

A statistical analysis of work-related accidents in women's employment

Analisis statistik terhadap kecelakaan kerja pada pekerja perempuan

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Article History: Received 28 April 2023; Accepted 30 August 2023; Published Online 8 September 2023

Abstract

Women are often victims of gender discrimination in various fields, including in the work environment. This research article aims to statistically evaluate the status of women's employment and occupational accidents in some countries where regular data are available, and to provide predictions in the future. Using quantitative methods, data were analyzed with panel data analysis, bivariate correlation and two-step clustering methods. The findings of this study indicate that there is a positive and stronger correlation between work-injury for women than for men in all but a few developed social welfare countries. In some countries, while the correlation is negative for men, it is positive and strong for women. This study concludes that existing preventive regulations, including those in developed countries, are not sufficient to protect women. Women are more likely to work in non-traditional sectors where occupational health and safety (OHS) regulations are more flexible. Therefore, public authorities related to OHS should focus more on the conditions of this new industry in the future.

Keywords: panel data analysis; two-step cluster; women safety; women workers; work-related accidents

Abstrak

Perempuan seringkali menjadi korban diskriminasi gender di berbagai bidang, termasuk di lingkungan kerja. Studi ini bertujuan untuk mengevaluasi secara statistik status pekerjaan perempuan dan kecelakaan kerja di beberapa negara di mana data reguler tersedia, dan untuk memberikan prediksi di masa depan. Menggunakan metode kuantitatif, data dianalisis dengan metode Panel Data Analysis, Bivariate Correlation dan Two-step Clustering. Hasil temuan studi ini menunjukkan adanya korelasi antara pekerjaan-kecelakaan kerja pada perempuan positif dan lebih kuat dibandingkan laki-laki di semua negara kecuali beberapa negara kesejahteraan sosial maju. Di beberapa negara, meskipun korelasinya negatif untuk laki-laki, korelasinya positif dan kuat untuk perempuan. Studi ini berkesimpulan bahwa regulasi preventif yang ada, termasuk di negara maju, tidak cukup untuk melindungi perempuan. Perempuan lebih banyak bekerja di sektor non-tradisional di mana peraturan K3 lebih fleksibel. Oleh karena itu, otoritas publik yang terkait dengan K3 harus lebih fokus pada kondisi industri baru ini di masa mendatang.

Kata kunci: analisis data panel; kluster dua langkah; keselamatan perempuan; pekerja perempuan; kecelakaan kerja

Introduction

Occupational health and safety (OHS) rules and practices are constantly evolving in line with technological innovations and changes in working life. New risk factors emerge with new production technologies. In addition to conventional risks arising from production methods and equipment, preventive studies are focused on eliminating ergonomic and psycho-social risks. Another issue that has become increasingly important in recent years in terms of occupational health and safety but has not been adequately examined is the demographic changes in working life. Women's labor force participation is increasing in all developed and developing countries, and female workers are more exposed to risks arising from the working environment (Ozturk & Esin 2011, Sio et al. 2017, Carpintero & Ramos 2018, Yildiz 2022).

In many countries, women are considered as a "disadvantaged group" and there are "positive discrimination" regulations to protect female workers. In risk assessment studies, special measures considering women as a disadvantaged group, overtime and leave arrangements for pregnant women,

limiting women's work in some high-hazardous and heavy-duty jobs, etc. Despite this, the increase in occupational accidents experienced by women in many developing and even developed countries evokes that the existing regulations are not sufficient to protect women.

In countries where the rules limiting women's work in heavy and hazardous jobs are not sufficient, women are employed in hazardous industries without adequate protection. On the other hand, in countries where women are restricted from working in heavy and hazardous industries and the regulations are considered relatively adequate, women work jobs in service sectors where flexible work arrangements are common. However, in these sectors where women are predominantly involved, the number and rate of occupational accidents are much higher than that of men. Complex structure of the service sector, its flexibility, insecurity and informality make women much more vulnerable than men in terms of OHS dimension. The sensitive nature of female employees in terms of OHS and their unique problems have been expressed in many studies. In addition, it is emphasized that there are few studies based on gender and the need for more studies (Botha & Cronje 2015, Rubín de Celis et al. 2017, Ahmed et al. 2018, Noman et al. 2021, Hasan & Kamardeen 2022).

This research was conducted to evaluate correlation between women's employment and occupational safety from a statistical perspective. In countries where official data can be accessed, the changes in the number of female and male employment and the number of occupational accidents and the relationship between them are examined, the correlation between women's employment and occupational accidents is determined and compared with men. The current and future trends of women in terms of OHS are analyzed with statistical methods and statistical attention is drawn to the issue. In many researches examining the risk factors and accidents in general and sectoral terms, women employees are considered as a demographic variable, but there are few studies that address women in general and comprehensively. In addition to some studies on the risks faced by women, causes of accidents and prevention recommendations, there are also studies on women's health in working life (Lu 2012, Telaprolu 2013, Akalp et al. 2015, Samaei et al. 2015, Aytac et al. 2016, Das 2020, Ashuro et al. 2021, Yilmaz 2023).

There are few studies in the literature that evaluate the occupational safety of women in comparison with men from a statistical and gender-based perspective. For example, Nielsen et al. (2015) examined the effect of masculinity on safety surveillance, safety priority and safety violations in two male-dominated occupations (Nielsen et al. 2015). Another similar study examining the effect of gender (masculinity) on occupational accidents was conducted with Australian construction workers by Iacuone (2005). Jensen et al. (2014), on the other hand, evaluated occupational accidents from a gender perspective. The article concluded that the gender perspective is useful to expand the knowledge about safety and work-related accidents in relation to, for instance, pride and bodily strength as well as the struggles between different masculinities.

Traditionally, heavy and hazardous works such as mining, construction, etc., are dominated by men. In official statistics, the number of fatal and non-fatal accidents that men are exposed to is higher than women, so there are opinions suggesting that men are more at risk of being exposed to work-related accidents than women in the literature. However, women's labor force participation and employment rates are constantly increasing in the world - although they are still behind in terms of the number of work-related accidents compared to men - and accordingly, the number of work-related accidents in women is increasing rapidly.

As a matter of fact, in a recent study by Rios et al. (2017), the need for detailed gender-based occupational safety analysis was emphasized. This research confirmed that women dealt with unique workplace hazards compared to men. Women working in nontraditional jobs are often exposed to extreme workplace hazards. These women have their safety and health threatened because there are no adequate policies to mitigate gender-specific risks such as discrimination and harassment. Statistics also confirmed that men and women faced different levels of risks in distinct work environments. In the study, it was stated that public institutions should record gender-specific data in detail, on the basis of occupations and sectors.

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Many authors have shown that women are exposed to workplace injuries, illnesses, and gender-specific deaths. In recent years, researchers argue that we know less about women's occupational health problems than men's. The World Health Organization recommends countries collect and analyze sex-disaggregated data for occupational exposures, diseases and injuries. Yet we fail to understand gender-specific health and safety issues. Safety and health data published by relevant government agencies in many countries are not comprehensive enough to provide detailed gender-specific information. For this reason, there is an absolute need to collect and analyze data on occupational accidents in women in the future, taking into account the unique conditions of women (Hoskins 2005, Messing & Östlin 2006, Messing et al. 2009, Yilmaz & Tosun 2018).

Especially in new sectors such as the service sector, more women are employed and our knowledge of health and safety conditions in these sectors is limited. For this reason, it is of great importance to correctly reveal and analyze the situation of female employees in terms of occupational health and safety in order to determine future policies. Approaches that consider women independently from men and data arranged accordingly are needed. Although there are studies in the literature stating that occupational accidents in women have increased globally, there is no study examining the trend of work accidents in countries against the increase in employment in women. This research presents an approach from a statistical window to the dimension of occupational health and safety in women.

Research Method

Research data were obtained from Eurostat and ILO statistical databases. The annual numbers of men and women employed and the annual non-fatal occupational accident numbers of EU countries and some countries that regularly send data to the ILO are used. Employment data of EU countries were obtained from Eurostat "population and social conditions" "labor market" and "employment and unemployment" databases, data on work related accidents were obtained from "quality of employment" and "safety at work" databases. Employment and occupational accident data of non-EU countries were compiled from the "labor supply-employment" and "working conditions-safety and health at work" databases. Employment figures include those aged 15-64 and are official data reported to the ILO or Eurostat by the respective countries.

Regular data of EU countries on employment and occupational accidents are available in Eurostat, but there are very few countries that regularly update their data on these issues in the ILO. In particular, up-to-date data on work accidents and occupational diseases in recent years are not available. For this reason, only the countries that sent data to the ILO in the period between 2010 and 2018 were selected. In addition, it is not possible to reach the data of the new member countries other than the core EU-15 after 2010. For this reason, data for the period covering the same years in all countries could not be used. For example, data covering the years 2001-2018 were used for EU-15 countries and data for 2011-2019 were used in new member countries. In the data from the ILO, data from 2001 to 2018, if available, were used. For each country, the period in which the data were analyzed is indicated in parentheses. Countries that reported both employment and occupational accident figures for the same period were evaluated.

In this study, panel data analysis was performed. The trend of women's employment and occupational accidents in women over time and their correlation with each other were examined. In addition, the countries were grouped with the help of cluster analysis. Data compiled from Eurostat and ILO databases were transferred to tables in the Excel program. The number of employment and accidents, employment and accident increase and decrease rates for all countries and the EU were calculated separately for men and women (See Table 1).

In the study, the statistical relationship between the change in the number of employment and the change numbers of occupational accidents was examined with the help of an appropriate statistical program. Bivariate correlation analysis was used to test the existence, direction and strength of a correlation between employment and occupational accident figures. The two variables used in the correlation analysis are the employment and occupational accident numbers of male and female employees for the years included in the analysis. The aim of analyzing separately as men and women is to investigate

the effect of increasing female employment in developing countries on the number of work accidents experienced by female workers; to reveal statistically the differences between countries in male-female accident correlation and male-female accident change rates.

In the final stage of the study, countries were grouped according to the rate of increase or decrease in the total number of non-fatal accidents experienced by female workers during the reference period. For this purpose, two-step cluster analysis method was used. The research process is hierarchically presented as follows: Step 1. Employment and non-fatal accident numbers of countries were examined from Eurostat and ILO databases, and data belonging to 30 countries with at least 10 years of reporting on these issues and the EU total were used until recently. Step 2. Since both employment and occupational accident numbers should be found for each country in the correlation analysis, the period with data for both variables was taken into consideration. In many countries, although employment data are up-to-date, there are no regular occupational accident notifications.

Step 3. On the data transferred to the Excel program, the employment and accident change rates (increase or decrease) for each country within the reference period were calculated separately as male and female (See Table 1). Step 4. With the help of the appropriate statistical program, the statistical relationship between the number of employment and the number of occupational accidents for each country and the EU was tested separately for men and women by bivariate correlation analysis (See Table 1). Step 5. Countries were grouped according to the correlation results calculated in female employees, the results were analyzed in comparison with men. Step 6. Finally, a two-step cluster analysis was used to group countries by risk level among female workers. As data in the cluster analysis, the accident rate of change (increase or decrease) of female workers in the analyzed countries and throughout the EU during the reference years was used.

Results and Discussion

In this section, four tables prepared using official data of Eurostat and ILO are presented. First, the increase in employment and occupational accident rates in women in countries and employment/occupational accident correlations in the reference period were calculated and turned into a table (See Table 1). The purpose of this table is to analyze the amount of change in the number of employment and occupational accidents in men and women over the years in the relevant countries, the direction and strength (correlation) of this change, and the differences between countries in men and women comparatively. Secondly, countries were divided into five different groups according to the correlation coefficients calculated in the first table (Table 2). The purpose of this table is to group countries according to the correlation coefficients calculated by gender. For example, countries where the correlation coefficient is positive for both men and women, or where it is positive for women and negative for men. In the third table, SPSS outputs show the results of clustering analysis calculated by using the occupational accident rate of change in women in the countries (See Table 3), and, in the fourth table, the country groups formed according to the clustering analysis are given (See Table 4). With the cluster analysis, it is aimed to divide the countries into groups according to the OHS dimension in women and to classify success.

In 22 countries and total EU, the employment growth rate for women is higher than for men. Only in Hungary, Sweden, Ukraine, Lithuania, Romania, Latvia, Finland and Bulgaria is female employment growth lower than that of men or female employment has decreased. In eight countries and the EU, the number of occupational accidents is decreasing for men but increasing for women (Poland, Hungary, Belgium, France, Portugal, the Netherlands, Romania, Croatia). In Turkey, Switzerland, Mexico, Australia, Lithuania and Latvia, the number of occupational accidents has increased for both men and women, but the increase rates for women are well above men. Compared to men, the rate of increase in female accidents is approximately nine times higher in Turkey, five times higher in Mexico, 2.5 times higher in Australia, and two times higher in Switzerland and Lithuania (see Table 1).

The countries where occupational accidents decreased for both men and women are Germany, Sweden, Austria, the United Kingdom, Ireland, Ukraine, Czechia, Italy, Norway, Slovakia, Finland, Slovenia, Greece, Spain and Denmark. However, in all of these countries, the rate of decrease in women is quite low compared to men. The countries where the rate of decrease is close to each other for men and

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women are Denmark, Norway and Sweden. The difference in other countries is over 10%. In countries with increasing female employment during the reference period, countries with positive and very strong employment-occupational accident correlations are Switzerland (0.964), Mexico (0.942), Turkey (0.856), Hungary (0.852) and Slovakia (0.843), respectively. EU-15 (0.713), France (0.676), Belgium (0.614) and EU-27 (0.602) are strong; Australia (0.585) and Poland (0.485) have medium level correlations.

Table 1.
Increase in employment and occupational accident rates and employment/occupational accident correlation in the reference period

| Countries | Data Period | Male Employment Change Rate (increase or decrease) | Male Accident Change Rate (increase or decrease) | Female Employment Change Rate (increase or decrease) | Female Accident Change Rate (increase or decrease) | Employment/occupational accident correlation (male) (r) | Employment/occupational accident correlation (female) (r) | Male Accident Incidence Rate (2018) | Female Accident Incidence Rate (2018) |
|-------------|-------------|----------------------------------------------------|--------------------------------------------------|------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-------------------------------------|---------------------------------------|
| EU27 | 2001-2018 | 4.6 | -30.5 | 14.9 | 8.4 | 0.161 | 0.602 | 2130.69 | 1120.51 |
| EU15 | 2008-2018 | -0.5 | -19.4 | 6.2 | 8.6 | 0.423 | 0.713 | 2199.63 | 1182.66 |
| Turkey | 2001-2019 | 152.3 | 381.9 | 356.3 | 3419.7 | 0.748 | 0.856 | 1760.2* | 913.6* |
| Poland | 2008-2018 | 3.2 | -29.3 | 4.2 | 5.1 | -0.484 | 0.485 | 709.22 | 429.87 |
| Germany | 2001-2018 | 8.5 | -36.6 | 20.4 | -19.9 | -0.540 | -0.074 | 2453.04 | 920.12 |
| Hungary | 2008-2018 | 16.1 | -1.8 | 14.7 | 20.1 | 0.722 | 0.852 | 695.77 | 461.84 |
| Switzerland | 2004-2018 | 13 | 22.0 | 19 | 47.0 | 0.895 | 0.964 | 3325.51 | 1056.51 |
| Sweden | 2001-2018 | 15.7 | -41.2 | 15.3 | -33.8 | -0.724 | -0.525 | 812.84 | 659.29 |
| Austria | 2001-2018 | 8.8 | -32.5 | 22.2 | -20.9 | -0.837 | -0.785 | 2151.69 | 683.78 |
| Belgium | 2001-2018 | 7.0 | -36.2 | 29.4 | 28.1 | -0.710 | 0.614 | 2435.42 | 1128.78 |
| France | 2001-2018 | 3.0 | -35.7 | 17.5 | 77.6 | -0.406 | 0.676 | 3903.18 | 2912.74 |
| UK | 2001-2018 | 11.4 | -50.7 | 17.9 | -20.0 | -0.722 | -0.690 | 821.05 | 544.84 |
| Portugal | 2001-2018 | -11.6 | -41.3 | 5.0 | 46.2 | 0.935 | 0.018 | 3451.64 | 1874.64 |
| Ireland | 2001-2018 | 11.6 | -39.0 | 36.3 | -13.0 | 0.505 | 0.066 | 945.03 | 625.1 |
| Mexico | 2001-2017 | 29.7 | 18.5 | 56.5 | 83.8 | 0.758 | 0.942 | 3052.2* | 2921.0* |
| Australia | 2011-2018 | 9.3 | 8.3 | 15.6 | 19.7 | 0.448 | 0.585 | 1068.4* | 708.1* |
| Ukraine | 2011-2018 | -19.1 | -67.2 | -20.0 | -49.1 | 0.944 | 0.919 | 81.9* | 29.1* |
| Lithuania | 2008-2019 | -6.8 | 34.3 | -3.7 | 67.6 | 0.632 | 0.332 | 411.68 | 220.15 |
| Czechia | 2008-2019 | 1.5 | -61.2 | 8.2 | -46.7 | 0.071 | -0.191 | 1246.78 | 611.55 |
| Netherlands | 2002-2019 | 1.1 | -7.4 | 15.5 | 104.8 | -0.057 | 0.079 | 1369.51 | 1020.85 |
| Romania | 2008-2019 | -2.1 | -8.9 | -9.5 | 49.3 | 0.715 | -0.130 | 114.64 | 52.92 |
| Latvia | 2008-2019 | -14.4 | 31.4 | -13.0 | 32.2 | 0.376 | -0.077 | 313.99 | 161.74 |
| Italy | 2001-2019 | -1.4 | -62.4 | 21.2 | -42.1 | 0.781 | -0.866 | 1584.0 | 803.7 |
| Norway | 2001-2019 | 16.6 | -88.2 | 18.0 | -84.1 | -0.595 | -0.678 | 412.31 | 326.24 |
| Slovakia | 2008-2019 | 2.8 | -22.7 | 7.8 | -3.0 | 0.521 | 0.843 | 584.37 | 330.69 |
| Finland | 2001-2018 | 12.6 | -39.7 | 6.4 | -6.7 | -0.248 | 0.018 | 2112.28 | 1099.87 |
| Slovenia | 2008-2019 | -1.4 | -38.0 | 0.5 | -26.3 | 0.624 | 0.590 | 1967.56 | 838.29 |
| Greece | 2001-2019 | -15.0 | -89.0 | 5.2 | -72.0 | 0.865 | 0.552 | 140.16 | 85.29 |
| Bulgaria | 2008-2019 | -4.6 | -35.6 | -5.8 | -15.2 | 0.587 | 0.775 | 106.62 | 54.13 |
| Spain | 2001-2019 | 5.6 | -44.6 | 51.2 | -7.9 | 0.705 | -0.195 | 3783.2 | 1762.49 |
| Croatia | 2010-2019 | -0.9 | -34.2 | 1.1 | 11.6 | -0.005 | 0.194 | 1045.49 | 600.1 |
| Denmark | 2008-2019 | -0.1 | -31.9 | 2.1 | -27.1 | 0.053 | -0.228 | 1984.51 | 1436.79 |

Source: Calculated using employment and occupational accident data from Eurostat and ILO

* Accident incidence rates; 2017 ILO data for Mexico, Australia and Ukraine and 2016 ILO data for Turkey

Table 2.
Groups of countries resulting from employment/occupational accident correlation results

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Countries with a positive correlation for women while men are in a negative correlation | Poland, Belgium, France, the Netherlands, Finland, Croatia |
| Countries with positive correlations for both men and women as employment increases for both men and women | Turkey, Hungary, Switzerland, Mexico, Australia, Slovakia, Ireland, |
| Countries with a positive correlation between men and women, while employment decreases for both men and women or increases only for women | Ukraine, Lithuania, Bulgaria, Slovenia, Greece, Portugal |
| Countries with negative correlations for both men and women | Germany, Sweden, Austria, the United Kingdom, Norway, |
| Countries with a negative correlation for women while men are positively correlated | Czechia, Romania, Latvia, Italy, Spain, Denmark |

Source: Created by the author according to the correlation coefficients calculated for the countries in Table 1

In six countries (Poland, Belgium, France, the Netherlands, Finland and Croatia), there is a negative correlation for men and a positive correlation for women in the employment-occupational accident correlation (Table 2). However, the strength of the correlation among women is weak in the Netherlands, Finland and Croatia. In Poland, Belgium, France, and the Netherlands, occupational accidents in men decreased by 30-35% and there was a large increase in women. In six countries (Turkey, Hungary, Switzerland, Mexico, Australia, Slovakia and Ireland) employment increased and a positive (linear) correlation was calculated for both men and women. In all of these countries, the correlation coefficient for women is higher and stronger than for men. In other countries, except Slovakia, the increase in occupational accident rates for women is much higher than for men.

In Ukraine and Bulgaria, a positive correlation is calculated as there is a decrease in employment as well as a decrease in work-related accidents for men and women during the reference period. However, the rate of decrease in women in these countries is lower than in men. However, if there is an increase in employment in the future, an increase in occupational accidents can be expected. Although there is a decrease in employment in Lithuania, an increase of 34.3% in men and 67.6% in women has been observed in occupational accidents.

Similarly, in Portugal, occupational accidents decreased by 41.3% linearly with the decrease in male employment. Thus, a positive and strong correlation coefficient (0.935) is calculated for men. However, employment in women increased by 5% and occupational accidents increased by 46.2%. In Greece, a strong linear correlation was calculated with the large decrease in occupational accidents with the decrease in employment in men, and it is medium in women.

In Germany, Sweden, Austria, the United Kingdom and Norway, the correlation coefficient is negative for both men and women. In these countries, employment increased for both men and women, but occupational accidents decreased in both groups. However, in other countries except Norway, the correlation coefficient for men is stronger than for women. Norway is the only country with a stronger negative correlation coefficient for women than for men.

Countries with a positive correlation for men but a negative correlation for women are Czechia, Romania, Latvia, Italy, Spain, and Denmark. The employment of men and women in Czechia has increased and occupational accidents have decreased significantly. Correlation is positive in men and negative in women, but at a very weak level. In Romania, occupational accidents and employment decreased in men and a strong positive correlation was found. On the other hand, although the employment rate of women (9.5%) decreased three times more than that of men, occupational accidents increased by 49.3%. In this sense, although the correlation is negative for women, it is quite weak. In Latvia, the employment increase rates for men and women are almost the same; there has been a similar increase in work accidents. The correlation was weak and positive in men and very weak and negative in women. In Latvia and Romania, statistics for women appear to be in poor condition.

In Italy, on the other hand, there was a 62.4% reduction in work-related accidents, with a slight decrease in male employment and a strong positive correlation was determined. However, despite the 21.2% increase in employment for women, there was a significant decrease of 42.1% in work-related accidents and, accordingly, a strong negative correlation of -0.866 was calculated. Italy is one of the most successful countries, along with Norway, in terms of women's occupational safety. In Spain, despite the increase in employment for women by more than 50%, the decrease in accidents remained at only 8%, and the correlation was negative but weak. In Denmark, female employment increased by 2.1%, accidents decreased by 27%, and the correlation was negative but weak. Denmark can also be mentioned among the successful countries.

The countries with strong negative correlation coefficient for women are Italy (-0.866), Austria (-0.785), the United Kingdom (-0.690), Norway (-0.678) and Sweden (-0.525). Despite the significant increase in women's employment in these countries, occupational accidents have been decreasing over the years. These countries can be listed as successful in women's occupational safety. Both the employment-

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accident correlation and the accident decrease rates among women are evaluated together, it should be noted that Germany, Spain, Czechia, Ireland, Finland and Greece are also in a good trend. Countries with poor statistics on female occupational accidents are Poland, Belgium, France, the Netherlands, Croatia, Turkey, Hungary, Switzerland, Mexico, Australia, Romania, Portugal, Latvia and Lithuania. There is a decrease in employment and occupational accidents in Ukraine and Bulgaria; however, if employment starts to increase, the accidents may also increase. According to accident incidence rates, it is observed that the number of official cases is high in countries where the trend of occupational accidents in women is relatively good, and the number of cases is low (with a few exceptions) in countries that are not well.

In all countries, the accident incidence rate in women in official data is lower than in men. In all countries, the incidence of accidents in women is lower than in men, according to official data. Occupational accidents that female employees are exposed to are not sufficiently reported to official institutions. Especially in developing countries, women mostly work in informal, precarious and flexible jobs. Men, on the other hand, mainly work in traditional industrial sectors, which are more risky in terms of occupational safety, but informality is low in these sectors. There are more opportunities such as occupational safety and union organization. The number of reported occupational accidents in traditional male-dominated sectors is higher.

The countries with the lowest occupational accidents in women are Scandinavian and Northern European countries with high welfare levels. However, in some developed countries such as the Netherlands, Belgium and France, the correlation coefficient and accident increase rates for women are higher than for men. In developing countries, women's accident correlation coefficients and accident increase rates are higher than in developed countries.

Results of cluster analysis

In the two-step cluster analysis optimization, countries are divided into three groups (see Table 3-4). In the first group, Turkey, the Netherlands, Mexico, France, Lithuania, Romania, Switzerland and Portugal, women's occupational accidents increased between 46.2% and 311.4% in the period examined. In the third group, although not as high as the countries in the first group, there are six countries and the EU total, where women's occupational accidents increased between 5.1% and 32.2%.

In the second group, there are 16 countries where the number of occupational accidents among women decreased during the reference period. The most successful countries are Norway, Greece and Ukraine. Although female employment increased by more than 15% in Germany, Sweden, Austria, the United Kingdom, Italy, Spain and Norway, there is a decrease in occupational accidents. In Czechia, Finland, Slovenia, Slovakia and Denmark, women's work-related accidents have decreased significantly, although there have been small increases in female employment.

Table 3.
Cluster distribution and centroids

| Cluster Distribution | | | | |
|-----------------------------|----------|--------------------------------------------|----------------|------------|
| Cluster | | N | % of Combined | % of Total |
| | 1 | 8 | 25.0% | 25.0% |
| | 2 | 16 | 50.0% | 50.0% |
| | 3 | 8 | 25.0% | 25.0% |
| | Combined | 32 | 100.0% | 100.0% |
| Total | | 32 | | 100.0% |
| Centroids | | | | |
| Cluster | | Female Occupational Accident Increase Rate | | |
| | | Mean | Std. Deviation | |
| | 1 | 98.4625 | 88.46467 | |
| | 2 | -30.4875 | 23.19025 | |
| | 3 | 16.7250 | 9.89830 | |
| | Combined | 13.5531 | 70.09789 | |

Source: Two-stage clustering analysis SPSS outputs

Table 4.
Cluster frequencies

| Groups | Countries and Female Occupational Accident Increase Rates |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Group 1 | Turkey (311,4)*, the Netherlands (104,8), Mexico (83,8), France (77,6), Lithuania (67,6), Romania (49,3), Switzerland (47), Portugal (46,2), |
| Group 2 | Norway (-84,1), Greece (-72), Ukraine (-49,1), Czechia (-46,7), Italy (-42,1), Sweden (-33,8), Denmark (-27,1), Slovenia (-26,3), Austria (-20,9), the United Kingdom (-20), Germany (-19,9), Bulgaria (-15,2), Ireland (-13), Spain (-7,9), Finland (-6,7), Slovakia (-3), |
| Group 3 | Latvia (32,2), Belgium (28,1), Hungary (20,1), Australia (19,7), Croatia (11,6), EU-15 (8,6), EU-27 (8,4), Poland (5,1) |

Source: Two-stage clustering analysis SPSS outputs

The results of the two-step clustering analysis and the correlation analysis overlap with each other except for a few countries. Scandinavian countries, the United Kingdom, Germany, Italy and Central European countries are successful; Eastern Bloc and Baltic countries and developing countries such as Turkey, Mexico and Portugal are not doing well. France, Belgium, the Netherlands and Switzerland were identified as developed countries with poor statistics in women's occupational safety.

Although there are few studies in the literature that empirically examine the occupational health and safety (OHS) dimension in women, there have been some that emphasize the unique problems and sensitivity of women in the context of occupational health and safety (OHS) and reveal statistical findings that they are at higher risk than men (Jensen et al. 2014, Botha & Cronje 2015, Nielsen 2015, Rubín de Celis et al. 2017, Hasan & Kamardeen 2022). Rios et al. (2017) also emphasized that women are exposed to different types and intensities of risks, especially discrimination and harassment, compared to men, and, therefore, the issue of OH&S in women is an area that needs to be investigated further.

In addition, it is stated that women are exposed to different gender-specific injuries, and the available findings on this subject are not sufficient. It has also been stated that the existing data on occupational accidents are not sufficient to reveal the problem and develop a solution, as women work more in precarious sectors where informal and makeshift work is more common. The World Health Organization also emphasizes the importance of collecting gender-disaggregated data on occupational accidents and occupational health and safety (OHS). It is noted that gender-based studies are few and more studies are needed (Hoskins 2005, Messing & Östlin 2006, Messing et al. 2009).

More women are employed, especially in new sectors such as the service sector; however, information on health and safety conditions in these sectors is limited. For this reason, revealing and analyzing female employees' health and safety conditions of great importance in terms of determining future policies. This research evaluated the occupational accident data of women over the years with a statistical perspective, using the panel data analysis method. In order to increase reliability, a large amount of data from different sources were collected and consolidated. The results obtained are consistent with previous specific studies. According to the results of this research, women are involved in working life at an increasing rate, and they are exposed to more work-related accidents, especially in sensitive work areas for women. The outlook is not different in most developed or developing countries, except for a few countries where gender and labor law rules are developed and social state institutions are implemented more effectively. It can be predicted that this increasing trend in employment and occupational accidents in women will continue in the coming years, but there will be an absolute need for new studies on this subject.

Conclusion

Women are more exposed to unique workplace hazards compared to men, exposed to different levels of risks in different working environments, negatively affected by flexible working arrangements, and have to struggle with gender-specific problems such as discrimination and harassment. In addition, the available data on the risks and accidents faced by women are insufficient and need to be improved. Women's

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employment is increasing rapidly in the world, but with the exception of a few countries, occupational accidents experienced by women are also increasing in all developed or developing countries. The most important reason for this is that women mostly work in the service sector, which is thought to be low risk, but where flexible working arrangements are dominant and which is growing in the world. Female workers are more vulnerable in working life and in terms of occupational health and safety. Women are preferred more in many sectors as a cheap labor force that can be easily managed. However, because the risks specific to women in the workplaces are not adequately analyzed and measures are not taken, the occupational accidents that female employees are exposed to are increasing. It should be emphasized that the current situation may be even more negative, especially if the widespread informality and low accident reporting among women in developing countries are taken into account.

This statistical study draws attention to the following points. Women's participation in employment is increasing and will continue to increase in the coming years. Based on recent data, accident rates for women are much higher than for men, although their employment in many heavy and hazardous traditional industries has been restricted. Existing traditional preventive regulations, especially in developing countries, are insufficient to protect women. Women are employed more especially in non-traditional sectors where regulations on labor law and occupational health and safety are more flexible or weak. Public authorities related to occupational health and safety must, therefore, focus more on conditions in these new industries in the future. For this reason, it is expected that more studies will be conducted on occupational safety in women in the coming years.

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