



Cancer Incidence Among Female Firefighters in Texas

**As Required by
House Bill 1639, 89th Texas Legislature,
Regular Session, 2025**



TEXAS
Health and Human
Services

**Texas Department of
State Health Services**

September 2026

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Executive Summary

[House Bill 1639](#), 89th Legislature, Regular Session, 2025, directed the Texas Department of State Health Services (DSHS) to collaborate with the Texas Commission on Fire Protection (TCFP) to conduct a study that evaluates cancer risk among female firefighters in Texas, focusing on female-specific cancers, and to submit a written report to the Texas Legislature.

This report provides data on cancer risk among Texas female firefighters to support informed decision-making for Texas policymakers, public health professionals, and the firefighting community. The findings are based on currently available TCFP and DSHS data.

Analysis of available data did not reveal a statistically significant difference in cancer incidence, including for female-specific cancers, among Texas certified female firefighters compared with the general Texas female population. These findings do not rule out firefighting as a cancer risk factor for women. Rather, these results likely reflect key limitations of the study, including the small number of female firefighters and cancer cases, limited follow-up time relative to the long latency of many cancers, and the influence of the “healthy worker effect.” The “healthy worker effect” refers to the tendency for workers in physically demanding jobs, such as firefighting, to be healthier than the general population at the time they enter and remain in the workforce. This can lead to occupational studies underestimating disease risks associated with potential workplace hazards.

The findings of this study suggest that a larger sample size and additional follow-up time would provide a better understanding of cancer risk among Texas-certified female firefighters. The Texas Cancer Registry (TCR) at DSHS can support this work by ensuring high-quality cancer data are available to support research. This includes TCR’s continued partnership with Texas-based efforts like UTHealth Houston’s Texas Firefighter Cancer Study and national efforts like the National Firefighter Registry for Cancer through the National Institute for Occupational Safety and Health (NIOSH).

Introduction

[HB 1639](#), 89th Legislature, Regular Session, 2025, requires DSHS to evaluate cancer risk among female firefighters by comparing cancer incidence rates with those of the general Texas female population. This bill directs DSHS to focus on female-specific cancers, including ovarian and breast cancer. Findings are to be reported to the Texas Legislature and made publicly available on both the DSHS and TCFP websites.

In 2022, the International Agency for Research on Cancer classified occupational exposure as a firefighter as “carcinogenic to humans,” based on sufficient evidence for certain cancers and supported by underlying mechanistic evidence.¹ Firefighters encounter numerous known and suspected carcinogens during fire suppression and related duties through toxic smoke, combustion byproducts, and contaminated personal protective equipment. These exposures include mixtures of carcinogens such as polycyclic aromatic hydrocarbons, volatile organic compounds, diesel exhaust, and per- and polyfluoroalkyl substances. These substances may enter the body through inhalation, dermal absorption, or ingestion and can contribute to long-term health risks, including cancer.

Recent meta-analyses of epidemiologic studies indicate that firefighters face elevated risks for multiple cancers.^{2,3} However, the underlying studies used in these meta-analyses are predominately based on male firefighter cohorts, reflecting a male-dominated firefighter workforce.⁴ As a result, most studies are unable to reliably evaluate cancer risk, especially site-specific cancer risk, among female firefighters. For example, a large United States study of approximately 30,000 career firefighters—fewer than four percent of whom were women—reported an overall nine percent excess in cancer diagnoses compared to the general

¹ International Agency for Research on Cancer (IARC). Volume 32: Occupational exposure as a firefighter. Lyon, France; 2023.

² Lee DJ, Ahn S, McClure LA, et al. Cancer risk and mortality among firefighters: a meta-analytic review. *Front Oncol.* 2023;13:1130754. doi:10.3389/fonc.2023.1130754.

³ DeBono NL, Daniels RD, Beane Freeman LE, et al. Firefighting and cancer: a meta-analysis of cohort studies in the context of hazard identification. *Saf Health Work.* 2023;141-152. doi: 10.1016/j.shaw.2023.02.003.

⁴ National Fire Protection Association (NFPA). U.S. Fire Department Profile 2020.

population.⁵ However, the study was unable to produce stable estimates for women alone, because of insufficient data related to female firefighters.

Women comprise approximately five percent of the firefighting workforce nationally.⁶ This proportion is similar in Texas, based on data from TCFP.

⁵ Daniels RD, Kubale TL, Yiin JH, et al. Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950-2009). *Occup Environ Med* 2014;71:388–397. doi:10.1136/oemed-2013-101662.

⁶ National Fire Protection Association (NFPA). U.S. Fire Department Profile 2020.

Methods

Data Sources

This study uses TCR data and available TCFP-certified firefighter personnel data for approximately 3,330 female firefighters to perform the analysis required by HB 1639.^{7,8} This small dataset limits the study's ability to assess statistically significant cancer incidence among female firefighters compared with the general population.

This study uses population-based, statewide cancer data from TCR, which collects data on all reportable cancers diagnosed or treated in Texas and is one of the largest cancer registries in the United States. TCR is funded by the Texas Legislature, the National Cancer Institute's (NCI's) Surveillance, Epidemiology, and End Results (SEER) Program, and the Centers for Disease Control and Prevention's (CDC) National Program of Cancer Registries (NPCR). TCR is Gold Certified by the North American Association for Central Cancer Registries (NAACCR) and meets NPCR high-quality data standards. For this study, DSHS used its statistically locked file of high-quality, complete cancer diagnosis data for Texas women aged 18 years or older from 1995 through 2023 (1,440,625 women).

TCFP, the state agency responsible for certifying and maintaining records for fire service professionals, provided certified fire service personnel records for this study. TCFP is the primary source of statewide information on the fire service workforce.

This study covers all available data for certified female firefighters who were Texas residents from the earliest year available (1972) through 2023, which was the latest year of complete TCR data. This included 3,330 certified female firefighters aged 18 years or older who were Texas residents.

Data Linkage

DSHS linked TCFP personnel data and TCR cancer outcome data using Match*Pro, a probabilistic record linkage software application commissioned by NCI. Probabilistic linkage methods account for incorrect or different spellings of text fields including names and addresses, transposition of numbers in fields such as date of birth, and other differences between files. Data items used in the linkage included the

⁷ Texas Commission on Fire Protection (TCFP). Accessed May 26, 2026. tcfp.texas.gov

⁸ Department of State Health Services (DSHS). Texas Cancer Registry (TCR). Accessed May 26, 2026. dshs.texas.gov/texas-cancer-registry

following, when available: first name, middle name, last name, date of birth, social security number, residence (street address, city, zip code), and phone number.

Statistical Analysis

This study uses standardized incidence ratios (SIRs) and 95% confidence intervals (CIs) to compare cancer risk among female firefighters with the general Texas female population. SIRs are calculated by dividing observed cancer incidence among female firefighters by the expected incidence among all females in Texas. The comparison accounted for age, race/ethnicity, and calendar year because these are factors that influence cancer incidence independent of occupational exposures. Adjustment for these factors helps ensure that any observed differences between female firefighters and the general Texas female population are not due to differences in population composition or background cancer rates. In general, a minimum of five observed cases is needed to produce stable SIR estimates. To comply with HB 1639, however, DSHS generated SIRs for all individual female-specific cancers, including female breast, cervical, ovarian, uterine, and other female reproductive cancers, even if there were fewer than five cases.

The 95% CIs provide a measure of the precision of the SIR estimates and indicate whether the observed differences were statistically significant. An SIR is considered statistically significant if the 95% CI range does not include 1.0 (if lower and upper bounds of the 95% CI are both greater than 1.0 or are both less than 1.0).

In addition, DSHS evaluated overall cancer incidence (all cancers combined) among female firefighters and the general Texas female population, as well as incidence of other cancer sites with at least five cases.

The analysis followed female firefighters from the time they became certified as firefighters through the end of the study period (December 31, 2023). The calculated SIRs quantified whether cancer incidence rates among female firefighters were higher, lower, or comparable to those expected based on the general Texas female population. Reference population rates were generated using NCI's SEER*Stat; all other analyses used SAS software (version 9.4).

Results

Characteristics of the Texas female firefighter cohort are shown in **Table 1** ([Appendix A](#)). There were 3,330 female firefighters included in the study. Most female firefighters were non-Hispanic White (75.4%), followed by Hispanic (13.0%), Other (7.1%), and Non-Hispanic Black (4.4%). More than half (56.8%) of the cohort were initially certified as firefighters between 2010 and 2023. The number of new firefighting certifications by year is shown in **Figure 1** ([Appendix B](#)), with a marked increase observed in initial certifications among women over time.

The data linkage between TCFP personnel records and TCR cancer outcome data identified 122 women who developed cancer. Among these 122 women, a total of 136 cancers were identified, as some women developed more than one cancer (multiple primaries). **Figure 2** ([Appendix B](#)) shows the initial number of personnel records provided by TCFP (n=133,885), and the subsequent remaining records after accounting for Texas residency (n=115,081), becoming certified as a firefighter (on or before 2023; n=67,998), and sex (n=3,330 female firefighters). **Table 2** ([Appendix A](#)) presents the types of cancers diagnosed among female firefighters from 1995 through 2023, as well as the distribution of cases by diagnosis year and age at diagnosis. The most diagnosed cancers included breast (n=49), thyroid (n=15), melanoma (n=12), colorectal (n=10), brain and central nervous system (n=7), uterine (n=7), and cervical (n=5). A majority of the cancers (68%) that occurred in this cohort were diagnosed in more recent years (2015-2023) and most women (82%) were aged 40 years or older at their first cancer diagnosis.

To assess whether cancer incidence among Texas-certified female firefighters significantly differed from the general population, DSHS calculated standardized incidence ratios and 95% confidence intervals for all cancers combined and for specific cancers, as shown in **Table 3** ([Appendix A](#)). All SIRs were adjusted for age, race/ethnicity, and calendar year. Overall, female firefighters had cancer incidence rates similar to those of the general Texas female population in this study, with none of the observed SIRs reaching statistical significance. An SIR is considered statistically significant if the 95% CI range does not include 1.0 (if lower and upper bounds of the 95% CI are both greater than 1.0 or are both less than 1.0).

The SIR for all cancers combined was 0.93 (95% CI: 0.78-1.10; n=136). For female-specific cancers, no SIRs were statistically significant. The SIRs for female-

specific cancers were as follows (SIR; 95% CI; n=cancer case count among female firefighters):

- Breast (0.95; 0.71-1.26; n=49);
- Cervical (1.00; 0.32-2.34; n=5);
- Ovarian (0.82; 0.17-2.41; n=3); and
- Uterine (0.98; 0.39-2.03; n=7).

For other cancers not specific to women with at least five cases among female firefighters, no SIRs were statistically significant. Those SIRs were as follows:

- Brain and central nervous system (0.94; 0.28-1.94; n=7);
- Colorectal (1.18; 0.56-2.17; n=10);
- Melanoma (1.24; 0.64-2.16; n=12); and
- Thyroid (1.65; 0.92-2.72; n=15).

Discussion

For this study, analysis of available data did not reveal a statistically significant difference in cancer incidence, including for female-specific cancers, among Texas certified female firefighters compared with the general Texas female population.

It is important to note that these findings do not rule out firefighting as a risk factor for cancer in women. Rather, the absence of statistically significant risk estimates in this analysis likely reflects methodological and data limitations that constrained the study's ability to detect associations. Given the small numbers of cases and data constraints, this study was also unable to conduct more detailed analyses, including evaluating the impact of years of service, use of personal protective equipment, job type (career vs. volunteer), or exposure-response relationships. However, the Texas Legislature appropriated funds to UTHealth Houston to establish the Texas Firefighter Cancer Study, a two-year initiative that aims to collect additional occupational data and conduct additional analyses, such as biomarker analysis of exposure to fire-related carcinogens.⁹ TCR can support Texas Firefighter Cancer Study efforts by conducting data linkages and sharing needed cancer data.

Second, the duration of follow-up was limited for many cohort members, especially given that a substantial proportion of women entered the fire service in more recent years, as shown in **Figure 1** ([Appendix B](#)). Because most cancers have long latency periods, an analysis with a longer follow-up period could capture cancer diagnoses that were not observable during the study period for this analysis.

Third, comparisons with the general population are subject to the "healthy worker effect," a well-established source of bias in studies of occupational epidemiology.^{10,11} Individuals entering physically demanding occupations, such as firefighting, are generally healthier at the time of hire compared to the general population, as they must pass rigorous physical fitness exams to be hired and remain active. This effect can bias risk estimates and obscure potential associations

⁹ UTHealth Houston School of Public Health. Texas Firefighter Cancer Study. Accessed May 26, 2026. sph.uth.edu/research/centers/swcoeh/firefighter-research/

¹⁰ McMichael AJ. Standardized mortality ratios and the "healthy worker effect": Scratching beneath the surface. *J Occup Med*. 1976;165-168. doi: 10.1097/00043764-197603000-00009.

¹¹ DeBono NL, Daniels RD, Beane Freeman LE, et al. Firefighting and cancer: a meta-analysis of cohort studies in the context of hazard identification. *Saf Health Work*. 2023;141-152. doi: 10.1016/j.shaw.2023.02.003.

between occupational exposures and cancer risk. As a result, cancer incidence in this cohort may appear comparable to or lower than that of the general population even if occupational exposures do in fact increase risk.

The findings from this study should be considered within a broader scientific context. Most large epidemiologic studies of cancer risk among firefighters are based predominantly on male cohorts, with insufficient numbers of women to generate stable, sex-specific estimates. As a result, the evidence base for cancer risk among female firefighters remains limited.

The present study contributes to addressing this gap by demonstrating the feasibility of linking statewide firefighter personnel records with cancer registry data, the first linkage of its kind for the state of Texas. These findings underscore the need for continued data collection, longer follow-up, additional sources of information on firefighters (e.g., volunteer firefighters), and additional outcomes such as mortality data to evaluate competing risks.

DSHS supports continued work on this issue through its cooperation with UTHealth Houston School of Public Health's Texas Firefighter Cancer Study. Additionally, DSHS supports large-scale, national efforts, including the National Firefighter Registry (NFR), by conducting data linkages between NFR and TCR cancer outcome data, as part of the North American Association of Central Cancer Registries Virtual Pooled Registry Cancer Linkage System.¹² NFR is a voluntary registry for individual firefighters that provides information about length of service, type of service, and potential chemical exposures. Participation is open to current or former firefighters, with or without cancer.¹³

¹² North American Association of Central Cancer Registries (NAACCR). Virtual Pooled Registry Cancer Linkage System (VPR-CLS). Accessed May 26, 2026. naaccr.org/about-vpr-cls/

¹³ Centers for Disease Control and Prevention. National Institute for Occupational Safety and Health. National Firefighter Registry (NFR) for Cancer. Accessed May 26, 2026. cdc.gov/niosh/firefighters/registry/index.html

Conclusion

Given this study's data limitations, future studies are warranted to better understand cancer incidence among Texas certified female firefighters. DSHS will continue providing support for firefighter cancer research, including UTHealth Houston's Texas Firefighter Cancer Study and the NIOSH National Firefighter Registry for Cancer, through conducting data linkages, sharing cancer registry data and expertise, and supporting required review and approval processes.

Appendix A. Tables

TABLE 1

Characteristics of Texas Certified Female Firefighters

	Entire cohort	Cancer	
		Yes ¹	No
Total number	3,330	122	3,208
Person-years of follow-up	43,503	2,343	41,160
Age at first certification ² (mean $\pm$ standard deviation)	28.8 $\pm$ 8.2	30.9 $\pm$ 8.0	28.8 $\pm$ 8.2
Race/ethnicity (%) ³			
Non-Hispanic White	2512 (75.4)	103 (84.4)	2,409 (75.1)
Non-Hispanic Black	147 (4.4)	5 (4.1)	142 (4.4)
Hispanic	434 (13.0)	2 (1.6)	432 (13.5)
Other ⁴	237 (7.1)	12 (9.8)	225 (7.0)
Initial firefighting certification (%)			
1972-1979	4 (0.1)	3 (2.5)	1 (0.03)
1980-1989	88 (2.6)	12 (9.8)	76 (2.4)
1990-1999	502 (15.1)	54 (44.3)	448 (14.0)
2000-2009	843 (25.3)	27 (22.1)	816 (25.4)
2010-2019	1,097 (32.9)	24 (19.7)	1073 (33.5)
2020-2023	796 (23.9)	2 (1.6)	794 (24.8)

¹ 136 cancers diagnosed among 122 women who developed cancer during the follow-up period

² Age when first certified to become a firefighter in Texas

³ Percentages may not equal 100 due to rounding.

⁴ The Other race/ethnicity category includes Non-Hispanic American Indian, Alaska Native, Asian, Pacific Islander, any other race, and unknown race.

TABLE 2Cancers Diagnosed Among Texas Certified Female Firefighters from 1995-2023¹

	Count
Cancer Type	
All cancer sites combined	136
Breast	49
Thyroid	15
Melanoma	12
Colon and rectum	10
Brain and central nervous system	7
Uterine	7
Cervical	5
Other endocrine including thymus	4
Lymphoma	3
Myeloma	3
Ovary	3
Pancreas	3
Lung and bronchus	2
Miscellaneous	2
Stomach	2
Anus, anal canal, and anorectum	1
Bones and joints	1
Kidney and renal pelvis	1
Leukemia	1
Oral cavity and pharynx	1
Peritoneum	1
Small intestine	1
Urinary bladder	1
Vagina	1
Diagnosis year	
1995-1999	2
2000-2004	5
2005-2009	20
2010-2014	16
2015-2019	38
2020-2023	55
Age at diagnosis	
18-29y	5
30-39y	20
40-49y	51
50-59y	39
60-69y	19
70y+	2

¹ 136 cancers diagnosed among 122 women who developed cancer during the follow-up period; all incident cancers included (multiple primaries)

TABLE 3

Standardized Incidence Ratios (SIRs) for Cancer and 95% Confidence Intervals (CIs) Among Texas Certified Female Firefighters¹

Cancer	Observed Cases²	SIR	95% CI
All sites combined	136	0.93	0.78-1.10
Female-specific			
Breast	49	0.95	0.71-1.26
Cervical	5	1.00	0.32-2.34
Ovarian	3	0.82	0.17-2.41
Uterine	7	0.98	0.39-2.03
Other female reproductive cancers	1	0.58	0.01-3.22
Other non-female specific cancers			
Brain & Central Nervous System	7	0.94	0.28-1.94
Colorectal	10	1.18	0.56-2.17
Melanoma	12	1.24	0.64-2.16
Thyroid	15	1.65	0.92-2.72

¹ SIRs are ratios of observed to expected cancers established by the cancer incidence rates in the reference Texas population (Texas Cancer Registry), adjusted for age, race/ethnicity, and calendar year.

² SIRs based on fewer than 5 cases can be unstable, as evidenced by wide 95% CIs, and should be interpreted with caution.

Appendix B. Figures

FIGURE 1

Number of New Initial Certifications Among Texas Female Firefighters, by Year, 1972-2023

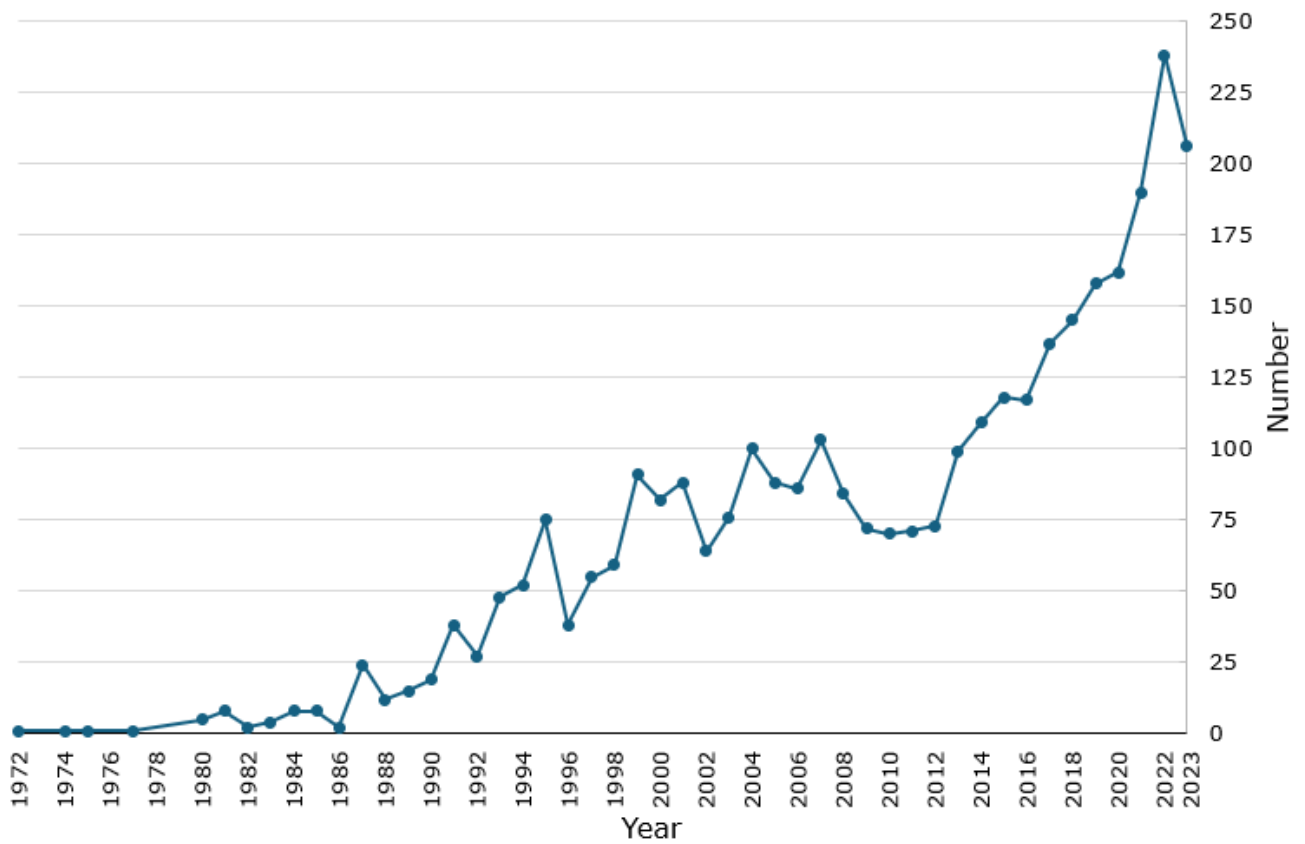


FIGURE 2.
Cohort Identification and Final Cancer Cases among Texas Certified Female Firefighters

