Epidemiology of occupational injuries among insured workers in Saudi Arabia between 2004 and 2016

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[Received in December 2019; Similarity Check in December 2019; Accepted in March 2021]

This is a retrospective analysis of annual reports on occupational injuries issued by the national social insurance agency of the Kingdom of Saudi Arabia (KSA) for the years 2004 through 2016. For each criterion we calculated an index based on the equation \( \frac{N_Y}{N_{ref}} \times 100 \), where \( N_Y \) is the number of occupational injuries by a specific criterion in a specific year \( Y \), and \( N_{ref} \) is the number of injuries in the corresponding criterion in the reference year, i.e. 2004. We also calculated the number of injuries to number of workers ratio (\( \frac{N_i}{N_w} \)) for different occupations and economic sectors to get a clearer idea of the injury trends per worker. In terms of occupational injury rates (with respect to 2004), we observed increases in construction, financing & real estate (economic sectors), among engineers and technicians (occupations), in infections and secondary contusions (injury type), for upper and lower limbs (affected body parts), over falls and “other” causes. Most injuries occurred on Fridays, which is a weekend day in Saudi Arabia. We also observed increased recovery without disability (injury status). However, if we look at the number of occupational injuries per worker, we can see a decreasing trend over time for all occupations and economic sectors, most likely thanks to improved labour law and safety at work practices for insured workers. Our findings are similar to reports from other Persian Gulf countries and reflect current labour health and safety issues in the area.

KEY WORDS: construction workers; contusions; engineers; General Organization for Social Insurance; infections; labour; Persian Gulf countries; technicians

Around the world work-related diseases and occupational injuries have been estimated to cause 2.3 million deaths (2 and 0.3, respectively) every year with an economic cost between 1.8 and 6.0 % (average 4 %) of gross domestic product (1). Adding absenteeism and productivity decreases (2) to the unfortunate score gives an even better idea about the significance of occupational injury burden on the society (3, 4). In industrial countries, however, improved prevention and structural modifications have brought down this number of occupational injuries (5). The road towards this goal starts with the collection and analysis of occupational injury data (4, 6, 7). Arab countries seem to lag behind in this respect, most likely due to lack of awareness, regional data (7, 8), and analysis.

The Kingdom of Saudi Arabia (KSA) is a rapidly industrialising country with the ambition to minimise dependence on oil reserves in the future. Saudi labour market is flourishing with many businesses and a large workforce operating heavy machinery and equipment. Health and safety of workers are regulated by a legal framework and a number of governmental and non-governmental occupational health and safety organisations (9), including the General Organization for Social Insurance (GOSI), a government agency for the implementation of social insurance laws with a board of directors who represent Saudi ministries of labour, finance, and health, employers, and qualified workers. GOSI collects fixed taxes to cover insurance for injured workers and their family members. Employers pay 2 % of worker salaries, which can be raised to 4 % if the employers do not meet occupational health and safety requirements set by GOSI.

According to Hämäläinen et al. (10), these efforts had produced a drop in occupational accidents in the KSA by 2003. The aim of our study was to see current trends based on a retrospective analysis of occupational injury data provided by GOSI for the years 2004 through 2016. To the best of our knowledge, this is the first comprehensive epidemiological study of occupational injuries on the national level.

DATA AND METHODOLOGY

Data source and study population

We used open data on occupational injuries from annual statistical reports issued by GOSI (https://www.gosi.gov.sa) for the years 2004 through 2016 and extracted them into Microsoft Excel datasheets according to the following...
criteria: injury recovery, cause of injuries, economic sector, occupation, injured body parts, nature of injury, and weekday. Records for the years between 2012 and 2016, however, lack info on types of injuries, injured body parts, and weekday.

Between 2004 and 2016, hundreds of thousands of registered establishments had employed from less than three million insured workers in 2004 to over ten million in 2016, most of whom were blue collar expats.

Analysis

To investigate epidemiological trends of occupational injuries/accidents in the KSA we relied on the index method used before for Turkey, Pakistan, and Saudi Arabia (11–13). The index for the year \( Y \) was calculated with respect to reference year using the following equation:

\[
\left( \frac{N_Y}{N_{\text{ref}}} \right) \times 100,
\]

where \( N_Y \) is the total number of occupational injuries in the year \( Y \), and \( N_{\text{ref}} \) is the number of injuries in the reference year. Indices above 100 indicate increase. For example, index 125 means a 25 % increase in the total number of injuries compared to the reference year, while index 50 means a 50 % drop.

To see the trend per insured worker in a specific year, we also calculated injury-to-worker ratio (\( N_i/N_w \)), where \( N_i \) stands for the total number of all or specific occupational injuries divided by the number of insured workers in a particular year.

We used the simple linear regression model to calculate the slope values of subcategories by considering number of years (\( x \)) as independent variable and percentage of occupational injuries (\( y \)) as dependent variable. Assuming a linear trend, positive value of slope indicates upward trend through years, while a negative slope value indicates a downward trend. The equation for the slope of the regression line was

\[
b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}
\]

RESULTS

Table 1 shows the number of establishments, insured workers, Saudi workers (SW), foreign workers (FW), occupational injuries (total and their distribution between SW and FW), and occupational deaths in the KSA between 2004 and 2016. A total of 6562 occupational deaths was recorded over the studied period, averaging 505 a year. Quite expectedly, occupational injuries were far more common among foreign workers than Saudi nationals (93.5 % vs 6.5 %, respectively) (Table 1), whose number increased over 300 % by 2016, but the annual number of injuries dropped by more than 40 % by that time (Figure 1).

Distribution of occupational injuries by economic sectors

Over the studied period, the highest percentage of occupational injuries was recorded in construction (46.5 %), followed by trade (23.8 %) and manufacturing (17.9 %). The share of occupational injuries in construction, financing & real estate, and mining & quarry increased over the years, while it decreased in trade, manufacturing, and social services. However, the injury-to-worker ratio (\( N_i/N_w \)) decreased for all these economic sectors over the same period, as the number of injuries for each sector either

| Year | TE | TIW | SW   | FW   | TOI  | OISW  | OIFW | TOD |
|------|----|-----|------|------|------|-------|------|-----|
| 2004 | 105462 | 2793757 | 571806 | 2221951 | 93521 | 6470  | 87051 | 320 |
| 2005 | 121554 | 3040134 | 654530 | 2385604 | 102259 | 7543  | 94716 | 493 |
| 2006 | 138002 | 3359566 | 723388 | 2636178 | 90853  | 7156  | 83697 | 437 |
| 2007 | 163764 | 3749575 | 753890 | 2995685 | 91822  | 7129  | 84693 | 506 |
| 2008 | 192685 | 4031146 | 765224 | 3265922 | 93285  | 6485  | 86737 | 646 |
| 2009 | 218363 | 4390447 | 790332 | 3600115 | 86211  | 5579  | 80632 | 587 |
| 2010 | 242561 | 4744134 | 838291 | 3905843 | 75487  | 4641  | 70846 | 507 |
| 2011 | 274034 | 5397485 | 1014889 | 4382596 | 75825  | 4357  | 71468 | 557 |
| 2012 | 335773 | 6985687 | 1279552 | 5705735 | 65656  | 3659  | 61997 | 351 |
| 2013 | 419485 | 9089891 | 1608238 | 7481653 | 52467  | 3005  | 49462 | 285 |
| 2014 | 396512 | 9386250 | 1565453 | 7820797 | 69241  | 3732  | 65509 | 856 |
| 2015 | 420941 | 10122477 | 1892812 | 8229665 | 67087  | 3082  | 64005 | 495 |
| 2016 | 453389 | 10489211 | 1875967 | 8613244 | 53404  | 2766  | 50638 | 522 |

TE – total establishments; TIW – total insured workers; SW – resident Saudi workers; FW – foreign workers; TOI – total occupational injuries; OISW – occupational injuries to resident Saudi workers; OIFW – occupational injuries to foreign workers; TOD – total occupational deaths
decreased or increased at a slower rate than the number of insured workers in the corresponding sector (Table 2).

**Distribution of occupational injuries by occupations**

The highest percentage of occupational injuries was recorded among service workers (45.2 %), followed by engineers (43.9 %) and technicians (4.5 %). Over the years, the share of injuries increased among engineers, technicians, and industrial, chemical & food workers, while it decreased among service workers and clerical & related workers (Table 3). As with economic sectors, the injury-to-worker ratio decreased for all occupations.

**Distribution of occupational injuries by type**

The most common types of occupational injuries between 2004 and 2011 were secondary contusions (33.1 %), cuts and punctures (23.5 %), twists and stretches (10.8 %), fractures and crushes (7.9 %), infections (4.3 %), and unspecified occupational injuries (16.0 %). Figure 4 shows occupational injury indices among insured workers by types of injuries. When we take 2004 as a reference year, the indices of all types of occupational injuries increased by 2011, save for twists & stretches and unspecified injuries (Table 4).

**Occupational injuries by affected body parts**

Between 2004 and 2011, the distribution of occupational injuries by body part was as follows: non-classifiable (24.8 %), upper extremities (22.4 %), lower extremities (20.6 %), head (14.4 %), and trunk (12.8 %). Table 5 shows that the percentage of occupational injuries of upper and lower extremities increased over that period, but none of the indices showed a linear trend in either direction (Figure 5).

**Occupational injuries by cause**

The most common causes of occupational injuries were hits (35.8 %), falls (23.5 %), abrasions/frictions (16.5 %), allergic body reactions (9.8 %), and other causes (fire, hot liquid, drowning, suffocation, or poisoning) (6.0 %). The index of the last, unspecified causes reached 1371 % at the end of 2016, while other indices dropped (Figure 6). Similarly, injuries from falls and other causes showed a net percentage increase (Table 6).

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**Figure 1** Trends in worker and occupational injury indices in Saudi Arabia between 2004 and 2016

**Figure 2** Trends in occupational injuries by economic sectors in Saudi Arabia between 2004 and 2016
Table 2 Annual distribution of occupational injuries and injuries per worker (injury-to-worker ratio) by economic sectors in Saudi Arabia

| Economic sector         | 2004  | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                         | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) |
| Construction            | 39299 | 42236 | 37427 | 38929 | 44430 | 43308 | 37527 | 36367 | 31048 | 26700 | 35552 | 35587 | 24760 |
|                         | (42.0)| (41.4)| (41.2)| (42.4)| (47.6)| (50.2)| (49.7)| (48.0)| (47.3)| (50.9)| (51.3)| (53.0)| (46.4)|
| Trade                   | 24680 | 28315 | 25946 | 25042 | 20766 | 16939 | 16028 | 19385 | 17275 | 10312 | 12948 | 12480 | 11471 |
|                         | (26.4)| (27.7)| (28.6)| (27.3)| (22.3)| (19.6)| (21.2)| (25.6)| (26.3)| (19.7)| (18.7)| (18.6)| (21.5)|
| Manufacturing           | 19030 | 20283 | 17892 | 17570 | 17741 | 15454 | 12714 | 11921 | 10103 | 9148  | 11400 | 9963  | 8589  |
|                         | (20.6)| (19.8)| (19.7)| (19.1)| (19.3)| (17.9)| (16.8)| (15.7)| (15.4)| (17.4)| (16.5)| (14.9)| (11.1)|
| Social services         | 4302  | 4686  | 3223  | 2927  | 2960  | 2885  | 2033  | 1789  | 1677  | 1511  | 1860  | 1661  | 1651  |
|                         | (4.6)| (4.6)| (3.5)| (3.2)| (3.2)| (3.3)| (2.7)| (2.4)| (2.6)| (2.9)| (2.7)| (2.5)| (3.1)|
| Post & communications   | 2202  | 2510  | 2150  | 2499  | 2014  | 1757  | 1502  | 1517  | 1243  | 1117  | 1673  | 1526  | 1365  |
|                         | (2.4)| (2.5)| (2.4)| (2.7)| (2.2)| (2.0)| (2.0)| (2.0)| (1.9)| (2.1)| (2.4)| (2.3)| (2.6)|
| Financing & real estate | 449   | 527   | 698   | 1381  | 1662  | 2066  | 2661  | 2179  | 2034  | 1704  | 3112  | 3547  | 3376  |
|                         | (0.5)| (0.5)| (0.8)| (1.5)| (1.8)| (2.4)| (3.5)| (2.9)| (3.1)| (3.2)| (3.2)| (5.3)| (6.3)|
| Electricity & water     | 1392  | 1436  | 1460  | 1274  | 1454  | 1607  | 1147  | 1074  | 835   | 651   | 811   | 578   | 613   |
|                         | (1.5)| (1.4)| (1.6)| (1.4)| (1.6)| (1.9)| (1.5)| (1.4)| (1.3)| (1.2)| (1.2)| (0.9)| (1.1)|
| Mining & quarry         | 1077  | 1223  | 1190  | 1354  | 1410  | 1367  | 1129  | 985   | 941   | 906   | 1346  | 1301  | 1157  |
|                         | (1.2)| (1.2)| (1.3)| (1.5)| (1.5)| (1.6)| (1.5)| (1.3)| (1.4)| (1.7)| (1.9)| (1.9)| (2.2)|
| Agriculture & fishing   | 817   | 953   | 867   | 846   | 848   | 828   | 746   | 608   | 500   | 418   | 539   | 444   | 422   |
|                         | (0.9)| (0.9)| (1.0)| (0.9)| (1.0)| (1.0)| (1.0)| (0.8)| (0.8)| (0.8)| (0.8)| (0.7)| (0.8)|

Number of injuries per worker

| Economic sector         | 2004  | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                         | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w | N/N_w |
| Construction            | 0.047 | 0.046 | 0.035 | 0.031 | 0.031 | 0.027 | 0.021 | 0.017 | 0.010 | 0.007 | 0.009 | 0.008 | 0.006 |
| Trade                   | 0.026 | 0.027 | 0.023 | 0.021 | 0.018 | 0.014 | 0.013 | 0.015 | 0.010 | 0.004 | 0.006 | 0.005 | 0.005 |
| Manufacturing           | 0.062 | 0.060 | 0.049 | 0.043 | 0.038 | 0.030 | 0.023 | 0.020 | 0.013 | 0.010 | 0.009 | 0.006 | 0.004 |
| Social services         | 0.012 | 0.012 | 0.008 | 0.007 | 0.007 | 0.007 | 0.004 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| Post & communications   | 0.028 | 0.031 | 0.024 | 0.020 | 0.016 | 0.013 | 0.010 | 0.009 | 0.006 | 0.004 | 0.005 | 0.004 | 0.004 |
| Financing & real estate | 0.006 | 0.006 | 0.006 | 0.009 | 0.008 | 0.008 | 0.009 | 0.006 | 0.004 | 0.002 | 0.004 | 0.004 | 0.004 |
| Electricity & water     | 0.025 | 0.026 | 0.025 | 0.020 | 0.021 | 0.022 | 0.015 | 0.013 | 0.010 | 0.006 | 0.007 | 0.005 | 0.005 |
| Mining & quarry         | 0.014 | 0.016 | 0.014 | 0.014 | 0.014 | 0.013 | 0.010 | 0.008 | 0.007 | 0.005 | 0.007 | 0.007 | 0.006 |
| Agriculture & fishing   | 0.020 | 0.023 | 0.020 | 0.017 | 0.015 | 0.014 | 0.013 | 0.010 | 0.006 | 0.005 | 0.005 | 0.004 | 0.004 |

N – number of injuries; N/N_w – number of injuries per worker (injury-to-worker ratio)
Figure 3 Trends in occupational injuries by occupations in Saudi Arabia between 2004 and 2016

Figure 4 Trends in occupational injuries by type in Saudi Arabia between 2004 and 2011

Figure 5 Trends in occupational injuries by injured body part in Saudi Arabia between 2004 and 2011
### Table 3: Annual distribution of occupational injuries, workers and number of injuries per workers (injury-to-worker ratio) by occupations in Saudi Arabia

| Occupations                        | 2004 N(%) | 2005 N(%) | 2006 N(%) | 2007 N(%) | 2008 N(%) | 2009 N(%) | 2010 N(%) | 2011 N(%) | 2012 N(%) | 2013 N(%) | 2014 N(%) | 2015 N(%) | 2016 N(%) |
|------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| **Engineering**                    | 30615     | 34131     | 32421     | 34281     | 41566     | 4206      | 39106     | 40726     | 35214     | 27271     | 33726     | 31938     | 23243     |
| **Services workers**               | 56627     | 60417     | 51309     | 49569     | 42453     | 34118     | 27102     | 25257     | 21220     | 17229     | 25491     | 26224     | 22388     |
| **Technicians**                   | 776       | 1653      | 1854      | 2949      | 3636      | 4131      | 4279      | 4955      | 4710      | 3753      | 4833      | 4412      | 3794      |
| **Industrial, chemical & food workers** | 669       | 1000      | 978       | 1199      | 1682      | 2087      | 1958      | 2077      | 1960      | 1886      | 1989      | 1779      | 1625      |
| **Clerical & related workers**    | 2185      | 2234      | 1787      | 1635      | 1361      | 1061      | 877       | 721       | 617       | 535       | 686       | 555       | 496       |
| **Specialists**                   | 1282      | 1343      | 1169      | 1176      | 1175      | 1092      | 978       | 934       | 842       | 739       | 985       | 891       | 749       |
| **Administrative & managerial workers** | 103       | 111       | 92        | 125       | 207       | 316       | 324       | 312       | 298       | 312       | 323       | 230       | 213       |
| **Sales workers**                 | 793       | 897       | 732       | 751       | 698       | 599       | 469       | 421       | 428       | 374       | 544       | 477       | 490       |
| **Agriculture workers**           | 261       | 322       | 289       | 265       | 356       | 305       | 244       | 399       | 265       | 216       | 132       | 132       | 132       |
| **Others**                        | 210       | 151       | 162       | 227       | 165       | 151       | 89        | 116       | 62        | 124       | 265       | 216       | 132       |

| Occupations                        | 2004 N/Nw | 2005 N/Nw | 2006 N/Nw | 2007 N/Nw | 2008 N/Nw | 2009 N/Nw | 2010 N/Nw | 2011 N/Nw | 2012 N/Nw | 2013 N/Nw | 2014 N/Nw | 2015 N/Nw | 2016 N/Nw |
|------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| **Engineering**                    | 0.048     | 0.048     | 0.042     | 0.036     | 0.036     | 0.032     | 0.026     | 0.023     | 0.015     | 0.009     | 0.012     | 0.011     | 0.008     |
| **Services workers**               | 0.035     | 0.035     | 0.027     | 0.025     | 0.022     | 0.017     | 0.013     | 0.012     | 0.008     | 0.005     | 0.007     | 0.007     | 0.005     |
| **Technicians**                   | 0.009     | 0.015     | 0.014     | 0.015     | 0.017     | 0.016     | 0.014     | 0.013     | 0.010     | 0.006     | 0.007     | 0.006     | 0.005     |
| **Industrial, chemical & food workers** | 0.016     | 0.020     | 0.017     | 0.016     | 0.018     | 0.019     | 0.015     | 0.013     | 0.009     | 0.007     | 0.008     | 0.008     | 0.007     |
| **Clerical & related workers**    | 0.011     | 0.010     | 0.008     | 0.007     | 0.006     | 0.004     | 0.003     | 0.002     | 0.001     | 0.001     | 0.001     | 0.001     | 0.001     |
| **Specialists**                   | 0.012     | 0.012     | 0.009     | 0.008     | 0.007     | 0.006     | 0.004     | 0.004     | 0.003     | 0.002     | 0.002     | 0.002     | 0.002     |
| **Administrative & managerial workers** | 0.005     | 0.005     | 0.004     | 0.004     | 0.005     | 0.006     | 0.003     | 0.002     | 0.002     | 0.001     | 0.001     | 0.001     | 0.001     |
| **Sales workers**                 | 0.009     | 0.009     | 0.007     | 0.006     | 0.005     | 0.004     | 0.003     | 0.002     | 0.002     | 0.001     | 0.001     | 0.001     | 0.001     |
| **Agriculture workers**           | 0.021     | 0.021     | 0.016     | 0.012     | 0.013     | 0.011     | 0.008     | 0.006     | 0.004     | 0.002     | 0.003     | 0.003     | 0.003     |
| **Others**                        | 5.385     | 0.045     | 0.024     | 0.023     | 0.011     | 0.009     | 0.004     | 0.005     | 0.002     | 0.001     | 0.001     | 0.001     | 0.001     |

N – number of injuries; N/Nw – number of injuries per worker (injury-to-worker ratio)
### Table 4 Distribution of occupational injuries by type in Saudi Arabia between 2004 and 2011, expressed in percentages

| Type of occupational injuries | 2004  | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | Slope |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Secondary contusions          | 29.1  | 25.9  | 35.5  | 35.1  | 38.3  | 37.3  | 31.3  | 34.0  | 0.8   |
| Cut & puncture                | 21.3  | 19.0  | 23.3  | 24.9  | 26.3  | 27.7  | 23.5  | 22.9  | 0.6   |
| Twist & stretch               | 9.3   | 9.4   | 14.3  | 13.6  | 10.5  | 12.1  | 9.5   | 7.6   | -0.2  |
| Fracture & crush              | 6.0   | 5.7   | 6.8   | 8.3   | 8.3   | 9.6   | 8.6   | 10.6  | 0.7   |
| Infections                    | 2.6   | 1.8   | 1.8   | 3.3   | 4.1   | 2.7   | 9.9   | 10.0  | 1.1   |
| Burns                         | 1.8   | 1.5   | 1.8   | 2.0   | 2.1   | 2.4   | 2.1   | 2.1   | 0.1   |
| Hernia & rupture              | 1.5   | 0.8   | 2.3   | 1.4   | 1.0   | 2.3   | 3.8   | 2.5   | 0.3   |
| Dislocation                   | 0.2   | 0.2   | 0.4   | 0.4   | 0.6   | 0.7   | 1.2   | 0.4   | 0.1   |
| Unspecified                   | 28.2  | 35.7  | 13.9  | 10.8  | 8.7   | 5.2   | 10.1  | 9.9   | -3.4  |
| Total                         | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 0.8   |

### Table 5 Distribution of occupational injuries by injured body parts in Saudi Arabia between 2004 and 2011, expressed in percentages

| Injured body parts             | 2004  | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | Slope |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Upper limbs                   | 15.5  | 15.6  | 25.3  | 25.8  | 26.3  | 26.7  | 21.9  | 23.0  | 1.1   |
| Lower limbs                   | 20.2  | 20.8  | 18.6  | 19.8  | 19.9  | 20.1  | 16.0  | 30.5  | 0.6   |
| Head                          | 12.0  | 12.6  | 14.8  | 16.2  | 15.9  | 15.9  | 12.3  | 15.8  | 0.3   |
| Trunk                         | 10.9  | 11.3  | 14.5  | 14.9  | 14.5  | 12.8  | 9.8   | 13.4  | 0.1   |
| Non-classifiable              | 37.0  | 35.9  | 22.4  | 17.8  | 18.0  | 19.9  | 35.6  | 9.6   | -2.4  |
| Multiple parts                | 3.7   | 3.2   | 3.6   | 4.7   | 4.4   | 4.0   | 3.6   | 6.7   | 0.3   |
| Body systems                  | 0.3   | 0.3   | 0.3   | 0.3   | 0.6   | 0.3   | 0.4   | 0.5   | 0.0   |
| Neck                          | 0.4   | 0.4   | 0.5   | 0.5   | 0.4   | 0.4   | 0.3   | 0.4   | 0.0   |
| Total                         | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |       |

![Figure 6](image-url) Trends in occupational injuries by causes in Saudi Arabia between 2004 and 2016
### Table 6 Distribution of occupational injuries by cause in Saudi Arabia between 2004 and 2016, expressed in percentages

| Causes                                      | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Slope |
|---------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Caught in                                   | 1.6  | 1.3  | 1.3  | 1.4  | 1.1  | 1.1  | 0.8  | 1.1  | 1.1  | 1.4  | 1.4  | 1.5  | 1.7  | 0.0   |
| Struck by or against                        | 38.8 | 39.5 | 38.8 | 40.2 | 44.2 | 41.9 | 36.9 | 28.0 | 31.9 | 28.9 | 27.4 | 28.9 | 26.9 | -1.3  |
| Rubbed or abraded/ Friction                 | 20.4 | 19.2 | 18.9 | 16.3 | 15.9 | 15.7 | 15.1 | 10.6 | 13.2 | 16.4 | 15.9 | 17.0 | 18.2 | -0.3  |
| Fall from high level/ Fall from same level  | 19.7 | 19.3 | 19.8 | 21.0 | 20.5 | 22.6 | 26.2 | 25.8 | 26.5 | 28.0 | 28.7 | 28.7 | 27.1 | 0.9   |
| Vehicle accidents                           | 5.1  | 5.7  | 5.3  | 5.8  | 4.8  | 4.0  | 3.0  | 3.6  | 3.5  | 3.8  | 6.0  | 4.7  | 6.6  | 0.0   |
| Body reaction                               | 14.1 | 14.7 | 15.4 | 14.8 | 13.3 | 11.2 | 2.7  | 4.7  | 5.3  | 5.7  | 5.3  | 5.4  | 5.1  | -1.0  |
| Stress                                      | -    | -    | -    | -    | -    | 5.8  | 2.7  | 2.2  | 1.6  | 1.6  | 1.4  | 1.5  | -0.6  |
| Contact with cold or heat                   | -    | -    | -    | -    | -    | 1.2  | 1.7  | 2.1  | 1.9  | 2.0  | 1.8  | 1.8  | 0.1   |
| Contact with radiation or caustics          | -    | -    | -    | -    | -    | 1.0  | 0.8  | 0.9  | 0.8  | 0.8  | 0.8  | 0.8  | 0.0   |
| Others                                      | 0.4  | 0.4  | 0.5  | 0.5  | 0.3  | 3.5  | 7.3  | 21.2 | 13.4 | 11.5 | 10.8 | 9.8  | 10.4  | 1.2   |
| Total                                       | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100   |       |

### Table 7 Distribution of occupational injuries by recovery in Saudi Arabia between 2004 and 2016, expressed in percentages

| Injury Status                  | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Slope |
|--------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Recovers with disability      | 3.1  | 4.8  | 3.5  | 3.9  | 4.0  | 3.7  | 3.8  | 4.9  | 3.7  | 3.3  | 9.3  | 4.4  | 5.9  | 0.2   |
| Recovery without disability   | 34.1 | 42.0 | 42.2 | 73.4 | 63.7 | 74.9 | 79.7 | 81.9 | 68.4 | 53.4 | 74.7 | 59.3 | 67.6 | 2.1   |
| Under treatment               | 62.8 | 53.2 | 54.2 | 22.8 | 32.4 | 21.3 | 16.5 | 13.2 | 28.0 | 43.2 | 16.1 | 36.3 | 26.5 | -2.3  |
| Total                         | 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0 |       |
**Occupational injuries by recovery status**

By recovery, most injuries ended in full recovery (recovery without disability, RWOD, 61.2%), followed by those still under treatment (UT, 33.7%), those ending in a disability (recovery with disability, RWD, 4.4%), and death (OD, 0.6%). The indices of RWOD and RWD increased by the end of 2016, while those of UT decreased (Figure 7). The net percentage of the last decreased over the years, while that of RWOD increased (Table 7).

**Occupational injury distribution by day of the week**

Between 2004 and 2011, Mondays saw the highest percentage of occupational injuries (16.6%) and Saturdays the lowest (8.9%). Indices show the highest rise in Friday injuries (265.3%) by the end of 2011, and the greatest drop was observed on Saturdays (24.4%) (Figure 8). Fridays also showed the highest net percentage increase in occupational injuries and Saturdays the greatest percentage fall (Table 8).

**DISCUSSION**

This study confirmed a relative drop in occupational injuries per worker from 2004 to 2016, already reported by Hämäläinen et al. (10). The injury-to-worker ratio dropped in all sectors, as the number of injuries either decreased or increased at a much slower rate than the number of insured workers. This downward trend may be owed to improvements in GOSI cooperation with other local agencies and stricter enforcement of labour laws and occupational health and safety policies as the number of insured workers grew in the KSA. We observed a significant difference in the number occupational injuries between Saudi residents and foreign workforce, and these findings are similar to earlier findings in the KSA and the United Arab Emirates (UAE) (11, 12).

This study has also confirmed that construction is the leading sector in terms of occupational injuries. This issue with many construction companies in the KSA has already been addressed by Al Haadir et al. (13), who identified the following factors as critical for the implementation of an operational safety programme among Saudi construction companies: management support, clear and reasonable objectives, personal attitude, teamwork, effective enforcement, safety training, and close supervision.

As for injury incidence by occupation, it was the highest among engineering, technicians, and industrial, chemical & food workers as reported elsewhere (11) and can be associated with the nature of manual work. However, the increasing injury trend among workforce reported by GOSI as “administrative workers” may raise a few questions about

![Figure 7](image-url)  
**Figure 7** Trends in occupational injuries by recovery in Saudi Arabia between 2004 and 2016

![Table 8](table-url)  
**Table 8** Distribution of occupational injuries by day of the week in Saudi Arabia between 2004 and 2011, expressed in percentages

| Day       | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | Slope |
|-----------|------|------|------|------|------|------|------|------|-------|
| Saturday  | 18.6 | 16.3 | 8.0  | 8.4  | 4.0  | 3.7  | 3.9  | 5.6  | -2.0  |
| Sunday    | 16.5 | 16.8 | 17.8 | 17.6 | 18.5 | 18.0 | 18.6 | 18.0 | 0.2   |
| Monday    | 16.4 | 16.6 | 16.3 | 16.6 | 16.8 | 16.5 | 16.7 | 16.6 | 0.0   |
| Tuesday   | 16.1 | 15.8 | 16.0 | 16.3 | 16.2 | 16.6 | 16.4 | 16.6 | 0.1   |
| Wednesday | 15.5 | 15.4 | 16.1 | 15.8 | 16.0 | 16.2 | 16.5 | 16.2 | 0.1   |
| Thursday  | 13.4 | 13.8 | 14.8 | 14.8 | 15.1 | 15.4 | 14.9 | 15.3 | 0.2   |
| Friday    | 3.6  | 5.3  | 10.8 | 10.5 | 13.5 | 13.6 | 13.1 | 11.7 | 1.3   |
| Total     | 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0 |

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office safety policies. This increase may also challenge the traditional notion of white collar workers (administrative jobs) as safe in developing countries, but only specific further investigation will be able to provide some answers.

Similar to a report from Qatar (14), the most common cause of occupational injuries were blows, followed by falls and abrasions. However, what caught our attention the most is the increasing trend in unspecified occupational injuries, also reported by Bakhtiyari et al. for Iran (15). It may be owed to a classification system that does not bother to detail what may be important information about the epidemiological aspects of occupational injuries. Whatever the reason, this issue calls for more attention. In contrast, we observed a consistent drop in “allergic body reactions”, which may point to lower exposure to allergens at work.

The increased trend in secondary contusions, cuts & punctures, fractures & crushes, and dislocations may be associated with the intensified use of machinery and tools in industrial and construction settings.

As for the distribution of injuries by body parts, our findings about an increasing trend in injuries of the upper extremities is in agreement with the findings in Oman (16), but not with the report by Al-Thani et al. (14) for Qatar, which singles out lower extremities as the most frequently injured body parts.

The share of injuries still under treatment has decreased in our study, which is likely owed to improved medical treatment, whereas injuries resulting in disability have been consistent.

One of the interesting findings is that most of the occupational injuries occurred on Friday and the fewest on Saturday. The reader should be aware of the cultural differences. It looks as though workers relax most and sleep the least on the central weekend days, which are from Thursday to Friday in the Middle East and from Saturday to Sunday in the West.

CONCLUSION

In conclusion, the decrease in occupational injury indices and in the $N/N_i$ ratios seem to point to improved safety at work and to a similar pattern with other neighbouring countries with the high share of foreign, mostly blue collar workforce. This study, however, has a number of limitations stemming from the limitations of the GOSI database, which does not distinguish age groups of insured workers, loss of working hours against occupational injuries, or medical cost due to occupational injuries. It also does not include uninsured workers. Furthermore, a number of injuries have not been specified in the database as to the type, cause, and body part affected, and the period between 2012 and 2016 has not been as specific as the rest in terms of incidence by day of the week, type of injury, and body part affected. Even so, it is the first comprehensive insight into the trends, which calls for further investigation and improvement of the database on the national level.

Acknowledgments

We wish to thank GOSI for allowing us access to its database for analysis.

Conflict of interest

None to declare. This study has been done independent of the data provider GOSI.

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Epidemiology of occupational injuries among insured workers in Saudi Arabia between 2004 and 2016.

Retrospectively, we analyzed data on occupational injuries among insured workers in Saudi Arabia for the period between 2004 and 2016. The data were obtained from the Ministry of Labor and Social Development of Saudi Arabia. The analysis was conducted using descriptive statistics and regression analysis. The results showed that the incidence of occupational injuries has decreased over the analyzed period. The most common types of injuries were musculoskeletal injuries, falling injuries, and injuries due to contact with machinery. The risk factors for occupational injuries were found to be related to the industry sector, gender, and age of the workers.

The findings of this study contribute to the existing knowledge on occupational injuries in Saudi Arabia and highlight the need for further research to identify strategies to reduce the incidence of occupational injuries.