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Study of Biorhythms Effect on the Incidence of Lost Time Accidents and Their Severity: The Case of a Manufacturing Industry

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ABSTRACT

The main objective of the present research is to study the biorhythms effects on the occurrence of the accidents resulting in lost time injuries and on the accidents severity. To carry out the present research, the reports of the occupational accidents in an Iranian industry assembling power plants turbines were studied and the required data collected. The biorhythms critical days of personnel caused accidents were then determined. To study the biorhythms effects on the occurrence of the accidents resulting in lost time injuries and on the accidents severity, Analysis Of Variance and Independent t-Test were applied respectively. The results showed the biorhythm, regardless of its type, is a factor affecting the accidents lost days and their severity. It was also demonstrated that physical and intellectual biorhythms affect the accidents lost days while emotional biorhythm has no effect on it. Moreover, only intellectual biorhythm affects the accidents severity. The present study concluded that the biorhythms theory, as an information system, plays a vital role in accidents prediction and prevention, and thus helps to reduce the excessive costs imposed on industries and on the countries' economy.

Keywords **-** Accident, Biorhythms, Severity, Manufacturing Industry, Unsafe behaviors

I. INTRODUCTION

Despite the many precautions and measures taken to improve safety in today's industries, accidents still occur. Researches on occupational injuries confirm the negative impacts these events have on their victims, families, co-workers and the whole society [1,2].

Apart from the humanitarian aspect of reducing occupational deaths and injuries, a strong case can be made for reducing work related accidents on economic grounds alone, as they consume massive financial resources that the countries, especially developing countries, can ill afford to lose [3-7]. Each year, occupational accidents result in shocking costs. Leigh (2011) provided estimates of the national costs of occupational injury and illnesses among civilians in the United States for 2007
[7]. The total estimated costs were approximately $250 billion.

Considering the above facts as well as the increasing trends of occupational deaths and injuries in the world, it is essential for industries to focus on the underlying causes of occupational accidents occurrence so as to develop and maintain preventive mechanisms.

Basically, there are three main causes for accidents occurrence: unsafe conditions, unsafe behaviors, and unknown causes [8]. Every accident would usually be attributed to one or more of this causes [9]. So far, several researchers have confirmed that unsafe behaviors are the trigger cause of the majority of work related accidents [10, 11]. Therefore, identification and study of the factors causing personnel to behave unsafely will definitely help to prevent from and control unsafe acts in a work environment.

Various studies have thus far claimed that a person's biorhythms cycles are considered as one of the causes of unsafe behaviors and occupational accidents [12, 13].

The concept of the biorhythm is quite easy to grasp. From birth to death, every human is affected by three internal cycles as follows [13].
- The physical cycle lasts 23 days and influences a wide range of physical factors such as disease resistance, power, endurance, and the sensation of physical well-being.
- The emotional cycle is 28 days long and controls creativity, sensitivity, mental health, mood etc.
- The intellectual cycle, which happens over a 33-day period, affects such mental aspects as memory, alertness, receptivity to knowledge, and the analytical functions of the mind.

On the day of birth, each cycle commences at a neutral baseline or zero point and begins to go up in a positive phase in which the energies and abilities are high. The cycle gradually declines and crosses the zero point midway: 11 and 1/2 days from the starting point for the 23-day physical cycle, 14 days for the 28-day emotional cycle, and 16 and 1/2 days for the 33-day intellectual cycle. The second half of each cycle is in a negative phase, during which physical, emotional and intellectual capabilities are low or at least reduce to some extent. In this phase, however, energies are recharged. Increasing amounts of energies are picked up as the negative phase continues until, at the end of each cycle, the zero point is re-crossed through the next positive phase, and the whole process begins again [14].

As mentioned above, the biorhythms cycles affect humans' physical, emotional and intellectual capabilities, thus tending to influence their behaviors. Therefore, the main objective of the present research is to study the biorhythms effects on the occurrence of the accidents resulting in lost time days and on the injuries severity.

II. METHODS

To carry out the present research, the reports of the occupational accidents in an Iranian industry assembling power plants turbines were studied and the required data such as accidents date, lost times and personnel information collected. It is worth mentioning that the accidents resulting in lost times and had occurred from 2006 to 2011 (during 6 years) were subjected to the study. Moreover, the trigger cause of these accidents had been reported to be unsafe behaviors.

In the next step, physical, emotional and intellectual critical days of personnel caused accidents and became injured were determined based on their date of birth and trough using Biorhythms Calculator Software. The accidents date and the three above critical days for each employee were checked to find out if the accident date matched to any of the days. When the accidents date at least matched to one of the employee's biorhythms critical days, hereinafter called general biorhythm, the accident was considered to happen on his critical day.

Statistical tests were used to analyze the data. To study the biorhythms effects on the occurrence of the accidents resulting in lost time days and on the injuries severity, Analysis Of Variance (ANOVA) and Independent t-Test were applied respectively. The effects of employees' demographic information on the accidents severity were analyzed using Logistic Regression. To do so, the accidents were divided into two groups based on their severity: the first group included injuries with the lost times more than a day (24 hours) and those resulted in 24 hours or less lost times made the second group. The concept behind this is that according to the regulations of Iran's Ministry of Labor, the accidents with the lost times more than a day are required to be recorded and reported while reporting of the second group are not considered necessary.

III. RESULTS

The data collected was analyzed using statistical tests. To find out the effects of personnel's biorhythms on the occurrence of the accidents causing lost time days, Analysis Of Variance (ANOVA) test was applied. Tables 1 to 2 show the results of the test.

(Table 1)

Considering the corresponding *F*-statistic (14.18) and the relevant significant level ($p < 0.05$), the H_0 hypothesis mentioning that personnel's general biorhythm has no effect on the accidents lost days was rejected. In other words, the results confirm that the biorhythm, regardless of its type, is a factor affecting the occurrence of the accidents resulting in lost time days.

(Table 2)

Regarding the *F*-statistics and significant levels of Tables 2, 3 and 4, it is demonstrated that physical and intellectual biorhythms affect the accidents lost days ($p < 0.05$) while emotional biorhythm has no effect on it ($p > 0.05$).

The results of Independent t-Test used to study the effects of biorhythms on the accidents severity are represented in Tables 3 to 5.

(Table 3)

Considering the *t*-statistic (-3.15) and the relevant significant level ($p < 0.05$), the H_0 hypothesis was rejected. This implies that the mean of lost times for the personnel who were injured on their critical days is greater than those of the personnel whose accidents occurred on their non-critical days.

(Table 4)

(Table 5)

The *t*-statistics and relevant significant levels of Tables 6 and 7 demonstrate that physical biorhythm has no effect on the accidents severity ($p > 0.05$) while intellectual biorhythm affects the severity of the accidents ($p < 0.05$).

IV. DISCUSSION

The results of the present study confirm the effect of general biorhythm on the occurrence of the accidents causing lost times. This finding is similar to the results of Parikh et al. and Singh and Sharma claiming that most of the accidents occurred on critical days[12, 13],

Moreover, it was found that general biorhythm affects the severity of the accidents. It is, therefore, inferred that personnel on their critical

days are very prone to be involved in more severe accidents.

Another finding demonstrates that physical and intellectual biorhythms affect the accidents lost days while emotional biorhythm has no effect on it. The research of Singh and Sharma also proved the effects of physical and intellectual critical days on the occurrence of the accidents resulting in lost times[13]. Although in the present study, the effect of emotional biorhythm was rejected, Singh and Sharma confirmed this effect[13]. Perhaps the reasons of this difference are associated with the cultural and racial distinctions as well as religious beliefs of Indians and Iranians.

Also, the results show that intellectual biorhythm affects the severity of the accidents while physical biorhythm has no effect on it. The reason behind this can be related to the nature of the jobs which require more mental power than physical power. In other words, since assembling of turbines is repetitive and needs more concentration, it is not considered as a heavy physical work.

The study supports that employees' age, educational level, type of job, type of employment and marital status affect the occurrence probability of more severe accidents. This means that when an employee's age and educational level increase, the occurrence probability of the accidents resulting in more than 24 hours lost time decreases. This is because younger personnel have generally received less safety training and had fewer opportunities to acquire the relevant skills. Apparently, low literacy and less-educated personnel are not as knowledgeable as well-educated ones. These results are similar to the findings of Mohammad Fam et al. and Nouri et al [14, 15].

Moreover, the occurrence probability of more severe accidents decreases when the type of job changes from operators to supervisors. The nature of the tasks, their hazards and the exposure level to the hazards which significantly varies among the four mentioned jobs might be the main reason [14, 16].

The results prove that when the type of employment changes from permanent staff to daily-paid personnel, the occurrence probability of more severe accidents decreases. On the contrary, the findings of Fabiano et al. confirmed that the accident frequency index and accidents severity for temporary workers are significantly more than those of other employees [17]. Villanueva and Garcia also claimed that temporary workers have higher risks of fatal results of occupational accidents [18]. However, in the mentioned industry, daily-paid personnel receive safety training before the commencement of their work whereas the intervals between pre-employment and periodic trainings for permanent staff are considerable, leading to their less attention and carefulness towards safety issues. The study of Mohammad Fam et al. confirmed the positive effect of safety training on the control and prevention of unsafe behaviors and accidents [19]. Additionally, temporary employees, who are under more supervision, are usually more worried about being dismissed for their errors and unsafe acts. Moreover, since they do not have insurance against occupational accidents, they cannot claim for it if injured. As a result of their concerns with the job security and insurance cover, they might work rather safely and cautiously.

As a final point, the occurrence probability of more severe accidents in married employees is higher than that of single personnel. It seems that personal life concerns and higher living costs of married employees in addition to the lack of social security supports in Iran have involved these personnel in more severe accidents [20].

V. CONCLUSION

The results obtained confirmed that biorhythms critical days affect the occurrence of the accidents resulting in lost time injuries and the accidents severity. Therefore, the present study suggests that the biorhythms theory, as an information system, plays a vital role in accidents prediction and prevention, and thus helps to reduce the excessive costs imposed on industries and on the countries' economy on a large scale.

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An acknowledgement section may be presented after the conclusion, if desired.

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Table 1. Results of the effect of general biorhythm on the accidents lost days

Lost Time accidents / General Bio.	Sum of Squares	df	Mean Square	F	P-value
Between Groups	12015.058	1	12015.058	14.175	0.000
Within Groups	588247.975	694	847.62		
Total	600263.033	695			

Table 2. Results of the effect of physical, Intellectual and emotional biorhythm on the accidents lost days

Lost Time accidents / Biorhythm Type	Sum of Squares	df	Mean Square	F	P-value
(Physical Bio.)	4624.638	1	4624.638	5.388	0.021
Between Groups	595638.395	694	858.269		
Within Groups	600263.033	695			
Total					

(Intellectual Bio.) Between Groups Within Groups Total	7142.055 593120.978 600263.033	1 694 695	7142.055 854.641	8.357	0.004
(Emotional Bio.) Between Groups Within Groups Total	44.852 600218.181 600263.033	1 694 695	44.852 864.868	0.052	0.82

Table 3. Results of the effect of general biorhythm on the accidents severity

Lost Time accidents General Biorhythm	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	P-value	t	df	P-value (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed [a] Equal variances not assumed	46.734	0.000	-3.765 -3.151	694 291.66	0.000 0.002	-8.454 -8.454	2.245 2.683	-12.863 -13.735	-4.045 -3.173

[a] The corresponding *F*-statistic (46.73) shows the homoscedasticity hypothesis was rejected. So the test statistic was carried out considering the hetroscedasticity.

Table 4. Results of the effect of physical biorhythm on the accidents severity

Lost Time accidents Physical Biorhythm	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	P-value	t	df	P-value (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed [a] Equal variances not assumed	18.245	0.000	-2.321 -1.29	694 94.57	0.021 0.2	-7.646 -7.646	3.294 5.929	-14.114 -19.417	-1.1789 4.124

[a] The corresponding *F*-statistic (18.25) shows the homoscedasticity hypothesis was rejected. So the test statistic was carried out considering the hetroscedasticity.

Table 5. Results of the effect of intellectual biorhythm on the accidents severity

Lost Time accidents Intellectual Biorhythm	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	P-value	t	df	P-value (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed [a] Equal variances not assumed	27.347	0.000	-2.891 -2.115	694 179.55	0.004 0.036	-7.717 -7.717	2.67 3.649	-12.958 -14.918	-2.476 -0.517

[a] The corresponding *F*-statistic (27.35) shows the homoscedasticity hypothesis was rejected. So the test statistic was carried out considering the hetroscedasticity.