

Psychological Impacts of (4x4) Shift Work

Field study at the Natural Gas Liquefaction Complex in Skikda.

الانعكاسات النفسية لنظام العمل بالمنوبة (4x4)
دراسة ميدانية بمركب تجميع الغاز الطبيعي سكيكدة

Dr. Bendjama Brahim*

University of Skikda

b.bendjama@univ-skikda.dz

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Abstract:

This study aimed to conduct a psychological evaluation of the (4x4) shift work system at the natural gas liquefaction complex (GL1K) in Skikda, focusing on measuring its potential psychological impacts, represented by depression, anxiety, and stress. In addition to asses levels of these impacts among shift workers, the study aimed also to examine their prevalence according to certain demographic Characteristics.

The study was conducted on a convenience sample of 76 individuals out of a total of 552 workers working on (4x4) shift work system at the Skikda Natural Gas Liquefaction Complex (GL1K), operated by Sonatrach petroleum company.

Data collection was conducted using a questionnaire consisting of two parts : The first part covered demographic data, while the second part included the Arabic version of the depression, anxiety, stress scale (dass- 21).

The results showed that participants working on (4x4) shift system, suffer from high levels of depression, anxiety, and stress, reaching intensities of 20.88, 18.68, and 27.84 respectively on the (dass-21) scale. These levels all fall into the severe category.

* المؤلف المرسل: Bendjama Brahim ، الإيميل: b.bendjama@univ-skikda.dz

The results also indicated a variation in the prevalence of depression, anxiety, and stress among participants. As participants with more seniority in the shift and those who are married, suffer from higher levels of depression, anxiety, and stress. Finally finding also suggested that participants who chose to work in shifts, suffer from similar levels of depression, anxiety, and stress to those who are assigned to the shift without being asked.

Keywords : shift work ; depression ; anxiety ; stress.

- Abstract in Arabic:

هدفت هذه الدراسة إلى التقييم النفسي لنظام العمل بالمناوبة (4x4) بمركب تمييع الغاز الطبيعي (GL1K) بسكيدة ، وهذا من خلال قياس انعكاساته النفسية المحتملة والمتمثلة في كل من الاكتئاب، القلق والضغط النفسي، بالإضافة إلى التعرف على مستويات هذه الانعكاسات على العمال المناوبين، فقد هدفت هذه الدراسة أيضا إلى فحص انتشارها بين العمال نسبة إلى بعض الخصائص الديموغرافية.

أجريت الدراسة على عينة عرضية بلغ عدد أفرادها 76 فردا من مجموع 552 عاملا مناوبا بنظام (4x4) بمركب تمييع الغاز الطبيعي (GL1K) بسكيدة التابع لشركة المحروقات سوناطراك.

تم جمع البيانات بواسطة استبيان يتكون من جزئين الجزء الأول خاص بالبيانات الديموغرافية، بينما الجزء الثاني يتكون من النسخة العربية لمقياس الاكتئاب، القلق والضغط النفسي (dass-21).

بينت النتائج أن المشاركين العاملين بنظام المناوبة (4x4) يعانون من مستويات مرتفعة من الاكتئاب، القلق والضغط النفسي، بلغت شدتها على التوالي: (20.88)، (18.68)، و(27.84) على مقياس (dass-21)، وهي تنتمي جميعها إلى فئات المستويات الشديدة.

دلت نتائج الدراسة أيضا على وجود تباين في انتشار كل من الاكتئاب، القلق والضغط النفسي بين المشاركين، فالأفراد الأكثر أقدمية في المناوبة والمتزوجون يعانون من مستويات أعلى من الاكتئاب والقلق والضغط النفسي. أخيرا أشارت النتائج أيضا إلى أن المشاركين الذين اختاروا العمل بالمناوبة والذين تم تعيينهم بالمناوبة دون طلب منهم، يعانون من مستويات متقاربة من الاكتئاب، القلق والضغط النفسي.

الكلمات المفتاحية: العمل بالمناوبة- الاكتئاب- القلق- الضغط النفسي.

Introduction :

Some professional activities require full-time positions, especially in the industrial, medical, and security. Some work organizations have even begun to resort to this type of work for purely competitive reasons, which has increased the spread of shift work in professional circles. However, from a health perspective, studies continue to prove day after day that shift work negatively affects individual's psychological, social, and physical health. On the one hand, night work hours conflict with biological rhythms, which affects the regularity of hormonal secretion, leading to negative psychological and physical effects, such as depression and anxiety (Larit and Bouhara, 2016), sleep disturbances (Leger and all, 2022 ; Philip and all, 2022 ; Riviere and all, 2025 ; Pallasen and all, 2021), cardiovascular diseases (Herontuin and all, 2013 ; Wang and all 2021), and cancerous diseases (International Agency for Research on Cancer, 2019). On the other hand, atypical schedules, affect individual's social participation and lead to social isolation, weakened family relationships, and loss of professional identity (Larit, 2015).

To mitigate these effects, work organizations resort to designing shift systems that include sufficient rest periods to achieve the greatest possible degree of physical and psychological recovery, in addition to paying attention to individual's healthy nutrition, and providing them with social support.

Since its establishment in 1963, the Algerian Petroleum Company Sonatrach, has relied on various shift work systems, the most famous of which, are the (3x8) shift work system for the northern regions, where individuals rotate within four groups in three eight-hour work shifts, ensuring 24-hour work, and the (4x4) shift work system for the southern regions, which means working for four consecutive weeks (12) hours a day, followed by four weeks of rest.

Many studies conducted on different samples of shift workers at the Algerian Petroleum Company Sonatrach according to these two shift work systems, have shown the negative effects of these systems on the psychological aspect of workers (Larit, 2015 ; Larit and Bouhara, 2016, Azawi and Mubarki, 2022-2023, Marouk and Quryshi 2016).

Since 2018, Sonatrach has completely abandoned the (3x8) shift work system, and adopted for the first time the new (4x4) shift work system for the northern regions, which is

still in use to this day. In fact, Sonatrach did not adopt the (4x4) shift work system in an effort to mitigate the negative effects of shift work, but this strategic decision was for purely security reasons, as the (4x4) shift work system achieves the simultaneous entry of shift and non-shift workers into industrial areas, and reduces the movement of workers to, and from these areas, which facilitates daily monitoring operations.

Despite this, the (4x4) shift work system has had a significant positive impact on the morale of shift workers, and is still well-received by them, as includes four consecutive days of rest. But what about the impact of this system on mental health individuals ?

The (4x4) shift work system has not received any psychological evaluation study its inception at Sonatrach until today. Since the periode of work with it, which is seven years, is considered sufficient to explore its psychological effects. This study comes to identify the psychological impacts of working on (4x4) shift work system, which was conducted on a sample of workers at the Skikda Gas Liquefaction Complex affiliated with Sonatrach, where we pose the following questions :

-What are the levels of psychological impacts (depression, anxiety, and stress), among shift workers at Skikda Gas Liquefaction Complex ?

-How do psychological impacts, (depression, anxiety, and stress) spread among shift workers at Skikda Gas Liquefaction Complex, according to demographic characteristics, (shift seniority, marital status, and the decision to work shifts)?

1- The importance of research :

The (4x4) shift work system has been widely accepted and appreciated by Sonatrach's shift workers, as it includes four full days of rest. However, this does not necessarily mean that it has positive impact on their health, nor does it mean that it does not have negative effects. To the best of the researcher's knowledge, this system has not been subjected to any psychological study since its inception in 2018.

Therefore, this study aims to evaluate this work system from a psychological perspective, by identifying the levels of its psychological impacts on shift workers, represented by depression, anxiety, and stress. This study provides field-based feedback that can be used to evaluate Sonatrach's strategic decision to switch to (4x4) shift work system,

and contributes to understanding the psychological impacts of (4x4) shift work system, which may help improve the work environment at Sonatrach and promote the mental health of employees.

2- Research objectives :

This aim of the study is to psychologically evaluate the (4x4) shift work system at Sonatrach Petroleum Company, by measuring its potential psychological impacts, represented by depression, anxiety, and stress, on a sample of workers at the Skikda Gas Liquefaction Complex affiliated with the company. The study also aims to examine the prevalence of these impacts according to demographic characteristics (shift seniority, marital status, and the decision to work shifts).

3- Definition of key concepts :

3-1- The (4x4) shift work system :

The (4x4) shift work system consists of four working days followed by four rest days, alternated by four work teams, each working 12 daytime hours for two days, then 12 nighttime hours for two days, and then benefiting from four rest days.

3-2- Psychological impacts :

Psychological impacts are a set of cognitive, emotional, behavioral, and physical responses that appear in individuals as a result of their interaction with a specific social or professional situation.

3-3- Operational definition of psychological impacts :

The psychological repercussions in this study are represented by the cognitive, emotional, and physical responses related to depression, anxiety, and stress that appear in participants who work a (4x4) shift work system, and which are measured by (dass-21) scale.

4- Field procedures :

4-1- Study areas :

The study was conducted at the Skikda Gas Liquefaction Complex, located in the major industrial zone east of the Skikda city. The complex was established in 1972, and its primary activity is the liquefaction of natural gas imported directly from the Hassi R'mel field via a 580 km pipeline. Field procedures for the study began on March 3, 2024, and continued for two months until May 7, 2024.

4-2- Population and sample :

The research community consist of (4x4) shift workers at the Skikda Gas Liquefaction Complex, totaling 552 shift workers, distributed among 3 departments : Exploitation, Security and prevention, and Maintenance. Data were collected from a convenience sample of 76 participants characterized by the following demographic characteristics :

Table N°1. Demographic characteristics of sample.

Demographic variables	Categories	<i>f</i>	%
Shift seniority (on years)	Less than 5	4	% 5
	5-10	31	%41
	10-15	9	%12
	More than 15	32	%42
	Total	76	%100
Marital Status	Married	63	%83
	Single	13	17%
	Total	76	100%
Decision to work shifts	By choice	45	% 59
	Without choice	31	%41
	Total	76	%100

4-3-Data collection tools :

A two-part questionnaire was used, the first part includes three items to identify demogrphic characteristics: seniority in the shift, marital status, and the decision to be assigned to the shift. The second part is dedicated to identifying the psychological impacts that may appear among the sample individuals, and consists of the arabic version of depression, anxiety, and stress scale (DASS-21), whose psychmetric properties were evaluated by AL-Shtewi and AL- Dhabyan (2023), who explained that the scale has good psychmetric properties.

The (DASS-21) is a set of three self-report scale, each of them contains 7 items (table°2). This scale is an abbreviated version of the (DASS-42) scale prepared by Lovibond in (1995). This scale is not used as a tool for diagnosing depression, anxiety, and stress, rather, high scores on the scale indicate a significant presence of these psychological problems in the respondent, that it is necessary for this person to undergo a clininal examination. The score assigned to each item ranges from (0) to (3) according to the chosen response (table n°3).

Table N°2. Distribution of item numbers across scale dimensions

Scale dimensions	Item numbers
Stress	1-2-3-4-5-6-7.
Anxiety	8-9-10-11-12-13-14.
Depression	15-16-17-18-19-20-21.

Table N°3. Response alternatives and their scores in (DASS-21) scale

Response alternatives	Scores
Did not apply to me at all.	0
Applied to me to some degree, or some of the time.	1
Applied to me to a considerable degree or a good part of time.	2
Applied to me very much, or most of the time.	3

To determine the level of psychological impacts the total score obtained by the respondent in each stress, anxiety, and depression is calculated, and the value of each score is multiplied by the number (2), and then compared as in table (4) with standard levels (DASS-21) scale, which are : normale, mild, moderate, severe, and extremely severe.

Table N°4. Standard (DASS-21) scale levels

Levels	Stress	Anxiety	Depression
Normale	0-10	0-6	0-9
Mild	11-18	7-9	10-12

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Moderate	19-26	10-14	13-20
Severe	27-34	15-19	21-27
Extremely Severe	35-42	20-42	28-42

5-Study results :

5-1-First question results :

Question text : --What are the levels of psychological impacts (depression, anxiety, and stress), among shift workers at Skikda Gas Liquefaction Complex ?

5-1-1- Stress results :

Table N°5. Mean, Standard Deviation, and Frequency scores of stress

Item numbers	\bar{x}	ϵ
1	1.88	0.77
2	1.93	0.64
3	2.72	0.51
4	1.75	0.58
5	2.55	0.69
6	0.86	0.32
7	2.23	0.57
Stress	13.92	3.08
Stress level	13.92x2=27.84	

Stress results presented in the previous table show that stress indicators appear in varying degrees, the means are high for some items (3,5,7) medium for others (1,2,2) and low for item (6). We also find that the the mean value for all items is (13.92). Multiplying this value by two we get (27.84), according to table (4) of the standard (DASS-21) levels, this value corresponds to a sever level of stress. The table also shows that standard deviation

values are all low, as they range between 0.32 and 0.77 for the items score, and aqual 3.08 for the total scores, indicating little variability in responses.

5-1-2-Anxiety results :

Table N°6. Mean, Standard Deviation, and Frequency scores of anxiety

Item numbers	\bar{x}	ϵ
8	1.47	0.34
9	2.06	0.16
10	0.75	0.23
11	1.36	1.02
12	0.60	0.75
13	2.25	1.29
14	0.85	0.68
Anxiety	9.34	2.45
Anxiety level	9.34x2=18.68	

The previous table diplays results related to the level of anxiety among the sample individuals. We note that there are low mean values for the indicator scores in items (10,12,14), hight values in items (9, 13) and moderate values in item (8,11). We also find that total mean score in anxiety is (9.34), mutiplying this value by 2 we get (18.68) which represents a severe level of anxiety in (DASS-21) scale. Value of standard deviation for the total score is (2.45) and for the item scores range between (0.16) and (1.29), these low values indicate that individual's responses are consistent.

5-1-3-Depression results :

Table N° 7. Mean, Standard Deviation, and Frequency scores of depression

Item numbers	\bar{x}	ϵ
15	2.44	0.73

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16	0.84	0.32
17	1.76	0.33
18	1.68	0.12
19	1.93	0.25
20	0.40	0.21
21	1.39	0.40
Depression	10.44	3.64
Depression level	10.44x2=20.88	

Looking at the results related to the level of depression in the previous table, we find low values for means in items (16, 20), high value in item 15, and medium values in items (17,18,19,21). Mean for total score is (10.44), multiplying this value by 2 we get 20.88, according to table (4) of standard (DASS-21) levels, this value approaches to severe depression level. As for the standard deviation values shown in the table, we find that they have low values. Standard deviation is equal to 3.64 for the total scores and ranges between 0.12 and 0.73 for the items scores. This indicates that responses are consistent.

5-1-Second question results :

Question text : -How do psychological impacts, (depression, anxiety, and stress) spread among shift workers at Skikda Gas Liquefaction Complex, according to demographic characteristics, (shift seniority, marital status, and the decision to work shifts)?

Table N°8. Mean, Standard Deviation, and Frequency scores of (DASS-21) according demographic variables.

Demographic	Categories	f	Stress		Anxiety		Depression	
			\bar{x}	ϵ	\bar{x}	ϵ	\bar{x}	ϵ

variables								
Shift seniority (on years)	Less than 5	4	12.32	2.65	7.00	3.18	8.87	5.11
	5-10	31	12.96	1.55	8.02	4.65	10.11	4.33
	10-15	9	14.52	2.45	11.02	2.35	10.25	3.15
	More than 15	32	15.88	5.21	11.32	5.11	12.53	2.99
	Total	76	13.92	3.08	9.34	2.45	10.44	3.64
Marital status	Married	63	15.07	4.12	11.08	2.12	12.91	4.11
	Single	13	12.77	2.56	7.60	4.36	7.97	4.01
	Total	76	13.92	3.08	9.34	2.45	10.44	3.64
Decision to work shifts	By choice	4	13.82	2.66	9.20	5.22	10.55	4.36
	Without choice	31	14.02	4.32	9.48	4.98	10.33	2.55
	Total	9	13.92	3.08	9.34	2.45	10.44	3.64

The means and standard deviation scores of psychological impacts according to demographic variables are shown in table (8), The findings suggested that high levels of psychological impacts are experienced by individuals with shift seniority more than 15 years, as the mean of depression, anxiety and stress $M=12.53$, $M=11.32$ and $M=15.88$ respectively. Whereas among individuals with shift seniority less than 5 years, there were not any high levels of psychological impacts. Among individuals with shift seniority from 5 to 10 years, only stress appears at high level, $M=12.69$. High levels of depression, anxiety and stress are also experienced by married individuals which means are $M=12.91$, $M=11.08$ and $M=15.07$. Whereas among singles, only anxiety appears at high level, $M=7.60$. The table also indicates similar levels of depression, anxiety and stress between workers who chose to work in shift and those who did not.

6-Discussion :

The study found that individuals working on (4x4) shift work system suffer from high levels of depression, anxiety and stress, with reaching 20.88, 18.68, and 27.84 respectively on (DASS-21) scale. These levels all fall into severe category.

Stress results are consistent with Larit's study (2015) which was conducted on the same population. High levels of stress may be due to an increased sense of responsibility for work among shift workers, or for an increase in the amount of actual responsibility, as levels of management and supervision decrease, and administrative and social decrease significantly during shift periods. It may also be due to an increase in workload, as the workload covered by individuals on shifts is usually not much less than the workload covered by a larger number of individuals during normal work periods.

We rule out the possibility that the content of shift work plays a role in the high stress, as the shift work does not include tasks different from those related to working during regular hours.

Anxiety results consistent with the studies conducted by Larit and Bouhara (2016), Marouk and Qureshi (2016). High anxiety levels can be explained by the unusual work schedules that impose severe changes on individuals's sleep schedules and exposure to light and darkness, which disrupts their biological clock, causing it to lose synchronization with the external environment, which leads to various sleep disorders and associated anxiety responses, as documented by Hadj Saeed (2022).

Our research findings demonstrate high levels of depression among participants, similar results were recorded in some previous studies (Larit & Bouhara, 2016 ; Marouk & Qureshi, 2022-2023). We can explain that as (4x4) shift work system causes an imbalance in individual's biosocial synchronization. Night work periods also affect the regularity of individual's hormonal secretion, especially serotonin, which causes many functional disorders such as depressive moods (Aeyoung, 2017).

The study results indicate also a variation in the prevalence of depression, anxiety and stress, among participants. Individuals with more shift seniority, and those who are married, suffered from higher levels of depression, anxiety and stress, which is consistent with results of studies by Azawi and Mubarki (2022-2023). This may be due to the accumulation of family stressors. However, these results must be taken with caution, as these demographic variables may overlap with each other in their relationship with psychological impacts, and may even overlap with many unstudied variables, such as age, and seniority at work. For example, age, seniority at work, shift seniority, and marital status often coincide. Thus we may find that single individuals are younger and have less seniority at work and in shift, they have greater potential to adapt to unusual work hours, thus managing stress better and creating a kind of harmony between professional and personal life.

Finally finding results show that participants who chose to work shifts and those who were assigned to shifts without their choice, suffer from similar levels of depression, anxiety and stress. This means that the development of psychological impacts among participants is not related to the possibilities given to them to intervene in their professional path.

Conclusion

It is reported by the current findings that shift workers on (4x4) system at Skikda Gas Liquefaction Complex, are seriously affected by mental health problems (depression, anxiety and stress). Sonatrach company must design immediately some preventive measures to promote the mental health of its workers in order to create a better working environment. However, it should be noted that there are two important limitations in this study : First the small size of sample and its type (a convenience sample of 76 individuals), which did not achieve a strong representation of the population, where study neglected a segment of population of great importance to the topic ; Individuals on sick leave. The other limitation is that study was limited to three demographic variables.

To our knowledge, the (4x4) shift work system at Sonatrach has not been the subject of any psychological study excepted the current study, therefore, conducting further studies

with larger samples on this topic is imperative, especially when taking into account individual and organizational differences not addressed by the current study, such as personality traits, type of tasks, social support, and transitions between different work systems.

We also recommend conducting comparative studies on the (4x4) shift work psychological impacts in the field of individual and organizational differences, we specifically mention comparisons between (4x4) shift workers, daytime workers, and individuals switching between different work systems.

Conducting longitudinal studies is also necessary to determine whether the (4x4) shift work system implemented actually at Sonatrach petroleum company, contributes to the development of depression, anxiety and stress among workers. Such studies can be conducted by observing (4x4) shift workers for a sufficient period of time, and why not continue observing those who stop working under this system and switch to daytime work.

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