"THE EFFECT OF NOISE AND TEMPERATURE THROUGH THE HEART RATE MEASUREMENT AND ITS INFLUENCE ON PRODUCTIVITY, ERGONOMIC EXPERIMENTAL STUDY IN CABINS"

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ABSTRACT

The economically active population in Mexico is 44,651,832 of which 16,847,300 are women (INEGI, quarter April / June 2010) combined with daily tasks that have to do at home, women represent an important segment worthy of consideration as they National level are 2,469,636 women employed in manufacturing and is a quantity that tends to rise for the physiological qualities of women suitable for this industry.(BARRIENTOS,2004)

On the other hand environmental illness within the term designates a group of no communicable diseases, which excludes the processes derived from personal habits like smoking, drug use or abuse alcohol or drugs such as, calls diseases, among which are the so-called occupational diseases, work related, workplace accidents and other injuries[10]. Fatigue is one of those, which can produce objective manifestations, physiological, subjective and sensory disorders. (GONZALEZ, 1996).

That is why it is intended by the study in women aged between 18 and 35, as this is the productive age group more attractive to the manufacturing sector contractors, an investigation that allows us to learn more about the most favorable conditions for labor may well contribute to a reduction of fatigue in terms of environmental conditions referred to.

KEYWORDS: Fatigue, Herat rate, Environmental Conditions.

RESUMEN

La población económicamente activa en México es de 44,651,832 de los cuales 16,847,300 son mujeres (INEGI, trimestre abril/junio 2010) aunándose a esto las labores cotidianas que tienen que realizar en el hogar, la mujer representa un importante rubro digno de estudiarse ya que a nivel Nacional son 2,469,636 las mujeres que laboran en la industria manufacturera y es una cantidad que tiende a

la alza por las cualidades fisiológicas de la mujer apta para este ramo (BARRIENTOS 2004).

Por otro lado dentro del término enfermedad ambiental se designa un grupo de enfermedades no transmisibles, que excluyen los procesos derivados de hábitos personales como el fumar, el uso o abuso de fármacos o drogas como el alcohol, las llamadas enfermedades laborales, entre las que se encuentran las denominadas enfermedades profesionales, las relacionadas con el trabajo, los accidentes de trabajo y otros daños. La fatiga es una de estas, la cual se puede producir manifestaciones objetivas, fisiológicas, subjetivas y trastornos sensoriales (GONZALEZ, 1996).

Es por ello que se pretende mediante el estudio en mujeres de entre los 18 y 35 años, por ser esta la edad productiva más atractiva para los contratistas del ramo manufacturero, realizar una investigación que nos permita saber más acerca de las condiciones más favorables para laborar pudiendo así contribuir a una reducción de la fatiga en cuanto a las condiciones medioambientales se refiere

PALABRAS CLAVE: Fatiga, Ritmo Cardiaco, Condiciones Ambientales

1. INTRODUCTION

This research project was carried out in experimental cabins, which enable us to vary the conditions simulating a workplace as is the case of an assembly plant and the fact that the female population of more production jobs required by their characteristics natural (dedicated, methodical, more strength, to name a few) has decided to study both affect working conditions such as noise, temperature and lighting when you are performing a physical activity that usually hurt in a real job. According to the Sinaloa state government weather conditions for 8 months of the year the average temperature are ranging between 23 ° C and 4 months remaining ranges from 29 ° C on average. The average annual temperature is 25 ° C, reaching a record up to 45 º C in some months. Because this has been taken as an object of study for women of working age from 18 to 35 years, under changing conditions of temperature and noise during the work period of 6 hours or more variable heart rate response as an association with fatigue.

2. OBJECTIVES

GENERAL PURPOSE

Analyze how environmental effects (noise and temperature) generated by the various factors in cardiac rhythm disorders to be performing a work activity taking into account the age of the operator.

SPECIFIC OBJECTIVE

Monitor noise levels, temperature and age of different parameters within a controlled environment in the experimental field in order to analyze the rapid heartbeat caused by these factors, and thus determine the most appropriate level to reduce fatigue.

3. JUSTIFICATION

The human factor is one of the most important within an industry, so the good performance of them is vital if the work is carried out in the best possible way, and thus the product or service has the expected quality by the customer and be competitive in this globalized world (HOLVELL,1988).

To do this research we focus on the first line of ergonomic, one of the topics of our interest, since it provides a better quality of life for people. From this point so important that it is the human being, we have decided to conduct our research in this very factor, specifically focusing on women 18 to 35 years. We chose women because they are the least studied today.

Analyze factors such as noise, temperature, body mass and age, which cause a change in heart rate and hence fatigue.

In order to understand how these factors influence the fatigue of operators, which prevents him from carrying out their work efficiently, resulting in monotony (Fiala, 2001)

3.1 FATIGUE

Masud and Fernandez (1990), identified fatigue as a general feeling of exhaustion and that under these conditions the subject and has no desire to further develop the mental or physical effort required by the activity.

Fatigue is a state of mind which accuses the body's physiological changes, or psychological tiredness as a result of which the decrease in work performance is present (Nielsen, 2003)

3.2 FATIGUE THROUGH THE HEART RATE.

CALCULATION OF MAXIMUM HEART RATE.

Your maximum heart rate (MHR) in the maximum frequency that can reach this level corresponds to the maximum aerobic effort, based on your fitness and physiology.

The heart rate may vary depending on the number of muscle groups used, for example in a test cycling, you will reach a peak heart rate significantly lower than in the test Waterrower because more muscle groups are used.

3.3 FACTORS OF EXPERIMENT

3.3.1 NOISE

Not all sound is noise, noise is sound that does not like people, can be annoying and hinder the ability to work to create tension and disrupt concentration, cause accidents by hindering communication and alarm signals, cause problems chronic health and also cause you to lose your hearing.

3.3.2 TEMPERATURE

It is important to take into account the temperature factor as it is basically a quantity referring to the common notions of hot or cold. Generally, an object's "hottest" have a higher temperature, and if it is cold will have a lower temperature. Physically it is a scalar quantity related to the internal energy of a thermodynamic system.

Because the human body is warm-blooded, can maintain an internal temperature more or less constant, even when exposed to varying environmental temperatures. To maintain the internal temperature within safe limits, the body has to eliminate the excessive heat. To remove heat, the body changes the pace and amount of blood flow to the skin. Also changes the amount of liquid off the sweat glands in the skin (Givoni, 1973).

HEALTH PROBLEMS

Excessive exposure to very hot work environment can cause a variety of conditions from the heat.

Heat stroke is the most serious problem for the health of everyone associated with work in hot environments. Heat stroke occurs when the system that controls body temperature and perspiration failure becomes inadequate. Perspiration is the only effective way that has the body to remove excess heat. The transpiration process can be put in jeopardy without the victim realizes having reached a state of crisis (DENMAN,1998)

HEAT EXHAUSTION

Heat exhaustion includes several clinical conditions that may resemble the early symptoms of heatstroke. Heat exhaustion results from loss of large amounts of fluid by sweating, sometimes with excessive loss of salt. A worker suffering from heat exhaustion still sweats, but feels a weakness or extreme fatigue, also dizziness, nausea, or headache. In more severe cases, the victim may vomit or lose consciousness.

3.3.3 AGE

The basal (minimum) high at birth we have, since then descend with age. On the maximum frequency over the pre-pubertal adolescents and those less than adults. The highest maximum frequency is reached between 8 and 10 years. Some studies claim that the major difference between the baseline and the maximum is reached after puberty and this difference diminishes with age.

4. MATERIALS AND METHODS

The development project was carried out experimentally in the cabins of industrial engineering laboratory where experiments were done working with duration of 6 hours each, applied to women 18 to 35 years of age.

The activity was conducted in the flashlight assembly, where he was monitoring the work area, taking into account the factors identified above, such as noise, temperature, age and body mass in order to demonstrate whether there fatigue or operators to perform a certain task, it was necessary to capture data on the behavior of heart rate in people who were tested by a pair of brand watches POLAR FT60, which store data on heart rate variability, primarily when the person is at rest, to determine your normal pulse, and during the day of the experiment. In the end, the clock we would produce the average and maximum frequency.

To determine body mass index, took the weight of people in kilograms and height in inches, using an electronic scale and a caliper. Noise controls it with a sonometer, temperature sensor using a Cube Science and was manipulated with a mini-split that is included in the cabin.

We obtained the pulse of the person with different factors, as was the temperature, noise, body mass worker and the worker still standing.
Heart rate was measured by worker watches, which we show results of how well your heart rate during the working day.

Total runs for the experiments in this case use the Taguchi methodology to determine the appropriate number of samples, resulting in a total of 27 runs at different levels. (See Table 1).

For each run made it took the weight and height of the person to determine your BMI, you told the person what would the experiment and was given a short training task to perform. After that he placed the watch and transmitter to take your resting heart rate which is sitting a period of 3 minutes, after which he was

transferred to the assigned booth, which previously that under the conditions and levels specified.

During the period of 6 hours continuously monitor noise levels and temperature, to ensure that these remain within the range.

At the end of the experiment data are recorded in the session, and he questions the person about how you feel, this part was subjected to a series of questions to record the parts of the body where the person feels tired or sore.

Matrix experiment

Controllable Factors	**Levels**		
	1	2	3
Temperature	20 ℃	25 ℃	30 ℃
Noise	>80 dB	> 70 dB < 80	> 60 dB < 70

Noise Factors	**Levels**		
	1	2	3
Ege	18 a 23 años	24 a 29 años	30 a 35 años

The subject remained standing during the experiment.
Table 1. Taguchi design matrix

Controlling		Noise factors					
		EGE	1	2	3		
	Temperature	Noise				Y_{ij}	
1	1	1					
2	1	2					
3	1	3					
4	2	1					
5	2	2					
6	2	3					
7	3	1					
8	3	2					
9	3	3					

He carried out the experiment in random order provided by the Minitab statistical package. Taking as a response variable Yij production in the assembly of flashlights, and the frequency of heart rhythm.

5. RESULTS

The results of each of the treatments are presented in the following table (see table 2) showing the number of flashlights assembled in a day of 6 hours, and the frequency of heart rate and average during the day.

Table 2. "Readings of treatments for Taguchi analysis"

TEMPERATURE	NOISE	PRODUCTION	F.R.C	AVERAGE
1	1	970	135	107

1	1	710	126	97
1	1	720	123	93
1	2	854	103	80
1	2	887	215	99
1	2	680	135	108
1	3	1166	126	86
1	3	790	103	91
1	3	710	109	99
2	1	1115	228	107
2	1	662	103	90
2	1	840	123	115
2	2	875	127	90
2	2	752	226	127
2	2	730	133	115
2	3	645	130	108
2	3	825	119	101
2	3	812	124	110
3	1	535	193	197
3	1	986	140	99
3	1	810	104	93
3	2	1060	153	104
3	2	729	111	84
3	2	859	95	91
3	3	445	122	85
3	3	852	130	95
3	3	630	135	101

Once data were processed using the Minitab statistical software.

5.1 RESULTS RESPONSE VARIABLE IN THE PRODUCTION

Table 3. Response signal to noise ratios.
"Bigger is better".

Level	TEMPERATURE	NOISE
1	58.06	57.66
2	57.84	58.13
3	56.94	57.04
Delta	1.12	1.09
Sort	1	2

Average response table

Level	TEMPERATURE	NOISE
1	831.9	816.4
2	806.2	825.1
3	767.3	763.9
Delta	64.6	61.2
Sort	1	2

Table 4. Graph in terms of production waste.

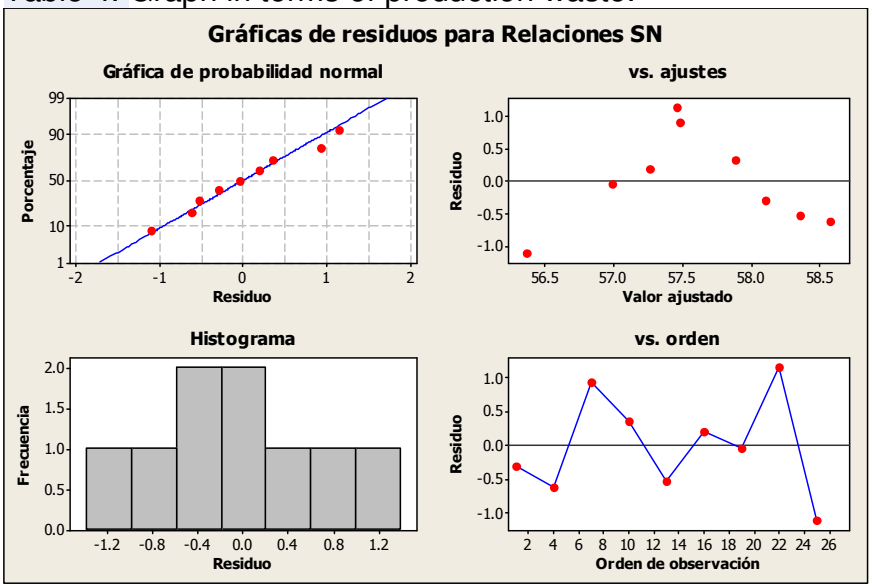


Table 5. Graph of means for main effects of production.

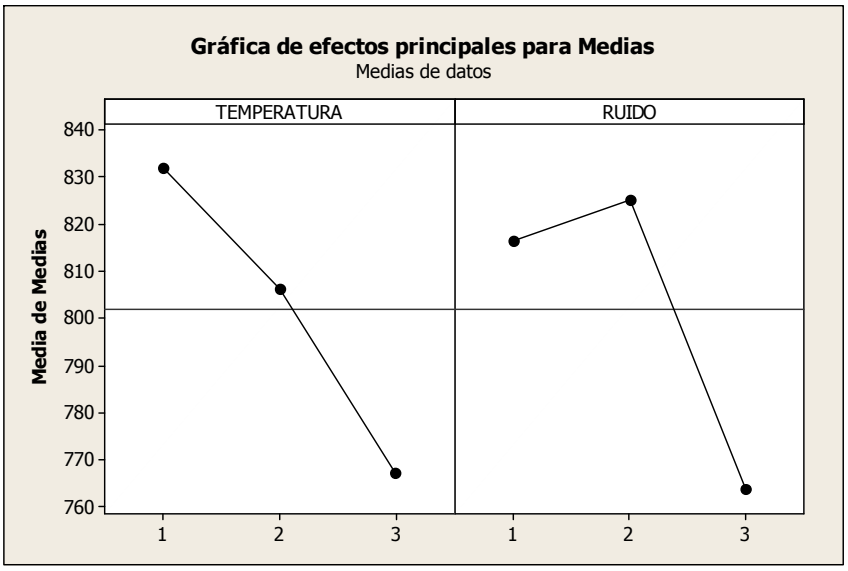
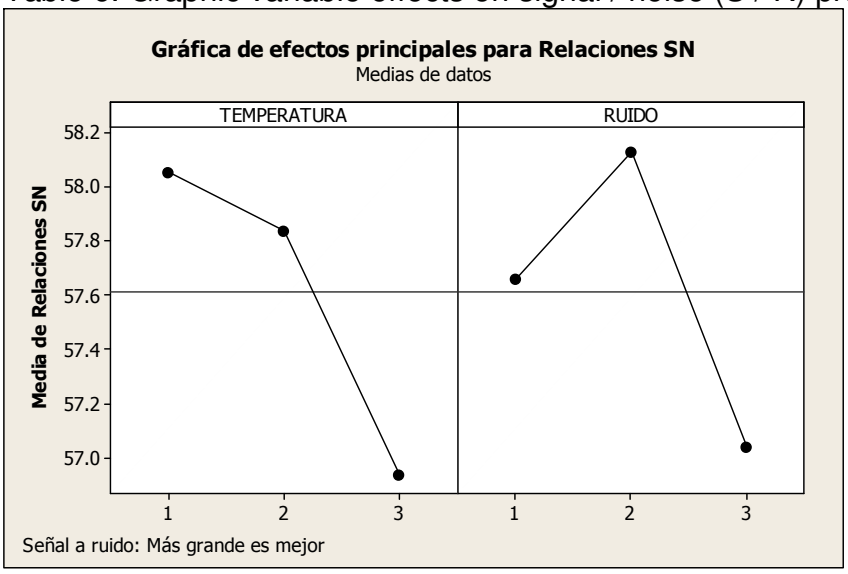


Table 6. Graphic variable effects on signal / noise (S / R) production



As can be seen from the graph of the main effects (Table 4-6) and taking into account the analysis of data "more is better" in this case we are considering a level 1 for temperature and noise level 2.

5.2 Results in terms of heart rate frequency (FRC)

Table 7. residual plots in terms of heart rate

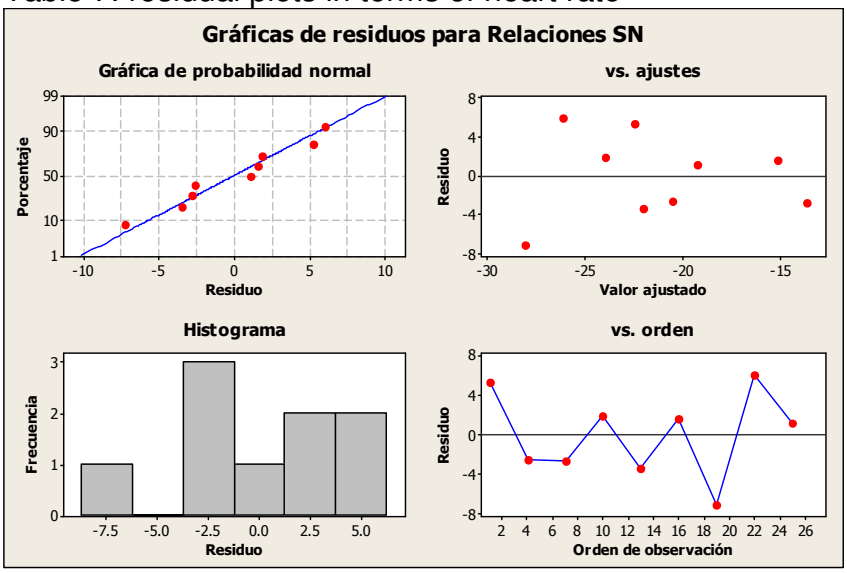


Table 8. Main effects on the heart rate.

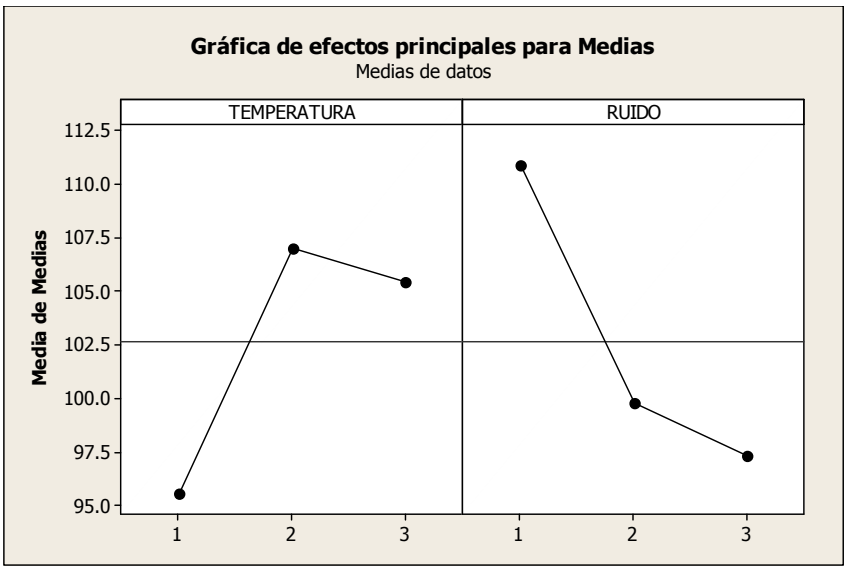
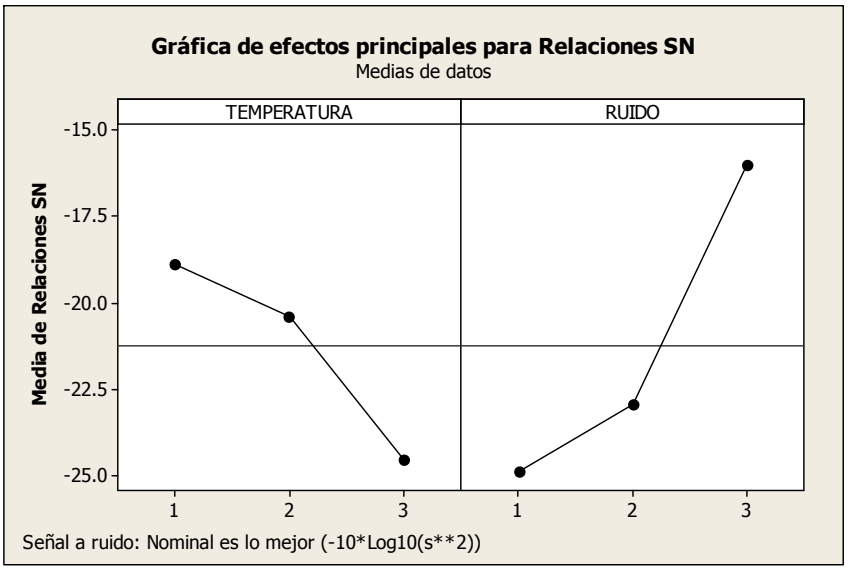


Table 9. Graphic variable effects on signal / noise (S / R) of FRC



As can be seen from the graph of the main effects (Table 7.8 and 9) and taking into account the "nominal is best" in this case would be considered nominal ranges of 70 to 90, average heart rate for graphic mean (Table 8) and plot of S / R (Table 9) is rated the best (closest to zero) we have a level 1 for temperature and noise level 3.

6. CONCLUSIONS

Based on the analysis of data obtained through Taguchi methodology, I conclude that the factors discussed above affect both production and heart rate of the women tested in the experimental field. These factors vary for each. Based on the results obtained that the most appropriate combination for greater production is labor at an average temperature of 20℃, with a noise> 70 dB <80.
If the company is interested in the quality of life of workers and this is not seen as a tool and take care of the health status of workers in terms of heart rate, making sure that the ranks of 70-90 to be considered a person working in good health, then levels of temperature should be 20℃ on average, and the noise should be an average of> 60 db <70db.

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