ORIGINAL RESEARCH
DOI: 10.17986/bml.1773
Adli Tıp Bülteni 2025;30(3):227-235

Causation between occupational disease and death: A forensic medical evaluation

Zafer Liman[1], Uğur Kayhan[2], Mustafa Erelel[3], İbrahim Üzün[4]

[1] Karabuk University, Faculty of Medicine, Department of Forensic Medicine, Karabuk, Türkiye
[2] Afyonkarahisar Health Sciences University, Faculty of Medicine, Department of Forensic Medicine, Afyonkarahisar, Türkiye
[3] Istanbul University, Faculty of Medicine, Department of Chest Diseases, Istanbul, Türkiye
[4] Cerrahpaşa University, Faculty of Medicine, Department of Forensic Medicine, Istanbul, Türkiye

Abstract

Causation between occupational disease and death: a forensic medical evaluation

Objective: This study examines the challenges encountered in the forensic evaluation of causal links in occupational disease-related deaths in Türkiye.
Methods: A total of 202 case files reviewed retrospectively by the First Specialization Board of the Council of Forensic Medicine between 2008 and 2012 were included. These cases were assessed to determine whether death was attributable to an occupational disease. Case characteristics, duration of employment, intervals between diagnosis and death, presence of histopathological evaluation, and expert opinions were analyzed.
Results: All cases involved male individuals, and 91.1% had worked in the coal mining sector. The mean duration of employment was 23.5 years, while the average time between diagnosis and death was 19.4 years. Pneumoconiosis was reported in the medical history of 92.6% of cases. Based on expert evaluations, 89.6% were diagnosed with an occupational disease, and in 15.8%, the death was attributed to the disease. Autopsy was performed in only one case (0.5%). No statistically significant relationship was found between duration of employment, time from diagnosis to death, or post-retirement lifespan and expert opinion on causality ($p>0.05$). However, comorbid systemic diseases were significantly associated with negative causality assessment ($p<0.05$).
Conclusion: Most cases lacked autopsy data, had long intervals between diagnosis and death, and showed incomplete medical documentation. The lack of documentation, absence of autopsy, and presence of comorbidities were the main factors complicating the determination of whether death was due to occupational disease. To improve recognition and documentation, structured forensic autopsy protocols and a national registry system are urgently needed.
Keywords: Occupational disease; pneumoconiosis; death; forensic medicine; causality

How to Cite: Liman Z, Kayhan U, Erelel M, Uzun I. Causation between occupational disease and death: a forensic medical evaluation. Bull Leg Med. 2025;30(3):227-235. https://doi.org/10.17986/bml.1773

Address for Correspondence:: Zafer Liman, Karabuk University, Faculty of Medicine, Department of Forensic Medicine, Karabuk, Türkiye
Email: zaferliman@yahoo.com **ORCID iD:** 0000-0002-8689-9808

Received: Aug 19, 2025
Accepted: Nov 27, 2025

Öz

Meslek hastalığı ve ölüm: adli tıbbi açıdan illiyetin değerlendirilmesi

Amaç: Bu çalışma, Türkiye'de ölümle sonuçlanan meslek hastalığı olgularında illiyet bağının adli tıbbi açıdan değerlendirilmesinde karşılaşılan sorunları incelemeyi amaçlamaktadır.
Yöntem: 2008–2012 yılları arasında Adli Tıp Kurumu 1. İhtisas Kurulu tarafından, ölümün meslek hastalığından kaynaklanıp kaynaklanmadığına ilişkin olarak değerlendirilen 202 dosya geriye dönük olarak incelendi. Vaka özellikleri, istihdam süresi, tanı ve ölüm arasındaki süreler, patolojik inceleme yapılma durumu ve uzman görüşleri analiz edildi.
Bulgular: Olguların tamamı erkekti ve %91,1'inin kömür madenciliği sektöründe çalıştığı görüldü. Ortalama meslek süresi 23,5 yıl, tanı ile ölüm arasındaki süre ise 19,4 yıl olarak bulundu. Olguların %92,6'sında özgeçmişte en az bir kez pnömokonyoz tanısı bulunduğu, kurul tarafından yapılan değerlendirmede ise %89,6'sında meslek hastalığı tespit edildiği ve %15,8'inde ölümün meslek hastalığına bağlı olduğunun mütalaa edildiği görüldü. Otopsi yapılan vaka sayısı yalnızca 1 (%0,5) idi. Çalışma süresi, tanı ile ölüm arasındaki süre ve emeklilik sonrası yaşam süresi ile ölümün meslek hastalığına bağlı olup olmadığı arasındaki ilişki istatistiksel olarak anlamlı bulunmadı ($p>0,05$). Meslek hastalığına eşlik eden sistemik hastalıkların varlığı, illiyet ilişkisinin reddi ile istatistiksel olarak anlamlı bulundu ($p<0,05$).
Sonuç: Olguların büyük bölümünde otopsi yapılmamış, tanı ile ölüm arasında uzun süre geçmiş ve bazı olgularda tıbbi belgeler yetersizdi. Belgelerin yetersizliği, otopsi eksikliği ve eşlik eden hastalıklar; birçok vakada ölümün meslek hastalığına bağlı olup olmadığına dair kesin bir değerlendirme yapmayı güçleştiren başlıca faktörlerdendir. Meslek hastalıklarının doğru tespiti ve kayıt altına alınabilmesi için yapılandırılmış adli otopsi protokollerine ve ulusal bir kayıt sistemine ihtiyaç vardır.
Anahtar Kelimeler: Meslek hastalığı; pnömokonyoz; ölüm; adli tıp; illiyet

INTRODUCTION

Occupational health and safety encompasses a range of public health initiatives aimed at promoting and sustaining the highest possible level of physical, mental, and social well-being of workers (1). One of the health problems that may arise during the course of work is occupational disease. According to the definition provided by the International Labour Organization (ILO), an 'occupational disease' refers to any disease for which a causal relationship has been scientifically established, primarily resulting from exposure to risk factors arising from the nature of the work or activity performed (2). In the early 2000s, ILO estimated that occupational accidents and diseases accounted for an annual global loss of approximately 4% of the Gross Domestic Product (GDP) per capita. Recent data suggest that this figure has increased to 5.8%, highlighting the growing economic burden of work-related health issues worldwide (3).

Recent international statistics indicate that nearly 3 million workers worldwide die annually due to work-related conditions, the majority of which are attributed to occupational diseases (4). In comparison, data from the Turkish Statistical Institute (TurkStat) show that a total of 489,361 deaths were reported in Türkiye (5). Furthermore, according to 2024 data from the Social Security Institution of Türkiye, a total of 733956 occupational accidents were officially reported, resulting in 1905 deaths. In contrast, only 888 cases were officially recognized as occupational diseases, with 3 deaths attributed to occupational diseases during the same year (6). As can be seen from the statistics, contrary to international practice, the overall number of reported occupational diseases in Türkiye remains notably lower than expected. According to national data although musculoskeletal disorders represent the most common medical diagnosis, respiratory diseases are more frequently recognized as occupational diseases within the legal framework (7).

The First Specialization Board of the Council of Forensic Medicine serves as the highest official expert authority in determining the cause of death and related matters in Türkiye. This board reviews case files submitted by courts and prosecutors, including available medical documentation, to assess and clarify the cause of death. In cases suspected to involve occupational diseases, the evaluation is carried out through a multidisciplinary approach involving specialists in pulmonary medicine, forensic medicine, and other relevant clinical disciplines. The final decision is rendered based on expert consensus and medical evidence. This study aims to examine the medico-legal challenges surrounding the diagnosis and classification of occupational diseases, especially in post-mortem evaluations. To that end, expert opinions issued by the First Specialization Board of the Council of Forensic Medicine were analyzed to explore how occupational disease-related deaths are assessed in practice.

METHODS

Between 2008 and 2012, approximately 25,000 forensic case files for which expert opinions were issued by the First Specialization Board of the Council of Forensic Medicine—particularly concerning issues such as the mechanism and timing of death—were retrospectively reviewed. Among these, 202 cases in which the cause of death was specifically evaluated in terms of a possible occupational disease were included in the study. Cases involving multiple forensic evaluations for the same individual, as well as those with multiple critical data deficiencies—such as concurrently missing employment history, incomplete medical records, and absent expert opinions—were excluded from the analysis to maintain the overall integrity and comparability of the dataset. Minor data gaps that did not affect the core analytic variables were tolerated. All data were anonymized prior to analysis to ensure confidentiality and compliance with ethical research standards.

Data were extracted from forensic files and systematically recorded into a structured database. The variables included sociodemographic characteristics, occupational field and specific job title, age at the beginning of employment, duration of occupational exposure (total time worked in the occupation before diagnosis or death), latency period between employment initiation and disease diagnosis, performance of histopathological analysis for diagnostic confirmation, and expert determination regarding whether the death resulted from an occupational disease.

Data were analyzed using the SPSS version 21.0 statistical software package. The normality of distribution for continuous variables was assessed using the Kolmogorov–Smirnov test. Continuous variables were evaluated with the Spearman correlation test, and the results were presented through tables and figures. A p-value of less than 0.05 was considered statistically significant.

The study was approved by Karabük University Non-Interventional Clinical Research Ethics Committee's decision dated 27/12/2023 and numbered 2023/1612.

RESULTS

Demographic and Occupational Characteristics

Among the 202 cases evaluated within the specified period, all individuals (100%) were found to be male. Analysis of the age distribution at the time of death revealed that 0.5% (n=1) of the cases were under 18 years of age, 1% (n=2) were between 30–39 years, 4% (n=8) between 40–49 years, 5.9% (n=12) between 50–59 years, 32.7% (n=66) between 60–69 years, 41.6% (n=84) between 70–79 years, and 9.4% (n=19) were aged 80 and above. The mean age at death was calculated as 68.9 years, with the youngest case being 15 and the oldest 92 years old. In 5% of the cases (n=10), exact age at death could not be determined due to insufficient data.

The distribution of cases by occupational sectors is presented in Figure 1. Of the total, 91.1% (n=184) were employed in coal mining, while 1.5% (n=3) worked in 'other' mining sectors such as quartz, antimony, and lead. Among the three cases in the leather and textile sector, all were employed in denim sandblasting. Three cases (1.5%) classified as 'other' had a history of working in multiple sectors at different times: One in both coal mining and construction, one in coal mining and a tea factory, and one in the leather-textile sector as well as in metal casting industry.

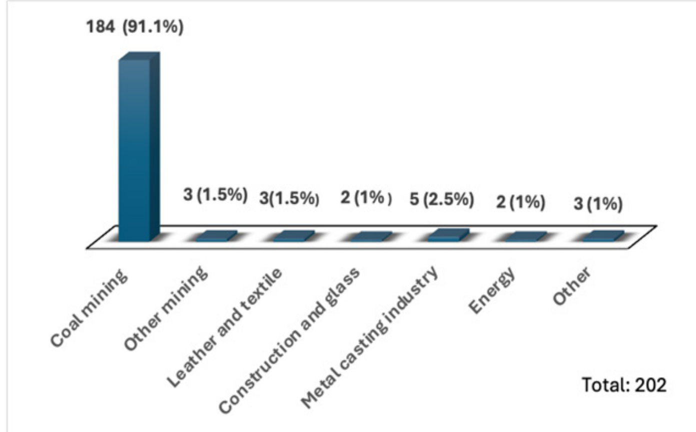

Figure 1. Distribution of cases by occupational sector

When the cases were analyzed based on the age at which they began the occupation alleged to have caused the occupational disease, the mean age of job initiation was 19.5 years. The earliest recorded age at job entry was 9, and the latest was 41. Specifically, 5% (n=10) of the cases began working between the ages of 0–15, 44% (n=89) between 16–18, 34.1% (n=69) between 19–30, 2.5% (n=5) between 31–40, and 1% (n=2) started after the age of 40.

When analyzed by duration of employment, the mean total working period was found to be 23.47 years. Specifically, 5.4% (n=11) of the cases had worked for 0–10 years, 17.3% (n=35) for 11–20 years, 50.5% (n=102) for 21–30 years, and 19.3% (n=39) for 31–40 years. In 7.4% of the cases (n=15), the exact duration of employment could not be determined. No statistically significant difference was observed between the duration of employment and the expert opinion regarding whether the death resulted from an occupational disease (p = 0,205).

Disease Onset, Diagnosis, and Mortality Timeline

An analysis of the time elapsed between the start of employment and the initial diagnosis of the occupational disease revealed that the diagnosis was made after an average of 30.2 years. Specifically, this interval was 11–20 years in 17.3% (n=35) of cases, 21–30 years in 25.2% (n=51), 31–40 years in 18.3% (n=37), 41–50 years in 18.8% (n=38), (Table 1)

An analysis of the time elapsed between the initial diagnosis of the occupational disease and the individual's death, categorized by decade intervals, showed that 21.8% (n=44) of cases died within 0–10 years after diagnosis, 25.2% (n=51) within 11–20 years, 17.8% (n=36) within 21–30 years, 15.8% (n=32) within 31–40 years, and 9.9% (n=20) within 41–50 years. The mean duration between initial diagnosis

Table 1: Distribution of Time Intervals Related to Occupational Disease Cases

Time Interval (Years)	Employment–Diagnosis		Diagnosis–Death		Retirement–Death	
	n	%	n	%	n	%
0–10	7	3.5%	44	21.8%	11	5.4%
11–20	35	17.3%	51	25.2%	28	13.9%
21–30	51	25.2%	36	17.8%	80	39.6%
31–40	37	18.3%	32	15.8%	46	22.8%
41–50	38	18.8%	20	9.9%	17	8.4%
51–60	9	4.5%	—		—	
61–70	2	1.0%	—		—	
Unknown	23	11.4%	19	9.4%	20	9.9%
Mean	30.2 years		19.4 years		25.9 years	

Note: "%" represent column percentages within each disease category.

and death was 19.4 years (Table 1). No statistically significant difference was found between the time from first diagnosis to death and the expert opinion regarding whether the death was attributed to an occupational disease (p = 0,096).

Regarding the time interval between retirement and death, the duration ranged from a minimum of 1 year to a maximum of 49 years, with a mean of 25.9 years. It was determined that 5.4% (n=11) of the individuals died within 0–10 years after retirement, 13.9% (n=28) within 11–20 years, 39.6% (n=80) within 21–30 years, 22.8% (n=46) within 31–40 years, and 8.4% (n=17) within 41–50 years (Table 1). No statistically significant relationship was found between the retirement-to-death interval and the expert opinion regarding whether the death was caused by an occupational disease (p = 0,102).

Distribution of Diagnosed Diseases

When examining the distribution of pneumoconiosis—either as a sole diagnosis or in combination with other diseases—among all cases, it was observed that 92.6% (n=187) of the 202 cases involved at least one condition diagnosed as pneumoconiosis, whereas in 7.5% (n=15) of the cases, pneumoconiosis was not diagnosed, and the evaluations were instead based on other suspected occupational diseases.

Cases Diagnosed with Pneumoconiosis

Within the subgroup of cases diagnosed with pneumoconiosis (n=187), the majority (87.5%, n=164) had coal workers' pneumoconiosis, followed by silicosis in 11.2% (n=21), and other types such as asbestosis in 1.3% (n=2).

Among all cases with a confirmed diagnosis of pneumoconiosis, 18.7% (n=35) were also found to have an additional condition attributed to occupational exposure. Specifically, 5.9% (n=11) of these cases had coexisting pneumoconiosis and lung cancer, 10.7% (n=20) had chronic obstructive pulmonary disease (COPD), 1.6% (n=3) were diagnosed with occupational hearing loss, and 0.5% (n=1) had a concurrent diagnosis of gastrointestinal system cancer.

Among the 11 cases in which pneumoconiosis and lung cancer were co-diagnosed, seven were diagnosed with coal workers' pneumoconiosis, and four with silicosis. When these cases were evaluated in terms of occupational sectors, it was found that seven individuals had worked in coal mining, one in antimony mining, one in the metal casting industry, one in denim sandblasting, and one had been employed at different times in both coal mining and a brick factory.

Non-Pneumoconiosis Occupational Disease Cases

Within the subgroup of cases without a diagnosis of pneumoconiosis (n=15), 8 were found to have chronic obstructive pulmonary disease (COPD), and 4 were diagnosed with lung cancer. Additionally, one case involved a cardiovascular system disease, another showed a combination of aplastic anemia and hepatitis, and one case presented with pneumonia coexisting with Guillain-Barré syndrome (Table 2).

Among the four cases diagnosed solely with lung cancer, two were found to have worked in coal mining, one in the metal casting industry, and one in the petrochemical industry.

Clinical and Forensic Evaluation

In 9.9% (n=20) of the cases, histopathological examinations had been conducted prior to referral, and their findings were included in the expert evaluation.

When the presence of additional systemic diseases other than the occupational disease was examined, it was found that 47% (n=95) of the cases had at least one comorbid condition. Among these, cardiovascular system diseases were the most common, accompanying the occupational disease in 62.1% of the cases (n=59). A statistically significant difference was observed between the presence of an additional systemic disease and the expert opinion on whether the death was caused by the occupational disease ($p < 0.05$).

When the cases were examined in terms of whether a systematic autopsy had been performed prior to burial, it was found that only 1 out of 202 cases (0.5%) had undergone such an autopsy. In this case, the cause of death was determined to be acute myocardial infarction due to coronary heart disease. It was understood that the expert opinion had been requested to evaluate whether the heart disease that caused the death was of occupational origin.

When examining the causes of death recorded on the death certificates of the evaluated cases, it was found that pneumoconiosis was listed as the cause in 21.3% (n=43), chronic obstructive pulmonary disease (COPD) in 11.4% (n=23), and COPD in combination with non-pneumoconiosis respiratory diseases (e.g., lung cancer, pneumonia, pulmonary embolism, etc.) in 8.9% (n=18). Additionally, cardiopulmonary arrest was reported in 14.4% (n=29), systemic diseases unrelated to the respiratory system in 16.8% (n=34), and "natural disease" in 4.9% (n=10). The cause of death was recorded as "unknown" in 7.4% (n=15), and no death certificate was available for 14.9% (n=30) of the cases.

According to the final assessments conducted by the Board, 89.6% of the cases (n=181) were determined to involve an occupational disease, while in 8.4% (n=17), the presence of an occupationally induced condition was ruled out. In 2% of the cases (n=4), it was not possible to determine whether the diagnosed condition was of occupational origin. Furthermore, in 15.8% of the cases (n=32), death was attributed to an occupational disease, whereas in 70.8% (n=143), the cause of death was deemed unrelated to occupational factors. In 13.4% of the cases (n=27), no definitive conclusion could be reached regarding whether the death was caused by an occupational disease.

Among the 32 cases in which death was determined to have resulted from an occupational disease, analysis of the official death certificates revealed that 40.7% (n=13) listed pneumoconiosis as the cause of death, 12.5% (n=4) listed chronic obstructive pulmonary disease (COPD), 9.4% (n=3) listed other pulmonary diseases, 9.4% (n=3) cited cardiopulmonary arrest, 3.1% (n=1) stated "natural disease," and 3.1% (n=1) recorded the cause as "unknown." In 21.9% (n=7) of the cases, death certificate records were unavailable. Among the three cases categorized under other pulmonary diseases, two were recorded as lung cancer and one as pulmonary thromboembolism on the death certificate.

Table 2. Distribution of cases by type of disease and expert opinion (OD-D / nonOD-D)

Cause of Death	OD-D		nonOD-D		Undetermined		Total
	n	%	n	%	n	%	
CWP	17	53.1%	98	68.5%	18	66.7%	133
Silicosis	4	12.5%	11	7.7%	2	7.4%	17
Asbestosis	0	0%	1	0.7%	1	3.7%	2
COPD	2	6.3%	3	2.1%	3	11.1%	8
Lung cancer	0	0%	3	2.1%	1	3.7%	4
CVD	0	0%	1	0.7%	0	0%	1
CWP+ Lung cancer	2	6.3%	9	6.3%	0	0%	11
CWP + COPD	5	15.6%	13	9.1%	2	7.4%	20
AA + Hepatitis	0	0%	1	0.7%	0	0%	1
CWP + GI Cancer	0	0%	1	0.7%	0	0%	1
CWP + HL	2	6.3%	1	0.7%	0	0%	3
Pneumonia + GB	0	0%	1	0.7%	0	0%	1
Total	32	15.8%	143	70.8%	27	13.4%	202

When examining the distribution of diseases in the 32 cases where death was determined to have resulted from an occupational disease, 53.1% (n=17) were diagnosed with coal workers' pneumoconiosis, 12.5% (n=4) with silicosis, and 6.3% (n=2) with chronic obstructive pulmonary disease (COPD). In 28.1% (n=9) of the cases, pneumoconiosis was accompanied by at least one additional condition, such as lung cancer, COPD, or hearing loss (Table 2).

Note: "%" represent column percentages within each disease category.

Abbreviations: OD-D: Death attributed to occupational disease, nonOD-D: Death not attributed to occupational disease, CWP: Coal Workers' Pneumoconiosis, COPD: Chronic Obstructive Pulmonary Disease, CVD: Cardiovascular disease, GI: Gastrointestinal, HL: Hearing Loss, AA: Aplastic Anemia, GB: Guillain–Barré syndrome

DISCUSSION

Diagnostic Challenges in Occupational Diseases

In Türkiye, where the active workforce exceeds 30 million, the current number of reported occupational diseases (6) remains markedly below Harrington's estimate of 4–12 new cases per 1,000 workers annually (8). This persistent gap reflects ongoing challenges in the diagnosis and reporting of occupational diseases. Long latency periods, limited awareness among healthcare professionals and workers, insufficient diagnostic resources, and administrative barriers contribute to delayed recognition. Additionally, an important distinction exists between clinical and legal recognition. While medical diagnosis establishes causality, legal acknowledgment requires confirmation by the Social Security Institution (SSI). Without SSI approval, the disease is not officially classified as occupational, and individuals must pursue a lengthy and complex judicial process.

Socioeconomic factors also contribute to underdiagnosis and underreporting. Workers in high-risk sectors often have limited education, reduced awareness of occupational hazards, and insufficient knowledge of legal procedures. These factors delay symptom recognition and hinder official reporting, further weakening national surveillance systems.

In this study, 202 cases were evaluated over a five-year period. When considered alongside national data, discrepancies between institutional records appear to stem largely from prolonged administrative and legal procedures, which often delay judicial outcomes. Official statistics for a given year usually include only those cases that completed both administrative and legal stages within that period. Since these processes frequently span multiple years, the true burden of occupational disease is likely underrepresented. Establishing an integrated national registry—similar to the Occupational Diseases Bureau in South Africa—could improve data accuracy and facilitate systematic monitoring (9). A coordinated structure involving the Ministry of Health, Ministry of Justice, and Ministry of Labor may enable more comprehensive surveillance of occupational diseases and exposures.

In our study, 91.1% of deceased individuals evaluated for suspected occupational disease had a history of coal mining. This distribution aligns with global data identifying coal mining as a leading industry associated with fatal pneumoconiosis and other dust-related diseases (10,11). The predominance of miners likely reflects a forensic selection bias toward fatal cases, whereas non-fatal occupational diseases are more common in other sectors such as agriculture, manufacturing, and healthcare.

Industries such as denim sandblasting, construction, and textiles—although known sources of silicosis and other lung diseases—were underrepresented. This may be related to informal or seasonal employment practices in these sectors, which hinder documentation and complicate causal assessments. Consequently, the low number of fatal cases from non-mining sectors likely reflects barriers in recognition rather than truly lower prevalence.

Accurate diagnosis of occupational diseases may require radiological, biochemical, or histopathological evaluation, especially in complex cases. In this study, histopathological analysis was performed in only 9.9% of cases, indicating its limited use in routine diagnostic practice. For pneumoconiosis, occupational history, exposure data, and radiological findings are generally sufficient to distinguish it from other conditions such as infections, malignancies, or connective tissue diseases. Current guidelines recommend histopathology primarily when standard methods yield inconclusive results or when rare subtypes are suspected (12,13). The selective use of histopathology in our cases therefore appears consistent with evidence-based diagnostic practice.

Determination of Cause of Death

All individuals evaluated for cause of death in this study were male, consistent with Article 72 of the Turkish Labor Law (14), which prohibits women and males under 18 from working in physically demanding occupations including mining. Despite these regulations, 49% (n=99) of individuals had begun working before age 18, mostly in mining or other heavy industries. This suggests either inadequate enforcement or that regulations were implemented after these individuals had entered the workforce. Early employment in high-risk sectors and prolonged exposure likely contributed to disease development.

Establishing a causal link between occupational exposure and disease is central to clinical and forensic evaluations. The Bradford Hill criteria (15) provide a widely accepted framework for causality, emphasizing temporality, dose–response relationship, and biological plausibility. In forensic practice, these criteria are adapted to include the nature of the diagnosed occupational disease, latency, exposure cessation or continuation, disease lethality, and comorbidities. Together, these parameters support a systematic, multidisciplinary assessment of whether occupational exposure contributed to death.

In this study, death was attributed to an occupational disease in 15.8% of cases (n=32), while 70.8% (n=143) were deemed unrelated to occupational exposure. In 13.4% (n=27), available information was insufficient for a definitive conclusion. These findings highlight the difficulties inherent in causality assessments, particularly when long latency periods, comorbid conditions, incomplete exposure histories, or limited postmortem data are present.

Nearly half (47%) of cases had at least one systemic comorbidity, 62.1% of which involved the cardiovascular system. A statistically significant association was identified between comorbidities and the expert opinion on occupational causality: cases attributed to occupational disease had fewer comorbid conditions. This suggests that alternative explanations such as comorbid diseases are carefully weighed during forensic evaluations.

Among cases in which causality could not be definitively established, 22.2% lacked autopsy data, and 74.1% had insufficient occupational or imaging information despite undergoing autopsy. In contrast, the only case with complete forensic documentation allowed a conclusive determination of death due to acute myocardial infarction secondary to coronary artery disease. These findings underscore the essential role of autopsy as the gold standard in medico-legal evaluations, enabling histopathological verification and supporting accurate cause-of-death determination(16,17).

Given the frequency of inconclusive assessments due to inadequate postmortem investigation, forensic autopsy should be proactively considered in deceased individuals with a documented occupational disease or long-term employment in high-risk sectors. Such an approach would improve diagnostic accuracy and provide clearer legal outcomes.

When autopsy is not performed, the official death certificate becomes the primary document available for assessing occupational disease–related mortality. In this study, 58.4% of certificates listed respiratory or organ-system–related causes; however, 26.7% used non-specific terms such as "cardiopulmonary arrest," "respiratory and circulatory failure," "natural death," or "unknown," sometimes signed by non-medical personnel. According to the World Health Organization's International Form of Medical Certificate of Cause of Death, a valid certificate should detail the causal sequence leading to death in a structured format (18,19). Accurate completion of this form by a licensed physician is critical in cases involving suspected occupational disease.

Many cases of pneumoconiosis in this study involved individuals who had died many years after retirement. Due to likely financial constraints, post-retirement medical follow-up and documentation were often lacking, particularly among workers who retired decades earlier under less developed occupational health systems. Deficiencies in pre-employment and periodic health screenings also complicate retrospective causal assessments.

Although reconstructing historical medical data is challenging, postmortem evaluation can partially compensate for this gap. South Africa provides a notable model, where legislation since 1973 allows miners or their families to request postmortem histopathological examination of thoracic organs regardless of the recorded cause of death (20). These examinations are archived in the Pathology Automation System (PATHAUT), and employment records are maintained by the Medical Bureau for Occupational Diseases (21). Establishing similar surveillance systems elsewhere could improve attribution of occupational disease–related deaths and support policy development and compensation processes.

Given the feasibility of long-term data preservation, establishing a comparable system tailored to the socioeconomic conditions of developing countries is increasingly necessary. Such a structure would ensure comprehensive documentation, reduce statistical discrepancies, and minimize disputes regarding occupational disease recognition.

In this study, the mean age at death among cases attributed to occupational disease was 64 years, compared to 70 years in non-occupational cases. According to TurkStat life tables, life expectancy for men during the study period was 75.3 years(22). The observed reduction of approximately 11 years highlights the substantial impact of occupational diseases on premature mortality. Although pneumoconiosis may not directly cause death in all cases, it significantly impairs functional capacity and may contribute to mortality through secondary complications.

The mean time from first diagnosis to death was 19.4 years. This aligns with previous studies reporting mean survival times of 14.7 ± 9.6 years (23) and 18.1 ± 11.2 years (10) among pneumoconiosis patients. These findings underscore the chronic and progressive nature of the disease, which contributes predominantly to long-term morbidity.

The average duration from retirement to death was 22.8 years in occupational disease–related cases versus 26.7 years in non-occupational cases. Although this difference was not statistically significant, it may reflect the enduring impact of occupational exposures extending into the post-employment period.

Overall, these findings highlight the need for systemic improvements in the diagnosis, documentation, and recognition of occupational disease–related deaths.

CONCLUSION

This study identifies major challenges in the medico-legal assessment of deaths potentially associated with occupational diseases in Türkiye. The lack of routine postmortem examinations, insufficient medical documentation from workers' pre-retirement years, and the systemic underreporting of occupational diseases—partly driven by limited clinical awareness and gaps in coverage for uninsured workers—significantly contribute to diagnostic uncertainty.

Despite these limitations, the findings emphasize the need for improved health surveillance systems, standardized physician-completed death certificates, and legal frameworks that acknowledge occupational disease risks extending into the post-employment period. Implementing postmortem investigation protocols adapted to Türkiye's socio-cultural and economic context could strengthen the identification and documentation of occupational disease-related mortality.

Ultimately, enhancing medico-legal procedures and public health infrastructure would not only protect workers' rights but also help reduce productivity losses and the broader economic burden at the national level.

LIMITATIONS OF THE STUDY

This study has several limitations. First, the cases analyzed were from earlier periods and may not fully represent current occupational health and safety conditions. Although the findings remain informative for understanding medico-legal challenges in occupational disease–related deaths, changes in regulations, diagnostic standards, and institutional practices over time may limit their direct applicability today.

Second, incomplete or missing documentation in some case files restricted access to essential clinical, occupational, or exposure information, thereby constraining causality assessments. The retrospective study design also prevented the collection of standardized data, such as uniform clinical evaluations or detailed exposure histories.

Finally, the study included only cases referred to the First Specialization Board of the Council of Forensic Medicine, which may not reflect the full national spectrum of occupational disease–related mortality in Türkiye. Thus, selection bias may have influenced the distribution and characteristics of the cases examined.

Despite these limitations, this study provides a unique contribution, representing the first comprehensive medico-legal evaluation of occupational disease–related deaths conducted in Türkiye.

ACKNOWLEDGEMENT

Peer-Review

Double blind internal peer review

Conflict of Interest

The authors declare that they have no conflict of interests regarding content of this article..

Financial Support

The Authors report no financial support regarding content of this article.

Ethical Declaration

Ethical approval was obtained from Karabük University Ethical Committee with date 27.12.2023 and number 2023/1612, and Helsinki Declaration rules were followed to conduct this study.

Thesis

This study was created by reorganizing the first author's medical specialization thesis titled "Forensic Medical Approach to Occupational Diseases", dated 2015.

Previous Presentation

Some part of this study was presented as oral presentation at "13th Forensic Sciences Congress, on April 27-30, 2016" held in Milas city, entitled as "Forensic approach to occupational diseases".

Authorship Contributions

Concept: ZL, UK, ME, IU Design: ZL, UK, ME, IU, Supervision: ZL, UK, ME, Data Collection and Processing: ZL, UK, Analysis and Interpretation: ZL, UK, ME, IU, Literature Review: ZL, UK, Writing – Original Draft: ZL, Writing – Review & Editing: ZL, UK, Supervision: UK, ME, IU

REFERENCES

1. World Health Organization. Occupational health [Internet]. [cited 2025 Apr 30]. Available from: https://www.who.int/health-topics/occupational-health
2. International Labour Office, editor. List of occupational diseases: identification and recognition of occupational diseases: criteria for incorporating diseases in the ILO list of occupational diseases. Rev. 2010. Geneva: International Labour Office; 2010. 72 p. (Occupational safety and health series).
3. Takala J, Hämäläinen P, Sauni R, Nygård CH, Gagliardi D, Neupane S. Global-, regional- and country-level estimates of the work-related burden of diseases and accidents in 2019. Scand J Work Environ Health. 2024;50(2):73-82. https://doi.org/10.5271/sjweh.4132
4. International Labour Organization. Nearly 3 million people die of work-related accidents and diseases [Internet]. 2023 [cited 2025 May 8]. Available from: https://www.ilo.org/resource/news/nearly-3-million-people-die-work-related-accidents-and-diseases
5. Turkish Statistical Institute (TurkStat). Deaths and causes of death statistics, 2024 [Internet]. [cited 2025 Jul 29]. Available from: https://data.tuik.gov.tr/Bulten/Index?p=Olum-ve-Olum-Nedeni-Istatistikleri-2024-54195
6. Social Security Institution (SGK). Social Security Institution annual, insured and workplace statistics, 2024 [Internet]. [cited 2025 May 8]. Available from: https://www.sgk.gov.tr/Istatistik/Yillik/fcd5e59b-6af9-4d90-a451-ee7500eb1cb4/
7. Medeni İ, Alagüney ME, Medeni V. Medical and legal diagnoses comparison of the occupational diseases: A nationwide study in Türkiye. J Eval Clin Pract. 2024;30(7):1449-56. doi:10.1111/jep.14064.
8. Aw TC, Gardiner K, Harrington JM. Pocket consultant occupational health [Internet]. Oxford: Blackwell Publishing; 2007. (Pocket consultant). Available from: https://books.google.com.tr/books?id=mR2nAQAACAAJ
9. Nelson G. Occupational respiratory diseases in the South African mining industry. Glob Health Action. 2013 Jan 24;6:19520. doi: 10.3402/gha.v6i0.19520.
10. Zhu H, Zhou L, Zhou J, Han L, Wu M. Analysis of mortality and life expectancy determinants among 5,791 deceased pneumoconiosis patients — Jiangsu Province, China, 2011–2023. China CDC Wkly. 2024 Dec 27;6(52):1417-24. doi: 10.46234/ccdcw2024.278.
11. Chen HL, Li CH, Zhai PY, Zhuang X, Lian YL, Qiao X, et al. Survival and disease burden analyses of occupational pneumoconiosis during 1958–2021 in Huangshi city, China: a retrospective cohort study. BMC Public Health. 2024 May 29;24(1):1437. doi:10.1186/s12889-024-18847-6.
12. Hua JT, Cool CD, Green FHY. Pathology and mineralogy of the pneumoconioses. Semin Respir Crit Care Med. 2023 Jun;44(3):327-39. doi:10.1055/s-0043-1764406.
13. Calabrese F, Montero-Fernandez MA, Kern I, Pezzuto F, Lunardi F, Hofman P, et al. The role of pathologists in the diagnosis of occupational lung diseases: an expert opinion of the European Society of Pathology Pulmonary Pathology Working Group. Virchows Arch. 2024 Aug;485(2):173-195. doi:10.1007/s00428-024-03845-1.

14. Republic of Türkiye. Turkish Labor Law [Internet]. 2003 May 22 [cited 2025 May 8].

15. Hill AB. The environment and disease: association or causation? Proc R Soc Med. 1965 May;58(5):295-300. doi:10.1177/003591576505800503.

16. Albano GD, Rodolico V, Di Franco S, Lo Re G, Midiri M, Malta G, et al. Asbestos exposure determined 357 days after death through autopsy: a report of a multidisciplinary approach. Forensic Sci Med Pathol. 2025 Mar;21(1):332 40. doi:10.1007/s12024-024-00838-z.

17. Costache M, Lazaroiu AM, Contolenco A, Costache D, George S, Sajin M, et al. Clinical or postmortem? The importance of the autopsy; a retrospective study. Maedica (Bucur). 2014 Sep;9(3):261-5. PMID: 25705246.

18. World Health Organization. Cause of death on the death certificate in line with ICD: quick reference guide [Internet]. Geneva: World Health Organization; 2015 [cited 2025 Jul 30]. Available from: https://cdn.who.int/media/docs/default-source/classification/icd/cause-of-death/causeofdeathflyer_2015.pdf

19. World Health Organization. International statistical classification of diseases and related health problems [Internet]. 10th revision, 2010 ed. Geneva: World Health Organization; [cited 2025 Jul 30]. Available from: https://cdn.who.int/media/docs/default-source/classification/icd/cause-of-death/icd10volume2_en_2016.pdf

20. International Labour Organization. NATLEX: South Africa – Occupational Diseases in Mines and Works Act, 1973 [Internet]. Geneva: International Labour Organization; [cited 2025 Jul 30]. Available from: https://natlex.ilo.org/dyn/natlex2/r/natlex/fe/details?p3_isn=15797

21. Nelson DI, Nelson RY, Concha-Barrientos M, Fingerhut M. The global burden of occupational noise-induced hearing loss. Am J Ind Med. 2005 Dec;48(6):446-58. doi:10.1002/ajim.20223.

22. Turkish Statistical Institute (TurkStat). Life tables, 2013–2014 [Internet]. [cited 2025 Jul 30]. Available from: https://data.tuik.gov.tr/Bulten/Index?p=Hayat-Tablolari-2013-2014-18618

23. Song X, Shen H, Zhou L, Qian G, Shi J, Xu S, et al. Survival analysis of 15,402 pneumoconiosis cases in Jiangsu Province of China from 1961 to 2019. Ann Palliat Med. 2022 Jul;11(7):2291 2301. doi:10.21037/apm 21 2824.