

THE IMPACT OF INDUSTRIAL NOISE ON WORKERS PSYCHOLOGICALLY AND ORGANICALLY. AN APPLIED STUDY IN THE BMS ELECTRIC COMPANY IN ALGIERS

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Abstract

This study aims to identify the impact of industrial noise on workers psychologically and organically.

The psychological effects were measured by the following symptoms: Behavioral symptoms, Cognitive symptoms, Psychological and social problems, and difficulties. The organic effects were determined by the following symptoms: physiological symptoms and auditory symptoms. The study was applied to a sample of BMS ELECTRIC workers in Algiers, and to achieve the objectives of this study, we relied on the descriptive approach, and we chose a sample consisting of 46 workers in the field of manufacturing and assembly in both branches - Birkhadem for females and Baba Hasan for males. The tools used to collect data on this study are observation, questionnaire, interview, and a noise-measuring "sonometer" to determine the degrees of noise to which workers are exposed.

After unpacking the obtained data and statistical processing and analysis, we concluded that industrial noise has psychological and organic effects on workers.

Keywords: Industrial noise, Psychological symptoms, Behavioral symptoms, Cognitive symptoms, Organic physiological symptoms.

1. Introduction

The world is witnessing competition, great progress, and rapid transformations in all industrial, technological, health, and digital fields... This shows us that this wave has achieved many positives, such as a high rate of inventions, advanced industries, microelectronics, the prosperity of the economy, and the largest possible amount of profits. At the same time, these industries have produced A lot of negative effects that affect the pleasure and well-being of a person until he becomes unjust to himself and his environment, a perpetrator of it and a victim of it. Hence, he breathes pollution, drinks pollution, eats pollution, hears pollution, sees pollution, produces pollution, consumes pollution, and leaves behind pollution, leaving after him Innovative, intensive, and pathogenic types of pollution that are far from harming and affecting future generations.

Yes, our planet has been affected by the disease, and this corresponds to what was stated by the Portuguese Secretary-General of the United Nations, António Guterres, on June 18, 2021, in his report on the state of the environment in the world, where he said "Our world faces a triple planetary crisis of climate change, nature loss, and pollution. This triple crisis is our number one existential threat. We need an urgent, all-out effort to turn things around" (Guterres, 2021).

This study is considered as an effort that pours into this goal, which is to shed light on a type of pollution and how to prevent and reduce it, which is acoustic pollution (industrial noise) as one of the pollutants that began to emerge and worsen to affect the calmness of our lives and disturb it, as we find that many Algerian industrial institutions suffer from problems Acute and complex, including the problem of the physical conditions surrounding the work environment, such as noise, heat, humidity, vibrations, etc., which still constitute a danger and a source of disturbance to the worker and a threat to his being and existence, and a scourge that environmental sciences seek to combat and limit its harmful negative effects.

On this basis, we find that many researchers emphasize the need to pay attention to the worker as the main engine of the production process, and this is by creating a harmonization between the physical and design conditions and the capabilities of the worker. Injuries resulting from work accidents have begun to increase and become more complicated among workers in industrial establishments with high industrial noise. Based on the above, the following questions can be asked.

2. Study questions.

- 2.1. What is the level of industrial noise to which BMS ELECTRIC workers are exposed?
- 2.2. Is there a correlation between the level of noise to which workers are exposed and psychological symptoms - behavioral, cognitive, and social - among BMS ELECTRIC workers?
- 2.3. Is there a correlation between the level of noise to which workers are exposed and the organic symptoms - physiological, auditory - among BMS ELECTRIC workers?

3. Study hypotheses.

- 3.1. BMS ELECTRIC workers are exposed to a high level of industrial noise.
- 3.2. BMS ELECTRIC workers suffer psychologically from industrial noise
- 3.3. BMS ELECTRIC workers suffer organically from industrial noise.

In order to answer the previous questions, we must clarify the following elements:

Defining the concept of industrial noise, its sources, and how to measure its levels in various industrial establishments.

Definition of psychological symptoms - behavioral, cognitive, and social.

Definition of organic symptoms - physiological and auditory.

Mention the importance of prevention, noise reduction, and adherence to occupational safety rules.

Presentation of various applied and methodological procedures in order to study this subject.

4. Concepts of the study.

4.1. Industrial noise:

The word noise is derived from the Latin word 'Nausea,' which means sickness in which one feels the need to vomit. Noise is the unpleasant and undesirable sound that leads to discomfort in human beings, which results from industrial activities, such as machinery, equipment, and production lines.

The intensity of sound is measured in decibels (dB). The faintest sound that the human ear can hear is 1 db (Byjus Learning, 2022).

Noise is generally defined as the unpleasant sounds that disturb the human being physically and physiologically.

4.2. Psychological symptoms:

They are mental health disorders that appear in several behavioral and emotional symptoms. These symptoms may be temporary and transient and disappear when the person stops noise exposure. Among the symptoms are anxiety, frustration, depression, dissatisfaction at work, and excitement for the most insignificant reasons. Jitteriness, thinking about leaving work, aggression, confusion, difficulty concentrating and paying attention...etc. These symptoms were measured in the study using the interview and questionnaire tools in addition to observation.

4.3. Organic symptoms:

They are physical health, and these disorders may be temporary or permanent and accompany the worker for life; among the symptoms are high blood pressure, increased heart rate, loss of appetite, shivering, pain in the ears, whistling in the ears...etc.

These symptoms were measured in the study using both interviews and questionnaires in addition to observation and analysis of medical files.

5. The theoretical side of the study.

5.1. The sound.

Sound is defined as the disturbance of layers of air in the form of successive waves, a disturbance that is perceived by the human ear. Humans perceive sound if its vibration ranges between 20 to 20,000 vibrations per

second.

Sound is also defined as an external effect on the ear that causes the sense of hearing, and it can be said that every vibrating body is a source of sound because the vibration of the body causes the air molecules around it to vibrate in the form of waves that spread in all directions, and these waves are known as sound waves, and the sound is completely cut off when the vibrating body stops vibrating.

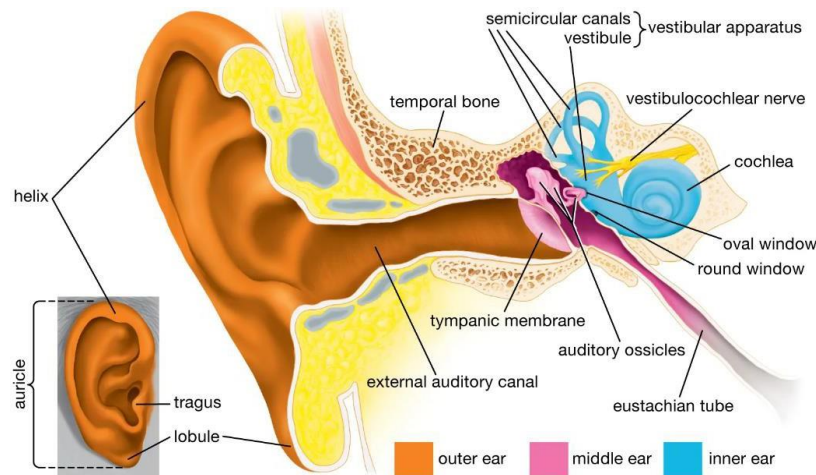


Figure 1. The structure of the human ear
Source: Encyclopedia Britannica (Hawkins, 2023)

5.2. Measurement techniques.

Noise levels in any environment are measured by a simple device called (sound level meters) (Boudrifa, 2002, p. 34).

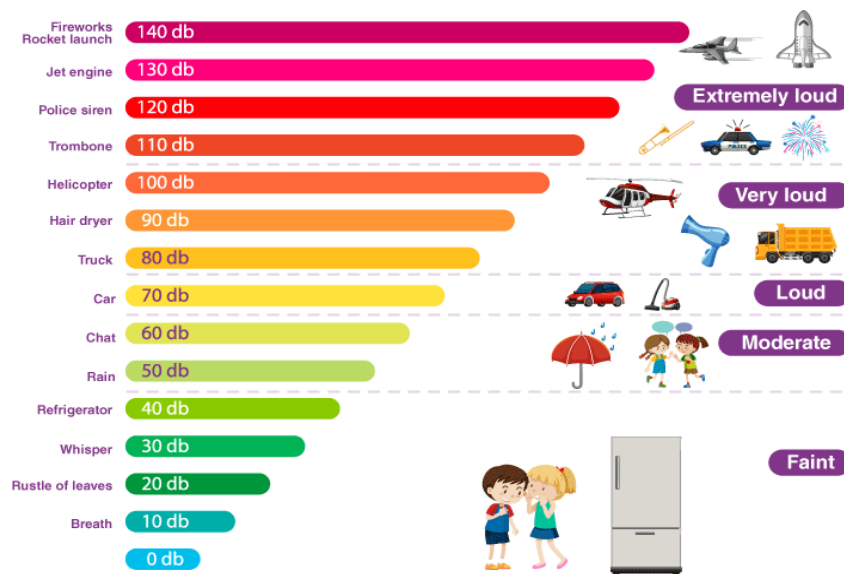


Figure 2. Shows the volume levels for common sounds
Source :(Byjus learning, 2022)

5.3. Types of noise.

Here's a breakdown of the different types of noise that affect us all (NoiseNews, 2021).

- Continuous noise.
- Intermittent noise.
- Impulsive noise.
- Low-frequency noise.

5.4. Effects of noise on individuals.

Health and safety laws ISO 6385 emphasizes the need for the work environment to be free of sound effects that cause harm to the health of individuals, as the negative effects of high noise extend from physiological damage to neurological and psychological damage (Hamid, 2004, p. 152), in general, noise can be considered as those sounds that are harmful and not desirable, and its rates exceed 70 decibels. Noise is considered one of the most important problems of contemporary life, as it constitutes a kind of pollution that affects human beings and their lifestyles, causing psychological and physiological damage to them. It also indirectly affects the economic, educational, and social life ... etc. (Imam, 2003, p. 3).

5.4.1. Psychological effects:

Noise has a clear effect on the psychological state of a person, as it creates hardship for him at work, and this appears in the form of anxiety, confusion, weakness in concentration and thinking, and mental and nervous exhaustion. Long-term noise exposure also leads to mood swings, which are scientifically known as feeling happy and then feeling upset in a sudden way. These mood fluctuations also lead to anxiety, tension, and the inability to express feelings and feelings on an ongoing basis. Researchers have concluded that there is a correlation between noise and difficult psychological problems, given that noise is a cause for hardship and hardship as a causal factor or a cause of mental health diseases, and other studies confirm this. Exposure to high-intensity noise is associated with instability, irritability, anxiety, and sexual disability. (saliha & adel, 2017, p. 59)

5.4.2. Organic effects:

❖ Physiological effects:

The study conducted by Robert B. Zajonc and Zox in 1972 to analyze the effect of noise on human health has shown that there is a positive correlation between the level of noise and rates of acute and chronic diseases, as well as an increase in frequency to doctors.

As for Döring's study in 1980, he concluded that noise directly affects the tissues of the digestive system (Döring, 2022).

Sudden noise also produces a decrease in the activity of the viscera, the flow of saliva, and the digestive nerve, so it can affect the digestive system of the worker who is repeatedly exposed to loud noises, which leads to bad consequences for both the health and efficiency of the workers who are exposed to it (Boudrifa, 2002, p. 88).

The noise affects the balance devices through ear disturbance and leads to a feeling of dizziness, nausea, vomiting, and imbalance.

❖ Auditor effects: there are many effects on the auditory system.

- **Temporary:** the effect of the sensory hair cells in the spiral body, which leads to a weakening of the auditory ability at the end of the work period.
- **Permanent:** The frequent exposure of the individual to noise, especially if its intensity is more than 85 decibels, leads to the decomposition of the sensitive hair cells in the spiral body of the inner ear, and then these hairs lose part of their sensitivity forever, and the individual is exposed to a condition called occupational deafness (Jamil h., 1980, p. 30) and it is of two types: (Conductive deafness, Perceptual deafness).

Occupational deafness is defined as the gradual decrease in the efficiency of the auditory system as a result of continuous exposure (08 hours a day), six days a week, for a period of more than ten years, to noise more than the allowable level.

The American Organization for Occupational Safety (OSHA) has established levels of permissible noise doses to which exposure is shown, as shown in Table 1.

Table1. Noise Exposure Limits

Sound level dBA	Permitted duration Workday (hours)	Sound level dBA	Permitted duration Workday (hours)
90	8.00	103	1.32
91	6.96	104	1.15
92	6.06	105	1.00
93	5.28	106	0.86
94	4.60	107	0.76
95	4.00	108	0.66
96	3.48	109	0.56
97	3.03	110	0.50
98	2.63	111	0.43
99	2.30	112	0.38
100	2.00	113	0.33
101	1.73	114	0.28
102	1.52	115	0.25

Source: (OSHA, OSHA Noise and Hearing Conservation, 2016)

5.5. Protect workers from industrial noise.

The responsibility for protecting workers in the factory environment lies with the management in the industrial establishments, so this can be achieved in one of the following ways:

5.5.1. Medical prevention methods:

- a. Initial medical examination.
- b. Periodic medical examination.

As this method helps to identify people whose hearing is impaired early on, the benefits of a medical examination are:

- Knowledge of the change in the efficiency of the hearing system.
- Detection of noise that affects some individuals and impairs their hearing.
- Sort people who should be transferred to other departments.
- Monitoring and following up with workers who are at risk of noise (Boudrifa, 2002, p. 135).

5.5.2. Engineering prevention methods:

Multiple methods can be used depending on the intensity of the noise from the source.

- Replacing high-noise machines with less noisy ones.
- Isolating the machines that cause noise from the workers and confining them to a private place.
- The use of sound-absorbing materials.
- Increasing the distance between workers and noise-creating machines (Jamil H., 1989, p. 94).

5.5.3. Prevention by planning and design:

- Selection of building materials and design method.
- Place the offices of employees who carry out administrative work away from noise sources.
- Examining machinery and equipment and identifying and treating noise causes.
- Subjecting the specifications of machines and manufactured devices to the maximum permissible noise level (Boudrifa, 2002, p. 136).

5.5.4. Ear protection devices:

Suppose the noise control process by bringing about a change in the environment and the use of various means and technological methods is impossible or insufficient. In that case, it is possible to determine the amount of continuous exposure to higher levels of noise for short periods only. In the event that the various methods fail to reduce noise to acceptable levels, it is possible to resort to the use of individual preventive measures. (Boudrifa, 2002, p. 145)

Earplugs.

Half inserted protection devices. Ear covers.

Soundproof helmet.

5.5.5. Introducing a change in the organization of work:

It is possible to reduce the number of hours of exposure to noise.

- Resorting to the work rotation system.
- Reorganizing work to allow part of it to be conducted in quiet places.
- Providing restrooms and a refuge from noise in the workplace. (Boudrifa, 2002, p. 55).

5.5.6. Finding regulations and laws to protect employees:

The application of medical and engineering prevention methods is achieved through the existence of legislation that obliges institutions and workers to apply conditions related to occupational health and safety and the existence of laws that punish those who violate instructions, as this helps protect the individual from occupational risks in general.

6. The applied side of the study.

6.1 Methodology

6.1.1 Study Approach

The current study falls within the descriptive exploratory study that aims to describe the phenomenon to be studied using appropriate techniques.

6.1.2 Place of conducting the study.

This study was conducted at the company BMS ELECTRIC, established in 2001 and manufactures accessories and electrical equipment. After four years of activity, the company has become a leader in the Algerian market, and its products are distributed in 9 countries.

It covers 90% of the national market, and its large production capacity has reached 130,000 devices per day.

Where the manufacturing process goes through several stages, starting from the raw material to packaging, in the various workshops:

-Plastic injection.

-metal sheet cutting.

-Ceramic press.

-Assembly and storage. The company is located in:

Showroom- Route de Douera Baba Hassen, Alger.

Usine- Rue Hamidi Said- Birkhadem, Alger.

6.1.3 The study sample:

The sample consisted of workers ranging in age from 25 to 58 years of both sexes, 20 males and 26 females working in workshops, with a total number of 46 workers, and they were chosen randomly.

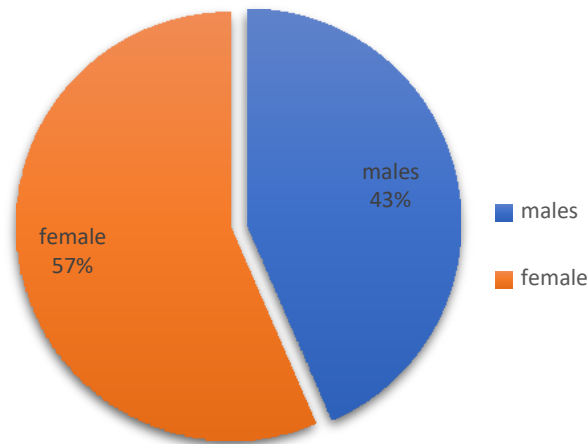


Figure 3. Sample volume

6.1.4 Study tools.

Observation: Its aim is to collect information about the physical conditions surrounding the worker and the impact of these conditions on the system (human-machine).

Interview: The interview was conducted with officials and workers with the aim:

- Inquiry about some of the observed behaviors during the Executing the tasks.
- Determine the tasks and objectives of the system, as well as the inputs and outputs of the system, the capabilities of the system, and the factors that affect the workers.
- The basic operations and their time sequence, the distribution of tasks in the system, how to perform the tasks, and the prepared and required equipment.

Noise measurement device: To estimate the noise level in the workshops, we relied on a noise meter, which allows measuring the noise level from 35 to 130 decibels, with the following functions and features specified: Measuring level - High (Hi) / Low (Lo). Two measurements: fast (F) / slow (S).

Questionnaire: The questionnaire was used to collect information about industrial noise to which workers are exposed to various physical conditions and the impact of all of this on workers' physical and psychological health.

Description of the questionnaire: The questionnaire consists of 50 items divided into three axes, as follows:

1st axis: contains four items under the question

Do you suffer from the influence of the following physical conditions?

2nd axis: contains 16 items under two questions, as follows:

Do you suffer from the following physiological symptoms? Contains ten items.

Do you suffer from the following auditory symptoms? Contains six items.

3rd axis contains 29 items under four questions, which are as follows:

Do you suffer from the following psychological symptoms? Contains nine items.

Do you suffer from the following behavioral symptoms? Contains eight items.

Do you suffer from the following cognitive symptoms? Contains five items. Do you suffer from the following social problems? Contains seven items.

6.2 Results

Table 2. The noise level in the various BMS ELECTRIC workshops.

The workshop	Noise level decibels dB		Noise type
	Lowest level	Highest level	
Assembly workshop	85	104,1	often continuous noise
Plastic injection workshop	86,8	102	Continuous noise
Ceramic injection workshop	95,3	104,7	Intermittent noise
Sheet metal cutting workshop	106,3	113,4	Impulsive noise

6.2.1 The results of the first hypothesis.

To verify the validity of the first hypothesis, we measured the noise to which workers are exposed and then obtained the data recorded in Table 2.

Through the table2, we note that the workers of BMS ELECTRIC are exposed to an industrial noise level that varies from one workshop to another and from one position to another, as it is generally high and exceeds the permissible limit set by the American Organization for Occupational Safety OSHA, especially when they are exposed to it for 8 hours a day, and this is what It negatively affects the psychological and physical health of workers, with the lack of respect for occupational safety and prevention measures, such as not wearing ear protection devices, which results in many damages.

6.2.2. Questionnaire Results and Evaluation

Table 3. Female Questionnaire Results

Sex	The sample	Noise level decibels dB	Psychological symptoms			Physiological symptoms		
			Psychological symptoms	Behavioral symptoms	Cognitive symptoms	Social symptoms	Auditory symptoms	Organic symptoms
female	1	85	11	15	8	7	6	20
	2	97,5	15	10	7	7	12	12
	3	93,4	9	17	7	11	7	14
	4	96,9	19	20	12	11	12	22
	5	89,6	33	22	18	11	9	19
	6	98,7	26	17	12	8	17	18
	7	94,6	29	17	12	11	15	31
	8	95,3	19	9	7	12	9	12
	9	94,9	21	17	7	12	10	17
	10	85	11	12	11	8	10	17
	11	97	30	22	16	9	25	42

Sex	The sample	Noise level decibels dB	Psychological symptoms				Physiological symptoms	
			Psychological symptoms	Behavioral symptoms	Cognitive symptoms	Social symptoms	Auditory symptoms	Organic symptoms
female	12	99,6	39	21	5	17	27	37
	13	98,8	31	18	12	15	10	32
	14	92,5	18	24	13	13	9	24
	15	88,9	11	13	5	13	10	21
	16	87,9	20	21	12	16	10	21
	17	98,5	20	14	5	11	12	24
	18	92,4	19	20	11	9	7	18
	19	97,7	23	16	5	9	10	25
	20	89,5	15	12	5	7	13	23
	21	88,5	15	10	6	13	15	14
	22	95,1	31	23	11	22	10	26
	23	95,8	23	16	5	9	12	22
	24	104,1	35	18	15	14	20	20
	25	91,8	37	29	12	20	18	33
	26	102,1	36	22	21	19	6	25

Table 4. Questionnaire Results

Sex	The sample	Noise level decibels dB	Psychological symptoms				Physiological symptoms	
			Psychological symptoms	Behavioral symptoms	Cognitive symptoms	Social symptoms	Auditory symptoms	Organic symptoms
males	27	88,8	18	16	16	16	12	37
	28	90,3	20	17	8	16	9	34
	29	95,3	12	8	5	7	12	12
	30	93	13	9	5	8	12	12
	31	94	12	10	6	7	9	14
	32	111,1	15	15	8	14	10	15
	33	104,1	25	26	7	24	16	24
	34	106,3	14	10	10	20	14	17
	35	106,5	23	13	11	17	14	25
	36	104,7	16	16	9	16	17	23
	37	108,7	14	18	12	16	20	14

Sex	The sample	Noise level decibels dB	Psychological symptoms				Physiological symptoms	
			Psychological symptoms	Behavioral symptoms	Cognitive symptoms	Social symptoms	Auditory symptoms	Organic symptoms
males	38	86,8	37	22	9	7	19	42
	39	107,1	23	19	11	16	9	14
	40	113,4	12	11	11	19	10	16
	41	99,1	12	10	7	7	12	16
	42	99,1	12	14	10	12	13	17
	43	96,2	19	12	11	13	7	15
	44	90,8	27	23	16	16	17	30
	45	88,7	32	25	14	26	21	25
	46	108	29	24	15	20	22	26

6.2.3. The results of the second hypothesis.

The second hypothesis states that there is a correlation between the level of pervasive noise and psychological symptoms - behavioral, cognitive, and social - among BMS ELECTRIC workers.

To verify the validity of the hypothesis, we analyzed the responses of the research sample to the axes designated for this in the questionnaire and calculated the Pearson correlation coefficient to study the relationship through the responses of the sample members. We obtained the results recorded in Table 5.

Table 5. The correlation between the level of noise and psychological symptoms

	Psychological symptoms			
	Psychological symptoms	Behavioral symptoms	Cognitive symptoms	Social symptoms
Pearson correlation coefficient	0.72			
Degree of freedom df	0,51			
The sample	46			
Average noise level	113,4 ≥ 85			

(at the significance level $p=0,01$)

Through Table 5, we find that the calculated Pearson correlation coefficient is equal to (0.72) greater than the tabulated df (0.51) at the significance level (0.01). This means that there is a statistically significant correlation, and therefore, we accept the second hypothesis of the study, which says That there is a correlation between psychological symptoms (behavioral, cognitive, social) and the level of pervasive noise.

6.2.4. The results of the third hypothesis.

The third hypothesis states that there is a correlation between the level of diffuse noise and the organic symptoms - physiological and auditory - among BMS ELECTRIC workers.

To verify the validity of the hypothesis, we analyzed the responses of the research sample on the axes designated for this in the questionnaire and calculated the Pearson correlation coefficient to study the relationship through the responses of the sample members. We obtained the results recorded in the table6:

Table 6. The correlation between the level of noise and Physiological symptoms

	Physiological symptoms	
	Auditory symptoms	Organic symptoms
Pearson correlation coefficient	0.59	
Degree of freedom df	0,51	
Sample	46	
Average noise level	113,4	≥ 85

(at the significance level $p=0,01$)

Through Table 6, we notice that the calculated correlation coefficient is equal to (0.59) greater than the tabulated df (0.51) at the significance level (0.01); this means that there is a statistically significant correlation and therefore, we accept the third hypothesis of the study, which says that There is a correlation between the organic symptoms (physiological, auditory) and the level of pervasive noise.

6.3. Conclusion.

It is clear from the results obtained by calculating the Pearson correlation coefficient to study the impact of the level of pervasive noise on psychological and physiological health that there is a statistically significant correlation, and thus, all the hypotheses of the study are fulfilled, as the workers confirm the following:

- Workers are exposed to noise that exceeds the noise level allowed for exposure and for a very long period of time.
- The workers also confirm, through the answers and results, that the level of noise affects mental health, as it leads to excessive anxiety, jitteriness, and anger for trivial reasons, feelings of depression, distress and annoyance, fear and insecurity in addition to aggression and a sense of isolation and psychological loneliness.
- The workers also confirm the presence of physiological symptoms, including fatigue and exhaustion, headaches, digestive disorders, dizziness, and ringing in the ears with partial or complete deafness.

Finally, the results of this study are consistent with most studies that search for the effect or relationship between continuous exposure to industrial noise and the psychological and physiological effects on workers.

6.4. Suggestions and recommendations.

- 1- Try to conduct this study in other institutions and with large samples so that the results can be generalized.
- 2- Re-studying this subject, but with other variables such as productivity, performance, loyalty...etc
- 3- The establishment should pay great attention to improving the physical conditions inside the workshop.
- 4- Constant awareness of workers about occupational safety and prevention measures and alerting them to the health risks that noise may cause.
- 5- Requiring workers to wear protective equipment by issuing strict instructions and procedures against rebels.
- 6- The problem of noise should be taken into consideration during the establishment phases (construction of the building, allocation of the machinery, etc).
- 7- Suitable protection accessories should be provided for the workers who will work in noisy environments, and they should be trained on regular usage of such accessories.

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