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OCCUPATIONAL HEALTH AND SAFETY IN THE LOGISTICS SECTOR: AN EXAMINATION OF WORK ACCIDENTS IN TURKEY

LOJİSTİK SEKTÖRÜNDE İŞ SAĞLIĞI VE GÜVENLİĞİ: TÜRKİYE'DEKİ İŞ KAZALARI ÜZERİNE BİR İNCELEME

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ABSTRACT

This study analyzes the significant role of occupational health and safety (OHS) in the rapidly growing logistics sector. The high incidence of work-related accidents in Turkey's logistics sector clearly highlights the extent of the risks faced by workers. The study provides a detailed examination of work accidents, occupational diseases, and fatality rates in the sector, based on the Social Security Institution (SSI) statistics from 2008 to 2023. The findings comprehensively reveal the work accidents and safety measures in the logistics sector. The research offers strategic recommendations for reducing these accidents and provides a methodological framework for developing policies to improve occupational safety in the sector.

ÖZ

Bu çalışma, hızla büyüyen lojistik sektöründe iş sağlığı ve güvenliğinin (İSG) önemli rolünü analiz etmektedir. Türkiye'de lojistik sektöründeki iş kazalarının yüksek oranları, çalışanların karşılaştığı risklerin büyüklüğünü açıkça ortaya koymaktadır. Çalışma, 2008-2023 yılları arasındaki Sosyal Güvenlik Kurumu (SGK) istatistiklerine dayanarak, sektör genelindeki iş kazalarını, meslek hastalıklarını ve ölüm oranlarını detaylı bir şekilde incelemektedir. Bulgular, lojistik sektöründeki iş kazalarını ve güvenlik önlemlerini kapsamlı bir şekilde ortaya koymaktadır. Araştırma, bu kazaları azaltmak için stratejik öneriler sunmakta ve sektörde iş güvenliğini iyileştirecek politikaların geliştirilmesine yönelik bir metodolojik çerçeve sağlamaktadır.

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1. Introduction

The logistics sector, as one of the cornerstones of modern economies, represents not only a multidimensional ecosystem encompassing production, supply, and distribution processes but also a strategic infrastructure that ensures the seamless functioning of global trade. This sector offers critical benefits to businesses, such as providing cost advantages, enhancing customer satisfaction, and maintaining competitive strength (Christopher, 2016). The rapid growth in global trade volume has led to more complex supply chains, increasing the importance of logistics services in creating strategic competitive advantages (Rushton et al., 2017). This transformation in the logistics sector has accelerated the integration of global markets, requiring businesses to adopt more dynamic and sustainable approaches to supply chain management (Mentzer et al., 2001).

However, the growth of the logistics sector also brings important social issues, such as occupational health and safety (OHS), to the forefront. The labor-intensive nature of the sector, tight time pressures, and the complexity of operational processes expose workers to significant risks. It is known that thousands of work-related accidents occur annually in the logistics sector worldwide. These accidents not only threaten the health and safety of employees but also negatively impact the operational continuity, productivity, and economic performance of businesses (Hämäläinen et al., 2017). The risks associated with processes such as warehousing, transportation, and loading and unloading make the implementation of effective and sustainable safety policies in the sector imperative (Reniers & Van Erp, 2016).

The high incidence of work-related accidents in Turkey's logistics sector clearly demonstrates the impact of sectoral dynamics on occupational safety. According to the Social Security Institution (SSI) statistics, the rate of work-related accidents in the logistics sector between 2008 and 2023 has remained high, as a result of the labor-intensive nature of the industry (SSI, 2023). Operational processes, particularly heavy load handling, vehicle operation, and hazardous materials transportation, constitute the main risk factors faced by workers (Rodrigue et al., 2020; Gültaç, 2023). If these risk factors are not properly managed, they jeopardize not only the health of employees but also the integrity of businesses' supply chain processes (Hale & Borys, 2013).

This study aims to analyze the current state of OHS practices in Turkey’s logistics sector, identify existing gaps, and provide strategic recommendations to address these deficiencies. The research is conducted within an analytical framework based on SSI statistics from 2008 to 2023, offering an evaluation of the sustainability of OHS policies in the sector. Additionally, this study emphasizes the importance of technology-based solutions and employee training programs as methods for improving the OHS culture in the logistics sector.

2. CONCEPTUAL FRAMEWORK

Logistics is a broad field of activity that involves the planning, implementation, and control of the movement of goods, services, information, and capital from the point of origin to the consumption point (Christopher, 2016). As a subfield of supply chain management, the sector includes transportation, warehousing, inventory management, distribution, and customer services. Due to its geographical location, Turkey holds a strategic advantage in the logistics sector, acting as a bridge between Asia and Europe and playing a crucial role in global trade (Erkan, 2014). However, the logistics sector presents numerous risks for employees due to both its physical and operational complexities.

OHS is an interdisciplinary field designed to protect workers from physical, chemical, ergonomic, and psychosocial risks they may encounter in the workplace (Hale & Hovden, 1998). The primary goal of OHS is to enhance workers' well-being by preventing workplace accidents and occupational diseases, and to create a safe working environment. Additionally, OHS holds strategic importance in terms of increasing business productivity and reducing costs (Neal & Griffin, 2006).

OHS practices in the logistics sector aim not only to protect workers from accidents and occupational diseases but also to enhance efficiency in business processes. In particular, activities such as road transportation, warehousing, and courier services carry a significantly high risk of work-related accidents (Gültaç, 2023; Engür, 2022). Therefore, strengthening OHS in the logistics sector is of critical importance for both employee health and the sustainability of the sector.

OHS policies are based on two fundamental strategies: proactive and reactive approaches. The proactive approach aims to prevent workplace accidents and occupational diseases through risk assessment, safety training, and preventive measures, while the reactive approach focuses on improving and making adjustments after accidents and diseases have occurred (Hale & Hovden, 1998). In labor-intensive fields like the logistics sector, OHS requires a more proactive approach. Protecting the physical and mental health of employees is a critical necessity for the efficiency and sustainability of the sector.

Ensuring occupational safety in the workplace requires maintaining the continuity of work by considering the risks of unexpected events. Such events are work accidents that can lead to harm or injury to employees (Özaslan, 2011). Work accidents are incidents that occur during employees' activities at the workplace, typically resulting in injury, illness, or death (Hämäläinen et al., 2017). Work accidents have been defined in various ways by different institutions and legal regulations. The Turkish Language Association (TLA) defines a work accident as an event that occurs at the workplace and has physical or psychological effects on the employee (TLA, 2024).

The International Labour Organization (ILO) defines a work accident as an unexpected and unplanned event occurring in connection with work, resulting in injury, illness, or death of the employee (ILO, 2015). In Turkey, the Occupational Health and Safety Law defines work accidents as situations that occur during the performance of work and result in the death or physical/mental harm to the employee (OHS Law, 2012). A work accident is an unexpected and sudden event that occurs at the workplace, as part of the job, or during activities under the employer's control, causing physical or psychological effects on the employee (Çalış, 2022).

Occupational diseases are long-term health issues that arise from physical, chemical, or biological factors to which employees are continuously exposed in the workplace. These diseases are defined as illnesses resulting from exposure to health risks due to the working environment or the nature of the job (Reniers & Van Erp, 2016). These diseases are typically associated with factors such as prolonged work hours, monotony, stress, and exposure to harmful agents (Özaslan, 2011). In Turkey, the Social Security and General Health Insurance Law (SSGHI Law, 2006) defines occupational diseases as temporary or permanent illnesses and physical or mental disabilities caused by the conditions of work or repetitive factors. Additionally, the Occupational Health and Safety Law No. 6331 defines occupational diseases as illnesses resulting from exposure to professional risks (OHS Law, 2012).

The key difference between an occupational disease and a work accident is that the disease typically develops due to the long-term effects of a specific factor in the workplace. For example, a worker who handles chemicals for extended periods without protective equipment and eventually develops chronic respiratory disease is considered to have an occupational disease. In contrast, a condition resulting from sudden exposure to a toxic chemical is classified as a work accident. This distinction highlights the fact that occupational diseases are generally caused by prolonged and repetitive factors (Sadullah, 2008; Özaslan, 2011).

3. METHODOLOGY

3.1. Data Sources and Scope

The data used in this study was obtained from the Social Security Institution (SSI) Annual Statistics, which is one of the main components of Turkey’s social security system. This dataset contains information on work accidents, occupational diseases, fatalities, and temporary incapacity durations for

insured workers within the 4a (Employees under a Service Contract) category in the logistics sector. According to the NACE Rev.2 Classification of Economic Activities developed by the European Union Statistical Office, the logistics sector is examined in five activity groups:

49: Land Transport and Transport via Pipelines

50: Water Transport

51: Air Transport

52: Warehousing and Support Activities for Transportation

53: Postal and Courier Activities

This sector-specific classification has facilitated more comprehensive and consistent sectoral analyses.

3.2. Analysis Methods

The data analysis was conducted in three stages:

Descriptive Statistics: The annual distribution of work accidents, occupational diseases, and fatalities in the logistics sector was examined, including the breakdown by activity groups and the ratio to total work accidents.

Trend Analysis: The changes in the data over time were examined graphically, and sectoral trends were identified. Specifically, periods of increase or decrease in work accidents and occupational diseases over the years were highlighted.

Regional and Gender-Based Distribution: Fatal work accidents and periods of incapacity were analyzed by region and gender. These analyses were conducted to understand sectoral and demographic risk factors.

3.3. Selection of Data

This study focuses only on employees within the 4a category. The reason for this is that the data related to 4a employees are recorded in a more organized and reliable manner. Employees in the 4a category are those working under a service contract for an employer, and they represent the vast majority of the workforce in the logistics sector. The detailed records kept by the Social Security Institution (SSI) for this group have increased the accuracy and reliability of the analysis.

In Turkey, the social security system categorizes insured employees according to their employment status under the Law No. 5510 on Social Security and General Health Insurance. These categories are based on how employees' insurance premiums are paid and their working conditions (SSGHI, 2006):

4a (Employees under a Service Contract): Covers insured employees working for an employer under a service contract. The premiums for employees in this group are paid by the employer and regularly recorded in the SSI system.

4b (Independent Workers): Covers individuals working independently in their own name and account, such as tradespeople, freelancers, or farmers. 4b insured individuals pay their own premiums, and their registration is more limited due to their employment status.

4c (Public Employees): Covers government employees. The premiums for employees in this group are paid by public institutions.

3.4. Limitations of the Study

The findings obtained in this study are based on analyses of registered employees in the logistics sector. Since the data used in the analysis covers only 4a insured employees, no assessment could be made regarding informal workers, which is considered a significant limitation of the study. Additionally, the NACE classification used for the logistics sector does not cover certain specific job categories within the activity groups. The inability of this classification to fully reflect sectoral diversity has been noted as another limitation that could impact the generalizability of the findings.

4. FINDINGS AND EVALUATION

This section presents the findings under various subheadings, including changes in the number of employees, work accidents, occupational diseases, fatalities resulting from work accidents, and distribution by region and gender between 2008 and 2023 in Turkey's logistics sector. The impact of developments in the logistics sector on sectoral growth, occupational safety practices, and employment dynamics has been analyzed. The data obtained reflects the economic and strategic importance of the logistics sector, while also highlighting the OHS issues faced by the sector. The analysis has been conducted based on employees subject to 4a coverage.

4.1. Employment in the Logistics Sector

The employment status of 4a employees in the logistics sector in Turkey between 2008 and 2023 is presented in Table 1. This table shows the change in sectoral distribution over the years and its share in total employment.

Table 1. Statistics of Employees in the Logistics Sector Between 2008-2023

Year		Land Transport and Pipeline Transport	Water Transport	Air Transport	Warehousing and Support Activities for Transportation	Postal and Courier Activities	Total Employees in the Logistics Sector	Total Number of Employees
2008	n	381,797	17,163	9,354	144,533	12,034	564,881	8,802,989
	%	67.6	3.0	1.7	25.6	2.1	100	6.42
2009	n	404,983	19,115	9,205	151,250	11,623	596,176	9,030,202
	%	67.93	3.21	1.54	25.37	1.95	100	6.60
2010	n	496,744	24,930	5,750	182,689	14,431	724,544	10,030,810
	%	68.6	3.4	0.8	25.2	2.0	100	7.22
2011	n	561,331	24,585	6,264	197,204	16,765	806,149	11,030,939
	%	69.63	3.05	0.78	24.46	2.08	100	7.31
2012	n	611,112	27,929	7,339	210,538	19,570	876,488	11,939,620
	%	69.72	3.19	0.84	24.02	2.23	100	7.34
2013	n	634,354	28,005	10,068	215,723	22,884	911,034	12,484,113
	%	69.63	3.07	1.11	23.68	2.51	100	7.30
2014	n	577,598	15,686	22,602	234,147	28,504	878,537	13,240,122
	%	65.75	1.79	2.57	26.65	3.24	100	6.64
2015	n	564,916	15,739	25,391	238,625	32,764	877,435	13,999,398
	%	64.4	1.8	2.9	27.2	3.7	100	6.27
2016	n	545,917	14,565	25,943	239,263	34,274	859,962	13,775,188
	%	63.48	1.69	3.02	27.82	3.99	100	6.24
2017	n	550,391	14,936	25,244	246,169	38,171	874,911	14,477,817
	%	62.9	1.7	2.9	28.1	4.4	100	6.04
2018	n	537,357	14,704	27,542	252,465	43,457	875,525	14,229,170
	%	61.4	1.7	3.1	28.8	5.0	100	6.15
2019	n	561,538	14,874	29,687	263,004	50,708	919,811	14,314,313
	%	61.05	1.62	3.23	28.59	5.51	100	6.43
2020	n	561,486	15,157	28,975	281,507	64,677	951,802	15,203,423
	%	58.99	1.59	3.04	29.58	6.80	100	6.26
2021	n	620,859	17,411	28,792	293,361	79,542	1,039,965	16,169,679
	%	59.70	1.67	2.77	28.21	7.65	100	6.43
2022	n	668,236	19,168	32,664	315,009	79,575	1,114,652	17,332,991
	%	59.95	1.72	2.93	28.26	7.14	100	6.43
2023	n	624,933	18,332	37,132	303,886	77,239	1,061,522	16,406,420
	%	58.9	1.7	3.5	28.6	7.3	100	6.47

Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

Table 1 presents the changes in the employment structure of 4a employees in Turkey's logistics sector between 2008 and 2023. The sector is divided into activity groups such as land transport, water transport,

air transport, warehousing and support activities for transportation, and postal and courier services. Additionally, it compares the share of the logistics sector in Turkey's total employment.

Land transport and pipeline transport accounted for 67.6% of the total employment in the logistics sector in 2008, making it the dominant activity group. However, this share has decreased to 58.9% by 2023. This decline can be explained by the growth in other activity groups. Nevertheless, land transport remains the largest employer in the sector, which is directly related to Turkey's geographical location and the characteristic features of its transportation infrastructure. Additionally, land transport continues to be the largest employment sector due to Turkey's geographical and logistical advantages. Positioned as a strategic bridge between Asia and Europe, Turkey is a critical transit point for road transportation. Furthermore, the extensive road network and investments in transportation infrastructure have helped maintain this activity group's leadership. This situation illustrates that land transport continues to play a central role in the sector's employment structure and logistics operations (Ministry of Trade of the Republic of Turkey, 2023).

Postal and courier services accounted for 2.1% of the logistics sector in 2008, but this figure rose to 7.3% by 2023. This dramatic increase can be attributed to the rapid growth of e-commerce and changes in consumer habits. The surge in online shopping demand during the pandemic has elevated this activity group to strategic importance and highlighted the significance of digitalization in logistics. The COVID-19 pandemic was a turning point that further accelerated this growth. During the pandemic, restricted access to physical stores and the widespread shift to online shopping significantly increased the demand for postal and courier services. This situation once again underscored the strategic importance of digitalization and technology usage in the logistics sector (UNCTAD, 2021). Moreover, the rise of e-commerce platforms has led to shorter delivery times and an increased focus on last-mile logistics, positioning postal and courier services as a critical component within the sector.

Warehousing and support activities have shown a steady growth trend in the logistics sector, increasing the employment share from 25.6% in 2008 to 28.6% by 2023. This growth is directly related to globalization, the increasing complexity of supply chains, and businesses' focus on efficiency-driven approaches. As global trade has expanded, the complexity of logistics processes has increased, raising the demand for warehousing and support activities. Additionally, with the expansion of the e-commerce sector, the importance of warehouse automation systems and modern logistics centers has grown. This has elevated warehousing activities to a strategic level in achieving critical objectives such as fast delivery and customer satisfaction in logistics operations. The growth of warehousing and supporting services highlights the increasing importance of concepts like efficiency and sustainability in the logistics sector, making these services one of the sector's foundational components.

Air transport, although representing a relatively small share of the logistics sector, has shown steady growth. In 2008, air transport accounted for 1.7% of total employment, increasing to 3.5% by 2023. This growth is primarily attributed to the preference for air transport in handling time-sensitive deliveries and high-value goods. Air transport offers significant advantages in meeting urgent delivery requirements. The preference for air transport in moving high-value electronic products, medical supplies, and other critical goods has been a key driver of growth in the sector (Button & Taylor, 2000). Furthermore, Turkey's investments in aviation infrastructure have significantly contributed to the growth of air transport. Major projects, such as Istanbul Airport, have positioned Turkey as a global aviation hub while enhancing the capacity of the logistics sector in air transport. These developments have facilitated more frequent use of air transport in both national and international logistics operations, accelerating the sector's growth.

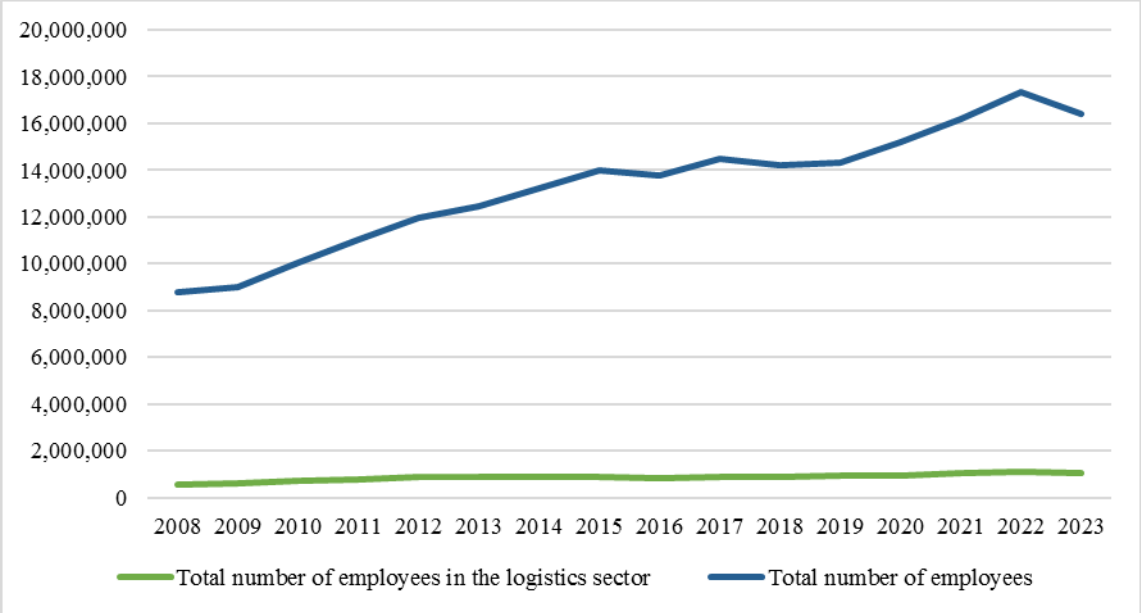
The share of the logistics sector in Turkey's total employment fluctuated between 6.42% and 7.34% from 2008 to 2023. This consistent range indicates that the sector has maintained its economic and strategic importance. While the logistics sector holds a significant position within Turkey's growing

economy, the impact of this growth on employment has been limited due to technological transformation and macroeconomic factors. Technological advancements, such as automation, digitalization, and process optimization, have particularly slowed the overall increase in employment within the sector (Neal & Griffin, 2006).

The 2020 data clearly reveal the effects of the COVID-19 pandemic on the logistics sector. During the pandemic, the surge in e-commerce significantly increased the demand for postal and courier activities. In 2020, this activity group's share of total logistics employment rose to 6.80%, marking a notable increase. The pandemic permanently altered consumer habits and accelerated digital transformation in the logistics sector. This shift has elevated e-commerce logistics and last-mile delivery operations to strategic importance, fundamentally reshaping the structure of the sector (UNCTAD, 2021).

Figure 1 illustrates the changes in the number of employees in Turkey's logistics sector and overall employment between 2008 and 2023.

Figure 1. Number of 4a Insured Employees in the Logistics Sector and Nationwide in Turkey



Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

Figure 1 compares the share of the logistics sector in total employment with sectoral growth.

The number of 4a insured employees in the logistics sector increased from 564,881 in 2008 to 1,061,522 in 2023. This growth indicates a consistent upward trend in the sector over the years. Notably, the increase in employment within the sector reflects the critical role of the logistics industry in Turkey's economy.

The total number of 4a insured employees nationwide in Turkey increased from approximately 8.8 million in 2008 to 16.4 million in 2023. This overall growth is associated with economic expansion and the development of various sectors. The logistics sector holds a strategic share within this growth.

The share of the logistics sector in total employment was recorded at 6.42% in 2008 and rose slightly to 6.47% in 2023. However, despite absolute growth in the sector, this ratio has remained relatively stable with limited fluctuations. This indicates that larger-scale investments and transformations are needed to significantly increase the logistics sector's share in total employment.

4.2. Work Accidents

Table 2 details the number of 4a insured employees who experienced work accidents in Turkey's logistics sector between 2008 and 2023, categorized by activity groups. The data provides a comparative overview of work accident rates across activity groups, including land transport, water transport, air transport, warehousing and support activities for transportation, and postal and courier activities.

Table 2. Work Accidents and Rates Between 2008-2023

Year	Land Transport and Pipeline Transport	Water Transport	Air Transport	Warehousing and Support Activities for Transportation	Postal and Courier Services	Total Work Accidents in the Logistics Sector	Total Work Accidents Nationwide	Logistics Sector Work Accidents / Total Work Accidents (%)
2008	1974	194	107	1113	12	3400	72963	4.66
2009	2329	222	37	1323	35	3946	64316	6.14
2010	2206	201	78	1623	30	4138	62903	6.58
2011	2363	240	52	1487	56	4198	69227	6.06
2012	2549	266	60	1689	75	4639	74871	6.20
2013	7597	594	928	6782	311	16212	191389	8.47
2014	7287	310	1398	8079	391	17465	221366	7.89
2015	7117	235	1705	8904	530	18491	241547	7.66
2016	7246	253	1526	9496	566	19087	286068	6.67
2017	8353	307	1420	10635	928	21643	359653	6.02
2018	8917	329	1564	13806	1613	26229	430985	6.09
2019	9039	358	1536	15537	2263	28733	422463	6.80
2020	8299	300	384	13131	3074	25188	384262	6.55
2021	10071	368	709	16833	4992	32973	511084	6.45
2022	11392	412	1338	21630	4718	39490	588823	6.71
2023	12513	431	1735	25605	5455	45739	681401	6.71

Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

In 2008, a total of 3,400 work accidents occurred in the logistics sector, increasing significantly to 45,739 by 2023. This indicates that the number of work accidents has risen markedly alongside the growth of the sector. The share of work accidents in the logistics sector relative to total work accidents in Turkey increased from 4.66% in 2008 to 6.71% in 2023. This upward trend raises concerns about the adequacy of OHS measures in logistics operations.

Land transport and pipeline transport accounts for the largest proportion of work accidents in the logistics sector. In 2008, 1,974 work accidents were recorded in this category, increasing to 12,513 by 2023. This trend is associated with the intense work pace, heavy freight transportation, and traffic accident risks inherent in land transport activities.

In 2008, 194 work accidents were reported in the water transport sector, increasing to 431 by 2023. The lower rate of work accidents in this sector is attributed to reduced reliance on manual labor and the strict implementation of safety protocols in maritime transport operations.

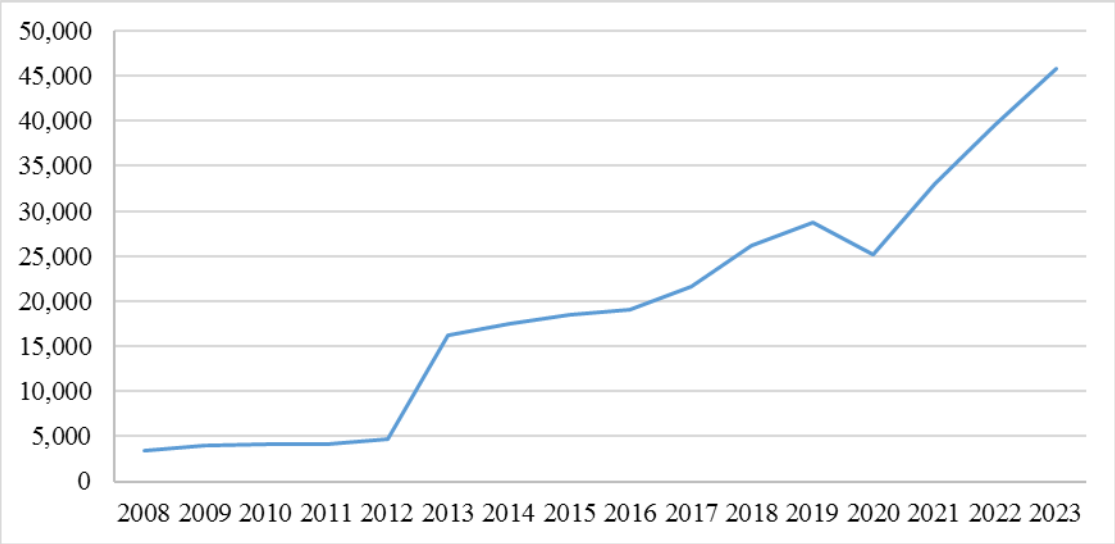
In the air transport sector, 107 work accidents were recorded in 2008, which surged to 1,735 by 2023. Despite advanced safety standards, the notable increase in work accidents is linked to the growing operational intensity within the sector.

Warehousing and support activities accounted for the second-largest share of work accidents in 2008, with 1,113 cases. By 2023, this number had risen significantly to 25,605. This increase is associated

with the expanding volume of warehouse operations, the use of equipment, and the growing complexity of logistics processes.

In postal and courier activities, the number of work accidents was only 12 in 2008 but escalated dramatically to 5,455 by 2023. This sharp increase is primarily attributed to the rapid growth of e-commerce and the effects of the pandemic period.

Figure 2. Distribution of Work Accidents in the Logistics Sector Between 2008 and 2023



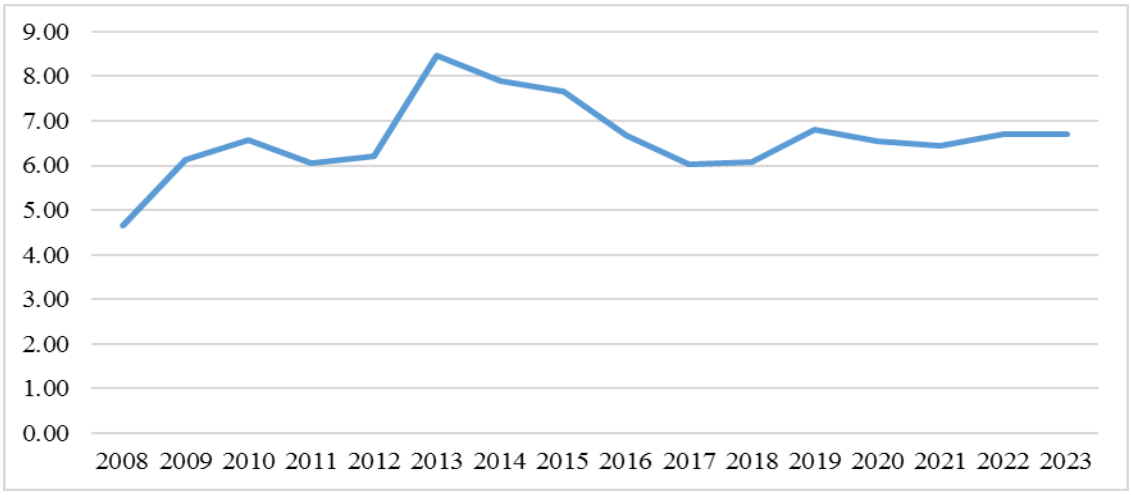
Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

Figure 2 illustrates the increase in work accidents in the logistics sector over the years, rising from 3,400 in 2008 to 45,739 in 2023. This growth highlights the increasing need for OHS measures alongside the expansion of the sector.

When activity groups are analyzed, land transport and pipeline transport emerge as the activity group with the highest rate of work accidents, reporting 12,513 incidents in 2023. Warehousing and support activities also stand out with 25,605 work accidents, which can be attributed to the heavy workload and operational complexities. In contrast, water transport and air transport exhibit comparatively lower rates of work accidents. Notably, postal and courier activities reported 5,455 work accidents in 2023, driven by the impact of e-commerce, digitalization, and increasing delivery demands. The rising number of work accidents in the logistics sector underscores the need for more effective implementation of OHS policies and the adoption of risk-focused preventive measures.

Figure 3 illustrates the proportion of work accidents in the logistics sector to total work accidents in Turkey between 2008 and 2023. The data reveal significant variations in the sector's contribution to total work accidents over the years.

Figure 3. Distribution of the Proportion of Work Accidents in the Logistics Sector to Total Work Accidents Between 2008 and 2023



Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

In 2008, the proportion of work accidents in the logistics sector to total work accidents was recorded at 4.66%, reaching its peak at 8.47% in 2013. This peak can be attributed to the rapid growth in the sector's workload and the increase in operational risks during this period. However, between 2014 and 2017, this proportion gradually declined and stabilized in the 6.00%-7.00% range after 2018. By 2023, the proportion stood at 6.71%. This trend can be associated with improvements in OHS practices across the sector and changes in sector dynamics. However, the stable rates indicate that further enhancements in OHS measures are still needed. The widespread implementation of sector-specific safety policies will play a critical role in reducing work accidents both at the sectoral and national levels.

4.3. Occupational Diseases

Table 3 provides a detailed breakdown of the number of 4a insured employees in Turkey's logistics sector who were affected by occupational diseases between 2008 and 2023, categorized by activity groups. Additionally, the table displays the proportion of occupational diseases in the logistics sector relative to total occupational diseases during this period. According to the data, occupational diseases in the logistics sector remain significantly lower compared to work accidents.

Table 3. Occupational Diseases and Rates Between 2008-2023

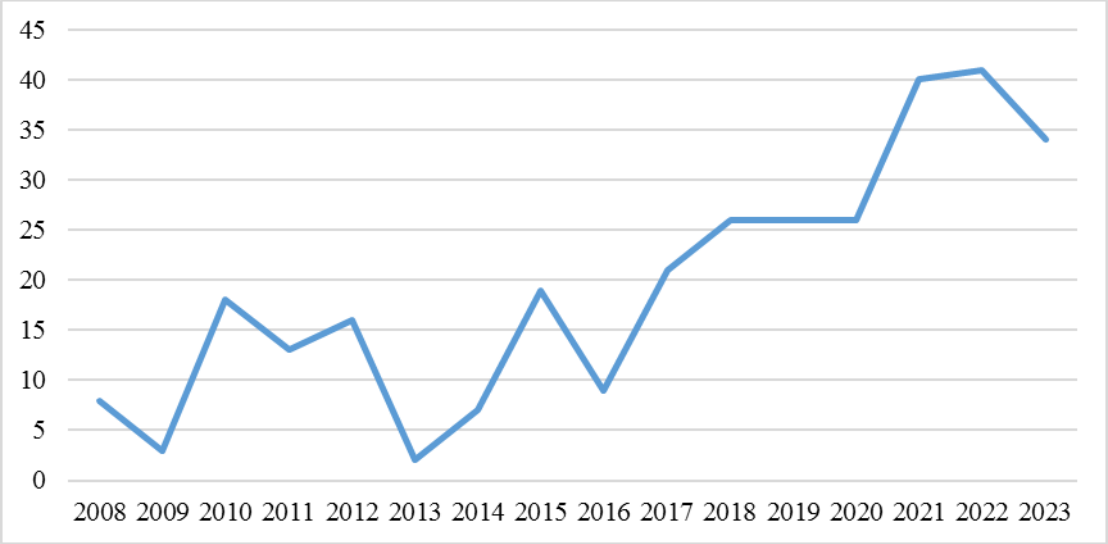
Year	Land Transport and Pipeline Transport	Water Transport	Air Transport	Warehousing and Support Activities for Transportation	Postal and Courier Services	Total Occupational Diseases in the Logistics Sector	Total Occupational Diseases Nationwide	Logistics Sector Occupational Diseases / Total Occupational Diseases (%)
2008	4	0	0	4	0	8	539	1.48
2009	3	0	0	0	0	3	429	0.70
2010	10	1	0	7	0	18	533	3.38
2011	3	3	0	7	0	13	697	1.87
2012	11	0	0	5	0	16	395	4.05
2013	2	0	0	0	0	2	351	0.57
2014	5	0	0	2	0	7	494	1.42
2015	6	2	3	8	0	19	510	3.73
2016	2	0	1	6	0	9	597	1.51
2017	10	0	1	10	0	21	691	3.04
2018	8	0	3	15	0	26	1044	2.49
2019	5	0	0	21	0	26	1088	2.39
2020	11	0	0	14	1	26	908	2.86
2021	12	1	0	27	0	40	1207	3.31
2022	15	0	0	26	0	41	953	4.30
2023	14	0	0	18	2	34	945	3.60

Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

In the logistics sector, the number of occupational disease cases increased from just 8 in 2008 to 34 in 2023. The sector's share of total occupational diseases also rose from 1.48% to 3.60%. Land transport and pipeline transport stand out as the activity groups with the highest incidence of occupational diseases. In contrast, activity groups such as water transport and air transport report relatively few cases of this type.

As of 2023, warehousing and support activities emerged as one of the activity groups with the highest incidence of occupational diseases, with ergonomic issues and health problems related to workload being particularly prominent. These findings highlight the importance of enhancing ergonomic arrangements and implementing measures aimed at improving employee health across the sector.

Figure 4. Distribution of Occupational Diseases in the Logistics Sector Between 2008 and 2023



Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

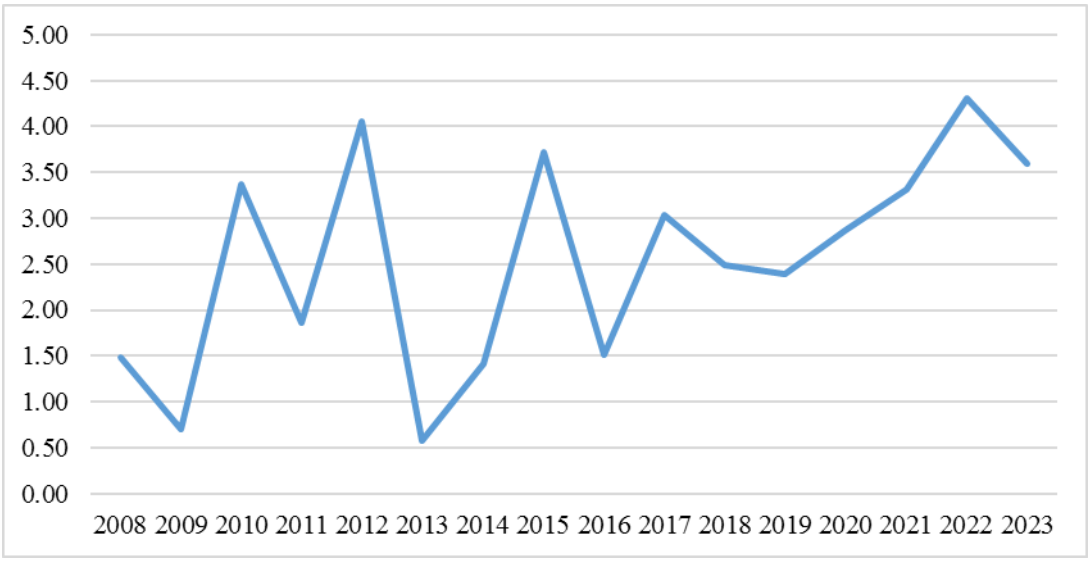
The number of occupational diseases, which was only 8 in 2008, increased to 26 in 2020 and reached its peak at 41 in 2022. However, this figure decreased to 34 in 2023. These fluctuations in the annual distribution of occupational diseases reflect operational changes within activity groups and variations in the implementation of OHS practices.

In activity groups with high physical workloads, such as warehousing and support activities, ergonomic problems and musculoskeletal disorders caused by repetitive movements are estimated to be prominent. On the other hand, the significantly lower incidence of occupational diseases in activity groups such as water transport and air transport can be attributed to better working conditions and the implementation of strict safety standards.

These findings emphasize the necessity of increasing employee awareness of occupational health, promoting ergonomic arrangements, and implementing regular health check-ups to prevent occupational diseases in the logistics sector.

Figure 5 illustrates the annual proportion of occupational diseases in the logistics sector compared to the total occupational diseases nationwide. This data is significant for understanding the relationship between sector-specific occupational diseases and broader national trends at a national level.

Figure 5. Distribution of the Proportion of Occupational Diseases in the Logistics Sector to Total Occupational Diseases Between 2008 and 2023



Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

In 2008, the proportion of occupational diseases in the logistics sector was 1.48%, reaching its peak at 4.05% in 2012. However, in 2013, this proportion dropped sharply to 0.57%, followed by fluctuations, rising again to 4.30% in 2022. By 2023, the proportion decreased to 3.60%. These variations can be attributed to differences in workload, safety measures, and regulatory practices across subfields within the sector.

Occupational disease rates are believed to be higher in areas with heavy physical workloads, such as warehousing and support activities, compared to other activity groups. Conversely, activity groups with lower physical risks, such as water transport and air transport, exhibit comparatively lower rates of occupational diseases.

These findings underscore the necessity of developing policies aimed at reducing occupational diseases in the logistics sector and promoting the implementation of ergonomic measures. In particular, regular health screenings and employee training programs are critical for the prevention of such diseases.

4.4. Fatalities Resulting from Work Accidents

Table 4 presents the distribution of fatalities resulting from work accidents in the logistics sector between 2008 and 2023, categorized by activity groups, along with their proportion of the total. The data provide valuable insights into the adequacy of safety measures across different areas of the sector and the impact of fatal accidents on overall trends.

Table 4. Statistics of Fatalities Among Insured Employees Resulting from Work Accidents

Year	Land Transport and Pipeline Transport	Water Transport	Air Transport	Warehousing and Support Activities for Transportation	Postal and Courier Services	Total Fatalities in the Logistics Sector	Total Fatalities Nationwide	Logistics Sector Total Fatalities/ Total Fatalities %
2008	111	7	0	18	1	137	865	15.84
2009	36	2	0	11	0	49	1171	4.18
2010	133	0	2	24	1	160	1444	11.08
2011	194	9	2	24	0	229	1700	13.47
2012	73	5	0	11	1	90	744	12.10
2013	183	11	2	30	4	230	1360	16.91

2014	172	9	1	29	6	217	1626	13.35
2015	162	3	2	23	0	190	1252	15.18
2016	179	4	2	37	3	225	1405	16.01
2017	211	17	3	29	4	264	1633	16.17
2018	175	12	4	27	6	224	1541	14.54
2019	184	4	0	24	4	216	1147	18.83
2020	209	5	2	22	3	241	1231	19.58
2021	220	4	0	27	6	257	1382	18.60
2022	224	8	1	21	6	260	1517	17.14
2023	277	11	1	48	10	347	1966	17.65

Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

Across the logistics sector, the number of fatalities resulting from work accidents increased from 137 in 2008 to 347 in 2023. During the same period, the proportion of fatalities in the logistics sector relative to total work accident fatalities nationwide rose from 15.84% to 17.65%. This increase indicates that the fatal outcomes of work accidents have grown in parallel with the sector's expansion.

Land transport and pipeline transport account for the largest proportion of fatalities resulting from work accidents in the logistics sector. While 111 fatalities were recorded in this sub-sector in 2008, the number rose to 277 in 2023. Traffic accidents, heavy freight transportation, and long working hours are considered the primary factors contributing to the high-risk levels in this sector.

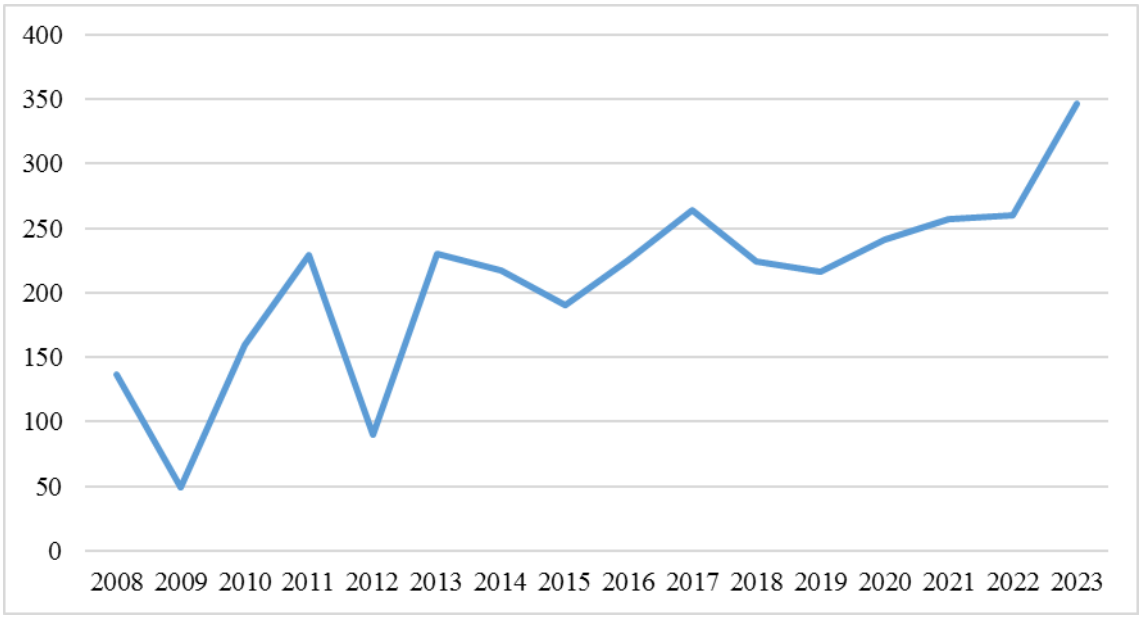
In water transport, 7 fatalities were recorded in 2008, increasing to 11 in 2023. This activity group has relatively low fatality rates compared to other logistics sub-sectors due to its reduced reliance on human labor and the strict implementation of safety standards.

Fatality rates in air transport are notably low. While no fatalities were recorded in 2008, only one fatality was reported in 2023. Advanced safety systems and adherence to international regulations significantly enhance safety levels in this sector.

Warehousing and support activities stand out as the second most hazardous area in the logistics sector. In 2008, 18 fatalities were recorded, increasing to 48 in 2023. The use of heavy equipment, ergonomic issues, and insufficient safety protocols are considered the primary factors contributing to this rise.
The growth of the e-commerce sector has increased the workload in postal and courier activities. While only one fatality was recorded in 2008, this number rose to 10 in 2023. This increase is directly linked to the growing demand for deliveries.

Figure 6 illustrates the annual changes in the number of fatalities resulting from work accidents in the logistics sector between 2008 and 2023.

Figure 6. Distribution of Fatalities Resulting from Work Accidents in the Logistics Sector Between 2008 and 2023



Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

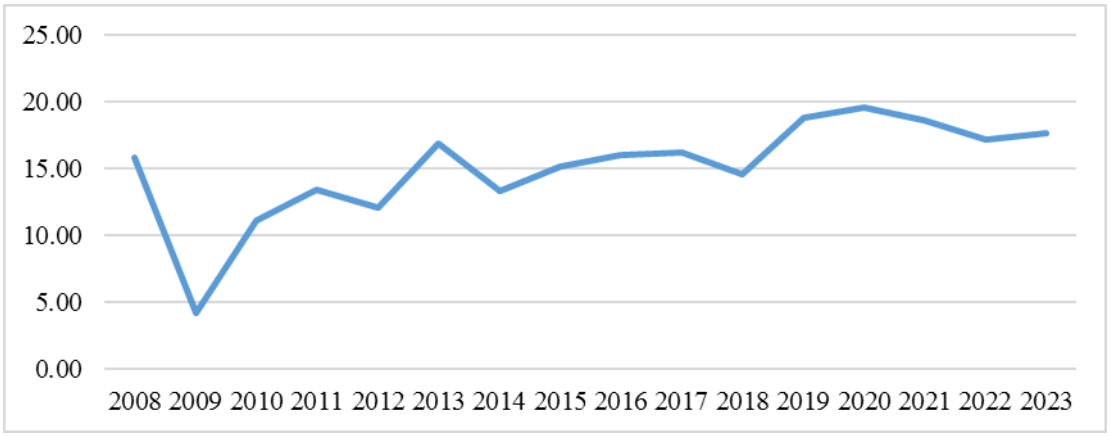
A significant increase in fatality rates has been observed, particularly in land transport and warehousing activities. The number of fatalities rose from 137 in 2008 to 347 in 2023. This increase is associated with intense work schedules, heavy freight handling processes, and inadequate safety measures.

Between 2015 and 2018, fatality rates exhibited relative stability; however, a renewed upward trend began in 2020. This increase can be attributed to changing working conditions and heightened workloads following the COVID-19 pandemic.

Land transport has the highest proportion of fatalities resulting from work accidents in the logistics sector. Additionally, warehousing and support activities are among the high-risk groups due to equipment-related accidents and ergonomic issues. This highlights the urgent need to enhance OHS measures across the sector. Comprehensive inspections, training programs, and investments in technology-supported safety solutions are essential to prevent work accidents.

Figure 7 illustrates the annual proportion of fatalities resulting from work accidents in the logistics sector relative to total work accident fatalities nationwide. These ratios highlight the logistics sector's share of fatal work accidents compared to other sectors in Turkey.

Figure 7. Distribution of the Proportion of Fatalities Resulting from Work Accidents in the Logistics Sector to Total Work Accident Fatalities Between 2008 and 2023



Source: SSI (Social Security Institution), 2008-2023 Statistical Yearbooks. Ankara: SSI Publication.

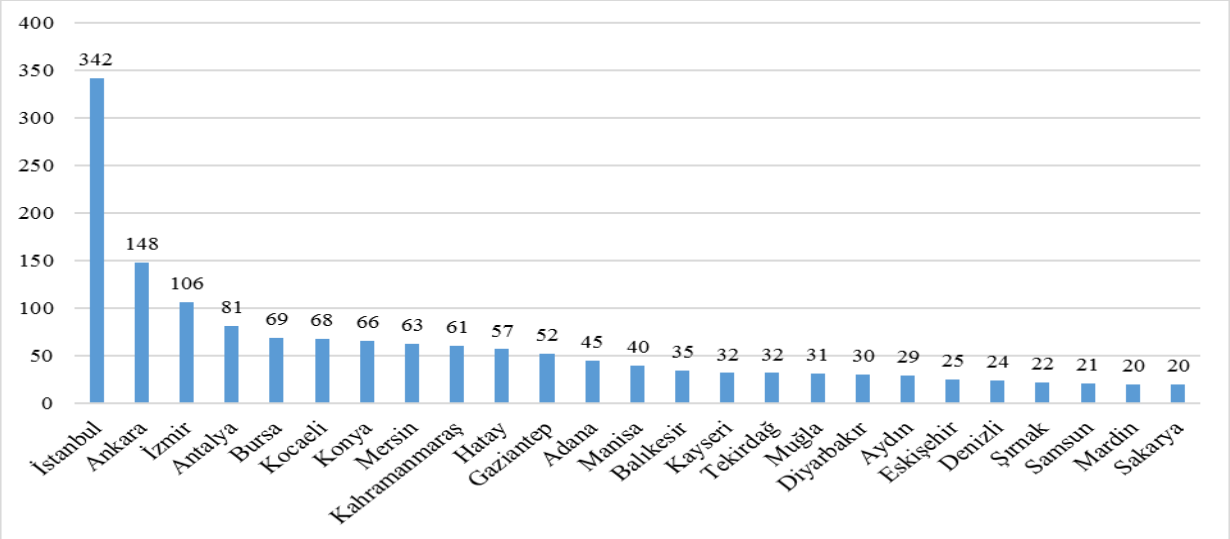
In 2008, fatalities in the logistics sector accounted for approximately 15.84% of total fatalities, rising to 17.65% by 2023. This increase reflects the growing risks associated with the sector's expansion. The fluctuations observed in Figure 7 can be attributed to changes in working conditions within the sector, economic variations, and differences in the implementation of OHS measures. The notable spike in 2020 is explained by the increased operational pressure and inadequate OHS practices during the COVID-19 pandemic. The consistently high proportion of logistics sector fatalities relative to total fatalities is primarily driven by high-risk activities in sub-sectors such as land transport and warehousing.

The consistently high fatality rates in the logistics sector compared to other industries clearly underscore the need for improved OHS practices within the sector. Revisiting OHS strategies and implementing effective measures, particularly in high-risk activity areas, is of critical importance.

4.5. Regional and Gender-Based Distribution

Figure 8 illustrates the distribution of fatal work accidents across provinces in Turkey in 2023. The figure includes only provinces with 20 or more recorded fatalities.

Figure 8. Distribution of Fatal Work Accidents by Province in 2023



(Only provinces with 20 or more fatalities are shown.)

Source: SSI (Social Security Institution), 2023 Statistical Yearbooks. Ankara: SSI Publication.

Istanbul stands out as the city with the highest number of fatal work accidents, accounting for 342 fatalities and holding a significant share of the total cases. Ankara and Izmir follow, with 148 and 106 fatalities, respectively.

Table 5 provides a detailed breakdown of fatalities resulting from work accidents and occupational diseases in the logistics sector in 2023, categorized by activity groups and gender.

Table 5. Gender-Based Distribution of Fatalities Resulting from Work Accidents and Occupational Diseases in 2023

	Number of People Experiencing Work Accidents			Number of Fatalities Resulting from Work Accidents			Number of Fatalities Resulting from Occupational Diseases		
Activity Group	Male	Female	Total	Male	Female	Total	Male	Female	Total
Land Transport and Pipeline Transport	11879	634	12513	276	1	277	0	0	0
Water Transport	415	16	431	11	0	11	0	0	0
Air Transport	490	1245	1735	1	0	1	0	0	0
Warehousing and Support Activities for Transport	20140	5465	25605	47	1	48	0	0	0
Postal and Courier Activities	4562	893	5455	10	0	10	0	0	0
Total	37486	8253	45739	345	2	347	0	0	0

Source: SSI (Social Security Institution), 2023 Statistical Yearbooks. Ankara: SSI Publication.

In 2023, a total of 45,739 people experienced work accidents in the logistics sector. Of these, 37,486 were male employees, while 8,253 were female employees.

Land transport and pipeline transport recorded the highest number of work accidents within the sector, with a total of 12,513 incidents. This was followed by warehousing and support activities for transportation, which reported 25,605 accidents.

In 2023, 347 fatalities resulting from work accidents occurred in the logistics sector. Of these, 345 were male employees, and 2 were female employees. No fatalities due to occupational diseases were reported in the logistics sector in 2023. This may indicate either insufficient recording of occupational diseases or that such diseases rarely result in fatalities within the sector.

Work accident and fatality rates by gender reveal differing risk profiles for male and female employees in the logistics sector. The higher rates of work accidents among female employees in specific activity groups, such as air transport, indicate the need to reassess occupational safety policies in these sectors. Conversely, the higher fatality rates among male employees are linked to harsh working conditions and deficiencies in safety measures.

Table 6 provides a detailed breakdown of the temporary incapacity durations, measured in days, of logistics sector employees who experienced work accidents in 2023, categorized by gender and economic activity groups.

Table 6. Distribution of Temporary Incapacity Durations (in Days) by Economic Activity and Gender for Employees Experiencing Work Accidents in 2023

	Temporary Incapacity Duration (Days) (Outpatient)		Temporary Incapacity Duration (Days) (Inpatient)		Total Temporary Incapacity Duration (Outpatient + Inpatient)		
Activity Group	Male	Female	Male	Female	Male	Female	Total
Land Transport and Pipeline Transport	102324	3316	4291	32	106615	3348	109963
Water Transport	4886	160	136	0	5022	160	5182
Air Transport	2448	8971	89	63	2537	9034	11571
Warehousing and Support Activities for Transport	112535	16082	2214	159	114749	16242	130991
Postal and Courier Activities	24608	3108	978	12	25586	3120	28706
Total	246801	31637	7708	267	254509	31904	286413

Source: SSI (Social Security Institution), 2023 Statistical Yearbooks. Ankara: SSI Publication.

Throughout 2023, a total of 286,413 days of temporary incapacity due to work accidents were recorded in the logistics sector. The majority of this duration (88.8%) was attributed to male employees, while female employees accounted for 11.2%.

Outpatient treatment durations constitute the majority of the total temporary incapacity period. For male employees, 246,801 days of outpatient treatment were recorded, compared to 31,637 days for female employees. The inpatient treatment durations were 7,708 days for males and 267 days for females.

Land transport and pipeline transport recorded the highest temporary incapacity duration within the logistics sector, totaling 109,963 days. In contrast, water transport had the lowest temporary incapacity duration, with a total of 5,182 days.

Temporary incapacity durations vary across activity groups within the logistics sector. Notably, activity groups such as land transport and warehousing and support activities exhibit significantly higher incapacity durations. These findings highlight the impact of work accidents on sectoral dynamics and underscore deficiencies in safety measures.

The notably high temporary incapacity durations experienced by female employees in certain activity groups, such as air transport, emphasize the need to assess gender-specific risk factors. OHS measures should be reevaluated with consideration for gender and sectoral dynamics.

The findings of this study illustrate that the dynamics within Turkey's logistics sector closely align with the conceptual underpinnings of occupational health and safety (OHS). The effective OHS policies necessitate proactive measures to prevent workplace accidents and diseases (Hale & Hovden, 1998). This study corroborates these principles, revealing a significant increase in work accidents over the years, which is symptomatic of insufficient implementation of proactive OHS strategies in certain sub-sectors. For instance, the labor-intensive nature of land transport and warehousing activities highlights the importance of ergonomic design and risk assessments, as discussed by Reniers & Van Erp (2016). The data indicates that these sub-sectors account for the majority of work accidents, validating the theoretical assertion that high-risk physical activities require more rigorous preventive measures. Conversely, the relatively lower incidence of occupational diseases, especially in sectors like water and air transport, aligns with the framework's emphasis on strict regulatory adherence and technological advancements. These findings echo the work of Neal & Griffin (2006), who emphasized the role of safety climate and organizational culture in reducing risks. Gender-based discrepancies in temporary incapacity durations, particularly the higher rates observed among female employees in air transport,

underscore the necessity of incorporating gender-sensitive policies, as outlined in the OHS literature. Addressing these disparities is critical for achieving equitable safety outcomes and aligns with broader goals of workplace inclusivity and sustainability. The spatial concentration of fatal work accidents in metropolitan areas like Istanbul, Ankara, and Izmir reflects the operational intensity in these regions, a phenomenon consistent with the logistics sector's strategic positioning as outlined by Rodrigue et al. (2020). This reinforces the need for region-specific safety interventions and infrastructure development to mitigate risks.

CONCLUSION AND RECOMMENDATIONS

This study examined the distribution of work accidents and occupational diseases within the scope of OHS in Turkey's logistics sector, categorized by years and activity groups. Analyses based on Social Security Institution (SSI) data reveal that the logistics sector presents significant challenges and opportunities in terms of both its employment structure and OHS practices.

The findings of the study indicate a significant increase in work accidents in the logistics sector over the years. Particularly high rates of work accidents were observed in activity groups requiring heavy physical workloads, such as land transport and warehousing activities. This underscores a lack of risk-focused OHS policies within the sector. Conversely, the lower incidence of occupational diseases suggests either insufficient reporting or a lack of awareness regarding such cases. On the other hand, the lower rates of work accidents and occupational diseases in activity groups like air transport, which adhere to advanced safety protocols, highlight the effectiveness of robust OHS policies.

In addition to general OHS measures, land transport activities require targeted initiatives such as traffic safety monitoring and the establishment of well-equipped rest areas to address driver fatigue. For warehousing activities, automation in heavy lifting tasks and ergonomic workplace designs should be prioritized. Furthermore, postal and courier services could benefit from digital route optimization tools to balance workload and reduce accidents driven by e-commerce demands.

Gender-based analyses reveal that female employees experience longer temporary incapacity durations, particularly in specific activity groups such as air transport. This finding highlights the distinct risk profiles of female employees within the sector. It is crucial to carefully analyze the risk factors affecting female workers and to develop tailored OHS policies accordingly. Additionally, the concentration of fatal work accidents in major cities like Istanbul, Ankara, and Izmir indicates that logistics activities in these regions carry higher risks.

The dynamics of each activity group within the logistics sector underscore the necessity for tailored OHS policies. While traffic safety measures and driver training should be prioritized in land transport, ergonomic adjustments and equipment safety measures must take precedence in warehousing activities. In activity groups such as postal and courier services, which are burdened by the high workload driven by e-commerce, the implementation of digital monitoring systems and accident prevention strategies could play a critical role in mitigating risks.

The logistics sector holds significant importance for Turkey due to its role in economic growth and its strategic position within the global supply chain. However, the rising number of work accidents and occupational diseases in the sector highlights the need to reassess OHS policies. Based on the findings of this study, the following recommendations are proposed:

Expansion of OHS Training Programs: Regular and sector-specific training programs are essential to enhancing employees' awareness and practical understanding of occupational health and safety (OHS). These programs should incorporate interactive learning methods, such as virtual reality simulations and scenario-based workshops, to engage employees effectively. Additionally, activity-specific modules

targeting unique risks, such as fatigue management for drivers or manual handling for warehouse workers, must be included. Continuous education through periodic refresher courses should ensure that employees stay updated on safety protocols, while post-training evaluations and feedback mechanisms will help refine the effectiveness of these initiatives.

Utilization of Technological Solutions: Technology-driven interventions play a critical role in mitigating risks and enhancing safety in high-risk activity areas. Automation systems in warehousing can minimize manual labor, while digital monitoring tools can track driver fatigue, equipment performance, and environmental hazards in real-time. Predictive analytics powered by big data and AI should be used to anticipate potential risks and enable proactive interventions. Additionally, wearable safety devices that monitor physical health indicators such as fatigue levels and heart rate can provide immediate feedback to employees and supervisors, enhancing overall workplace safety.

Activity Group-Specific Strategies: Tailored risk assessment and prevention policies are needed to address the unique operational challenges of each activity group. For land transport, traffic safety monitoring systems and regulated rest breaks should be enforced, complemented by the development of well-equipped rest areas for long-haul drivers. Warehousing activities require ergonomic workplace designs and automated equipment to reduce repetitive strain injuries. In postal and courier services, digital route optimization software can alleviate workload imbalances and reduce time pressures. Meanwhile, in air transport, adherence to international safety standards and specialized training for handling high-value, time-sensitive goods are essential to maintaining a safe working environment.

Regional OHS Measures: Given the higher risks associated with urban logistics hubs, region-specific OHS measures should be prioritized. Intensified safety audits and compliance inspections should focus on high-activity cities such as Istanbul, Ankara, and Izmir. Localized solutions addressing urban challenges, including traffic congestion and accident hotspots, are critical for ensuring safety. Collaborating with municipal governments to improve infrastructure, such as safer loading zones and optimized transport routes, can further enhance the effectiveness of these regional policies, ensuring that urban centers remain both safe and operationally efficient.

Gender-Sensitive Policies: The unique risks faced by female employees in the logistics sector necessitate the implementation of gender-sensitive measures. Providing ergonomic adjustments, such as lighter tools and adjustable workstations, can mitigate physical strain, while flexible scheduling options can support work-life balance. Safety training tailored to the challenges faced by women in activity groups like air transport and warehousing should be integrated into overall OHS programs. Regular gender-based risk assessments will ensure that workplace policies remain responsive to the specific hazards faced by female employees, fostering an inclusive and safe working environment.

In conclusion, improving occupational health and safety in Turkey's logistics sector will not only prevent work accidents and occupational diseases but also enhance the sector's overall efficiency and employee satisfaction. This study highlights the deficiencies in OHS practices within the logistics sector, providing a valuable foundation for future regulations and policy developments.

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