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Individual and workplace factors related to fatal occupational accidents among shipyard workers in Turkey

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ABSTRACT

Risks for occupational accidents are significantly associated by individual and workplace factors. This study has been designed in order to identify individual and workplace factors that increase the risk of an accident, and to provide evidence for the achievement of precautionary actions in workplace environment. Registered fatal occupational injuries between the years 2004 and 2014 were investigated. The case reports of shipyard occupational accidents of Ministry of Labour and Social Security of Turkey have been analyzed. Then, a workplace survey was conducted among workers and foremen at Turkish shipyards located in Istanbul region. Classification of fatal occupational accidents revealed five major reasons for the shipyard workers; falling from higher elevation to a lower level, exposed to electric shock, fire and/or explosion, being struck by or struck against objects and caught in between, and drowning. The ratio of the places of fatal occupational accidents at Turkish shipyards can be classified as occurring inside the ship (43.7%) and the shipyard (56.3%). The questionnaire contains four groups: personal data, workplace environment, personal factors and commuting factors. The total number of questions is 56. The results reveal that substandard low education level of shipyard workers, housekeeping at workshops, lunch effect, bad weather conditions, improper use of PPE, being tired and sleepy, overcapacity ship production, hectic work, overtime, being a subcontractor worker and strenuous work are main risk factors for workplace accidents.

1. Introduction

Shipbuilding is an extremely complex business, it includes jobs as diverse as naval architecture, ocean engineering, marine engineering, mechanical engineering and electrical engineering. The construction of a ship at a shipyard can be considered to start at the time when the ordered steels are received. The received steels must be blasted and primed first then stored for future usage. Next, each part starts the assembly process cut to shape, formed and welded to make assemblies, panel fabrication and block assembly. Blocks have varying sizes and shapes depending on the ship. Also, pre-outfitting, pipe routing, air conditioning, electrical cable fitting, surface preparation and coating jobs should be done. Besides, the time between order and delivery restricted and delays are highly penalized, putting pressure onto all partners of the industry. Usually, shipbuilding is considered as a dirty and dangerous job. The characteristics of the shipbuilding involve both the construction and the transportation equipment and machinery manufacturing sectors.

According to world ship completions in 2013, Turkey is the 10th place in world shipbuilding, completing 68 ships by 194,000 GT total (SAJ, 2014). The shipbuilding industry in Turkey is predominantly located in Tuzla/Istanbul region, and there are 1.21 million m^2 total amount of shipbuilding area accommodating 45 shipyards. The majority of ship yards are locally owned and privately held, and the leading shipyards exported approximately 60–100% of their shipbuilding output over the past decade. From small size to handy size chemical tankers, container ships, up to Panamax bulk carriers, general cargo ships, tugs, ocean supply vessels, mega yachts, fishing vessels and other types of ships are constructed at Turkish shipyards. Since 2009 the freight rates have stumbled for all major shipping segments. For this reason, the newbuilding deliveries reduced speed, thus some of the shipyards mainly focused on ship maintenance rather than newbuilding. Providing a safer environment at shipyards remains as an urgent and important issue to be addressed in recent years. Between the years 2004–2014, 126 workers died from occupational accidents. 77.8% of fatal accidents occurred in Tuzla/Istanbul, the major shipyard region of Turkey.

The shipyards subcontract certain parts of the work on nearly all of

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the projects. Thus, the workers on each shipyard come from different companies, worsen the work schedules, organization and integration problems, hence manipulate the safety negatively. Shipyard workers are exposed to a wide variety of hazards, in which construction is usually prioritized over safety during hectic and strenuous work in some shipyards. Shipyard occupational accidents are similar to those of construction industry generally with the modification created by the characteristic requirements to work in restrained places.

There are various articles in the literature regarding occupational accidents in shipyards (Baginsky, 1976; Ferris and Heimann, 1976; Petronio, 1984; Näsänen and Saari, 1987; Arcaleni et al., 1990; Moll Van Charante et al., 1991; Krstev et al., 2007; Ozkok, 2015; Tsoukalas and Fragiadakis, 2016). On the health and occupational accidents of shipyard workers Barlas (2012a) and Akyildiz and Barlas (2015) give a comprehensive background review.

A detailed investigation of causes and incidence rates of fatalities in Turkish shipyards and strategies recommended to minimize the occupational accidents are discussed in Barlas (2012a). It was found that, the highest number of cases of fatal accidents was found among welders, blasters, painters and substructure workers. Working on Mondays and Saturdays have special impact on the fatality probability. Also, the number of fatalities is highest at temperatures above average 25 °C, ranging from June through September. A comprehensive survey was conducted at Turkish shipyards appropriate for the Analytic Hierarchy Process (AHP) technique in order to determine the order of importance for precautions to be taken in Barlas (2012b) and Barlas (2011). The average shipyard fatality rate is 3.5 times higher than the average of all other industry groups in Turkey (Barlas and Celebi, 2014).

Between January 2004 and December 2014, 126 work-related fatal accidents, the incidence rates and their relation to occupational exposure among male workers employed at Turkish shipyards were analyzed. Furthermore, the case reports of shipyard occupational accidents of Ministry of Labour and Social Security between 2002 and 2012 have been investigated in detail. The highest number of accidents is found among welders, blasters, painters and substructure workers. Then, a workplace survey was carried out among the shipyard workers. The scope of this work is to investigate the individual and workplace factors related to fatal occupational accidents in Turkish shipbuilding industry in order to help to select and define priorities aimed to prevent from occupational injuries.

2. Materials and methods

In this study, first the data of fatality rates were investigated. The data of fatal occupational accidents in Turkish shipyards were collected from Port and Shipyard Workers Union of Turkey, and the details of the accidents were collected from case reports of Ministry of Labour and Social Security. The incidence rate is taken as the number of cases per population employed in shipyards per year. Additionally, the case reports of occupational accidents at shipyards of Ministry of Labour and Social Security have been investigated carefully. Number of employed workers, fatalities, and fatality rates in Turkish shipyards occurring between 2004 and 2014 is given in Table 1. The employment data reflect end-of-year numbers. During the high demand in shipbuilding market in 2008, the number of employment in Turkish shipyards hit an all time peak of 34,500 in May 2008 (Barlas, 2011). As a result, the fatalities increased to 29 in 2008, at the height of the shipbuilding boom, and then declined to 3 in 2011, which was during the depression in shipbuilding industry.

From 2004 through 2014 the fatality rates, total production and fatality rate per thousand Gross Tonnage in Turkish shipyards are shown in Table 2. The fatality rate was surged in 2008 to 107.8 value, which means a fatal accident occurred every 91,400 GT of ship was constructed. On the average a fatal accident occurred every 37,400 GT of ship was constructed between the years of 2004 and 2014. Lower-the-better fatality rate, higher-the-better fatality rate per thousand GT ship production. Although, all the precautions voluntarily or convincingly taken by the management of shipyards with the aid of regulations and law, except the years 2011 and 2014, the fatality rates per thousand GT ship production are above the average rate of 37.4. This much high rates noticeably show that, safety management system in shipyards could not acknowledge by all the parties, i.e. workers in particular. After the year 2012 the penalties against occupational accidents were stiffened by law. Though, stricter penalties visibly did not lead to a reduction in work-related accidents. Improvement of work safety as a culture is crucial to the prevention of accidents.

Consequently a shipyard questionnaire was carried out among the workers at shipyards. The use of a questionnaire provides assessment of responses and achieves quantitative measurements of a wide diversity of characteristics. Workers and foremen working at Turkish Shipyards located in Tuzla/Istanbul region were surveyed in detail between the years 2012 and 2014. There are 45 shipyards in that region. All of the 271 respondents were male and resided in Istanbul. During the visits at the shipyards, the question surveys distributed to group of workers during their lunch or tea breaks and then collected after a short while. Therefore the rate of return of the survey is almost hundred percent. The questionnaire is made up of four parts: personal data, workplace environment, personal factors and commuting factors. The total number of questions is 56. The questionnaire is given in the Appendix A. The data obtained from the questionnaire then processed by using Excel.

Table 1
Number of employed workers, fatalities, and fatality rates in Turkish shipyards occurring between 2004 and 2014.

Years	Number of employed	Number of fatalities	Fatality rate (1/100000)
2004	14,750	6	40.7
2005	24,200	13	53.7
2006	28,580	10	35.0
2007	33,000	12	36.4
2008	26,910	29	107.8
2009	19,179	15	78.2
2010	21,449	11	51.3
2011	20,516	3	14.6
2012	16,000	8	50.0
2013	17,000	15	88.2
2014	20,334	4	19.7
		Σ = 126	Avg = 52.3

Table 2
Completions at year-end at Turkish shipyards and fatal occupational accidents.

Years	Fatality rate	Completion (1000GT)	Fatality rate per 1000GT	Deaths per 1000GT
2004	40.7	130	3.2	21.7
2005	53.7	244	4.5	18.8
2006	35.0	320	9.1	32.0
2007	36.4	560	15.4	46.7
2008	107.8	710	6.6	24.5
2009	78.2	515	6.6	34.3
2010	51.3	364	7.1	33.1
2011	14.6	359	24.6	119.7
2012	50.0	190	3.8	23.8
2013	88.2	194	2.2	12.9
2014	19.7	174	8.8	43.5
	Avg = 52.3	Avg = 342	Avg = 8.4	Avg = 37.4