



Evaluation of Burnout Syndrome, Anxiety, Stress and Nutritious Food in Industrial Operations Workers in the Electronics Industry of Tijuana, México

Luis Andrés Mondragón Chavero¹, Hugo Lee Martínez², Denise Lee Garibi², María Elena Garibi Chapula², ENF ECI Ángel Antonio Colorado Rodríguez³, Carlos Raúl Navarro González⁴, Rosa María Duque Sevilla⁵, María del Carmen Corral Nuñez⁶, Gustavo López Badilla^{6,7}, Lorena Jazmín Rodríguez Martínez⁷, Rocío Selene Rodríguez Galindo⁷, Ana Karen Villaseñor Alemán⁷, Marina Mayela Rosales Cerda⁷, Osiris Muro Arcadia⁷

¹Departamento de Ingeniería Industrial, CETYS Universidad, Tijuana, Baja California, México.

²Departamento Ergonomía Aplicada, Ergomedical de México, Astrónomos 13802, INDECO Universidad, Tijuana, Baja California, México.

³Profesor de Campo Clínico en UABC–Universidad Autónoma de Baja California, Valle de las Palmas, Tijuana, Baja California, México.

⁴Departamento de Ingeniería Industrial, Universidad Autónoma de Baja California, Mexicali, Baja California, México.

⁵Departamento de Ingeniería Industrial, Tecnológico Nacional de México, Instituto Tecnológico de Tijuana, Tijuana, Baja California, México.

⁶Departamento de Ciencias Aplicadas, Instituto Internacional para el Desarrollo Empresarial (INIDE), Tijuana, Baja California, México.

⁷Departamento de Ciencias, Secundaria Federal Emiliano Zapata No. 32, Valle Las Palmas, Campus Tijuana, Baja California, México.

Abstract – The presence of the Burnout Syndrome (BS) in the manufacturing of industrial companies, is very evaluated by specialists of physiological thematic, with specialized strategies to improve the operative yielding of workers of the industrial processes. This scientific study is part of an analysis of the presence of a great exhaustion of workers in manufacturing areas, where the personnel of these important areas of any industry worldwide, will make great efforts, creativity, and imagination to achieve the goals that are proposed in each daily, weekly, monthly, seasonal, or annual period. This considers that the investigation made in the industrial company that permitted the scientific study in an electronics industry of the Tijuana city, determines the main objective of analyzing the main factors of the generation of the great exhaustion of workers in industrial processes. To achieve an improvement in the activities of the manufacturing areas in the activities of the operational staff, some actions were developed: (1) made of active breaks of 10 minutes for every four hours in a period of 12 hours of each workday, (2) development of support systems to reduce the workload and (3) constant medical check-ups of the workers in these relevant areas of the evaluated company. With this, it was possible to reduce the level of exhaustion, stress and generation of health symptoms, mainly in back, neck, head, waist, arms, shoulders and hands pain, obtaining a 40% increase in the operational level of the workers in the industrial processes of this evaluated industry. Based on the above, increases were generated in the productivity and quality indexes and with it the economic gains.

Keywords: Burnout Syndrome, Exhaustion, Anxiety, stress, Electronics industry, Manufacturing areas.

1. INTRODUCTION

The bad nutrition of some industrial workers, as the labor stress, combined with the anxiety in industrial operations of personnel of manufacturing areas, are relevant factors in the operative yielding, and with this, in the evaluation of the productivity and quality indices, which can determine the economic gains or losses (Devlin, 2018). This can generate the Burnout Syndrome, which some specialists of labor medicine and industrial ergonomics, mention that this relevant syndrome can originate low operative yielding of workers of manufacturing areas, for some interesting aspects as bad nutrition, labor stress and anxiety, causing in sometimes disinterest in the development of industrial process activities. Figure 1 illustrates the three important factors mentioned above that can originate from the low operative yielding of workers of the manufacturing areas (Mumovic et al, 2019).

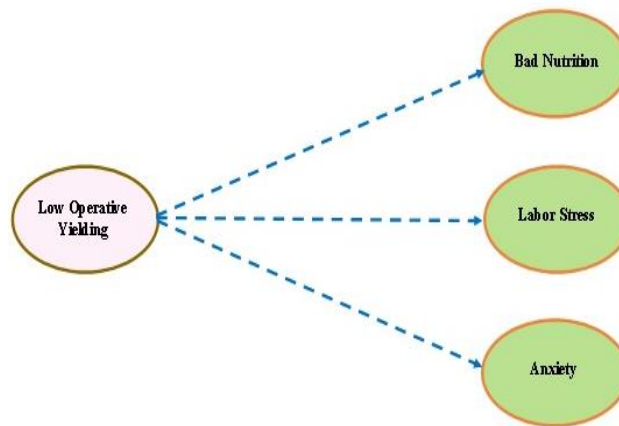


Fig -1: Relevant aspects in the low operation yielding of workers evaluated (2023)

Source: Analysis of the investigation

For this reason, an investigation was made to evaluate the main causes of the labor stress and anxiety, and the bad nutrition, which are presented in the majority of periods of labor activities in the manufacturing areas and in the majority of workers that are make its functions in industrial processes (Belmonte et al, 2021).

1.1 Electronics Industry in Tijuana

In this type of industry located in the Tijuana city, and where was made this scientific study, are fabricated some electronics products as is observed in figure 2, with different flow production process (AIMT, 2023; G. López-Badilla et al, 2012).



Fig -2: Main electronic products manufactured in the electronic industry evaluated (2023)

Source: Analysis of the investigation

Figure 2 shows the main electronic products fabricated in the electronics industry where was made this investigation, which are utilized in a lot places of the world and that were need different flow production processes (G. López et al, 2007).

1.2 Manufacturing Operations

In this investigation was used four type of flow production processes, to manufactures the diverse type of electronics industry mentioned in the last section, and is observed in figure 3 (Arenas-Ortiz et al, 2022).

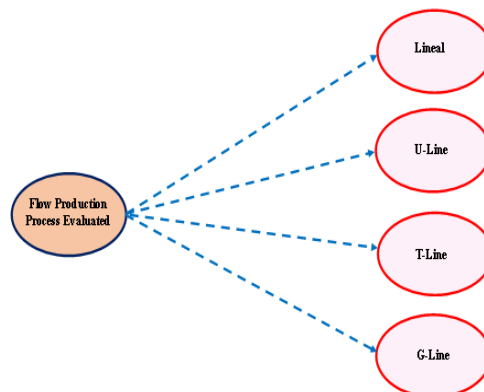


Fig -3: Principal flow production process utilized in the electronic industry evaluated (2023)

Source: Analysis of the investigation

Figure 3 illustrates the four types of flow processes that were used to fabricate the electronics products in the industrial company evaluated, and which are utilized specialized personnel in the manufacturing processes (Robson et al, 2020).

1.3 Industrial Exhaustion, Stress, and Anxiety

In industrial operations can originate three healthy symptoms, as is illustrated in figure 4, which are exhaustion, labor stress and anxiety that can generates bad behavior of industrial workers, eat without measure (could causes obesity and diabetes) and anxiety (could causes obesity, diabetes and not emotional control). These three healthy symptoms are necessary check every time because can cause health problems in industrial workers and low operative yielding and with this low production and quality levels, causing economical losses in the electronics industry, where was made this scientific study or in any type of industries (Sierra et al, 2020; Mattia et al, 2016).

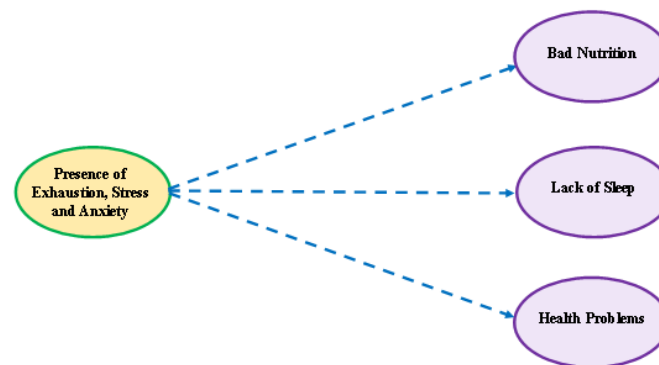


Fig -4: Main aspects that caused the three healthy symptoms in the electronic industry evaluated (2023)

Source: Analysis of the investigation

Figure 4 shows the three principal causes of the presence of exhaustion, labor stress and anxiety in workers of the manufacturing processes, where was evaluated by specialized personnel to reduce or avoid these symptoms in workers of industrial processes and increase its operative yielding and with this the productivity and quality indices. One of improvements applied in this scientific study was the active breaks in the industrial processes (Ahmed et al, 2020).

2. METHODOLOGY

In this scientific study was made an evaluation of the causes of the generation of healthy symptoms, which were have a negative effect in the operative yielding of personnel of the manufacturing areas of the electronics industry evaluated and, in the productivity, and quality levels. In the next activities are observed the forms that was made this investigation:

- a) Analysis of the operative yielding of workers of the manufacturing areas.
- b) Evaluation of healthy symptoms of workers of the industrial processes.
- c) Correlation of ergonomics strategies with productivity and quality indices.

3. RESULTS

This scientific study was relevant because can obtained interesting information to avoid or decrease the healthy symptoms, which appeared in industrial workers of manufacturing areas that were affecting the operative yielding of workers and the productivity and quality levels. For this reason, was applied

specialized ergonomics strategies to maintain good health of workers of industrial processes and increase this operative yielding and the productivity and quality indices, which are illustrated in the next sections.

3.1 Analysis of Operative Yielding of Workers

An evaluation of the operative yielding of workers of the manufacturing areas of the electronics industry evaluated, was made to identify the possible causes and the specialized strategies applied to improve this operative yielding, being illustrated in table 1.

Table -1: Operative yielding of workers evaluated (2023)

Main Aspects Workers	Operative Yielding, %		Causes	Strategies to Improve
	BAAB	AAAB		
1	56	78	Exhaust, Labor Stress	Apply Active Breaks, Check Health Nutrition of Workers Frequently
2	58	80	Exhaust, Anxiety	Apply Active Breaks, Check Health Nutrition of Workers Frequently
3	55	81	Labor Stress, Anxiety	Apply Active Breaks, Check Health Nutrition of Workers Frequently
4	53	79	Exhaust, Anxiety	Apply Active Breaks, Check Health Nutrition of Workers Frequently
5	58	77	Exhaust, Labor Stress	Apply Active Breaks, Check Health Nutrition of Workers Frequently
6	64	79	Exhaust, Labor Stress	Apply Active Breaks, Check Health Nutrition of Workers Frequently
7	67	80	Labor Stress, Anxiety	Apply Active Breaks, Check Health Nutrition of Workers Frequently
8	68	82	Exhaust, Labor Stress	Apply Active Breaks, Check Health Nutrition of Workers Frequently
9	65	81	Exhaust, Anxiety	Apply Active Breaks, Check Health Nutrition of Workers Frequently
10	66	80	Exhaust, Labor Stress	Apply Active Breaks, Check Health Nutrition of Workers Frequently

BAAB. Before apply Active Breaks; AAAB. After apply Active Breaks

Table 1 presents the main characteristics of the correlation analysis of the operative yielding of ten workers evaluated (all men), related with the causes and strategies applied to improve the operative yielding of workers, observing that when not was applied the active breaks, the operative yielding of workers were low and when were applied the active breaks, the operative yielding of workers increased, obtaining good productive and quality indices, and improve the economical gains of this industrial company evaluated.

3.2 Evaluation of Healthy Symptoms of Workers

An analysis was elaborated to detect any type of mental health of workers of the industrial process that were affecting in this operative yielding and causing low productivity and quality indices. This is presented in table 2.

Table -2: Analysis of healthy symptoms of workers evaluated (2023)

Principal Factors Workers	Exhausting, %		Labor Stress, %		Anxiety, %	
	BAAB	AAAB	BAAB	AAAB	BAAB	AAAB
1	93	58	88	67	88	55
2	90	60	89	66	92	58
3	95	62	90	64	90	54
4	93	63	88	66	91	60
5	90	58	86	58	90	58
6	91	59	87	60	93	59
7	89	60	90	63	89	57
8	88	62	89	58	90	60
9	90	59	90	56	90	59
10	93	58	88	60	89	60

BAAB. Before apply Active Breaks; AAAB. After apply Active Breaks

Table 2 indicates that when were applied the active breaks were decreased the health symptoms in workers of the manufacturing processes, where was observed in this analysis that the health symptoms decreased around a 40% in each worker, and with this its operative yielding was increased, and was working with more enthusiasm.

3.3 Correlation Analysis of Ergonomics Strategies With Productivity and Quality Levels

In this section a correlation analysis of the ergonomics specialized strategies applied were related with the operative yielding of the workers evaluated and with the productivity and quality levels that are presented in table 3.

Table -3: Evaluation of operative yielding, productivity and quality levels with ergonomics strategies (2023)

Relevant Factors Workers	Operative Yielding, %		Productivity, %		Quality, %	
	BAAB	AAAB	BAAB	AAAB	BAAB	AAAB
1	55	84	57	80	56	80
2	48	83	53	84	57	82
3	50	80	52	88	55	80
4	52	85	55	85	54	83

5	57	86	50	82	57	81
6	56	83	56	83	55	84
7	50	88	53	84	53	86
8	54	84	51	81	50	87
9	55	83	54	82	53	85
10	58	84	55	80	52	84

BAAB. Before apply Active Breaks; AAAB. After applying Active Breaks

Table 3 shows the correlation analysis of the operative yielding with productivity and quality levels in the manufacturing areas of the electronics industry, where was made this scientific study. This indicates that with the application of the active breaks, the operative yielding increase and with this the productivity and quality indices. This improve the operation activities in this industrial company evaluated.

4. CONCLUSIONS

This investigation was relevant and supported to improve the operative yielding of workers of the manufacturing areas where was made and, in the electronics industry, evaluated, obtaining interesting information that specialists of this scientific study, both scientists from universities and from the industry where the research was made, learned about this critical situation and supported to reduce or avoid the exhaustion, labor stress and anxiety. This was important to improve the operative yielding of workers and the productivity and quality indices, passing from the economic losses to the economical gains in the electronics industry evaluated.

REFERENCES

- [1] Ahmed T., Kumar P., Mottet L. (2021). Natural ventilation in warm climates: the challenges of thermal comfort, heatwave resilience and indoor air quality, *Renew. Sustain. Energy Rev.*, 138.
- [2] Arenas-Ortiz L., Martínez O. (2022). "Factores de riesgo de trastornos músculo-esqueléticos crónicos laborales, *Medicina Interna de México*, Volumen 29, núm. 4, Julio-Agosto 2022, V 11 2, pp. 18-26.
- [3] AIMT-Asociación de la Industria Maquiladora de Tijuana (2023). Anuario Estadístico de la Industria Maquiladora de Tijuana.
- [4] Belmonte M., Díaz-López C., Gavilanes J., Millán J. (2021). Introducing passive strategies in the initial stage of the design to reduce the energy demanding single-family dwellings", *Health and Industry*, V 6, 11, pp. 44-59.
- [5] Devlin A. (2018). *Environmental Psychology and Human Well-Being: Effects of Built and Natural Settings* Academic Press, pp. 44.
- [6] G. López-Badilla, H. Tiznado-Vázquez, G. Soto-Herrera Gerardo (2012). "Análisis de EEA en la corrosión de cobre utilizado en la industria electrónica de ambientes áridos y marinos," *Nova Scientia*, vol. 4, no. 7, pp. 1-16, abril.
- [7] G. López, S. Valdez, K. Zlatev, P. Flores, B. Carrillo, W. Schorr (2007). "Corrosion of metals at indoor conditions in the electronics manufacturing industry", *Anti-Corrosion Methods and Materials*, vol. 54, no. 6, pp. 354 -359.
- [8] Mattia P., Gabrielle F. (2016). "A passive opportunity for improving air quality in the school's environment: a real-world scale testing", *Am. J. Environ. Sci.*, 12 (2016), pp. 206-212.
- [9] Mumovic D., Palmer J., Davies M., Orme M., Ridley I., Oreszczyn T., Judd C., Critchlow R., Medina H., Pilmoor G., Pearson C., Way P. (2019). "Winter indoor air quality, thermal comfort and acoustic performance of newly built secondary schools in England", *Build. Environ.*, 44, pp.1466-1477.



- [10] Robson L., Stephenson C., Schulte P., Amick B., Irvin I., Eggerth D., Chan S., Bielecky A., Wang A., Heidotting T., Peters R., Clarke J., Cullen K., Rotunda C., Grubb P. (2020). 'A systematic review of the effectiveness of occupational health and safety training Posted, *Ergonomics Industry Journal*; V 4, I 2, pp. 34-49.
- [11] Sierra O., Pardo N. (2020). "Prevalencia de síntomas osteomusculares y factores asociados en los embaladores de leche de una pasteurizadora en Neumocón", *Rev Col Enf.*, V.5, I 3, pp. 88- 101.