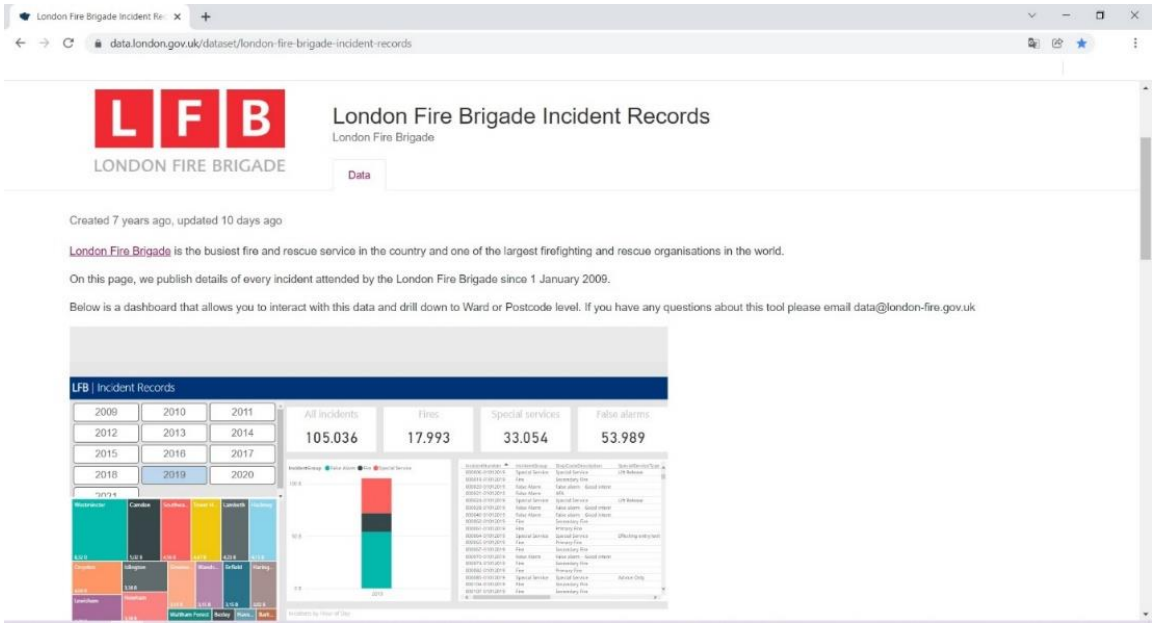


Figure 4.25. London Fire Brigade incident reports database web page (London Datastore, 2021)

The above figure presents the dashboard on the web page which has contain detailed information about all incidents including fires, special services, and false alarms starting from January 2009. Furthermore, this dashboard gives the user control of filtering data. For instance, searching for only one borough is one of the filtering options.

It is also possible to observe incidents by the hour of the day of a certain year or more than one year. The dashboard allows users to choose random years at one time. Chosen data is seen in the dashboard with detailed information such as incident number, incident borough, incident ward, and postal district.

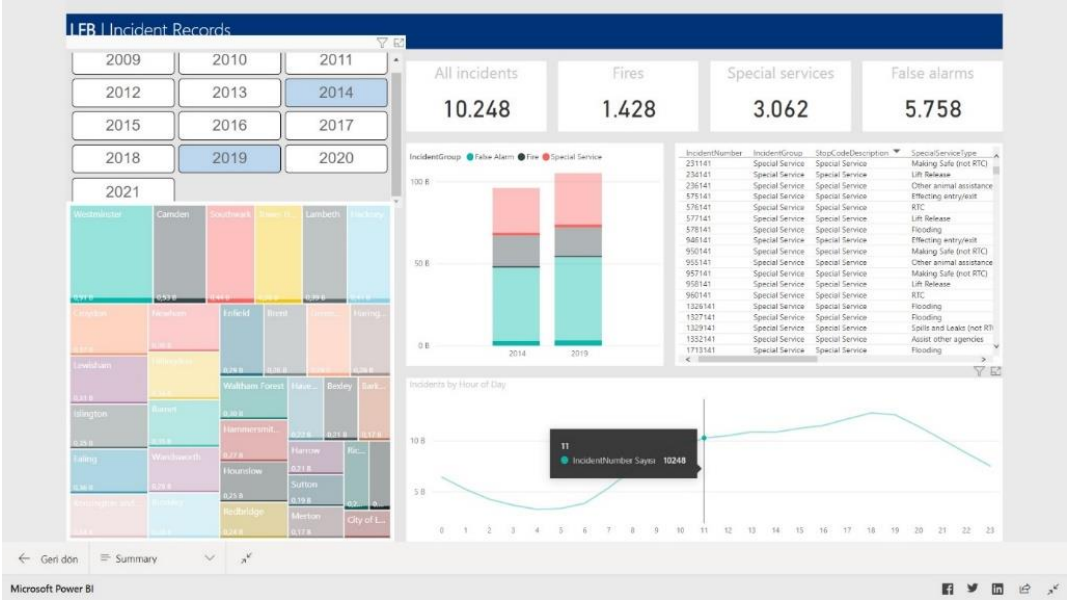


Figure 4.26. Incident reports dashboard (London Datastore, 2021)

Figure 4.26 is an example of the usage of the dashboard. In the example, the years are determined as 2014 and 2019. The left part of the dashboard contains boroughs, and it is possible to determine filtered data among all incidents in chosen years. Graphics show all data with transparent colors and the data which is filtered by the user is seen with opaque colors in the same graphics. In the right part of the dashboard, there is an option to sort information by priority such as listing special services at first in summary. Consequently, the user can perceive an inference to reach what he is looking for.

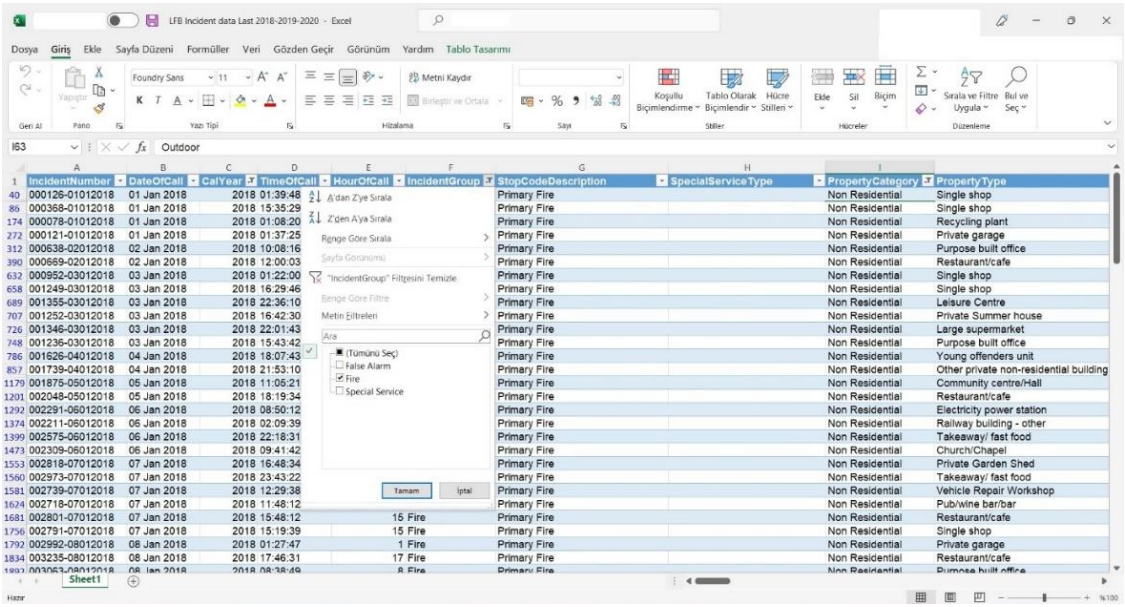


Figure 4.27. London Fire Brigade incident reports database (London Datastore, 2021)

The web page of London Datastore also publishes the incidents as xlsx format file from January 2009. In these files, every incident has detailly introduced. As seen in the figure 4.27, every headline has a feature of filtering. That gives the opportunity to focus on what researchers look for.

All of the fire data of London for creating graphs for this thesis are received from London Fire Brigade (London Fire Brigade, 2021:1-47). Additionally, during industrial disputes between the years 1969 and 1976, no details were recorded of the circumstances in which the fire started. Data is only available until 31 October 1977 as 887 fires due to a fire service national strike. For 1978, there is no data available on the split between primary fire and secondary fire however there are total fire numbers. To avoid creating a discrepancy in statistics, 1978 and later years are given in graphics. Population numbers are received from London Datastore (London Datastore, 2021a).

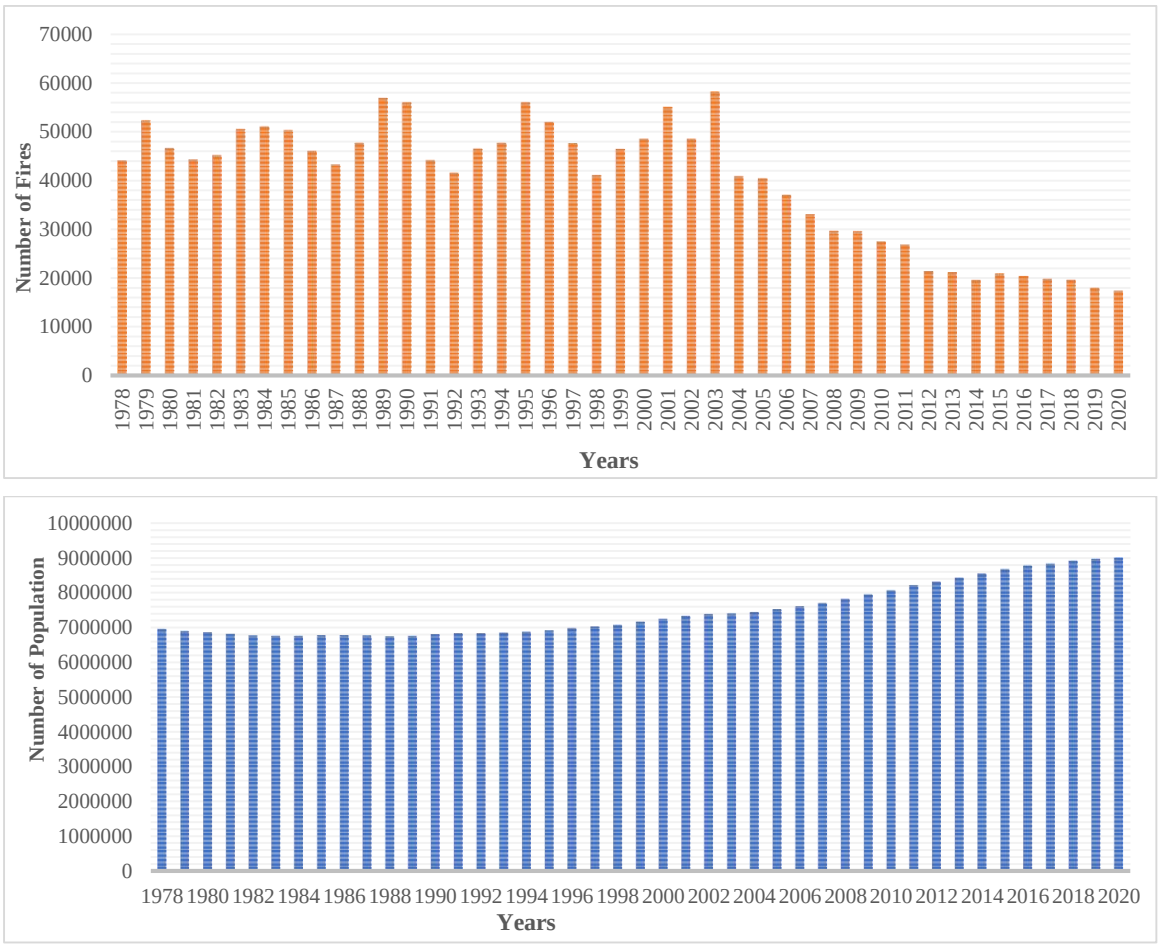


Figure 4.28. Annual distribution of the number of fires and population in London (1978-2020)

The total number of fires in London from 1978 to 2020 is 1711732. The distribution of these fires by year is shown in the Figure. When the figure is examined; it is seen that most fires occurred in 2003 with 58233 and the least fires occurred in 2020 with 17411 in the years between 1978 and 2020. Although the number of total fires is increased in the years 1979, 1983, 1989, 1995, 2001, and 2003, there is an overall decline in the number of fires that occurred from 1978 to 2020. In this context, it is thought that the number of fires decreases depending on advanced research and codes applied.

Table 4.8. The number of fires in relation to the number of inhabitants in London (1978-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2020	17 411	9 002 488	1,93
2019	17 993	8 961 989	2,00
2018	19 675	8 908 081	2,20
2017	19 863	8 825 001	2,25
2016	20 391	8 769 659	2,32
2015	20 923	8 666 930	2,41
2014	19 622	8 539 398	2,29
2013	21 158	8 417 458	2,51
2012	21 443	8 308 833	2,58
2011	26 847	8 204 407	3,27
2010	27 467	8 061 495	3,40
2009	29 591	7 942 594	3,72
2008	29 653	7 812 161	3,79
2007	33 084	7 693 473	4,30
2006	37 113	7 597 825	4,88
2005	40 441	7 519 009	5,37
2004	40 883	7 432 730	5,50

Table 4.8. (continues) The number of fires in relation to the number of inhabitants in London (1978-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2003	58 233	7 394 817	7,87
2002	48 544	7 376 671	6,58
2001	55 063	7 322 403	7,51
2000	48 554	7 236 700	6,70
1999	46 455	7 153 900	6,49
1998	41 071	7 065 500	5,81
1997	47 678	7 014 800	6,79
1996	51 959	6 974 400	7,44
1995	55 962	6 913 100	8,09
1994	47 693	6 873 500	6,93
1993	46 543	6 844 500	6,80
1992	41 638	6 829 400	6,09
1991	44 184	6 829 300	6,46
1990	55 994	6 798 800	8,23
1989	56 893	6 751 600	8,42
1988	47 733	6 729 300	7,09
1987	43 268	6 765 600	6,39
1986	46 070	6 774 200	6,80
1985	50 326	6 767 000	7,43
1984	51 076	6 754 700	7,56
1983	50 549	6 753 000	7,48
1982	45 215	6 765 100	6,68
1981	44 331	6 805 000	6,51
1980	46 645	6 850 600	6,80

Table 4.8. (continues) The number of fires in relation to the number of inhabitants in London (1978-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
1979	52 331	6 887 600	7,59
1978	44 136	6 946 800	6,35

When the populations of each year are compared with the total number of fires, it is seen that the number of fires per 1000 inhabitants diminished significantly during the period 1978-2020, and then the trend leveled out.

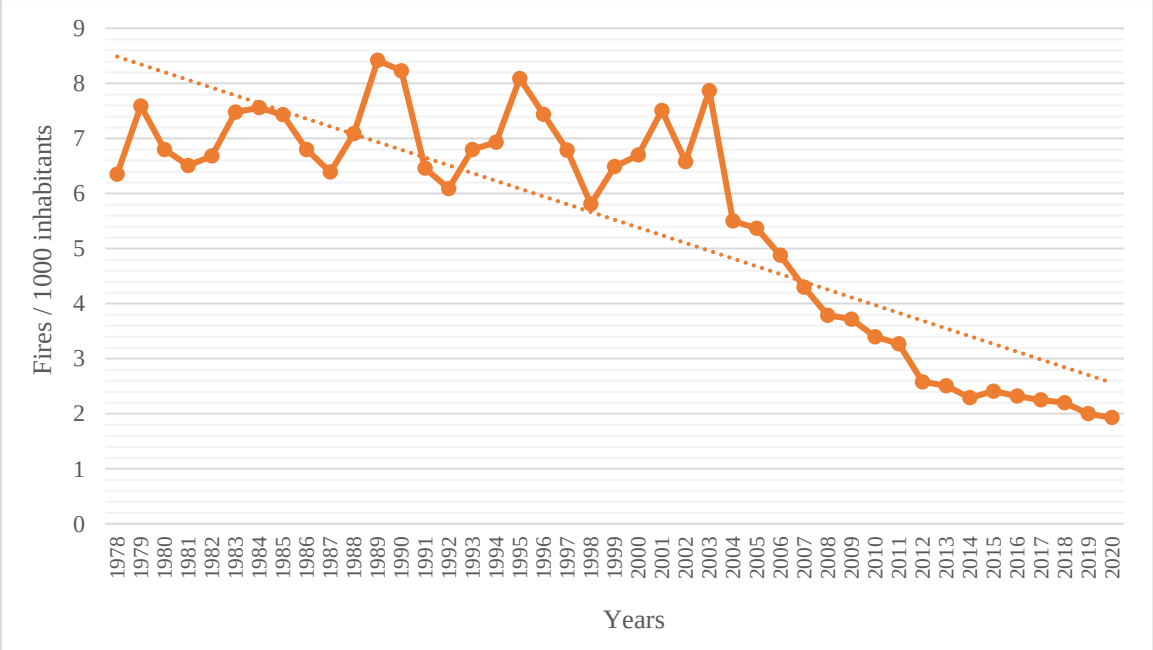


Figure 4.29. Annual distribution of fires in London per 1000 inhabitants (1978-2020)

Although the most fires occurred in 2003, 7,87 fires happened per 1000 inhabitants. The year 1989 with a population of nearly 7 million accounts for the highest ratio, 8,42 fires per 1000 inhabitants. On the other hand, the year 2020 with a population of nearly 9 million accounts for the lowest ratio with 1,93. Furthermore, it is observed that although the population increases every year in London, the total number of fires decreases. To illustrate, in 2020 London's population accounted for nearly 9 million. This is the most number for inhabitants in London, but also the least fire occurred and the rate of inhabitant to fire that happened is the lowest. Consequently, advanced research on fire and codes for safety applied are directly related to fire rates.

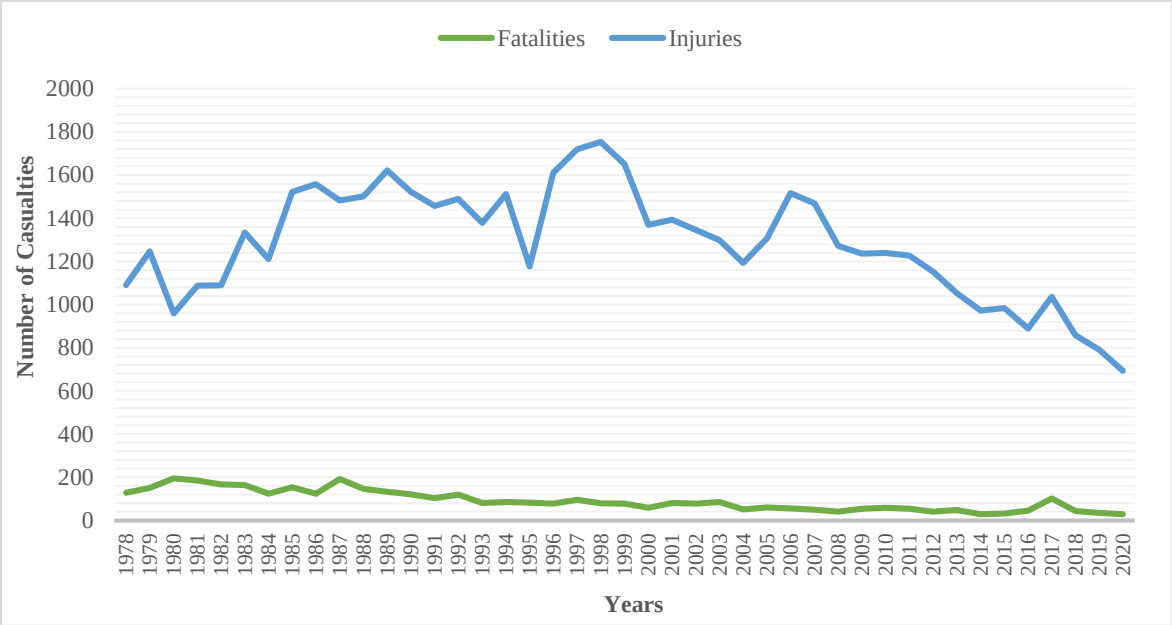
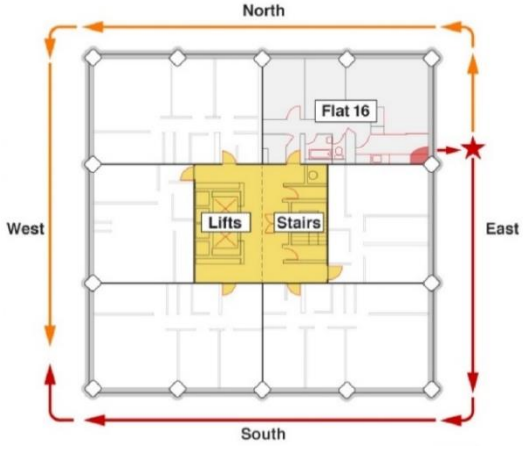


Figure 4.30. Annual distribution of numbers of fatalities and injuries caused by fires in London (1978-2020)

Besides financial losses, fires can cause fatalities and injuries. This figure is created to point out to show fire's destructive power on human life. The total number of fatalities caused by fires between the years 1978 and 2020 is 3941. The 43-year average is determined as 92. On the other hand, between 2016 and 2020, the 5-year average is 52. When the figure is examined, it is seen that most fatalities occurred in 1980 with 196 and the least fatalities occurred in 2014 with 29. Although fatality numbers are increased in the years 1980, 1985, 1987, 1992, 1997, 2003, 2010, and 2017, there is an overall decline in fatalities.

Between the years 1978 and 2020, 55254 injuries happened due to fires that occurred in London. The 43-year average is determined as 1285. On the other hand, between 2016 and 2020, the 5- year average is 854. Since there is a significant decline in averages, it is an indication of an overall decline in the number of injuries. When the figure is examined, it is seen that most injuries happened in the year 1998 with 1753 and the least injuries happened in 2020 with 694. Although injuries that are caused by fires are increased in 1986, 1989, 1994, 1998, 2001, 2006, and 2017, it is thought that this decline in both injuries and fatalities was caused by decreasing numbers in total fires, developed fire codes, and research on fire issues.

(a)



(b)

Figure 4.31. The Grenfell Tower fire occurred in London (a), The spread of the fire illustrated by the example floor plan(b) (BBC News, 2019)

The fire which destroyed Grenfell Tower on 14 June 2017 broke out in the kitchen of a fourth-floor flat at the 23-story tower block in North Kensington, West London just before 01 am. The fire had raced up the exterior of the tower block within minutes. From the fourth floor, the fire spread initially vertically up the tower columns and across the eastern side of the building. From there, it spread across the north face of the building and then spread to all four sides of the building. The reason for the spread beyond the kitchen was flame and hot gases penetrated the internal window frame. Afterward, the polyethylene material in the cladding caused the spread beyond facades.

The fire started in a residential building while inhabitants of the building were asleep and many residents were told to stay in their flats by the emergency services, only to become

trapped as the fire blazed out of control and smoke spread up the one narrow stairwell. This situation resulted in the number of 72 fire-related fatalities. That is why it is very predictable that most fatalities per 1000 fires happened in 2017 (GOV.UK, 2021b).

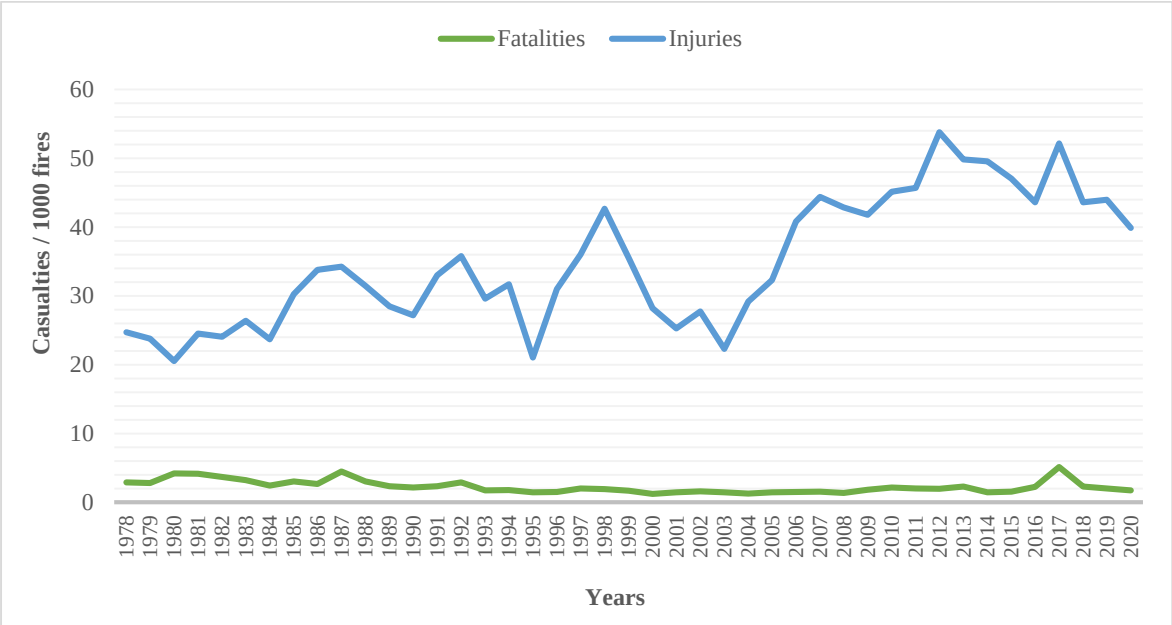


Figure 4.32. Annual distribution of fatalities and injuries occurred in London per 1000 fires (1978-2020)

For making a comparison between cities, fatality and injury numbers are reviewed in relation to total fire numbers in the same year. This analysis is crucial to determine whether the decline in injury and fatality numbers is real or is an illusion when these data are analyzed in detail. As seen in the previous figure, it is possible to say that there is a decline in the number of deaths and injuries. However, this figure provides another perspective to the same issue.

The number of fatalities per 1000 fires between the years 1978 and 2020 has a declining pattern. When the figure is examined, it is seen that most fatalities occurred in 2017 with 5,13 per 1000 fires and the least fatalities occurred in 2000 with 1,21. Although fatality numbers per 1000 fires are increased in the years 1980, 1987, 1992, 1997, 2002, 2010, 2013, and 2017, there is an overall decline in fatalities like the previous figure.

When the figure is examined, it is seen that most injuries per 1000 fires happened in the year 2012 with 53,77 and the least injuries per 1000 fires happened in 1995 with 21,03.

Although injuries that are caused by fires are increased in 1983, 1987, 1992, 1998, 2007, 2012, and 2017, as a result, there is an increase in the number of injuries per 1000 fires, as opposed to the decrease in the number of injuries in the previous figure. This is a debate over whether the decline in the number of injuries is real or just an illusion resulting from a review of one side of the issue.

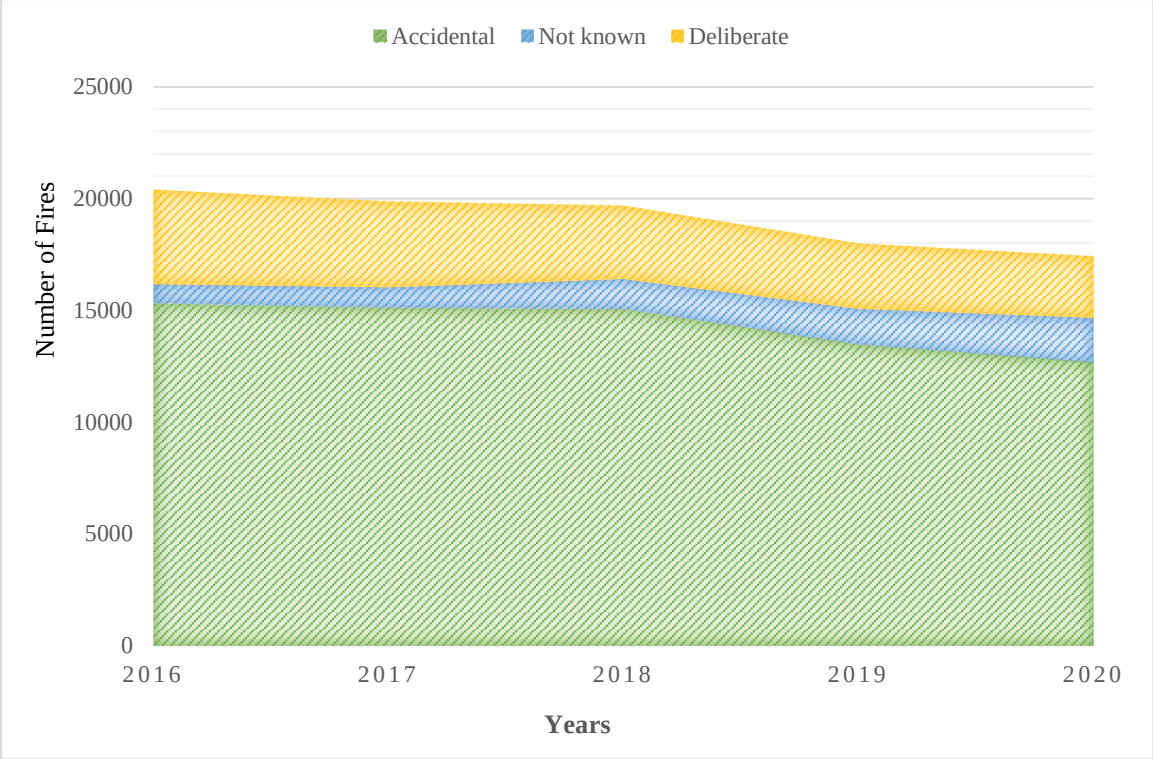


Figure 4.33. Annual distribution of fires in London by motive (2016-2020)

It is crucial to determine the motive to enhance fire codes. The above figure is prepared for determining the main motive of fires in London. Willfully set fires are recorded as 4220 in 2016, however, in 2020, it decreases to 2742. Raising the level of consciousness has a direct effect on a decrease in deliberately set fires. Every year, accidental fires make up the vast majority of total fires. In 2016, the number of accidental fires was 15315. Additionally, 2017 and 2018 are very close to 2016 with respectively 15018 and 15055. The decline continues in accidental fires too, in 2020 it decreases to 12673.

Education for fire protection in every age is very common in the United Kingdom. As a result of this education, it is possible to observe a decline in accidental fires. Although the total number of fires decreased, the number of motivations not known fires increased

every year since 2016. In 2016, the number of unknowns was 856. However, this number increases to 1996 in the year 2020.

Table 4.9. Annual distribution of fires in London by property categories (2016-2020)

Year	Total fires	Building fires	Vehicle Fires	Outdoor Fires
2020	17 411	6727	1507	9177
2019	17 993	7285	1925	8783
2018	19 675	7615	2076	9984
2017	19 863	8050	2225	9588
2016	20 391	7838	2313	10 240

The above table explains building fires in terms of property categories annually between the years 2016-2020 for London. In general, it is possible to see an overall decline in total fires. Although in 2016 total fires are at the highest number with 20391, the 5-year average is determined as 19067. On the other hand, the least number of fires occurred in London in the year 2020 with 17411. The number of fires is below the 5-year average in the years 2019 and 2020 with respectively 17993 and 17411.

Building headline has the 5- year average of 7503 between the years 2016 and 2020. In 2017, building fires are at the highest number with 8050. In 2020, 6727 fires occurred in London. It is the lowest number and under the average. In addition, fires that occurred in 2019 are below average.

The vehicle property category constitutes the smallest percentile among total fires between 2016 and 2020. In 2016, the number of fires is at the highest level with 2313. Its 5-year average is determined as 2009. Fires that occurred in 2019 and 2020 are below average with respectively 1925 and 1507.

The 5-year average of outdoor fires is determined as 9554. The number of fires is below average in 2019 and 2020 with respectively 8783 and 9177. In 2016, outdoor fires reach the highest number with 10240 between the years 2016 and 2020.

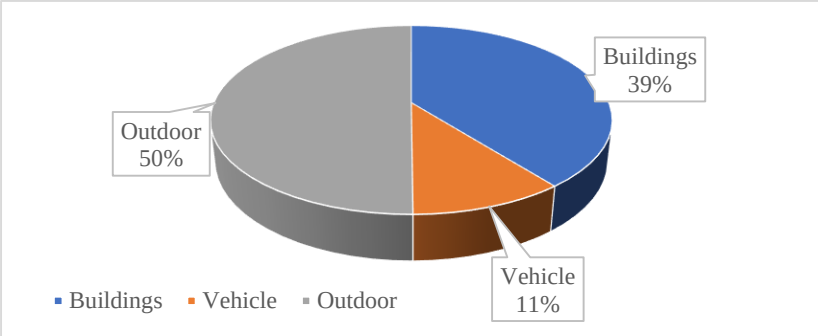


Figure 4.34. Distribution of the 5-year average of fires that occurred in London by property categories (2016-2020)

To focus on building fires, fires by property category are reviewed. From 2016 to 2020, every year, outdoor fires make up the vast majority of total fires with a 5-year average of 9554. Secondly, building fires are following outdoor fires in total fires which has a 5-year average of 19067. The average of five years is determined as 7503 for building fires. This shows in five years, the number of building fires is very close and almost equal. Vehicle fires have the least percentile among other categories with a five-year average of 2009 and a constant decrease every year. Consequently, buildings and outdoors are places where most of the fire occurred.

4.1.6. Fire statistics in buildings in London

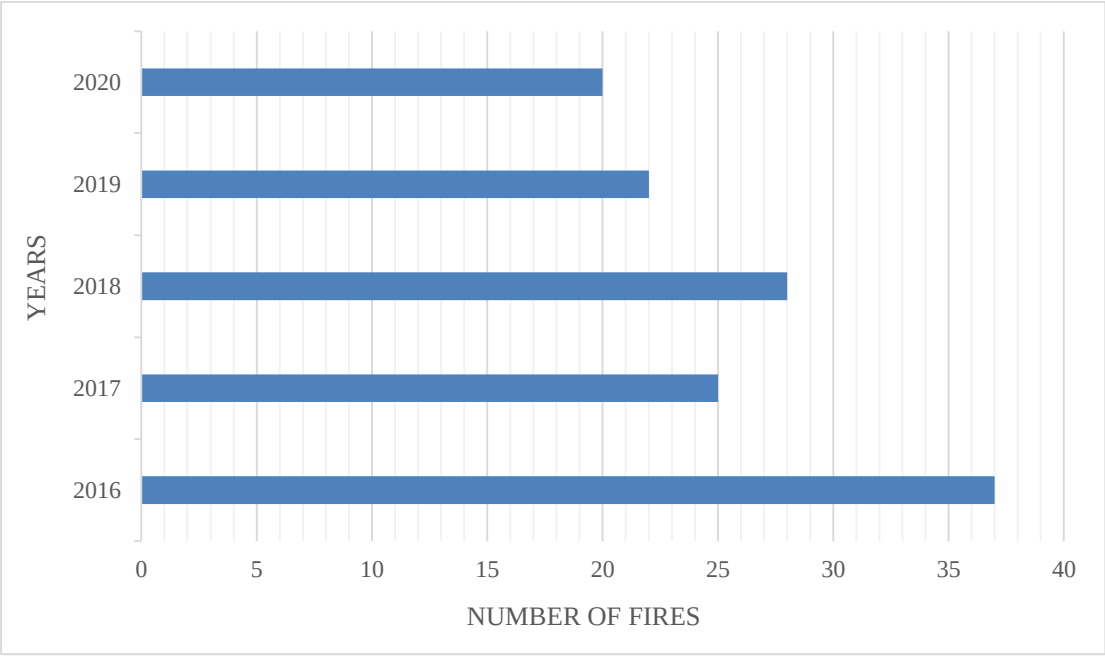


Figure 4.35. Annual distribution of chimney fires in London (2016-2020)

In the publication of London Fire Brigade, which is called ‘Fire Facts, Fires in Great London’, chimney fires are one of the headlines of primary fires. The total number of chimney fires in London from 2016 to 2020 is 132. Chimney fires are recorded as 37 in the year 2016, however, in 2020 it decreases to 20. The 5-year average is determined 26 for chimney fires that occurred between the years 2016 and 2020. Fires that happened in 2017, 2019, and 2020 are below average with respectively 25, 22, and 20.

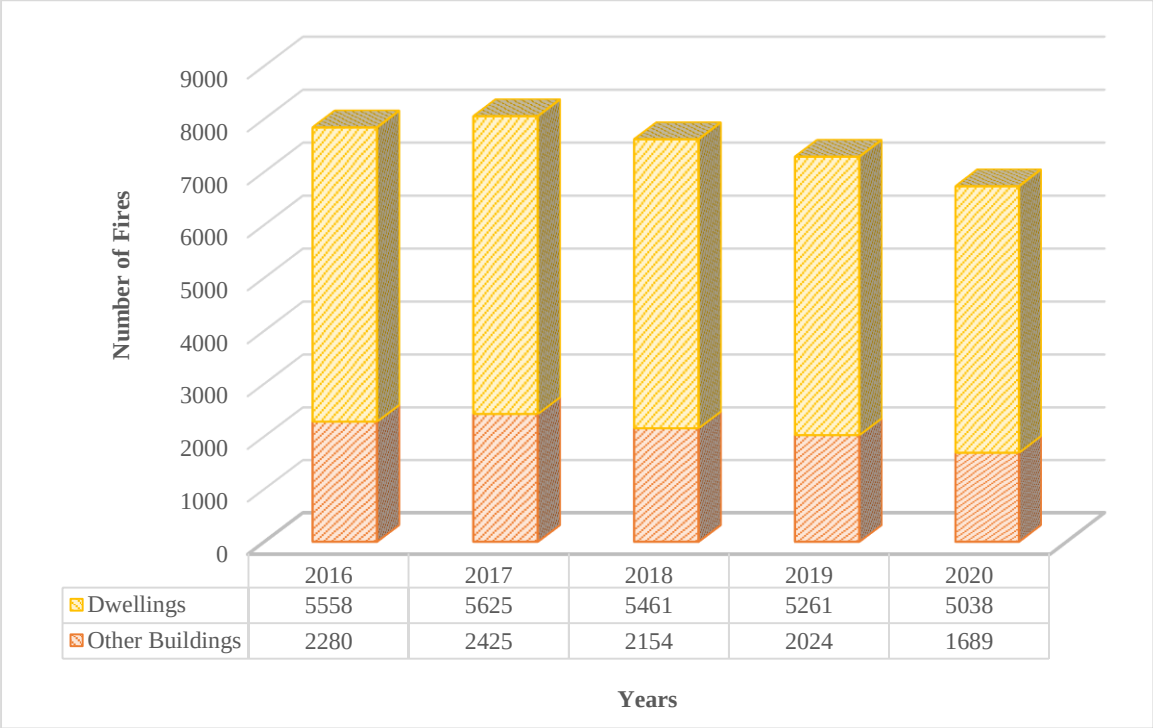


Figure 4.36. Annual distribution of the number of fires that occurred in dwellings and other buildings in London (2016-2020)

Figure 4.36 shows the number of fires between 2016 and 2020 which occurred in other buildings and dwellings by year. Among building fires, other building fires have a five-year average of 2114. In every year between 2016 and 2020, dwellings make up the vast majority with the five-year average of 5389. Although in 2017, both in other buildings and dwellings are at the highest number with respectively 2425 and 5625. Consequently, there is an overall decline in the number of fires.

Building types are divided into two categories as dwellings and other buildings because Istanbul Fire Department publishes the building fire data as dwellings, workspaces, and other buildings. To make comparisons between cities, London’s and New York City’s

building data are also reviewed under two categories like Istanbul. However, to indicate that London Fire Brigade keeps the fire data detailly, other buildings are tabulated under property type.

Table 4.10. Annual distribution of other building fires in London by property type (2016-2020)

Property type / Year	2016	2017	2018	2019	2020
Total fires (other buildings)	2280	2425	2154	2024	1689
Hotel	110	126	131	98	90
Dormitory	47	53	58	56	36
Care homes	130	150	138	139	107
Religious buildings	13	20	26	27	10
Education premises	92	123	103	101	57
Hospitals	109	96	97	81	68
Entertainment / culture / sport	463	501	429	365	311
Food and drink premises	346	372	321	310	224
Public utilities	294	294	192	258	205
Workspaces	249	252	237	214	150
Unspecified	427	438	422	375	431

The table explains other building fires in terms of the type of building annually between the years 2016-2020. In general, it is possible to see an overall decline in other building fires. Although in 2017 total other building fires are at the highest number with 2425, the 5-year average is determined as 2114. If unspecified fires are ignored, entertainment and culture make up the vast majority of other building fires every year.

Hotel headline includes temporary accommodation such as motel, hostel, boarding house, and other holiday residences. The 5-year average of this headline is determined as 111. Between 2016 and 2020, the number of hotel fires reaches the highest point with 131 in 2018. In 2019 and 2020, the trend is leveled out with respectively 98 and 90.

The dormitory covers student hall of residence, boarding school accommodation, and barracks. In 2018, dormitory fires are at the highest number with 58. In the years between 2016 and 2020, the 5-year average is 50. In 2020, 36 dormitory fires occurred in London. It is the lowest number and under the average.

Care homes headline contains nursing homes, care homes, hospice, old persons home, sheltered housing, and children's home. The 5-year average of care homes is 133. In 2017, care home fires reach the highest number with 150 between the years 2016 and 2020. In 2020, the lowest care home fires occurred in London with 107.

Religious buildings include monasteries and convents. This property type constitutes the smallest percentile among other building fires between 2016 and 2020. In 2019, the number of fires is at the highest level with 27. Its 5-year average is determined as 19. Fires that occurred in 2016 and 2020 are below average with respectively 13 and 10.

Education premises covers primary schools, high schools, universities, and other educational buildings. Between 2016 and 2020, the number of educational building fires reaches the highest point in 2017 with 123. Since the 5-year average of this headline is 95, in 2016 and 2020 the number of fires is below average with respectively 92 and 57.

Hospital headline also contains doctors' accommodation in campuses since the users of accommodation use building for providing service to the hospital. The 5-year average of hospital fires in London is 90. In 2016, the number of fires is at the highest with 109. There is an overall decline between the years 2016 and 2020. Furthermore, in 2019 and 2020, fires that occurred are below average with respectively 81 and 68.

Entertainment, culture, and sport are the headline of cinema, theatre, clubhouse, recreation facilities, sporting venues, and retail premises. In 2017, the number of fires reaches the highest with 501. However, this headline has a 5-year average of 414. Between 2016 and 2020, the trend is leveled out in 2019 and 2020 with respectively 365 and 311.

Food and drink premises include restaurants, cafes, bars, pubs, etc. The 5-year average of this headline is determined as 315. Between 2016 and 2020, the highest number of fires occurred in 2017 and the lowest in 2020. In 2019 and 2020, fires are below average.

Public utilities contain business undertakings that provide necessary services to society. The undertakings dealing with the supply of electricity, power, gas, water, transport, etc. are all covered under the title of public utility services. Public admin, security, safety, warehouses, bulk storage, transport buildings, car parks, and animal boarding are also considered in this headline since in these buildings, inhabitants' needs are provided. All these things are needed in the daily life of the people. In 2016 and 2017, public utility fires are at the highest number with 294. Between the years 2016 and 2020, the 5-year average is 249. Unlike other building types, the lowest fire number has occurred in 2017 with 192.

Workspaces define offices, call centers, and production spaces such as industrial manufacturing and processing premises. The 5-year average of this headline is determined as 220. The number of fires is below average in 2019 and 2020 with respectively 214 and 150. In 2017, workspace fires reach the highest number with 252 between 2016 and 2020.

Unspecified is the headline of buildings that are known however not detailed as one of the building types. In the publication of London Fire Brigade, under the category of fires in non-residential buildings, there are fire numbers by building type. One of the building types is defined as non-residential. However, there is no further information about their type. In 2017, the highest number of fires occurred in London with 438. Between the years 2016 and 2020, the 5-year average is 419.

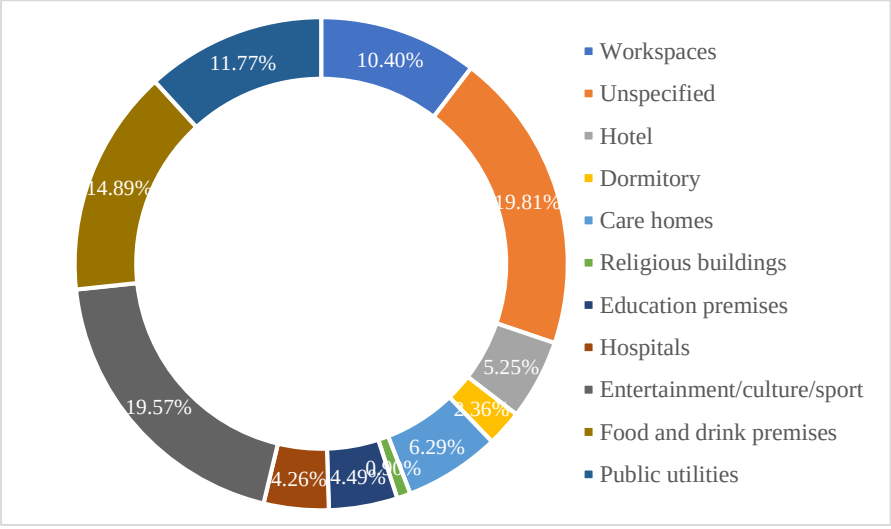


Figure 4.37. Distribution of the 5-year average of fires that occurred in other buildings in London by property type (2016-2020)

According to 5-year averages, between the years 2016 and 2020, the building types with the most fires occurred are respectively unspecified, entertainment and culture, food and drink, public utilities, workspaces, care homes, hotel, education, hospitals, dormitory, and religious buildings. It should be noted that every unspecified information causes unreliable statistics. Although London Fire Brigade publishes every detail of every fire, their annual publications should have given detailed information too. If unspecified fires are ignored, the category of entertainment and culture has the vast majority of other building fires. The religious buildings constitute the smallest percentile among all.

To identify if there is a decline in fires, every building type is evaluated within their averages annually. Except for unspecified fires, every building type is below average in the year 2020. However, most of them such as hotels, hospitals, entertainment and culture, food and drink, and workspaces are also below their averages in 2019. With this information, it is possible to say there is an overall decline in every building type in case of fire occurred. Furthermore, between 2016 and 2020, from 2019 the trend of increasing is leveled out.

Table 4.11. Annual distribution of other building fires in London by causes of fires (2016-2020)

Causes of fires / Year	2016	2017	2018	2019	2020
Electrical cause	1071	1128	991	936	706
Smoking	499	528	434	451	369
Chimney fires	4	5	2	3	-
Hot work	116	124	125	86	65
Fireplace	77	107	86	81	70
Other known	513	533	516	467	479

To enhance fire precautions, it is very important to determine the causes of fires. The above table is created for this purpose. In Chapter 3 (General Knowledge about Causes of Fires), causes of fires are introduced as the electrical cause, smoking, willfully/intentionally started by man, self-ignition, chimney fires, hot work, fireplace, lightning, children carelessness, other known causes, and unknown causes.

Willfully/intentionally started fires are one of the causes of fires. However, the publication of London Fire Brigade shares this data generally. Since it is impossible to determine whether it represents which type of building, deliberate fires are reviewed separately rather than reviewed under causes of fires of other buildings.

In the publication of London Fire Brigade, there is information about the source of ignitions of fires. However, there is no information about whether it is caused by spontaneous combustion. This is the reason why the self-ignition headline is absent at the table. This situation also includes children carelessness too. Although the source of ignitions includes matches and candles, there is no information that it is a child playing with them. It should be noted that all information about fires plays a crucial role to determine fire precautions. Besides all these shortcomings, the absence of unknown causes is a sign of reliable statistics.

Electrical causes include electricity supply, electric lightning, cooking appliance, and other domestic style appliance. In 2017, it reaches the highest number with 1128. Between the years 2016 and 2020, it is at the lowest point with 706 in 2020. In 2019 and 2020, the number of electrically caused fires is below the 5-year average with respectively 936 and 706.

Smoking fires contain tobacco products and matches which are used for smoking. In 2018, 2019, and 2020, the numbers are below the 5-year average with respectively 434, 451, and 369. In 2020, the number of smoking fires is at the lowest point with 369. Between the years 2016 and 2020, it reaches the highest number in 2017 with 528.

The ignition of soot accumulated in the kitchen aspirator and chimneys poses a potential fire hazard. Chimney fires can easily turn into roof fires. Furthermore, roof fires can turn into building fires. Between 2016 and 2020, the most chimney fires have occurred in the year 2017 with only 5 fires. Among all other building fires that occurred in 2020, no chimney fires happened, and this is the lowest number between 2016 and 2020. The 5-year average of chimney fires is determined as 3. Fires in 2018 and 2020 are below average with respectively 2 and 0. As seen on the table, there is an overall decline in chimney fires.

Hot work headline also includes industrial equipment. Between 2016 and 2020, it is at the lowest number with 65 in 2020. However, the greatest number of hot work fires occurred in 2018 with 125. In 2019 and 2020, fire numbers are below the 5-year average with respectively 86 and 65.

The headline of fireplace fires can be renamed as heating equipment. In 2017, the number of fires has reached the highest point with 107. Between the years between 2016 and 2020, the 5-year average is above the number of fires that occurred in 2016, 2019, and 2020. Furthermore, in 2020, only 70 fireplace fires happened, and it is the lowest number.

Other known causes contain other sources, naked flame, fuel fires caused by the evaporation of fuel in open containers and igniting from the environment, chemicals, office equipment, bombs, and explosives. These causes are considered under other known causes because the reason why the fire started is known however these cannot be categorized under other headlines. The 5-year average of this headline is above the number of fires that occurred in 2019 and 2020 with respectively 470 and 479. The lowest number of fires caused by other known reasons is in the year 2020.

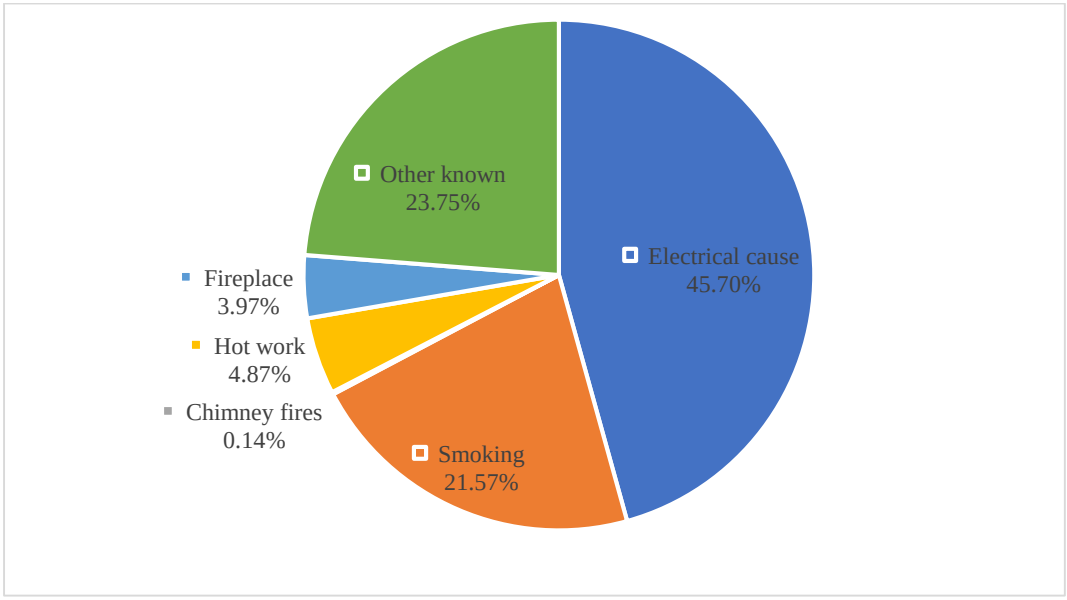


Figure 4.38. Distribution of the 5-year average of causes of fires that occurred in other buildings in London (2016-2020)

When the causes of fires in other buildings in London between 2016 and 2020 are examined, it was seen that the highest rate was the electrical cause with 45,70% and the 5-

year average of this cause is determined as 966. Non-compliance with the operating instructions, negligence, and carelessness during the use of electrical devices cause fires. In addition, failure to make electrical installations under the instructions also creates a fire hazard.

Fires originating from other known causes take second place with a rate of 23,75% in the causes of fire. Between the years 2016 and 2020, the 5-year average of these fires is 502. 21,57% of the fires that occurred between 2016 and 2020 are seen as smoking and its 5-year average is determined as 456. Because people throwing their cigarettes into the trash cans or out of the balcony without putting them out causes fires. The rate of fires caused by hot work in London is 4,87% since its average is 103. Fireplace fires account for 3,97% of the fires that occurred in other buildings between 2016 and 2020 in London with a 5-year average of 84. Lastly, chimney fires account for 0,14% since the 5-year average is 3. This ratio is the lowest of all causes of fires.

4.2. National Fire Statistics

Analysis of fire statistics is crucial for fire safety. The future of national fire services is determined by statistics of fire. At present, fire departments in some provinces publish fire numbers in Turkey. There is no organization that reports fire statistics across the country. However, fire statistics are kept identifying the strategies of fire statistics, especially in other countries that have high standards and regulations of fire safety. Comparing types of statistical data between our country and other countries can be used for creating fire strategies. Since fires caused naturally or man-made can cause property losses and even casualties. The risk of fires can be altered when statistical data is collected professionally, and the results of these fires become minimized.

For keeping statistical data of Turkey, Devlet İstatistik Umum Müdürlüğü was established in 1927 and was organized as Devlet İstatistik Enstitüsü in 1963. Although it is seen that the need for statistics has grown and its importance has increased, sufficient importance was not given to the keeping of fire data. This did not allow our country to evaluate fire statistics and analyze them effectively. Furthermore, the European Fire Database was developed to keep the national fire statistics of European Union countries, and in this

database, the conversion results of historical fire data are detailed for each country. Conversion to the standard class corresponding to the national fire classification of 22 EU countries was carried out. Most countries began keeping data around 1980 or even earlier. However, the European fire database started to include data from Turkey after 2005 (Bakırcı, Karatop, and Bayındır, 2019).

Statistics, which expresses systematically collected numerical facts, is frequently used in continuous improvement studies as well as providing research on a subject. It is an undeniable fact that a system should be established that will not allow any increase in the headings of "other" and "unknown" in this classification. It is an undesirable situation as the numerical accumulation of uncertain data will prevent us from finding the real result in the analysis and evaluations of the data.

4.2.1. National fire statistics in Turkey

There are many problems in assembling a real-world fire database, and Turkey is no exception. In fire reports, data are collected throughout Turkey without using a common language. In the data collection by Istanbul Fire Department, the buildings are classified into 26 classes according to their use, while the other 3 major cities of Turkey, Ankara, Izmir, and Antalya, are classified into 20 classes (Şengöz, 2018). This difference may occur from the characteristics of the provinces such as population, industry, trade, education, and cultural activities. That causes statistics not to be compared correctly.

At Turkey's regulation on fire protection article 8 classifies buildings into 10 headlines as dwellings, buildings for accommodation purposes, institutional buildings, office buildings, buildings for commercial purposes, industrial buildings, assembly buildings, facilities for storage purposes, high-risk spaces, and multipurpose buildings (Binaların Yangından Korunması Hakkında Yönetmelik, 2007). It is seen that the classification of Turkey's regulation on fire protection is insufficient in terms of the measures to be taken.

Fire departments are within the municipality due to their structuring and there is no organic link between the provinces. Therefore, the developments made remain within the province and this experience created by other provinces is not utilized. Fire data are kept at the fire brigade departments in each provincial municipality in Turkey.

Since there is no information that is published about Turkey's fire statistics, the author of this thesis sent petitions to the Disaster and Emergency Management Presidency to request Turkey's fire statistics on 21 December 2021 and then on 28 January 2022. Ministry of Interior Disaster and Emergency Management Presidency responded to the petitions on 28 February 2022 saying that Turkey's fire data should be requested from Directorate General for Local Authorities under the Ministry of Environment, Urbanization and Climate Change. Afterward, the author sent a petition to Directorate General for Local Authorities on 10 March 2022. Directorate General for Local Authorities under the Ministry of Environment, Urbanization and Climate Change responded to the petition on 11 March 2022 saying that based on law no 4982, the requested data was rejected because it required a separate or special study, research, examination, or analysis. Consequently, the author couldn't access the data.

4.2.2. National fire statistics in İstanbul

The aim of this chapter is to determine whether the data kept by Istanbul Fire Department throughout Turkey is suitable for creating strategies in this regard with scientific studies and a preventive approach and to offer suggestions for creating fire safety strategies.

Marmara Region has strategic importance in terms of industry and human density in our country. Representing a quarter of the country's population, Istanbul has the most developed fire department. Since fire statistics are kept in a certain order, the largest and most comprehensive statistics database in Turkey is also collected by the Istanbul Fire Department.

In Turkey, every fire department is one of the departments of municipalities. Istanbul Metropolitan Municipality's fire department publishes fire statistics in pdf format publication. In this publication, there are information about resources, intervention work, response times, causes of the fire, awareness-raising activities and training, and ambulance services. This publication is shared via the official web page of Istanbul Fire Department by calendar year.

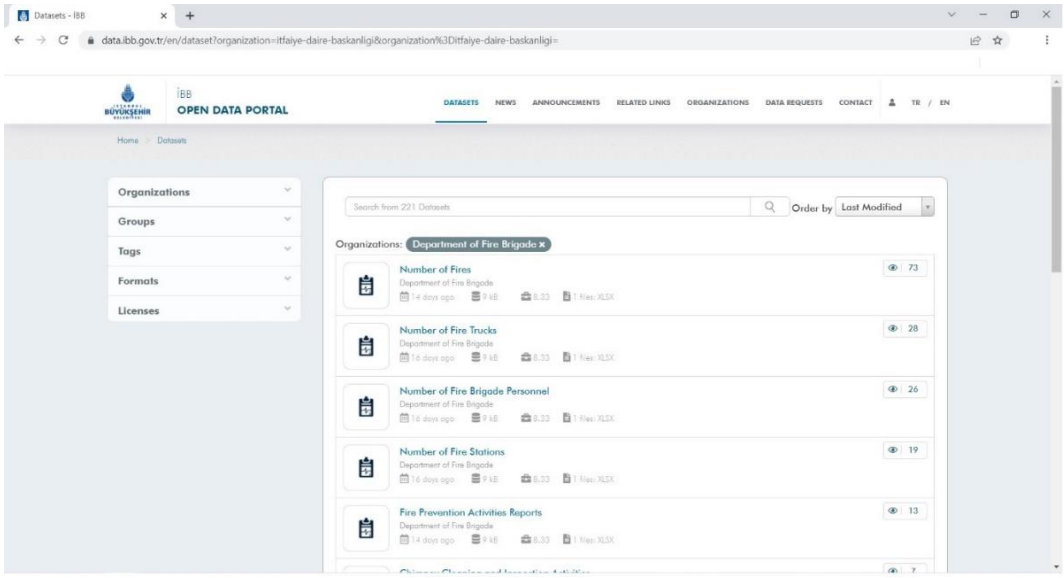


Figure 4.39. Istanbul Metropolitan Municipality's Open Data Portal which has statistics of fires prepared by the Department of Fire Brigade (İstanbul Büyükşehir Belediyesi, 2021)

Open Data Portal of Istanbul Metropolitan Municipality has some statistical fire data covering only 5- year periods. These statistics are updated regularly with the data from the Department of Fire Brigade. It is possible to access the statistics in excel format such as number of fires, number of fire tracks, number of fire brigade personnel, number of fire stations, fire prevention activities report, chimney cleaning and inspection activities, fire events, fire events average arrival time, fire awareness studying and training, etc.

Figure 4.40. Istanbul Fire Department's publication about statistics of incident (İstanbul Büyükşehir Belediyesi İtfaiye Daire Başkanlığı, 2021)

Resources headline contains detailed information about staff, fire engines, and stations. In the section of staff, the number of professional firefighters and volunteer firefighters is given annually. The fire engines section provides the number of fire-extinguishing engines, rescue engines, support vehicles, featured vehicles, and ambulances. Lastly, stations are categorized as a group, platoon, and volunteer, and their numbers are shared in this section.

The headline of intervention work refers to incidents, and fire incidents specifically. Incidents contain fire incidents, non-fire incidents, and others. Fire incidents are divided into two categories as building fires and non-building fires. Building fires are kept under four sub-headings as dwellings, industrial buildings, other buildings, and vehicles. In addition, fires are also shared per 100000 inhabitants, hour, and months. Non-building fires are grass, landfill, and forest. Non-fire incidents cover road traffic collisions, floods, security measures, and rescue services. On the other hand, there is no further information about the headline of others. Since the users of the data cannot identify the other section, it creates unreliable statistics.

Response times provide detailed information about arrival times for fire incidents, arrival times for incidents, arrival times for medical emergencies. In the annual publication, arrival times are shared as minutes.

The causes of fire are defined as smoking, electrical cause, willfully started fires, sparks, chimney fires, domestic style electrical appliance, self-heating (with high temperatures), unknown, other known, children carelessness, and flashing (caused by heated oil etc.). These data are given as numbers and ratios in the publication.

Awareness-raising activities and training are listed as in-service training, public and private sector training, training for vocational high school and vocational school students, first aid education and public health seminar, volunteer firefighter training, drills in schools and institutions, awareness activities (training for prevention from disasters, training for kindergarten and primary schools, training for the station and the disabled).

Lastly, ambulance services are divided into two main categories as medical emergency, and precautionary and support purposes. Medical emergency has 6 sub-headings which

are medical, road traffic collision, other accidents, injuries, attempted suicide, and fire. Precautionary and support purposes have 3 sub-headings precaution, intercity transfer, and others (İstanbul Büyükşehir Belediyesi İtfaiye Daire Başkanlığı, 2021).

1978-2020 DÖNEMİNE AİT YANGIN SAYILARI TABLOSU

YIL	YANGIN SAYISI
1978	3.100
1979	3.141
1980	2.912
1981	2.912
1982	3.398

Figure 4.41. An example of requested data for the academic study from Istanbul Fire Department

There is no possibility to access the detailed data which covers long-term in excel format unless academicians or students request information and document regarding academic studies. For this request to be accepted, for all kinds of information and document requests regarding undergraduate and graduate homework, thesis, article studies, etc., a petition must be filled. In the petition, the researcher or student must give some specific details such as the subject and scope of the research, method, and content of data collection. When the application is considered appropriate, the data is shared via researcher or student.

For this thesis, the author sent a petition that requests data on 22 December 2021. Afterward, Istanbul Fire Department sent the data with an official letter to Gazi University in the name of the author on 3 January 2022. For National fire statistics in Istanbul and national fire statistics in buildings in Istanbul, the data is received from Istanbul Metropolitan Municipality.

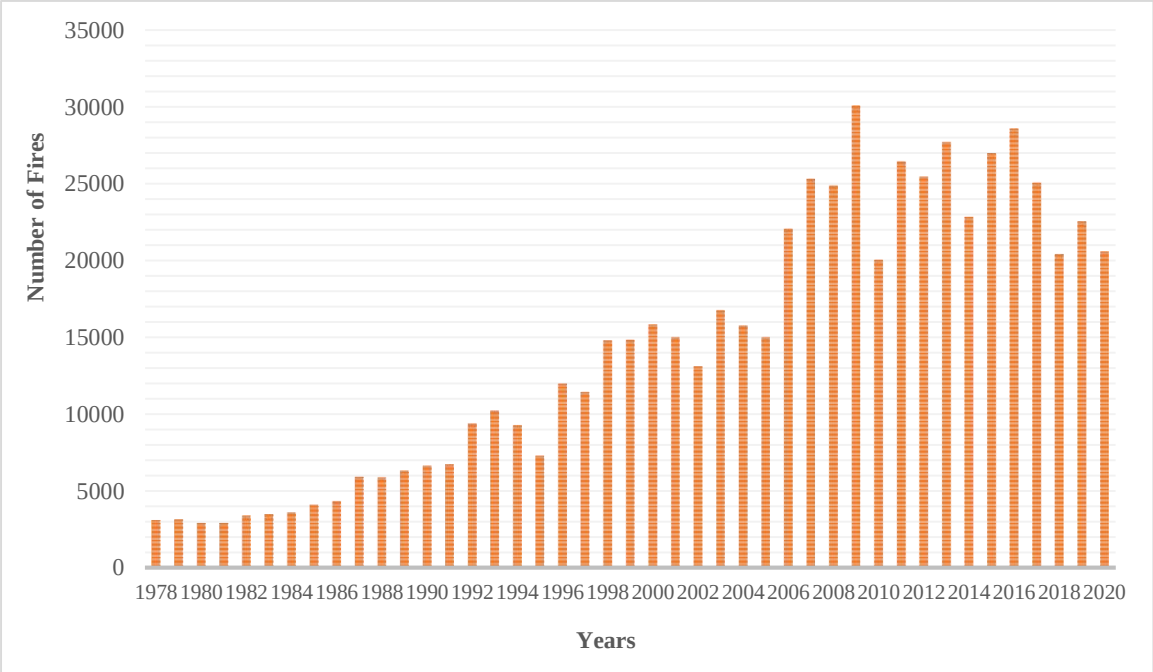


Figure 4.42. Annual distribution of the number of fires in Istanbul (1978-2020)

The total number of fires in Istanbul from 1978 to 2020 is 612277. When the figure is examined; it is seen that most fires occurred in 2009 with 30089 and the least fires occurred in 1980 and 1981 with 2912 in the years between 1978 and 2020. Although the number of total fires is decreased greatly in the years 1995, 2002, 2005, 2010, 2014, and 2018, there is an overall increase in the number of fires that occurred from 1978 to 2020. In this context, it is thought that the number of fires is not collected correctly for the past years. Since Istanbul is the most crowded city in Turkey, there is no possibility that only 3100 fires occurred in the year 1981. This inference covers other years as well. However, the increase seen in the graph shows that it has been more attentive in keeping the data over the years.

Table 4.12. The number of fires in relation to the number of inhabitants in Istanbul (2000-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2020	20 584	15 462 452	1,33
2019	22 546	15 519 267	1,45
2018	20 416	15 067 724	1,35

Table 4.12. (continues) The number of fires in relation to the number of inhabitants in Istanbul (2000-2020)

Year	Fire	Inhabitants	Fires / 1000 inhabitants
2017	25 073	15 029 231	1,66
2016	28 586	14 804 116	1,93
2015	26 978	14 657 434	1,84
2014	22 848	14 377 018	1,58
2013	27 717	14 160 467	1,95
2012	25 469	13 854 740	1,83
2011	26 444	13 624 240	1,94
2010	20 046	13 255 685	1,51
2009	30 089	12 915 158	2,32
2008	24 889	12 697 164	1,96
2007	25 319	12 573 836	2,01
2006	22 064	12 351 506	1,78
2005	15 004	12 128 577	1,23
2004	15 767	11 910 733	1,32
2003	16 763	11 699 172	1,43
2002	13 114	11 495 948	1,14
2001	15 012	11 292 009	1,32
2000	15 844	11 076 840	1,43

The number of fires is shown in the table above in relation to the number of people living in Istanbul. Population numbers are received from Turkish Statistical Institute (Turkish Statistical Institute, 2021). End-of-the-year populations for the 2000-2006 period were estimated based on Address Based Population Registration System results by TurkStat. From 2007 to 2020, results are received from the Address Based Population Registration System. Although the fire precautions taken in Istanbul have improved in recent years, the biggest reason for the increase in fires is the rapid increase in the number of buildings and the population.

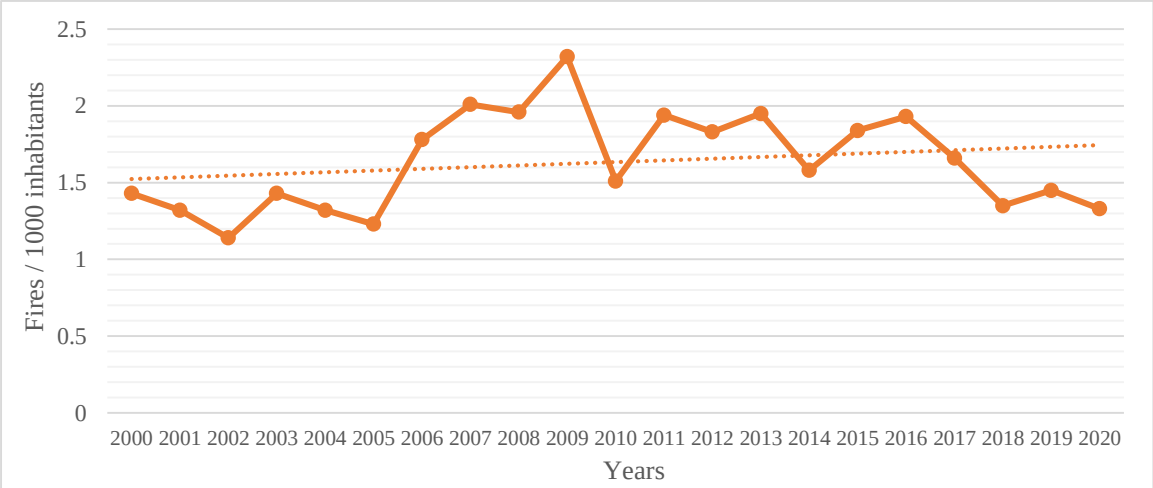


Figure 4.43. Annual distribution of fires in Istanbul per 1000 inhabitants (2000-2020)

When the populations of each year are compared with the total number of fires, it is seen that the number of fires per 1000 inhabitants increased slightly during the period 2000-2020. Although, between the years 2000 and 2020, Istanbul has the least population in 2000, the same year with a population of nearly 11 million accounts for the ratio of 1,43 fires per 1000 inhabitants. On the other hand, with a population close to 16 million, which is the largest population number, 2019 constitutes this rate with 1,45. In 2009, since the number of total fires accounted for the highest at all, the ratio is also highest with 2,32. Furthermore, in 2002, the number of total fires is at the lowest point between 2000 and 2020, in the same year the ratio is determined to be 1,14.

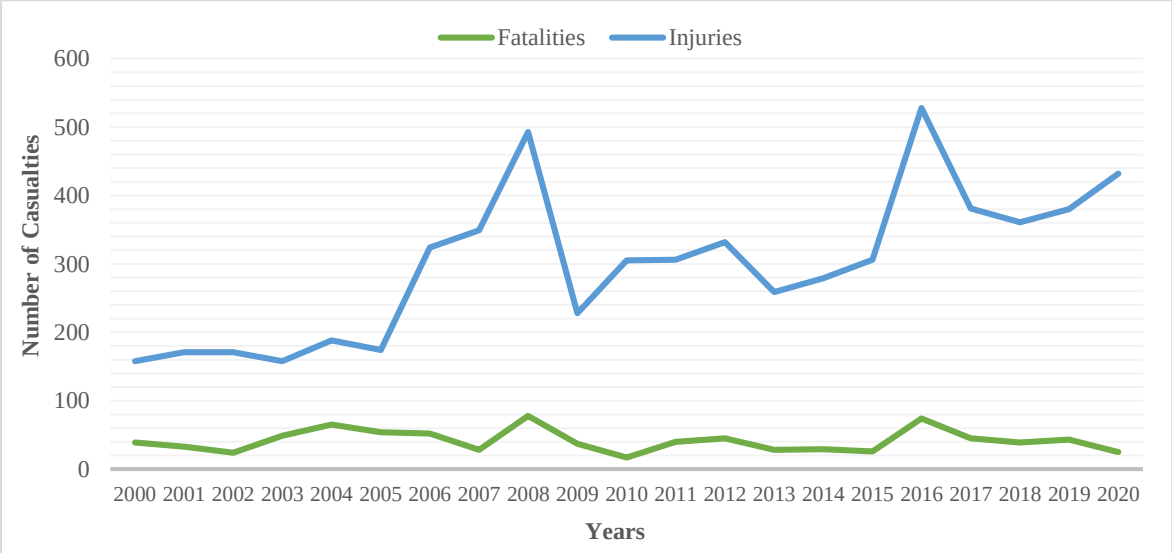


Figure 4.44. Annual distribution of numbers of fatalities and injuries caused by fires in Istanbul (2000-2020)

For this figure, the data on fatalities and injuries are received from Istanbul Fire Department. The total number of fatalities caused by fires between the years 2000 and 2020 is 870. The 5-year average is determined as 41. When the figure is examined, it is seen that most fatalities occurred in 2008 with 78 and the least fatalities occurred in 2010 with 17.

Between the years 2000 and 2020, 6283 injuries happened due to fires that occurred in Istanbul. The 21-year average is determined as 299. On the other hand, between 2016 and 2020, the 5- year average is 416. Since there is a significant increase in averages, it is an indication of an overall increase in the number of injuries. When the figure is examined, it is seen that most injuries happened in the year 2016 with 528 and the least injuries happened in 2000 and 2003 with 158.

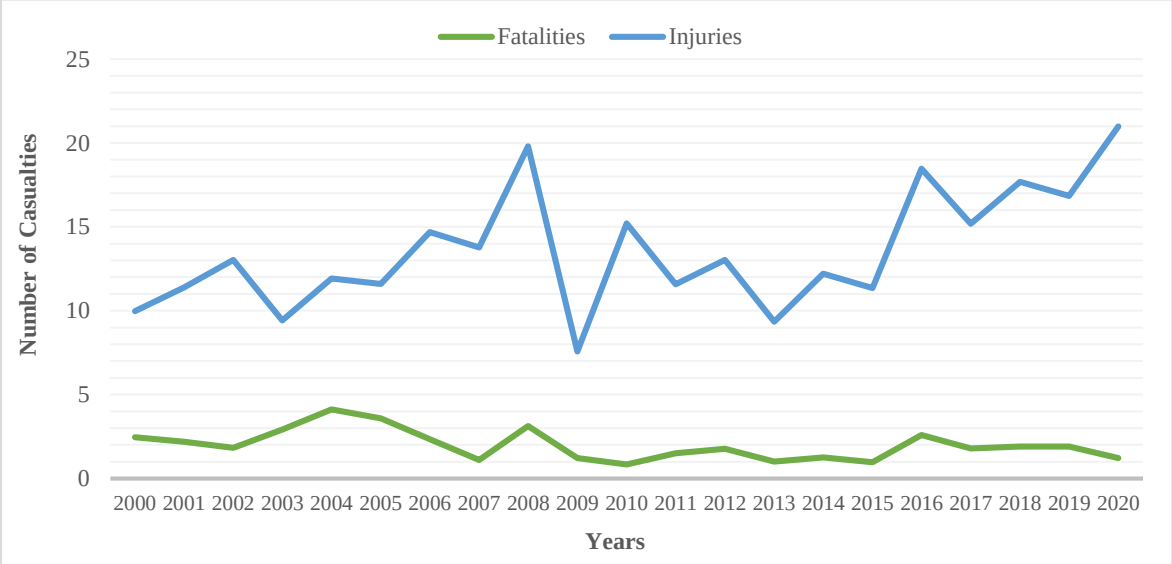


Figure 4.45. Annual distribution of fatalities and injuries occurred in Istanbul per 1000 fires (2000-2020)

When the figure is examined, between 2000 and 2020, it is seen that most fatalities occurred in 2005 with 3,59 per 1000 fires and the least fatalities occurred in 2010 with 0,84. As seen in the previous figure, it is possible to say that there is an increase in the number of injuries. This figure also supports the increase with a different perspective to the same issue. Most injuries per 1000 fires happened in the year 2020 with 20,98 and the least injuries per 1000 fires happened in 2009 with 7,57. This result also supports the increase in the number of injuries in the previous figure.

Table 4.13. Annual distribution of total fires in Istanbul by causes of fires (2016-2020)

Causes of fires / Year	2016	2017	2018	2019	2020
Electrical cause	7555	7645	6514	5823	5517
Smoking	11 341	8420	7153	9201	8110
Deliberate fires	1701	1550	1493	1329	1286
Self-ignition	842	943	862	924	886
Chimney fires	1374	867	553	614	396
Hot work	2729	1981	1486	1749	1516
Fireplace	141	121	107	69	109
Lightning	13	55	21	15	12
Children Carelessness	1272	1206	1138	1238	1049
Other known	1296	2004	805	1302	1415
Unknown	322	281	284	282	288

The above table is created for presenting the annual distribution of total fires in Istanbul in terms of causes of fires. In Chapter 3 (General Knowledge about Causes of Fires), causes of fires are introduced as the electrical cause, smoking, willfully/intentionally started by man, self-ignition, chimney fires, hot work, fireplace, lightning, children carelessness, other known causes, and unknown causes. So, the data which is received from İstanbul Fire Department is adapted to causes which are defined detailly in this thesis.

Electrical causes include electrical causes and domestic style electrical appliances. In 2017, it reaches the highest number with 7645. Between the years 2016 and 2020, it is at the lowest point with 5517 in 2020. In 2018, 2019, and 2020, the number of electrically caused fires is below the 5-year average with respectively 6514, 5823, and 5517.

Smoking fires contain tobacco products and matches which are used for smoking. In 2017, 2018, and 2020, the numbers are below the 5-year average with respectively 8420, 7153, and 8110. In 2018, the number of smoking fires is at the lowest point with 7153. Between the years 2016 and 2020, it reaches the highest number in 2016 with 11341.

Deliberate fires are also named as willfully/intentionally started fires by man. Istanbul Fire Department keeps this data under two different headlines as sabotage and willfully (motivation undetermined). Between 2016 and 2020, these fires are at the lowest point with 1286 in the year 2020. However, the greatest number of deliberate fires occurred in 2016 with 1701. The number of fires is below the 5-year average in 2019, and 2020 with respectively 1329, and 1286.

Self-ignition is also known as spontaneous combustion. In the publication of Istanbul Fire Department, these fires are named self-heating (with high temperatures). In 2017, it reaches the highest number with 943. Between the years 2016 and 2020, it is at the lowest point with 842 in 2016. In 2016, 2018, and 2020, the number of self-ignition fires is below the 5-year average with respectively 842, 862, and 886.

Between 2016 and 2020, the most chimney fires have occurred in the year 2016 with only 1374 fires. Among all fires that occurred in 2020, 396 chimney fires happened, and this is the lowest number between 2016 and 2020. Fires in 2018, 2019, and 2020 are below average with respectively 553, 614, and 396.

Hot work headline includes sparks. Between 2016 and 2020, it is at the lowest number with 1486 in 2018. However, the greatest number of hot work fires occurred in 2016 with 2729. In 2018, 2019, and 2020, fire numbers are below the 5-year average with respectively 1486, 1749, and 1516.

In Turkey, fireplace fires contain stoves that are used for heating purposes. In 2018, and 2019, the numbers are below the 5-year average with respectively 107, and 69. In 2019, the number of fireplace fires is at the lowest point with 69. Between the years 2016 and 2020, it reaches the highest number in 2016 with 141.

In 2017, lightning fires reaches the highest number with 55. Between the years 2016 and 2020, it is at the lowest point with 12 in 2020. In 2016, 2018, 2019, and 2020, the number of lightning fires is below the 5-year average with respectively 13, 21, 15, and 12.

The headline of children carelessness can be renamed as fires caused by children playing with fire. In 2016, the number of fires has reached the highest point with 1272. Between

the years between 2016 and 2020, the 5-year average is above the number of fires that occurred in 2018, and 2020. Furthermore, in 2020, only 1049 fire incidents caused by children playing with fire happened, and it is the lowest number.

Other known causes contain flashing (caused by heated oil, flammable liquid, etc.), explosion of LPG, deflagration of fuel oil and gasoline, natural gas explosion, ignition of chemicals, explosion, and candles. These causes are considered under other known causes because the reason why the fire started is known however these cannot be categorized under other headlines. The 5-year average of this headline is above the number of fires that occurred in 2016, 2018, and 2019 with respectively 1296, 805, and 1302. The lowest number of fires caused by other known reasons is in the year 2018.

It should be noted that all information about fires plays a crucial role to determine fire precautions. Besides all these shortcomings, the absence of unknown causes is a sign of reliable statistics. Between 2016 and 2020, the most fires caused by unknown reasons have occurred in the year 2016 with 322 fires. Among all fires that occurred in 2017, 281 fires happened, and this is the lowest number between 2016 and 2020. Fires in 2017, 2018, 2019, and 2020 are below average with respectively 281, 284, 282, and 288.

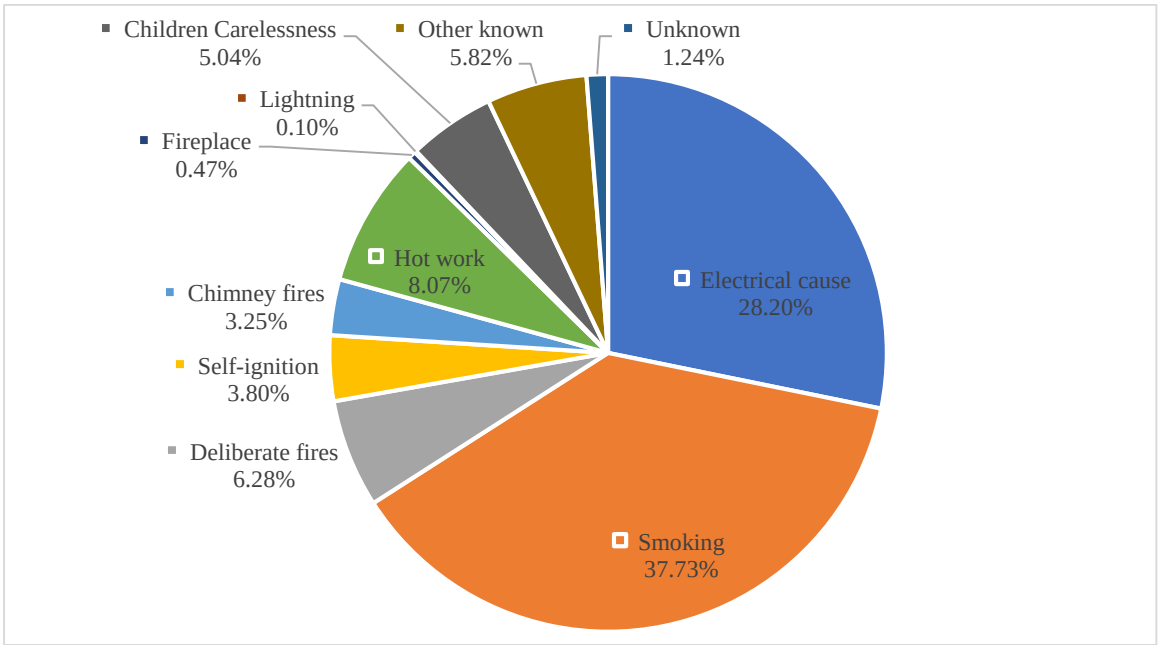


Figure 4.46. Distribution of the 5-year average of causes of all fires that occurred in Istanbul (2016-2020)

When the causes of fires in Istanbul between 2016 and 2020 are examined, it was seen that the highest rate is smoking with 37,73% and the 5-year average of this cause is determined as 8845. Fires originating from the electrical causes take second place with a rate of 28,20% in the causes of fire. Between the years 2016 and 2020, the 5-year average of these fires is 6611. The aging installations and the increase in the energy consumed per person have also been effective for the ratio of electrical causes.

8,07% of the fires that occurred between 2016 and 2020 are caused by hot work and its 5-year average is determined as 1892. The rate of fires caused by willfully/intentionally started fires by man in Istanbul is 6,28% since its average is 1472. Fires caused by other known reasons account for 5,82% of the fires that occurred between 2016 and 2020 in Istanbul with a 5-year average of 1364. Other known reasons are followed by children carelessness which has a 5-year average of 1181, and the percentage is determined as 5,04%. Fires caused by self-ignition account for 3,80% since the 5-year average is 891. Chimney fires have a 5-year average of 761 and it is accounted for 3,25%. Unknown causes average is 291 and the percentage is determined 1,24%. 0,47% of the fires are caused by fireplaces with a 5-year average of 109. Lastly, the headline of lightning has a percentage of 0,10 and its 5-year average is 23. This ratio is the lowest of all causes of fires.

Table 4.14. Annual distribution of fires in Istanbul by property categories (2016-2020)

Year	Total fires	Building fires	Vehicle Fires	Outdoor Fires
2020	20 584	11 496	1584	7504
2019	22 546	12 040	1630	8876
2018	20 416	12 416	1558	6442
2017	25 073	15 152	1781	8140
2016	28 586	14 950	1940	11 696

The above table explains building fires in Istanbul in terms of property categories annually between the years 2016-2020. In general, it is possible to see an overall decline in total fires. Although in 2016 total fires are at the highest number with 28586, the 5-year average is determined as 23441. On the other hand, the least number of fires occurred in

Istanbul in the year 2018 with 20416. The number of fires is below the 5-year average in the years 2018, 2019, and 2020 with respectively 20416, 22546, and 20584.

Building headline has the 5- year average of 13211 between the years 2016 and 2020. In 2017, building fires are at the highest number with 15152. In 2020, 11496 building fires occurred in Istanbul. It is the lowest number and under the average. In addition, fires that occurred in 2018 and 2019 are below average.

The vehicle property category constitutes the smallest percentile among total fires between 2016 and 2020. In 2016, the number of fires is at the highest level with 1940. Its 5-year average is determined as 1699. Fires that occurred in 2018, 2019, and 2020 are below average with respectively 1558, 1630, and 1584.

The 5-year average of outdoor fires is determined as 8532. The number of fires is below average in 2017, 2018, and 2020 with respectively 8140, 6442, and 7504. In 2016, outdoor fires reach the highest number with 11696 between the years 2016 and 2020.

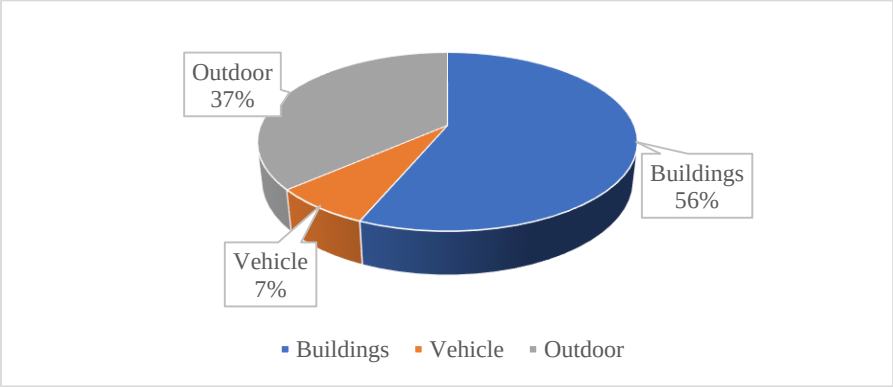


Figure 4.47. Distribution of the 5-year average of fires that occurred in Istanbul by property categories (2016-2020)

To focus on the building fires, property categories of total fires are reviewed. From 2016 to 2020, every year, building fires make up the vast majority of total fires with a 5-year average of 13211. Secondly, outdoor fires are following building fires in total fires which has a 5-year average of 23441. The average of five years is determined as 8532 for outdoor fires. Vehicle fires have the least percentile among other categories with a five-year average of 1699 and a constant decrease every year. Consequently, buildings and outdoors are places where most of the fire occurred.

4.2.3. National fire statistics in buildings in Istanbul

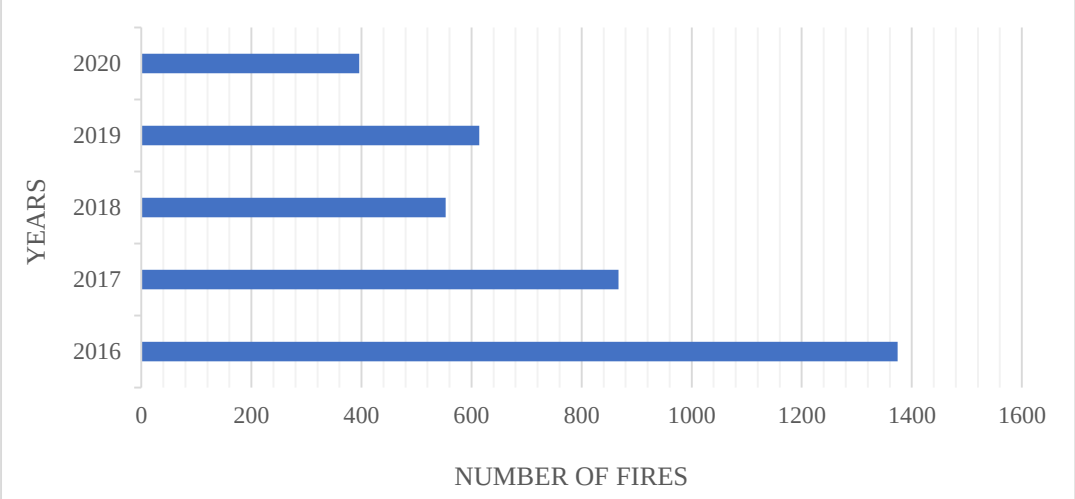


Figure 4.48. Annual distribution of chimney fires in Istanbul (2016-2020)

The total number of chimney fires in Istanbul from 2016 to 2020 is 3804. Chimney fires are recorded as 1374 in the year 2016, however, in 2020 it decreases to 396. The 5-year average is determined 761 for chimney fires that occurred between the years 2016 and 2020. Fires that happened in 2018, 2019, and 2020 are below average with respectively 553, 614, and 396.

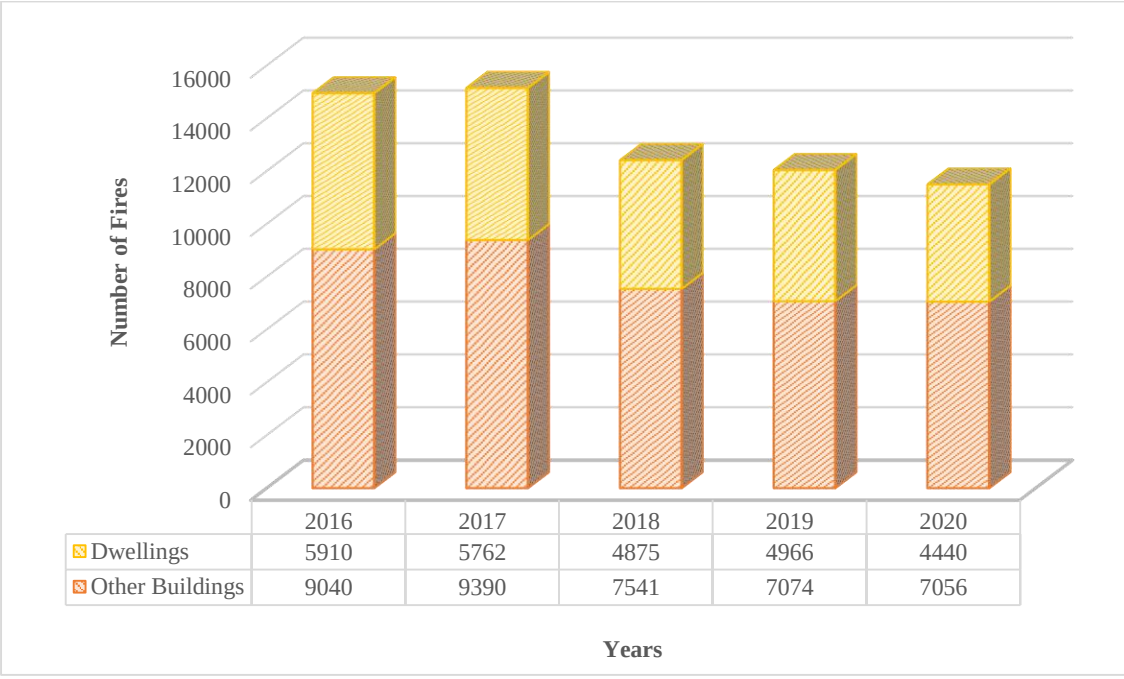


Figure 4.49. Annual distribution of the number of fires that occurred in dwellings and other buildings in Istanbul (2016-2020)

Istanbul Fire Department publishes the building fire data as dwellings, workspace including industrial manufacturing and processing premises, and lastly other buildings. To make comparisons between cities, London's and New York City's building types are also reviewed under two categories like Istanbul. However, extra tables and graphics are prepared to indicate that under the other building headline, it is possible to access every building type and their causes of fire for London and New York City.

The above figure shows the number of fires in Istanbul between 2016 and 2020 which occurred in dwellings and other buildings by year. In every year between 2016 and 2020, other buildings make up the vast majority with the five-year average of 8020 among all building fires. In 2018, 2019, and 2020 the number of other building fires is below average. Additionally, dwellings have a 5-year average of 5191. The 5-year average of dwelling fires is above the number of fires that occurred in the years 2018, 2019, and 2020.

The number and cause of fires in a residential area depend on the population of the city, the education level of the people, the infrastructure of the city, the amount of energy consumed per capita, and the type of energy. As the population increases and the amount of energy consumed per person increases, the number of fires increases. As fire precautions improve, the number of fires decreases (Kılıç, 2018). Consequently, there is an overall decline in the number of fires that occurred in Istanbul.

Table 4.15. Annual distribution of other building fires in Istanbul by property type (2016-2020)

Property type / Year	2016	2017	2018	2019	2020
Total fires (other buildings)	9040	9390	7541	7074	7056
Workspaces	153	166	164	179	182
Unspecified	8887	9224	7377	6895	6874

The table explains other building fires in terms of the type of building annually between the years 2016-2020. In general, it is possible to see an overall decline in other building fires. Although in 2017 total other building fires are at the highest number with 9390, the 5-year average is determined as 8020.

Workspaces define offices and production spaces such as industrial manufacturing and processing premises. The 5-year average of this headline is determined as 169. The number of fires is below average in 2016, 2017, and 2018 with respectively 153, 166, and 164. In 2020, workspace fires reach the highest number with 182 between 2016 and 2020.

Unspecified is the headline of buildings that are known however not detailed as one of the building types. In the publication of Istanbul Fire Department, there are fire numbers by building type. One of the building types is defined as other buildings. However, there is no further information about their building type. In 2017, the highest number of fires occurred in unspecified buildings with 9224. Since, between the years 2016 and 2020, the 5-year average is 7851, fires that occurred in 2018, 2019, and 2020 are below the 5-year average.

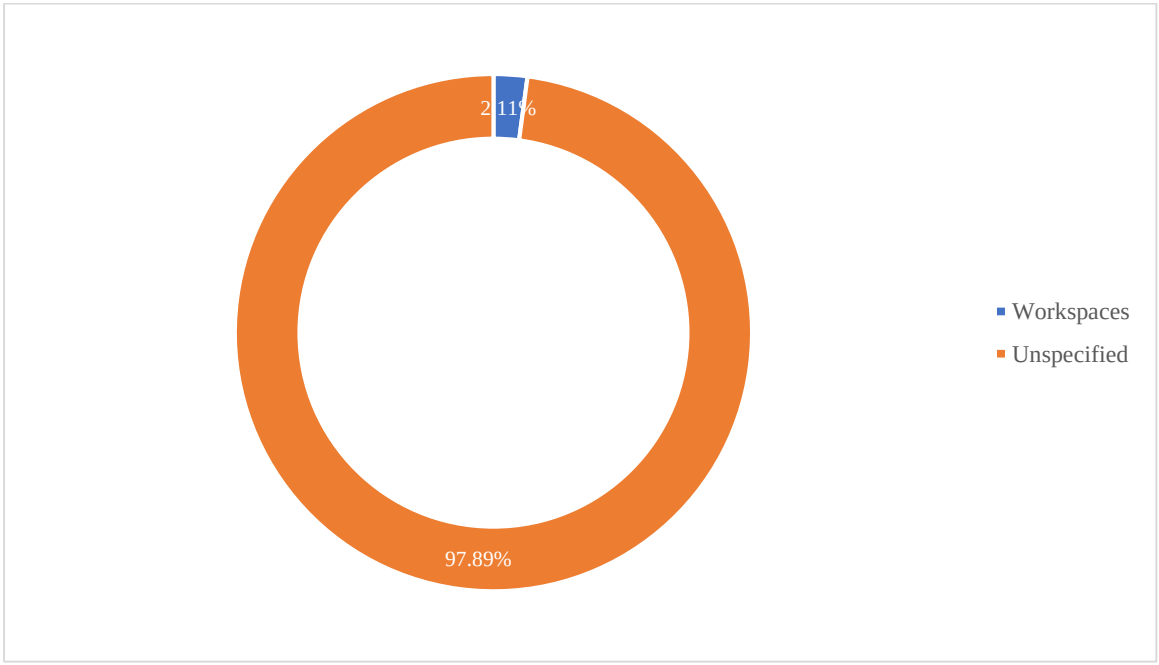


Figure 4.50. Distribution of the 5-year average of fires that occurred in other buildings in Istanbul by property type (2016-2020)

According to 5-year averages, between the years 2016 and 2020, the building types with the most fires that occurred are respectively unspecified, and workspaces. It should be noted that every unspecified information causes unreliable statistics. Although Istanbul Fire Department keeps the fire data more detailed, their publications should have given detailed information too. If unspecified fires are ignored, the category of workspaces has the vast majority of other building fires.

5. FINDINGS AND CONCLUSION

In this chapter, findings and conclusion contains comparison within countries (England and United States of America) and cities (Istanbul, London and New York City).

5.1. Findings

Table 5.1. Comparison of data collected for fire statistics within Turkey, United States of America, and England tabulated by the author

Subject of Statistics	Turkey	United States of America	England
Number of fires	X	X	X
Types of fires	X	X	X
Structural fires	X	X	X
Non-structural fires	X	X	X
Time of fire	X	X	X
Distribution of fires in months	X	X	X
Average response times	X	X	X
Number of fire departments	X	X	X
Number of fire engines	X	X	X
Number of firefighters	X	X	X
Number of volunteer firefighters	X	X	X
Number of firefighter deaths	X	X	X
Number of firefighter injuries	X	X	X
Number of civilian injuries	X	X	X
Number of civilian deaths	X	X	X
Financial losses		X	X
Number of false fire alarms		X	X

In terms of the scope and depth of the statistics kept, it is possible to say that it is not very suitable and sufficient for creating a strategy for fire safety. For instance, the type, material, age, and similar features of the buildings are not available. The title, which is left too wide as the other building, should be narrowed. It will help experts and researchers to make more effective and efficient analyses to take precautions and make decisions for the future. The property type is one of the key fields used for reporting and producing analysis. For instance, the IRS has 305 different property types which allow detailed analysis. However, the great number of options can mean that it can be difficult to find the accurate option.

On the other hand, in Istanbul Fire Department's fire reports, buildings are classified into 26 headlines as apartment building, street, office buildings, café, business center, private workplace, slum, facilities for storage purposes, factory, construction zone, hospital, school, hotel, and motel, the building of worship, institutional buildings, dormitory, entertainment hall, shopping mall, barn, kindergarten, prison, building for accommodation purposes, cinema, library, nursing home and industrial buildings (Şengöz, 2018). For a metropolitan city, 26 property types are not enough to classify buildings properly.

Istanbul Fire Department shares information about fires in their annual publications by the hour of the day. However, the data is given for every 6 hours of the day such as between the hours 00:00 to 05:59, 06:00 to 11:59, 12:00 to 17:59, and 18:00 to 23:59. On the other hand, London Fire Brigade shares this data according to every hour of the day. Statistics of fires with a 6-hours period are very long for determining which hour of the day most of the fires occurred.

The release date of publication is also important for statistics. London Fire Brigade publishes fire data annually and the release date is every year's month of June. England has many publications about fire statistics, some of them are published annually some of them quarterly. Every publication's next release date is also shared on their web page. However, there is no publication and fire data sharing through Turkey. Istanbul Fire Department shares some publications however, this publication is not regularly and there is no possibility to access past year's publication. Furthermore, there is no information about the publication's release date and future release dates.

5.1.1. Comparisons between countries

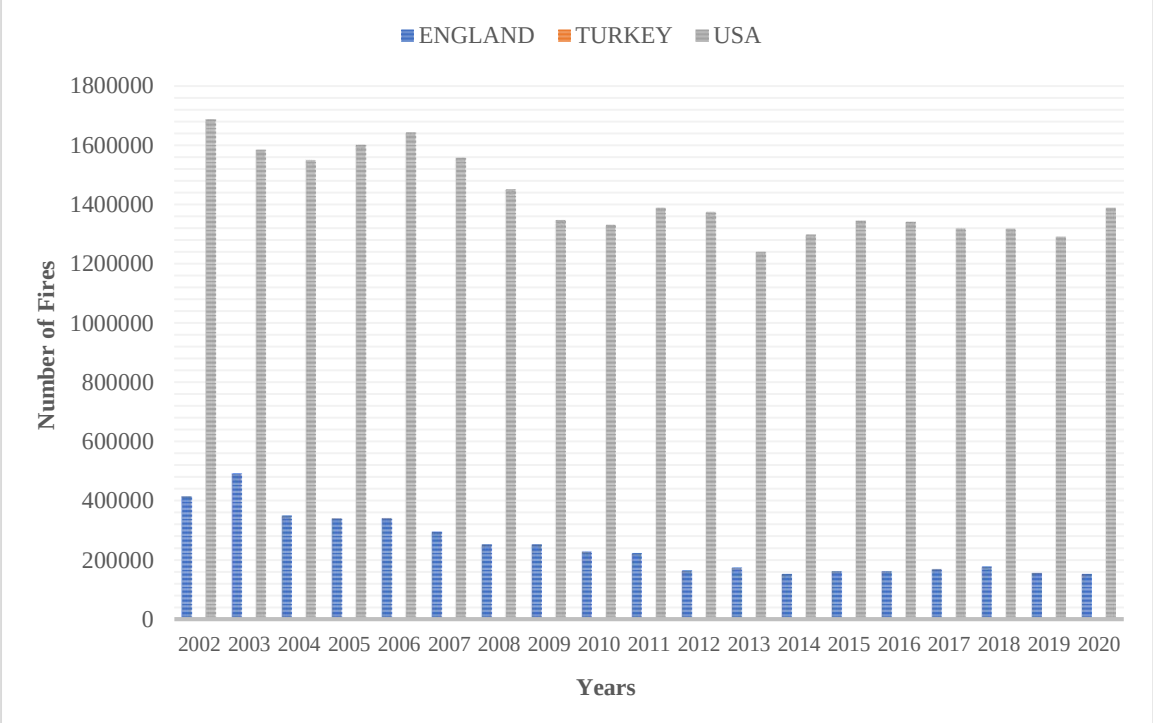


Figure 5.1. Annual distribution of the number of fires in England and United States of America (2002-2020)

The above figure is a comparison of the total number of fires that occurred in England and United States of America. The total number of fires in England from 2002 to 2020 is 4671928. On the other hand, the total number of fires in the United States for the same years is 27064000. This numerical difference is caused by population numbers. To illustrate, in the year 2020, USA's population is nearly 333 million and England's population is nearly 57 million.

When the figure is examined; the number of total fires is decreased greatly from 2002 to 2020. In this context, it is thought that the number of fires decreases depending on advanced research and codes applied for both countries.

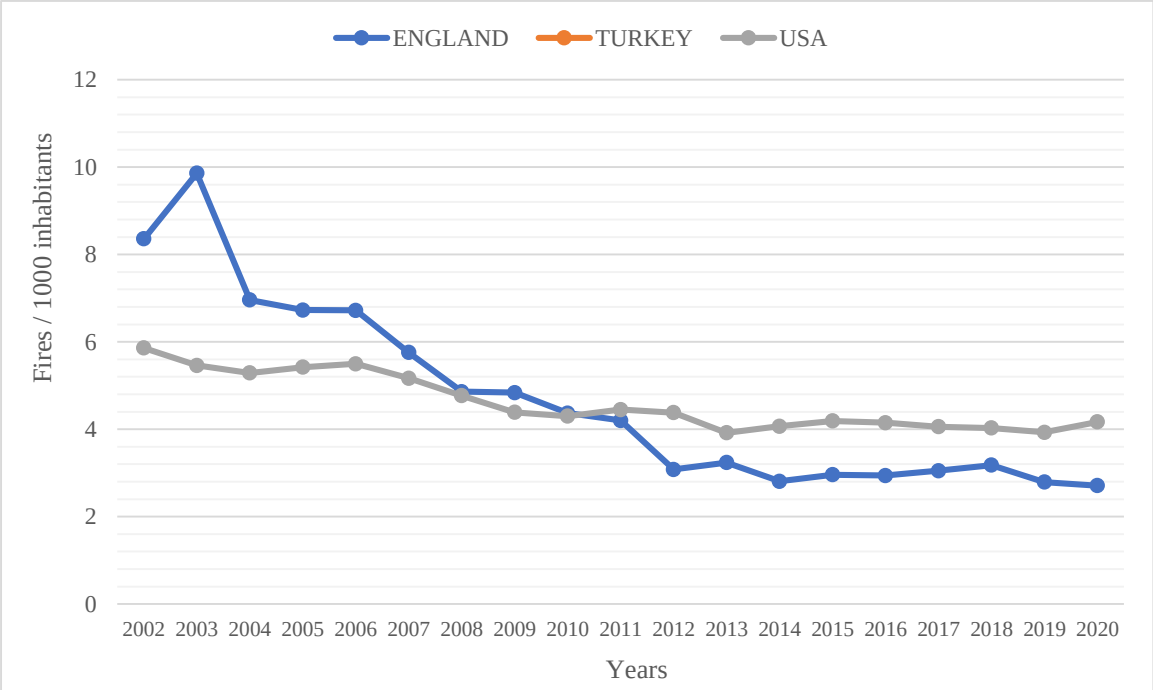


Figure 5.2. Annual distribution of fires in England and United States of America per 1000 inhabitants (2002-2020)

Annual distribution of fires per 1000 inhabitants provides a comparison between countries in terms of converting the total number of fires comparable. This is very important because every country's population differs significantly. When the populations of each year are compared with the total number of fires, for both countries, it is seen that the number of fires per 1000 inhabitants decreased significantly during the period 2002-2020, and then the trend of decreasing levelled out. To give an example of decreasing trend, between the years 2002 and 2020, United States of America has the greatest population in 2020, the same year with a population of approximately 333 million accounts for the ratio of 4,17 fires per 1000 inhabitants. For England, this rate is 2,71.

This figure is produced for having equal comparison criteria. Although fire precautions take place with codes applied and enhanced through research, per 1000 inhabitants, from the year 2010, more fires occurred in United States of America than England. In addition to that, although the population increases every year in England and United States of America, the total number of fires decreases.

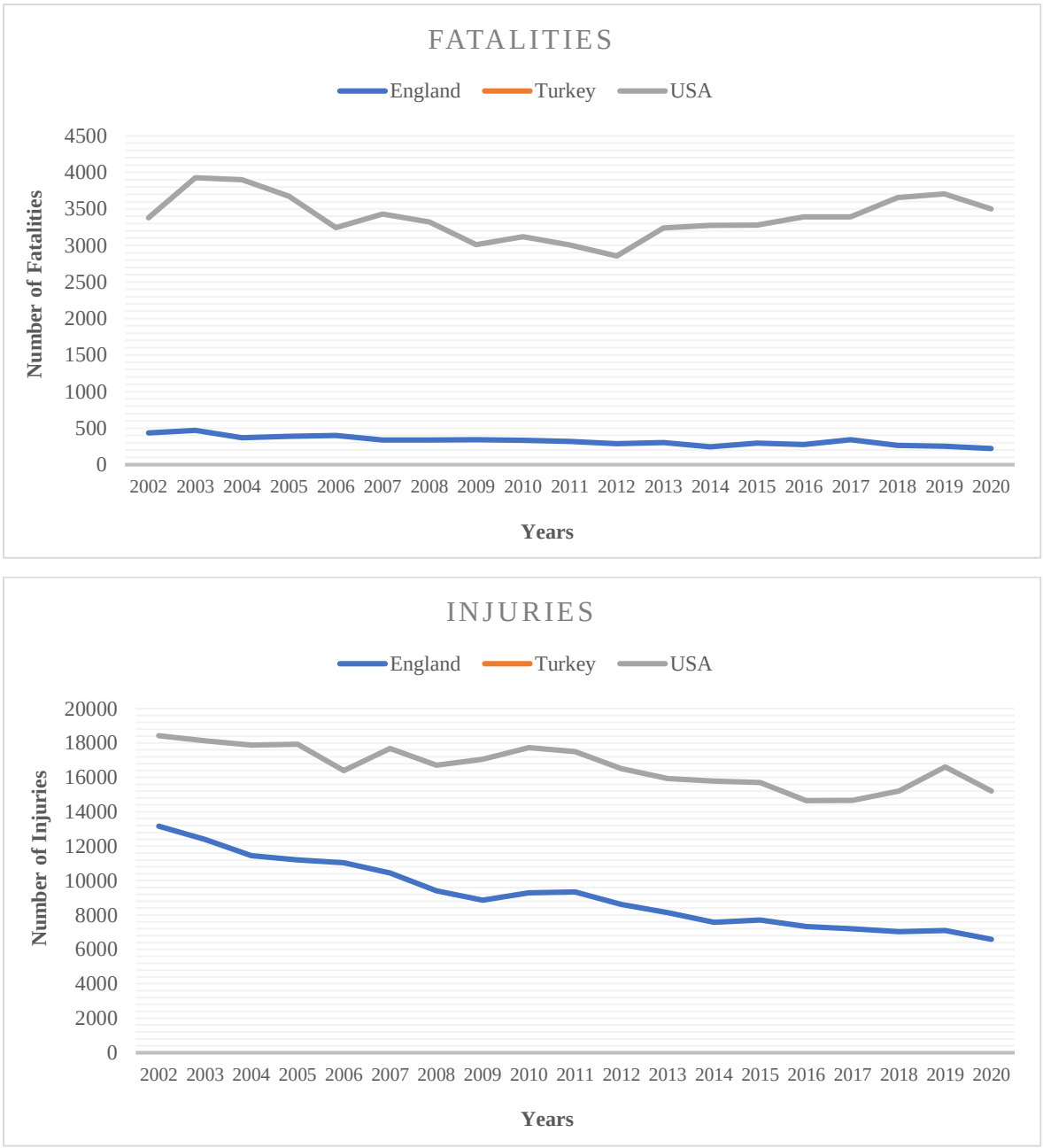
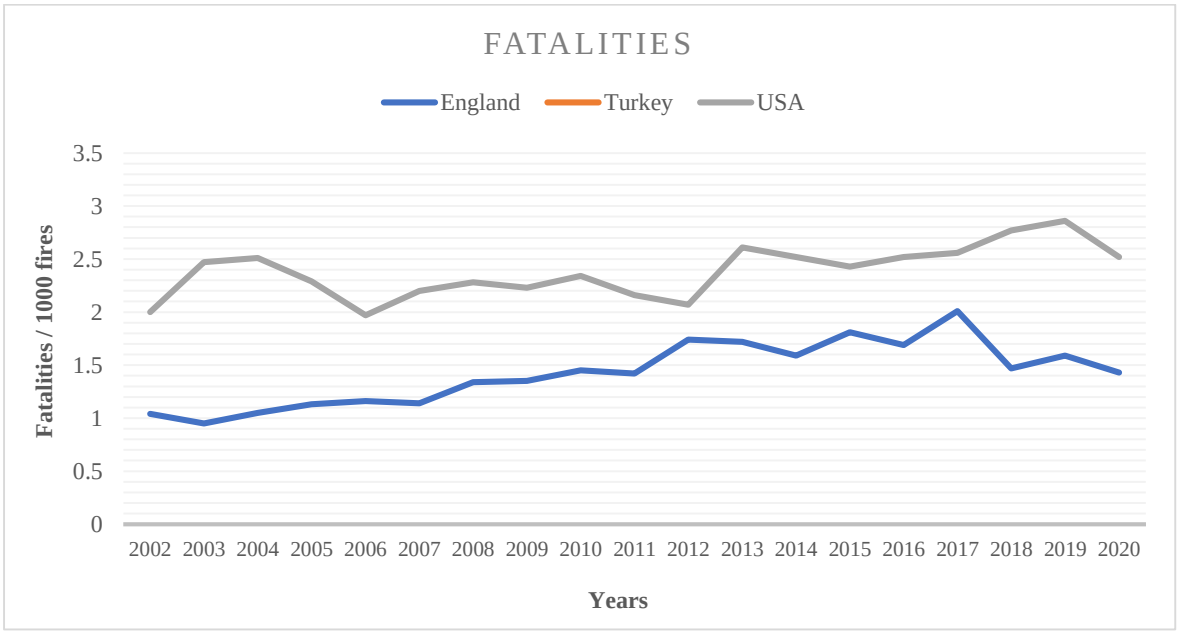


Figure 5.3. Annual distribution of numbers of fatalities and injuries caused by fires in England and United States of America (2002-2020)

The total number of fatalities caused by fires between the years 2002 and 2020 is 6207 for England and 64299 for USA. The 19-year average is determined as 327 and 3384 respectively for England and USA. On the other hand, between 2016 and 2020, the 5-year average is 3528 for USA and 270 for England. When the figure is examined, it is seen that most fatalities occurred in United States of America. On the other hand, there is an overall decline in fatalities only for England.

Between the years 2002 and 2020, 315620 injuries happened due to fires that occurred in United States of America. Between the same years, 173836 injuries occurred in England. The 19-year average is determined as 16612 for USA and 9149 for England. On the other hand, between 2016 and 2020, the 5-year average is 15264 for USA and 7047 for England. Since there is a decline in averages, it is a possible indication of a decline in the number of non-fatal casualties for both countries. When the figure is examined, it is seen that most injuries happened in United States of America.



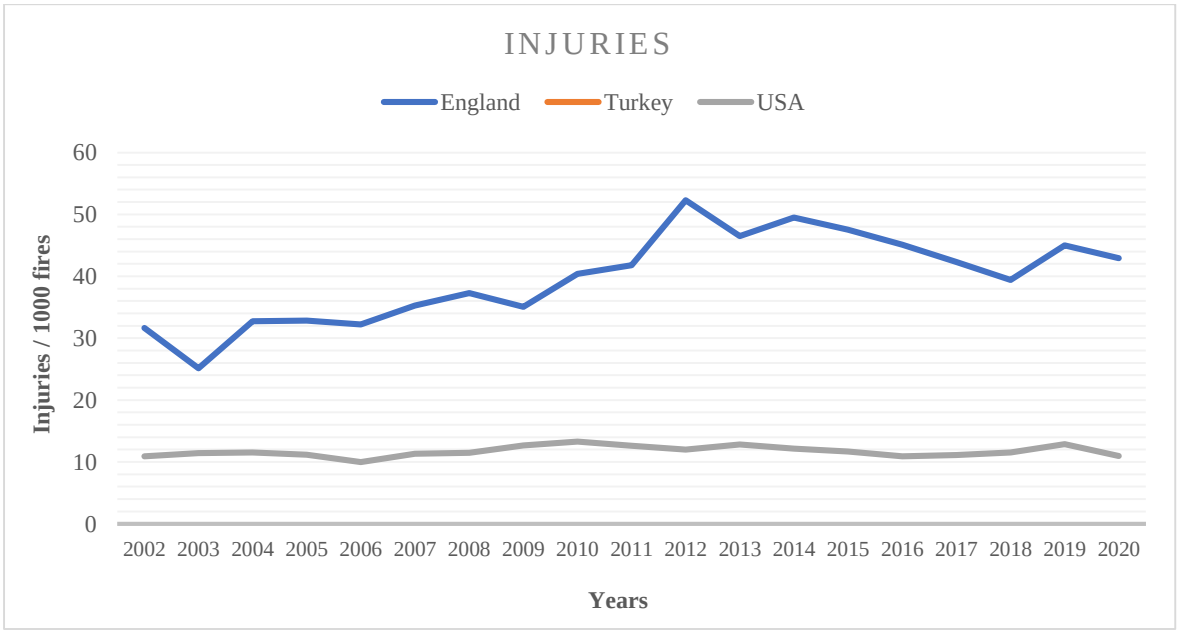


Figure 5.4. Annual distribution of fatalities and injuries occurred in England and United States of America per 1000 fires (2002-2020)

For making a comparison between countries, casualty numbers are reviewed in relation to total fire numbers in the same year. When only total casualty numbers are compared, this comparison can be misleading since every country's population and total fire numbers are different. To make reliable comparisons, casualty numbers are reviewed through a common point which is per 1000 fires. Before this analysis, total fire numbers are reviewed in relation to population numbers, however, for this one, analysis in relation to inhabitant numbers can be misleading. Since people are injured or dead due to the fires that happened, it will be logical to review fatality and injury numbers in relation to total fire numbers instead of inhabitant numbers.

As seen in the previous figure, it is possible to say that there is a decline in the number of deaths in England. For United States of America, the pattern is seemed to be balanced. However, this figure provides another perspective to the same issue. The number of fatalities per 1000 fires between the years 2002 and 2020 has an increasing pattern for both countries. When the figure is examined, it is seen that most fatalities occurred in United States of America.

According to the previous figure, most injuries happened in United States of America. However, this figure is more reliable than the previous one since the comparison is based on 1000 fires. This analysis, on the other hand, proves that most injuries occurred in England rather than USA. Furthermore, it provides another perspective to the decline in total non-fatal numbers for England. The previous figure shows that there is a decline in injury numbers, but this analysis indicates otherwise. Per 1000 fires, there is an increase in the non-fatal casualty numbers for England.

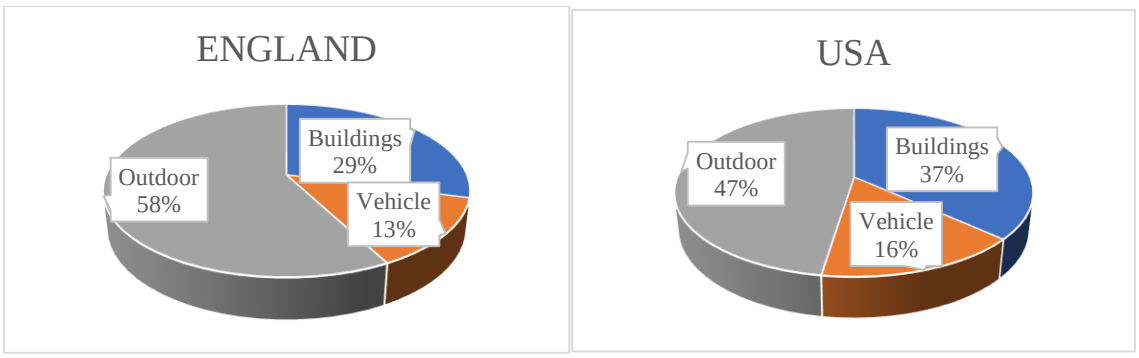


Figure 5.5. Distribution of the 5-year average of fires that occurred in England and United States of America by property categories (2016-2020)

Fires that occurred in England and United States of America are shown in the figure by property categories. The 5-year averages between the years 2016 and 2020 are compared. For both countries, outdoor fires make up the vast majority. Outdoor fires are followed by respectively building and vehicle fires. In the USA, building and vehicle fire's percentages are more than England's. It is possible to say that the vehicle and building density of the country is a parameter that is very effective on the percentages. Consequently, for both countries, outdoors and buildings are places where most of the fire occurred.

5.1.2. Comparison between cities

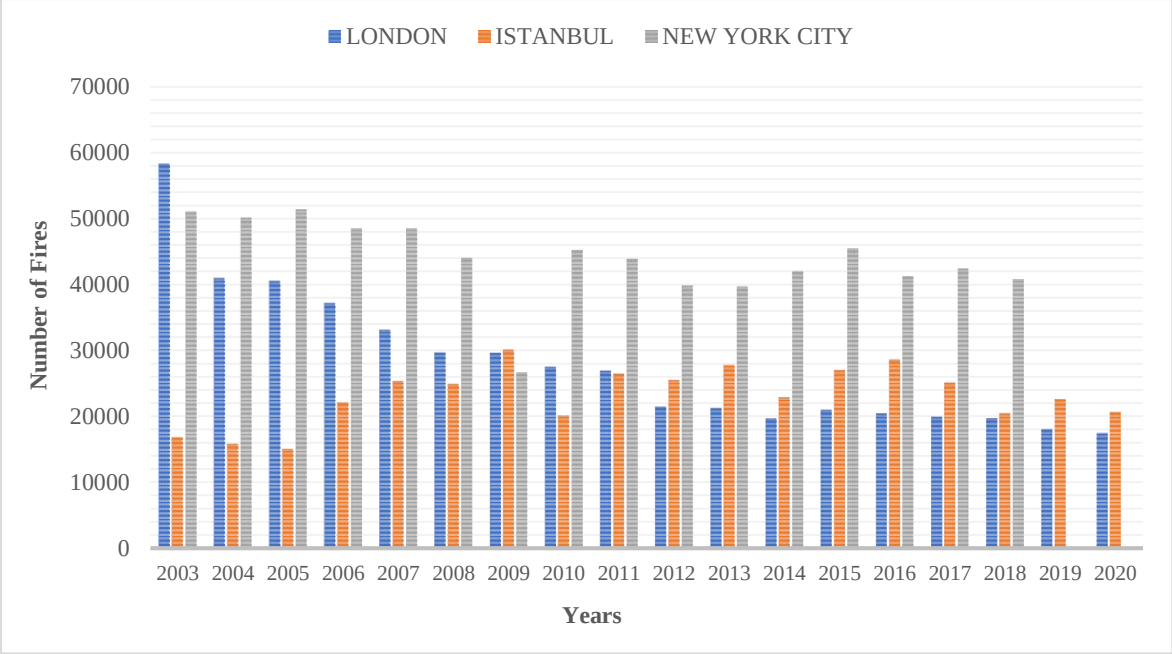


Figure 5.6. Annual distribution of the number of fires in Istanbul, London, and New York City (2003-2020)

The above figure is a comparison of the total number of fires that occurred in London, Istanbul, and New York City. The distribution of these fires by year is shown in the Figure. The number of fires that occurred in London from 2003 to 2020 is 501791. On the other hand, the total number of fires in Istanbul is counted as 416602. Between the years 2003 and 2018, 700986 fires have occurred in New York City. As seen in the figure, it is possible to say that the number of fires in Istanbul is not collected correctly for the past years. Because, for London and New York City, there is an overall decline while for Istanbul there is an increase in the number of fires. In this context, it is thought that the

number of fires decreases depending on precautions in London while the increase for Istanbul seen in the graph shows that it has been more attentive in keeping the data over the years.

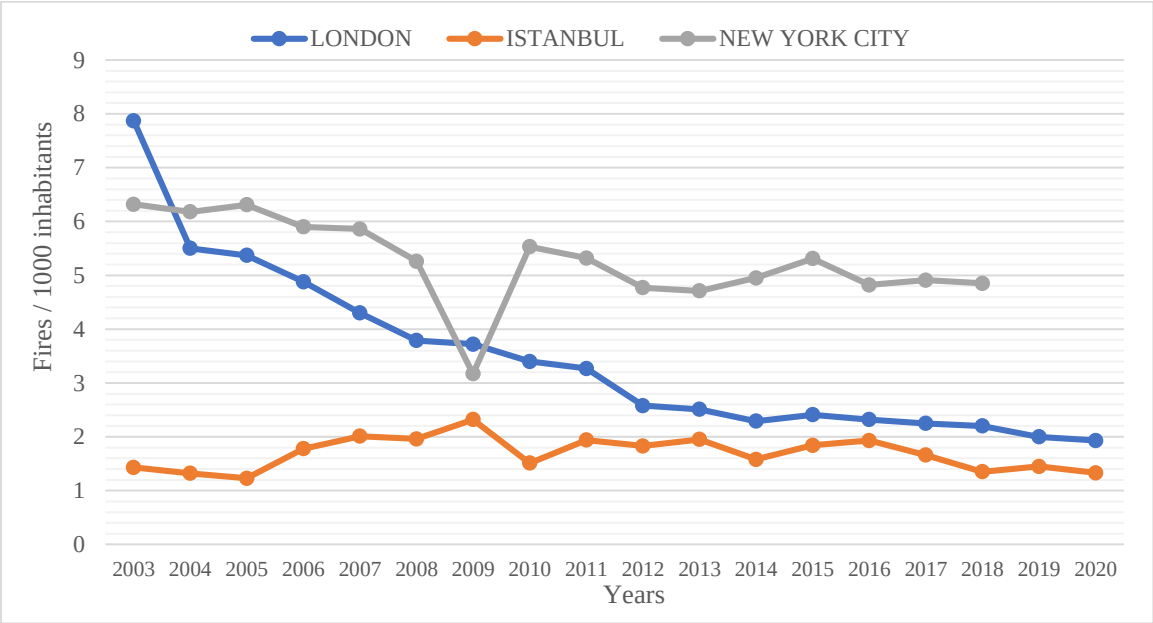


Figure 5.7. Annual distribution of fires in Istanbul, London, and New York City per 1000 inhabitants (2003-2020)

When the populations of each year are compared with the total number of fires for Istanbul, London, and New York City it is seen that the number of fires per 1000 inhabitants diminished significantly during the period 2003-2020 for London and New York City, while for Istanbul, increased slightly. However, for New York City, the fire numbers are above the other two cities. It is observed that although the population increases every year in London, New York City, and Istanbul, the total number of fires decreases in London and New York city and increases in Istanbul. Although the fire precautions taken in Istanbul have improved, the cause of the increase is the rapid increase in the number of buildings and the population. On the other hand, while there is an increase in the number of fires per 1000 inhabitants, Istanbul is still the city with the fewest fire numbers.

To illustrate, in İstanbul, with a population of close to 16 million, which is the largest population number for Istanbul, the year 2020 has a rate of 1,33 fires per 1000 inhabitants. On the other hand, in 2020, London's population is nearly 9 million. This is

the greatest number of inhabitants in London, but also the least fire occurred and the rate of inhabitant to fire that happened is the lowest with 1,93. Consequently, although there is an increase trend for Istanbul, every year the least fires per 1000 inhabitants also occurred in Istanbul.

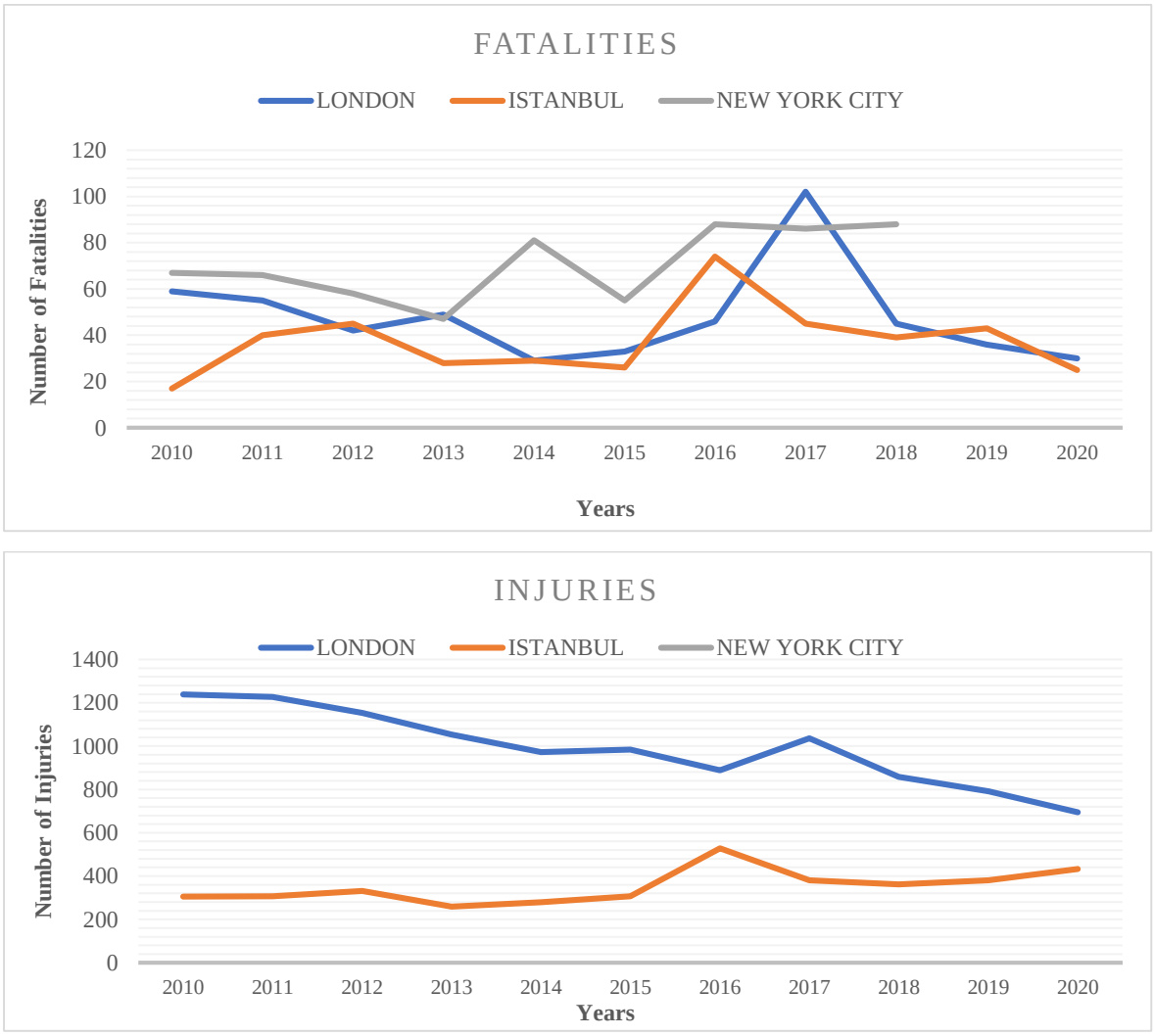


Figure 5.8. Annual distribution of numbers of fatalities and injuries caused by fires in Istanbul and London (2010-2020)

The total number of fatalities caused by fires between the years 2010 and 2020 is 526 for London. Between 2010 and 2018, total fatal casualties are counted as 636 for New York City. Between 2010 and 2020 fatal casualties are counted as 411 for Istanbul. Between 2016 and 2018, the 3-year average is determined as 64, 52, and 87 respectively for London, Istanbul, and New York City. On the other hand, between 2010 and 2020, the 11-year average is 48 for London and 37 for İstanbul. As a result, the decline in London's fatal casualty averages is an indication of an overall decline in deaths. New York City has

an increasing pattern for fatal casualties. As seen in the figure, most fatalities occurred in New York City between the three cities.

Between the years 2010 and 2020, 10897 injuries happened due to fires that occurred in London. Between the same years, 3869 injuries occurred in Istanbul. The 11-year average is determined as 991 for London and 352 for Istanbul. On the other hand, between 2016 and 2020, the 5- year average is 854 for London and 416 for Istanbul. Since there is a decline in the averages of London, it is a possible indication of a decline in the number of non-fatal casualties. However, for Istanbul, there is an increase in the averages. When the figure is examined, it is seen that most injuries happened in London.

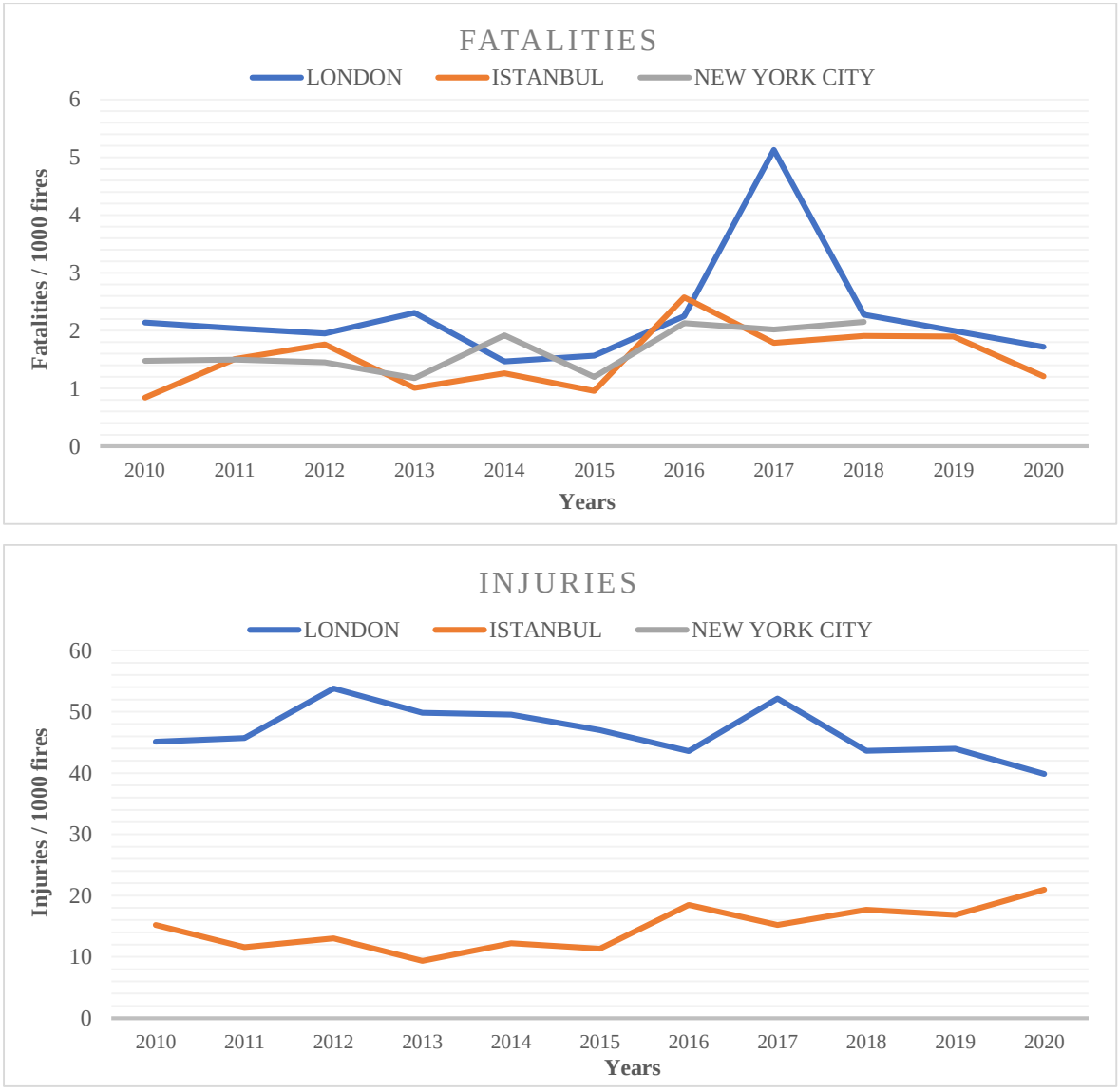


Figure 5.9. Annual distribution of fatalities and injuries occurred in Istanbul and London per 1000 fires (2010-2020)

For making a comparison between cities, casualty numbers are reviewed in relation to total fire numbers in the same year. As seen in the previous figure, it is possible to say that there is a decline in the number of deaths and injuries for London and an increase in the number of injuries for Istanbul. However, this figure provides another perspective to the same issue.

As seen in the previous figure, there is a decline in the number of deaths in London and an increase in New York City. This figure provides another perspective to the same issue with the same result. The number of fatalities per 1000 fires between the years 2010 and 2020 has a declining pattern for London. Furthermore, New York City's increasing pattern of fatality numbers is also seen in this figure. On the other hand, different from the previous analysis, most fatalities occurred in London rather than New York City. Since this analysis is more reliable than the previous one, it can be said that the number of deaths per 1000 fires for London was at most among the three cities between 2010 and 2020.

According to the previous figure, most injuries happened in London, this figure also supports this. Furthermore, it provides another perspective to the decline in total non-fatal casualty numbers for London. The previous figure shows that there is a decline in injury numbers and this analysis indicates a similar view. Consequently, per 1000 fires, while there is an increase in the non-fatal casualty numbers for Istanbul, there is a decline for London.

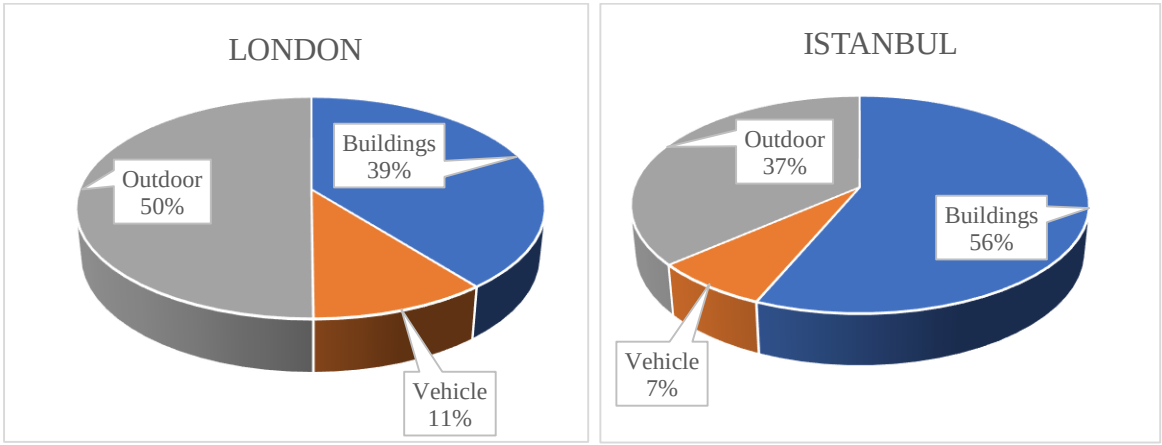


Figure 5.10. Distribution of the 5-year average of fires that occurred in Istanbul and London by property categories (2016-2020)

The above figure illustrates a comparison between Istanbul and London about the distribution of the 5-year averages of all fires that occurred by property categories. New York City's distribution by property categories isn't included in this comparison because there is no information about fire numbers in the years 2019 and 2020. Since the author can only prepare a 3-year average, for making a reliable comparison, only London and Istanbul are compared.

For Istanbul, building fires make up the vast majority of total fires between the years 2016 and 2020. On the other hand, For London, outdoor fires make up the vast majority of total fires. For both of the cities, vehicle fires have the least percentile among other categories. Consequently, buildings and outdoors are places where most of the fire occurred.

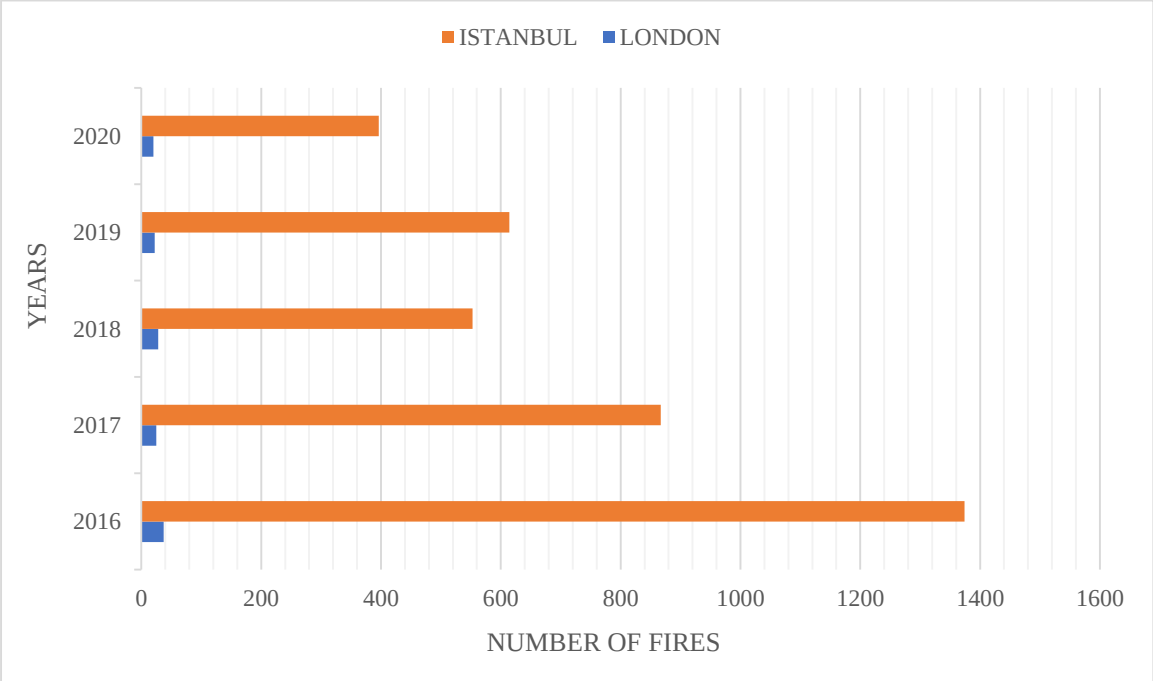
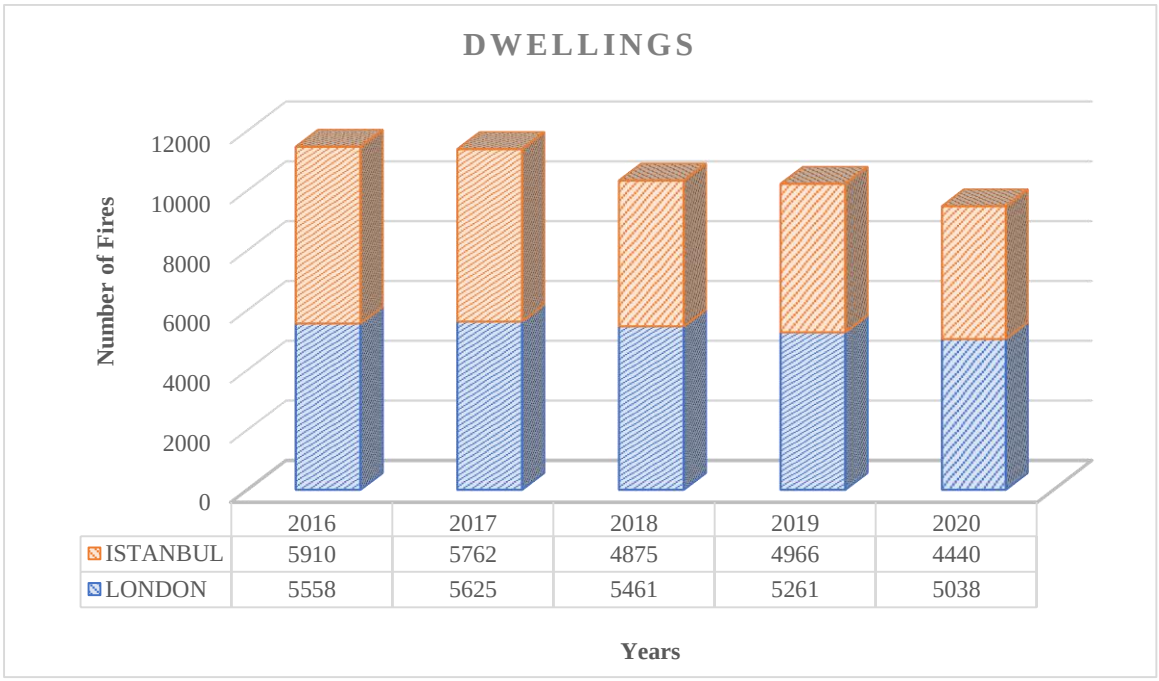


Figure 5.11. Annual distribution of chimney fires in Istanbul and London (2016-2020)

The total number of chimney fires in London from 2016 to 2020 is 132. On the other hand, the chimney fire number for Istanbul is 3804 between the same years. In the year 2016, most chimney fires occurred in both Istanbul and London respectively 1374 and 37. Likewise, in 2020, these numbers decrease to 20 and 396 for London and Istanbul. The 5-year average is determined 26 for London and 761 for Istanbul. The reason for the numerical difference is the number of inhabitants. In 2020, London's population is counted as nearly 9 million while Istanbul's population is nearly 15 million.



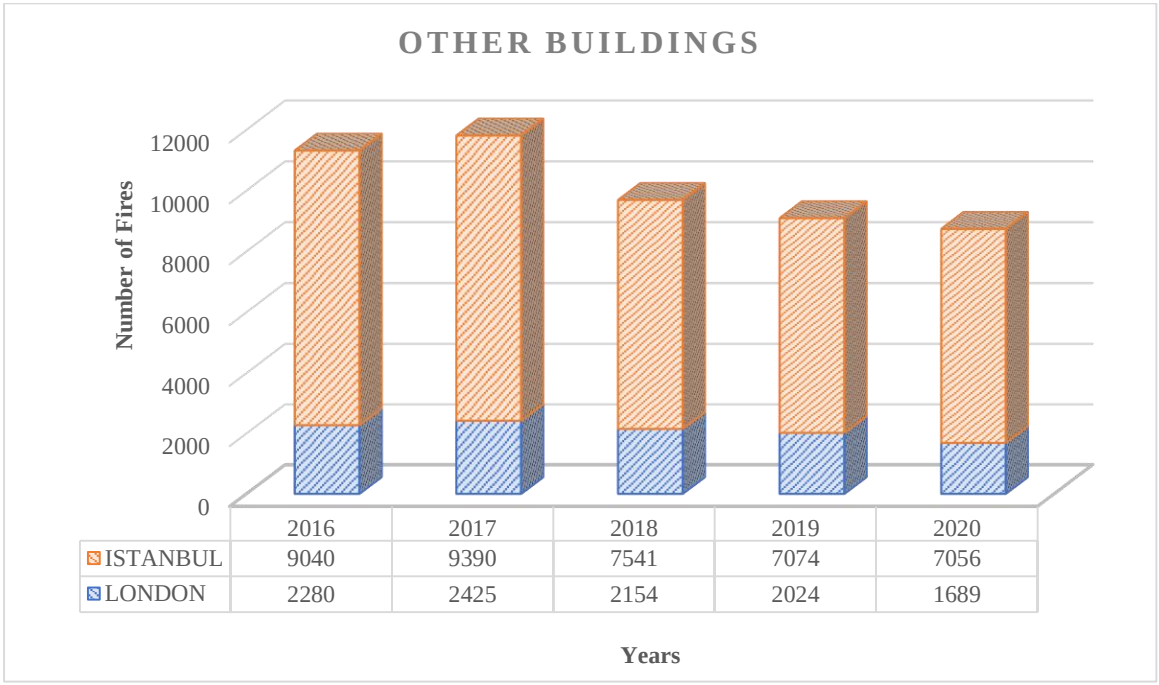


Figure 5.12. Annual distribution of the number of fires that occurred in dwellings and other buildings in Istanbul and London (2016-2020)

The above figure shows the number of fires in Istanbul and London between 2016 and 2020 which occurred in dwellings and other buildings by year. Since Istanbul Fire Department keeps the building fire data as dwellings, workspace including industrial manufacturing and processing premises, and lastly other buildings, to make comparisons between cities, London's building types are also reviewed under two categories like Istanbul.

Among building fires, dwelling fires that occurred in London have a five-year average of 5389. On the other hand, this average for Istanbul is determined as 5191. In 2020, dwelling fires that occurred in Istanbul and London decreased to respectively 4440 and 5038. This numerical decrease is proof of enhancing fire prevention in both cities.

Among building fires, other building fires have a five-year average of 8020 for Istanbul. On the other hand, for London, the 5-year average is determined as 2114. In 2017, both in Istanbul and London, other building fires are at the highest number with respectively 9390 and 2425. In 2020, other building fires decrease to 7056 and 1689 for respectively Istanbul and London. Consequently, there is an overall decline in the number of other building fires.

In every year between 2016 and 2020, other building fires make up the vast majority of Istanbul, and dwelling fires make up the vast majority of London. Based on this information, it is possible to say that fire prevention should be developed locally. Every country has a different pattern of fire history. More efficient precautions can be taken with making improvements not globally but locally.

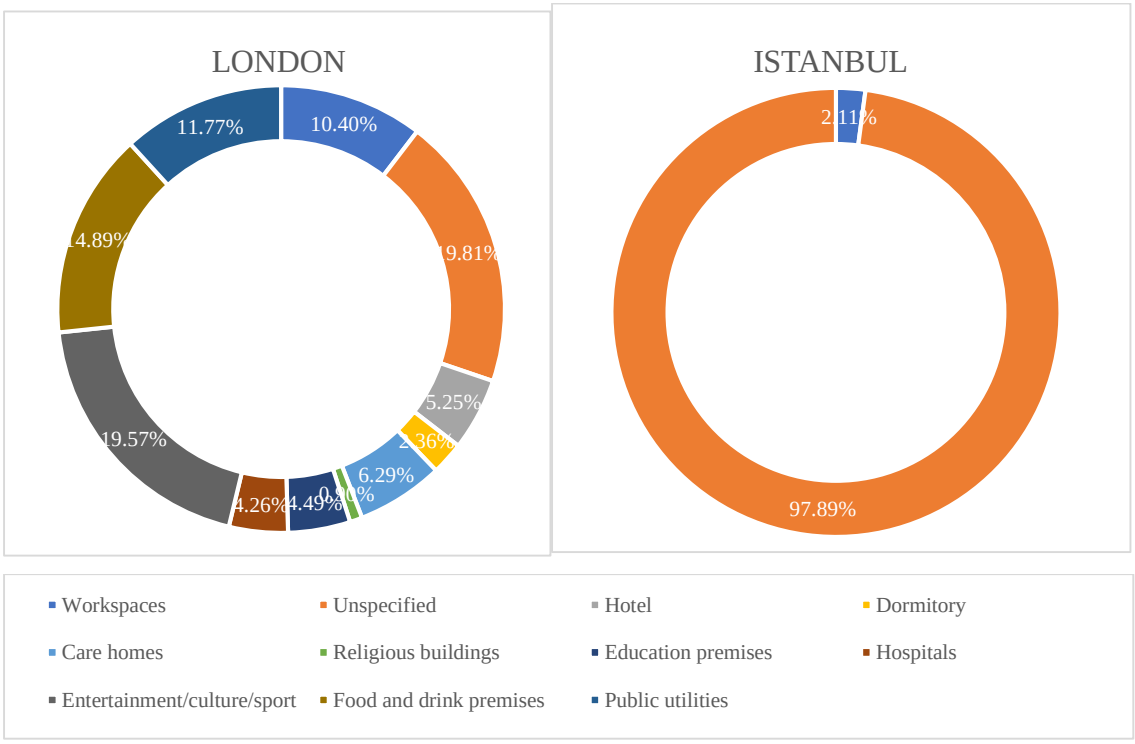


Figure 5.13. Distribution of the 5-year average of fires that occurred in other buildings in Istanbul and London by property type (2016-2020)

The distribution of the 5-year average of other building fires is shown in the above figure by property type for both Istanbul and London. According to 5-year averages, between the years 2016 and 2020, the building types with the most fires occurred are respectively unspecified with %19,81, entertainment and culture with %19,57, food and drink with %14,89, public utilities with %11,77, workspaces with %10,40, care homes with %6,29, hotel with %5,25, education with %4,49, hospitals with %4,26, dormitory with %2,36, and religious buildings with %0,90 for London. However, for Istanbul, the building types for most fires that occurred are only undefined with %97,89, and workspaces with %2,11 respectively.

It should be noted that every unspecified information causes unreliable statistics. Although both Istanbul Fire Department and London Fire Brigade keep every detail of every fire, their annual publications should have given detailed information too. Consequently, these graphics reveal that Istanbul's data variation for building type is insufficient.

5.2. Conclusion

Every year, in fires, huge financial losses occur due to property damage, and too many casualties can be numbered. There are also indirect costs of fire, including lost business revenues, medical expenses, temporary lodging, psychological damage, etc. Developing technology with ignitable organic materials contained, widespread use of electrical devices, and the rapid growth of the population causes an increase in the number of fires and damages. Fire statistics with detailed database provide reducing the fire incidents and alleviating the results of it. Therefore, fire statistics and analysis have great importance.

In this study, fire statistics of New York City, İstanbul and London introduced. These cities were selected for comparison because of high social awareness on fire safety precautions and those that produce and sell technology and set standards in this regard. These cities are also leaders in the production-based industry, export and import, technological research, tourism, and most importantly, in the economic field, in their country.

When the national and international studies on fire prevention are examined, it is revealed that statistical-based research studies are given importance. In international statistical studies, data on building classification, interior spaces where the fire started, and the times, months, and seasons when fires started are also determined. Studies on the use of developed data collection methods in our country have not been adequately conducted and the current data collection method is not sufficient to prevent fires. So, in this study, it is discussed whether the data kept are eligible for improving strategies and preventative approaches, and suggestions for improving the statistics are presented.

Compared to the fire statistics of countries, it was determined that there are differences from country to country in how statistics are obtained and recorded. Due to the lack of consistency, there are deficiencies in the evaluation of statistics.

The largest fire statistics database in our country is collected by the İstanbul Fire Department. Since there is no coordination regarding the fire departments throughout the country, there is no information about how many fires occurred, how many people died and were injured in our country over the years. The fire data should be collected from all providers in the country in the same form with accompanying guidance and definitions. This provides consistency across the different types of data providers. The data about fires published in Turkey contains only the cause of the fire and when occurred.

For all fire incidents, there are fundamental fields that should be checked. For instance, the property type, address and location information, casualty information, the cause of the fire, the source of ignition, the item which was mainly responsible for the spread of the fire, and false alarms. Furthermore, statisticians of fire departments must run some specific checks during some periods. This provides looking at data gaps to identify figures that seem unusually compared with figures for the same time in the previous year.

As a result, the preparation of strategies for the reduction of fire numbers in Turkey should benefit from fire statistics. It is recommended that these statistics use a common language for international comparisons. If fire departments better understand the relative importance of the factors that lessen the fire number, resources can be better targeted to have a great impact. With advances in data collection techniques over years, the analysis can be revised periodically and accurately.

The main factor in the establishment of developable data systems is the creation of an objective statistical data pool. Under a national organization, the data can be collected with authorization and funding from the government to develop enhancements. This organization may offer several classrooms and online training courses for fire departments to explain how they should obtain information. To enhance firefighters' understanding of how the statistics and recording system is used can provide data to remain relevant and suitable for their purpose.

Other improvements also must be provided such as periodical publications and sharing Excel format of data. Accessibility should be the main idea of publications. The outputs should aim to provide a balance of commentary, charts, and summary tables. Publications should be named to describe their content and improve collating all the data tables and graphics in one place. Previous versions of publications and tables must be available on an archive page.

At the local level, incident and casualty information can be used for determining priorities and targeting resources. At the country level, government agencies may take advantage of analysis and universities may conduct research by referencing the data pool. The data also should be used to inform discussion around the allocation of rescue and fire resources and to provide advice to Ministers.

In addition, this analysis can motivate decision-makers to strengthen the fire codes, giving support to academicians for conducting studies to develop construction techniques and materials specifically for fire prevention by sponsoring, caring about public education, and improving firefighter equipment and their training.

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