

# An evaluation of the variation in the rates of occupational accidents in Turkey with trend analysis methodology

## Are occupational accidents really diminishing?

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### ABSTRACT

**Objectives:** To show whether the rate of occupational accidents is decreasing in Turkey.

**Methods:** Data on incidence and deaths due to occupational accidents in Turkey during the period 1970-2000 were obtained and evaluated at the Department of Public Health, Hacettepe University, Ankara, Turkey. The data were collected in January 2003. The occupational accident rates were analyzed by morbidity, mortality and case fatality rates. The change in each variable over years was tested by trend analysis methodology. A regression analysis was performed on data on 3-point moving averages.

**Results:** The morbidity decreases significantly over the last 30 years ( $p<0.01$ ) with a slope of  $-0.003$ . The correlation of the morbidity tendency due to years was

0.995 ( $p<0.01$ ) and the total variance descriptive rate was 0.991. In respect to mortality, the variation due to years was declining (0.00001,  $p<0.01$ ). The correlation of the model was 0.950 ( $p<0.01$ ) and brings out the total variance to 0.903. The trend analysis model can be explained meaningfully in respect of constant and slope ( $p<0.01$ ). In respect of fatality the variance over the years was 0.00029 ( $p<0.01$ ). The correlation of the model was 0.934 ( $p<0.01$ ) and brings out the total variance of 0.872.

**Conclusions:** The main reason of the decrease of occupational accidents was probably due to unreported accidents, which do not cause injury. Reasons for underreporting of minor accidents should be investigated and this point should be taken into consideration when planning an occupational accident prevention programs.

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Factors such as the composition of workforce and community, details of the accident, the insurance system, the variation rate of accidents in relation to time are accidents. In 1994, an estimate of the average annual fatal occupational accident rate worldwide was 14 per 100,000 workers, and the estimated total number of fatal occupational accidents was 335,000. The rates are different for

individual countries and regions and for separate branches of economic activity.<sup>1</sup> In Turkey, occupational accidents and diseases are defined for, and applied only to wage earners.<sup>2</sup> An occupational accident is defined as any one of the circumstances or situations indicated below, which causes an immediate or subsequent physical or mental disability in a person: when the insured person is in

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the work place, and injured in connection with work activity for the employer, while insured persons are transported as a group by a vehicle supplied by the employer to and from the place where the work is being carried out, when the insured person has been sent by the employer to perform work duties at another location, during the period allocated for nursing of the child of an insured woman worker. These stipulations have not changed since 1946, the year of implementation of the occupational accident insurance scheme in Turkey.<sup>3</sup> Occupational accident insurance premiums are paid by the employer in proportions calculated according to the risk evaluation of the workplace. The principles applied to this evaluation have not been changed for the past 30 years. A workplace health unit keeps records of occupational accidents. The employer has to report such accidents to the Ministry of Labor and Social Security, via District Labor Directorate, within 2 days of an accident. The Social Insurance Institution data was published as annual reports. In Turkey, for the year 2000 the total number of workers was 5,254,125. In the same year, the number of occupational accidents was 75,578, occupational diseases was 803,000 the number of workers with permanent incapacity for work due to occupational accidents or diseases was 1,818,000 and cases of occupational mortality total 1,173. Temporary incapacity for work led to lost workdays totaling to 1,697,695 days, and hospitalization for work injury amounted to 46,075 days.<sup>4</sup> Turkey was in the process of joining the European Union, and high occupational accident rates do not fit the rates of

European countries. The aim of this study was to discuss, whether occupational accidents is really diminishing via an evaluation and comparison of the variation in these rates.

**Methods.** Data on number of workers, number of occupational accidents and deaths due to occupational accidents in the last 30 years (1970-2000) were obtained from the Social Insurance Institution statistical yearbooks and evaluated at the Department of Public Health, Hacettepe University, Ankara, Turkey. This system covers all paid workers excluding civil servants. The occupational accident rates were analyzed by morbidity (frequency of occupational accident) and mortality rates. The change in each variable over years was tested by trend analysis methodology. First, the 3-point moving averages of the data were taken. This procedure smoothes the data and indicates the trend of the rates.<sup>5-11</sup> A regression analysis was performed on the data on 3-point moving averages. Morbidity, mortality (number of deaths divided by the number of workers) and case-fatality (number of deaths divided by number of accidents) were included into the regression analysis as dependent variables. The year was taken as an independent variable. The direction of the trend was determined.<sup>6-11</sup>

**Results.** When the changes in occupational accident rates over the last 30 years were examined, (Table 1, Figure 1) a decrease in morbidity and mortality rates was noted, while there was an

Table 1 - Variations in occupational accident rates in Turkey (1970-2000).<sup>4</sup>

| Year | Number of workers | Occupational accident |            |               |               |              |
|------|-------------------|-----------------------|------------|---------------|---------------|--------------|
|      |                   | N of accident         | N of death | Morbidity (%) | Mortality (%) | Fatality (%) |
| 1970 | 1 313 500         | 143194                | 679        | 10.90         | 5.17          | 4.74         |
| 1972 | 1 525 012         | 164659                | 682        | 10.79         | 4.47          | 4.14         |
| 1974 | 1 799 998         | 175862                | 983        | 9.77          | 5.46          | 5.59         |
| 1976 | 2 017 875         | 197961                | 947        | 9.81          | 4.69          | 4.78         |
| 1978 | 2 206 056         | 196640                | 975        | 8.91          | 4.42          | 4.95         |
| 1980 | 2 204 807         | 160614                | 1014       | 7.28          | 4.60          | 6.31         |
| 1982 | 2 264 788         | 147949                | 831        | 6.53          | 3.67          | 5.61         |
| 1984 | 2 439 036         | 153534                | 884        | 6.29          | 3.62          | 5.75         |
| 1986 | 2 815 230         | 151929                | 1108       | 5.39          | 3.94          | 7.29         |
| 1988 | 3 140 071         | 172932                | 1163       | 5.50          | 3.70          | 6.72         |
| 1990 | 3 446 502         | 157149                | 1292       | 4.55          | 3.75          | 8.22         |
| 1992 | 3 796 702         | 141047                | 1583       | 3.71          | 4.17          | 11.22        |
| 1994 | 3 933 289         | 93121                 | 1034       | 2.36          | 2.63          | 11.10        |
| 1996 | 4 377 914         | 88103                 | 1296       | 2.01          | 2.96          | 14.71        |
| 1998 | 5 299 533         | 92989                 | 1094       | 1.75          | 2.06          | 11.76        |
| 2000 | 5 254 125         | 75578                 | 731        | 1.43          | 1.39          | 9.67         |

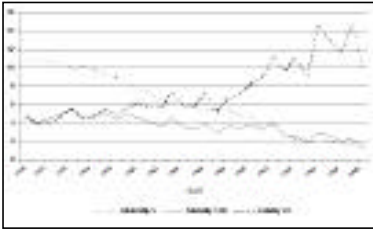


Figure 1 - Variations in change of occupational accident rates in Turkey (1970-2000).<sup>4</sup>

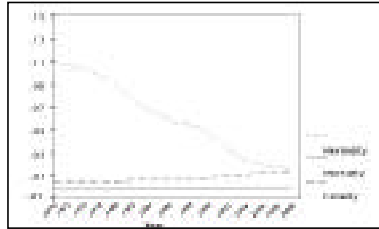


Figure 2 - Variations in change of occupational accident rates in Turkey after moving average smoothing (1970-2000).

increase in the fatality rate. Between 1970 and 2000, the occupational accident morbidity rate showed a general decrease over the years and falls to 1.43% from a high of 10.9%. During the same period, the mortality rate went down from 5.17 - 1.39 per 10,000 workers. Also for the same period, the case-fatality rate went up from 4.74 - 14.72 per 1000 workers in 1999. Each of the 3 variables over the years was tested by trend analysis (Figure 2). The results of regression analysis on moving average smoothing are summarized in Table 2. By this way the trend slope and constant was calculated. The constant shows that the start point amount of occupational accident and the slope shows that decrease of occupational accident according to years. The constants of occupational data (morbidity, mortality, fatality) was significant, also increase slope of fatality and the decrease slope of mortality and morbidity was significant. Morbidity decreases from years 1970 - 2000. The initial value of morbidity (constant of regression) starts at 6.97 and it is statistically significant ( $p < 0.01$ ). The morbidity decreases over the years, significantly ( $p < 0.01$ ) with a slope of  $-0.003$ . As morbidity can be explained by the constant and the slope, the model of trend analysis was significant ( $F = 3234.2$ ,  $p < 0.01$ ). The correlation of the morbidity tendency due to years was 0.995 ( $p < 0.01$ ) and the total variance descriptive rate was 0.991. In respect to mortality, the constant was 0.019 ( $p < 0.01$ ). The variation due to years was declining (0.00001,  $p < 0.01$ ). This, in some respect, means that there is no variation connected with years, as it requires 100,000 years for one unit of decrease. The correlation of the model was 0.950 ( $p < 0.01$ ) and brings out the total variance to 0.903. The trend analysis model can be explained meaningfully in respect to constant and slope ( $F = 287$ ,  $p < 0.01$ ). Fatality was constant  $-0.563$  ( $p < 0.01$ ) and the variance over years was 0.00029 ( $p < 0.01$ ). The regression analysis has been carried out using

moving averages. The regression constant was  $-0.563$ . Therefore, it does not seem possible to mention a variance due to years. The correlation of the model was 0.934 ( $p < 0.01$ ) and brings out the total variance of 0.872.

While the accidents that did not cause a loss in workdays remained relatively constant, but those, which caused about 1 - 7 workdays loss decreased gradually, accidents causing 8-15 days maintained nearly the same level. However, reporting of the accidents resulting in 16 or more workdays showed a rise through the years (Table 3).

**DISCUSSION.** In many countries, as a result of increasingly growing numbers of employees working in the service sector, and technological progress towards measures taken for occupational accidents and spreading of successful occupational health practices, occupational accidents have been decreasing through the years. In the USA, the injury rate for all industries decreased from 11 injuries per 100 workers in 1975 to 8 injuries per 100 workers in 1995.<sup>12</sup> Injury rates may continue to decline because of a continuing expansion of the service sector relative to manufacturing.<sup>12</sup> During the same period in Turkey the morbidity rate of occupational accidents declined from 10 to 2 per 100 workers.<sup>2</sup> The mortality rate also showed a decrease. In the USA, between 1912 and 1990, accidental work deaths reduced from 21 to 4 per 100,000 workers.<sup>13</sup> In Turkey between 1946-1960 a total of 441,686 occupational accidents were reported, and of the 6567 were deaths.<sup>2</sup> Between the years 1961 and 2002 the mortality rate declined from 63 - 16 per 10,000 workers.<sup>2,4</sup> According to Social Insurance Institution records, the mortality and morbidity rates of occupational accidents in Turkey have been decreasing whereas the case-fatality rate has been increasing for the last 30 years. The variations in the 3 rates are statistically meaningful. The rate of fatality is the ratio of mortality to morbidity.

Therefore the increase in the fatality rate stems essentially from the difference in the other 2 rates. Morbidity rate, slope declining 300 times more than mortality rate. While the declining slope of morbidity is  $-0.003$ , the slope of mortality rate is  $-0.00001$ . As consequence, the slope of increase in fatality was  $0.00029$ . This variation can be explained as a decrease in proportion of workers having accidents and deaths of workers after accidents, but as an increase in fatal accidents. In the light of these data, the decline in morbidity, but not in mortality should be discussed. Improvement in technology, increase in the education level of employees, improvements in occupational health services and increase in workers in the service sector should be considered. Besides, a change in the recording policy of the workplaces for occupational accidents should also be taken into account. Possibly, some of the minor accidents have not been reported.

As the service sector is viewed as being a safer industry, the expansion of this service sector in Turkey over the years may explain the declining rate of occupational accidents. In Turkey, the number of workers employed in the service sector has been gradually growing. Nevertheless, a decline in the number of workers employed in the agricultural sector and an increase in the proportion of those employed in the industrial sector, which is considered as a high-risk occupation in respect of occupational accidents was observed. The proportion of workers employed in the service sector was 24.3% in 1970. This percentage showed

an increasing trend and reached to 40.1% in the year 2000.<sup>4</sup>

In countries, which are in the process of economic development, it is expected that the technology and preventive methods used in workplaces are becoming contemporary. This development will reflect on the occupational accident rates. However, this expectation should also reflect a decline in mortality and morbidity rates. Technological advances alone cannot explain the more gradual decline in the mortality rate over that of the morbidity rate.

Turkish law requires every occupational accident to be notified within 2 days. No change in the description and scope of occupational accidents necessitates a discussion on the factors, which can influence the variations in the rates of accidents. Reporting and recording fatal accidents and the growing deficiencies over years in reporting accidents that are not fatal can explain why the level of decline in the mortality rate is not the same as that for the morbidity rate. However, the reason for this variation may be the poor system of record keeping of non-fatal accidents or accidents that cause less loss in working days.

Legislation since 1930 require companies employing fifty or more workers to set up a work place health unit and to employ a physician. The certificate programs for training occupational physicians started in 1988 and thus, companies, which employ physicians have increased in number. As a consequence of organized workplace, health services referrals to hospitals for accidents have

|           | R     | R <sup>2</sup> | p<    | a      | p<    | b        | p<    | F      | df   | p<    |
|-----------|-------|----------------|-------|--------|-------|----------|-------|--------|------|-------|
| Morbidity | 0.995 | 0.990          | 0.001 | 6.970  | 0.001 | -0.00300 | 0.001 | 3234.2 | 1 31 | 0.001 |
| Mortality | 0.950 | 0.903          | 0.001 | 0.019  | 0.001 | -0.00001 | 0.001 | 287.5  | 1 31 | 0.001 |
| Fatality  | 0.934 | 0.868          | 0.001 | -0.563 | 0.001 | 0.00029  | 0.001 | 211.4  | 1 31 | 0.001 |

R - correlation, R<sup>2</sup> - square of correlation, a - constant of regression, b - slope of regression, F - statistics, df - degrees of freedom of regression model

Table 2 - Variations in change of occupational accident rates in Turkey after moving average smoothing (1970-2000).

| Year | Incapacity for work period (days) |       |       |       |       |       |      | Total |
|------|-----------------------------------|-------|-------|-------|-------|-------|------|-------|
|      | 0                                 | 1-3   | 4-7   | 8-15  | 16-30 | 31-90 | 91+  |       |
| 1970 | 3.44                              | 10.50 | 36.43 | 30.46 | 10.61 | 7.61  | 1.62 | 100   |
| 1975 | 3.53                              | 11.70 | 33.18 | 28.80 | 12.01 | 8.14  | 2.59 | 100   |
| 1980 | 4.27                              | 11.69 | 35.89 | 29.24 | 10.33 | 6.84  | 1.74 | 100   |
| 1985 | 4.47                              | 13.32 | 32.23 | 28.71 | 11.22 | 7.83  | 2.22 | 100   |
| 1990 | 5.45                              | 11.58 | 31.92 | 29.15 | 11.65 | 7.91  | 2.34 | 100   |
| 1995 | 9.29                              | 7.93  | 25.66 | 28.76 | 13.97 | 10.76 | 3.63 | 100   |
| 2000 | 4.53                              | 6.93  | 25.22 | 30.71 | 16.34 | 12.17 | 4.10 | 100   |

Table 3 - Percent distribution of incapacity for work resulting from occupational accidents in Turkey (1970-2000).<sup>4</sup>

decreased, and although reports and records of accidents were expected to increase, this has not been the case.

The insurance premiums for occupational accidents and diseases have been applied since 1946 to be paid totally by employers with percentages of 0.5 - 7, depending on the risk status of the workplace. This proportion was 1.5 - 7% as from 1970 without change.<sup>3</sup> When determining the amount of premium payable, the characteristics of the workplace along with the frequency of the occupational accidents are taken into consideration. The infrequent reporting of non-fatal accidents may be due to the insurance premium system. However, no change has taken place in premium payments for the last 30 years. Decrease in minor accident rates causing 1 - 7 workdays loss, supports the idea of under reporting of the minor accidents.

For a single fatal workplace accident, 7400 other non-fatal occupational injuries (3 days' or more absence from work, 1-3 days absence from work, first aid injury) are expected.<sup>14</sup> Based on this, 5,024,600 non-fatal accidents were expected for the years 1970 and 5,409,400 for the 2000, while the numbers reported were only 143,194 in 1970 and 75,578 in the year 2000.

In another study, in one of the highly industrialized provinces of Turkey, similar decreasing trend was also seen in the frequency and mortality of occupational accidents.<sup>15</sup> The decrease in rate for fatal accidents is much lower than the decline in the rate of all workplace accidents. This can be explained by a failure in recording minor accidents, whereas fatal accidents or accidents causing more than a fortnight work time loss are usually recorded. In this case, to state that occupational accidents are declining will not be correct, what is probable is a decline in the recording rate of minor accidents.

Every year 335,000 workers die in occupational accidents in the world and altogether 1.1 million fatalities are caused by work-related factors. Some 250 million nonfatal accidents causing absence from work are aggravated by permanent disabilities, reduced capacity of life and work, and economic losses amounting to 4% of gross national product.<sup>16</sup> An evaluation of the variation in occupational accident rates will be beneficial in planning the preventive programs to be maintained. In Turkey, the rate of occupational accidents, show a

considerable decrease over the years. This can partly be explained by an increase in the services sector relative to the manufacturing sector. But when the mortality and fatality rates are considered, this decreasing trend is not seen. The reasons for under reporting of minor accidents should be investigated and this point should be taken into consideration when planning occupational accident prevention programs.

## References

- Takala J. Global estimates of fatal occupational accidents. *Epidemiology* 1996; 10: 640-646.
- Bilir N, Yıldız A N. Türkiye'de iş sağlığı konusuna tarihsel bakış [In English: Historical aspect to occupational health in Turkey]. Ankara, Turkey: Hacettepe Public Health Foundation; 1998. p. 78-88.
- Fisek G, Özsuca ST, Sugle MA. Sosyal sigortalar kurumu tarihi [In English: History of social insurance institution]. Ankara, Turkey: Social Insurance Institution; 1998.
- Türkisch Social Insurance Institution statistics yearbooks. Ankara: Social Insurance Institution publications, 1970-2002.
- Montgomery DC, Johnson LA, Gardiner JS. Forecasting and time series analysis. 2nd ed. New York (NY): McGraw-Hill Inc; 1999.
- Pindyck RS, Rubinfeld DL. Econometric models and economic forecasts. 3rd ed. New York (NY): McGraw-Hill Inc; 1999.
- Wei WWS. Time series analysis, California (CA): Addison-Wesley Publishing Company Inc; 1996.
- Cryer JD. Time series analysis. Boston: PWS-KENT Publishing Company; 1986.
- Goodrich RL. Applied statistical forecasting. Belmont: Business Forecast Systems Inc; 1992.
- Çömlekçi N. İstatistik [In English: Statistics]. Eskişehir: Bilim ve Teknik Kitabevi publication; 1983.
- Köksal BA. İstatistik [In English: Statistics]. 3rd Ed. İstanbul: Çağlayan Kitabevi publication; 1986.
- LaDou J. The practice of occupational medicine. In: LaDou J, editor. Occupational Environmental Medicine. Prentice Hall, Upper Saddle River, New Jersey: A Simon and Schuster Company; 1997. p. 1-5.
- Dudley B. Trauma and emergencies in the workplace. In: Zenz C, editor. Occupational Medicine. Missouri: Mosby-Year Book Inc; 1994. p. 37-47.
- Takala J. Introductory Report of ILO, XVI World Congress on Occupational Safety and Health, Vienna 26-31 May 2002.
- Eitler N, Colak B, Bicer U, Barut N. Fatal occupational injuries among workers in Kocaeli, Turkey, 1990-1999. *Int J Occup Environ Health* 2004; 10: 55-62.
- Takala J. International agency efforts to protect workers and the environment. *Int J Occup Environ Health* 1999; 5: 30-37.