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Assessing the Relationships between Occupation Stress, Psychosocial Determinants and Work Ability in the Air Conditioning Assembly Industry

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***Abstract*—** *Purpose Occupational stress is one of the major phenomena that should be considered to maintain health and improve workforce productivity. The study was aimed for different task groups to determine the correlation between job stress, psychosocial factors and work ability. A cross-sectional study of 178 male workers in an air conditioning assembly factory was carried out. Three questionnaires— the work ability index (WAI), the Job Content Questionnaire (JCQ), and an instrument assessing work-related stress—were used to measure work ability, psychosocial group characteristics, and job stress, respectively. The maintenance and workshop group observed the highest occupational stress score at 161.3. The WAI of office employees group was excellent, and the other two groups had low scores in a "good" range of the WAI. The highest average JCQ score was obtained by the maintenance and workshop group, with a value of 132.8 ± 3.3. Low WAI was associated with a high occupational stress score. Workers among groups with low WAI had high JCQ scores. Generally, stress among worker groups was high, and the factory management should develop a plan to improve physical workload and safety conditions among the maintenance and production groups to enhance work ability.*

***Keywords*—** *Occupation stress, work ability, psychosocial factors, assembly industry.*

I. INTRODUCTION

Work-related stress is one of the common factors that impacts health and safety at the workplace. Stress at the workplace is considered a serious hazard that can lead to poor health, particularly in the industrial sectors [1], [2]. A mismatch between individual capabilities (i.e., physical and mental) and job demand increases the potential of stress hazard, which may cause health problems and performance deterioration [3], [4]. In addition to job demands, worker skill, experience, attitude and satisfaction levels contribute to task stress levels [2], [5]. Poor skills and lack of experience lead to low task control, which in turn leads to negative feelings and emotional status [4]. Job stress is defined as the negative physical, mental and emotional responses of workers at a workplace due to a mismatch between the requirements of a job and the capabilities of the workers [6]. Task stress leads to numerous health problems, such as mental illness, heart problems and musculoskeletal symptoms. Lost work days are one common result of occupational stress [7]. Occupational stress also negatively impacts worker performance and early retirement [2]. However, an overly low stress level can lead to poor performance, similar to high work-related stress, as a very low stress level produces low attention and impairs productivity among workers [3]. Organizations should try to reach a balance between worker's capabilities (i.e., physical and mental limitations) and their tasks, defined as the work ability index (WAI), to increase safety levels and decrease costs (i.e., loss of working days and medical expenses). Management should consider the concept of work ability, which refers to the consideration of the physical and mental capacities of workers and task demand [5], [8], [9]. Many researchers have demonstrated the low performance, physical health problems and poor psychological status associated with low WAI values [5], [10]. High occupational stress levels can impact worker safety and productivity, particularly in stressful jobs, such as those in the healthcare sector [11]. Habibi et al. [2] concluded that the high stress scores observed among workers in refineries led to low task control. A positive correlation has been found between task stress and unsafe acts and accidents among vehicle manufacturing workers [12].

In the assembly industry (i.e., a home air-conditioning and refrigerator assembly factory), the workplace involves numerous health and safety issues that can increase the level of stress; however, that level depends upon the work environment in a factory. For instance, chemical hazards in a painting workstation, high noise level, and inappropriate design (office workplace design) are all types of safety issues that can cause stress at a workplace [2]. The majority of tasks in a factory depend on manual activities, such as lifting heavy objects and pulling and pushing material between workstations (e.g., material handling tasks), and ergonomic hazards such as these increase the likelihood of stress among workers [5]. Many countries are considering the issues of occupation stress, safety climate and good working safety conditions, and ergonomics issues in various business sectors [3]. Because failure to consider all these issues at a workplace, in addition to task demands, increases the potential for accidents, poor performance, illness, and high stress levels, it can lead to high management costs [13].

The WAI is a common instrument that has been used widely to assess occupational work ability in different sectors, such as services [14] and health care [5], [15]. However, the effect of occupation stress on work ability in industrial sectors has not received considerable attention [2], [12]. Therefore, the current study was undertaken to identify the correlation between occupational stress and work ability in an assembly industry. Determination of the correlation between job stress and work ability helps top management to make improvements and intervene in a work environment to increase safety levels, productivity and worker satisfaction

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[16]. Stress can occur due to poor safety conditions, which negatively impact the perception of workers toward physical demand, mental demand and work satisfaction [5], [17]. Stress at the workplace causes numerous health problems (e.g., cardiovascular and psychological problems) and poor work ability. According to Fam et al. [12], high job stress reduces the level of attention, causing poor decision making and unsafe attitude and acts. Reduction of worker job satisfaction is associated with high stress job conditions [18]. Choobineh et al. [19] stated that psychosocial factors include different parameters, such as decision making, physical load, social relations and support, psychological load and workplace hazards. Therefore, increasing the level of stress could negatively influence these factors, causing decreased performance and raising health and safety problems. Lin et al. [20] found that there is a correlation between task stress and psychosocial problems and that heavy physical activity leads to unacceptable performance, health hazards and poor psychosocial status. Repetitive movement, sitting in awkward postures for long periods of time, and insufficient psychosocial conditions all contribute significantly to stress levels, which lead to body pain [20]. There is also a correlation between high physical activity, poor social support, task control, pain and performance [21]. However, the level of job stress depends on the type of task; thus, stressors at the workplace can involve different variables, such as personal relations at work, management rules and regulations, task autonomy, task workload (i.e., physical and mental demand) and working safety conditions [3], [13]. Other factors, such as age and level of education, can lead to work ability deterioration [5]. High work ability is associated with a high level of education [22]. Numerous studies have observed older people with low WAI values and high stress levels [23],[25]. Golubic et al. [15] demonstrated that nurses with a high level of education scored high on the WAI and had low job stress scores.

Many researchers have studied the effect of task stress on work ability in service sectors rather than industrial sectors [3], [12]. The correlation between job stress and psychosocial stress has not received considerable attention [20]. Consequently, the current study carries out a cross-sectional survey study to determine the relationship between occupation stress, work ability and psychosocial factors among different groups of workers in a factory assembling air-conditioners and refrigerators in Saudi Arabia. Determination of this type of correlation helps management to redesign jobs to satisfy the balance between workers' job demands, work ambience and environmental conditions.

II. Materials and Methods

A. Design

The present study is a cross-sectional field study designed to investigate the correlation between occupation stress, work ability and psychosocial issues among different groups of workers in an assembly industry. The study was implemented in two plants of an air-conditioning assembly organization in Saudi Arabia. The worker groups were divided depending on their function (office employees, production workers and maintenance and workshop workers). Office employees are individuals in the management departments (e.g., top management, sales and marketing department, human resource departments). Production workers are operations people who work in production areas and warehouses, and maintenance workers are the operators in repair workshops and are involved in activities such as painting, welding and electrical processes. The objectives of the study were explained to all the employees and workers who volunteered for the study. The study measured three dependent variables: WAI, job stress and psychosocial factors.

B. Study Participants

The study was conducted in two branches of an air-conditioning factory in Saudi Arabia from May to July 2015. All participants were male, and the sample size was 178 workers. The workers were divided into three groups: employees (43 office employees), maintenance and workshop workers (63 workers) and production workers (72 workers). The total number of workers in both assembly factories during the time of the study was 538 employees and workers. Three outcomes were measured: occupation stress, WAI and psychosocial status. A significance level of 0.05 with an error rate of 1 was selected to determine a suitable sample size. According to a study carried out by Bresic et al. [26], the standard deviation of the WAI was 2.9; this value was also used by Habibi et al. [2] with a sufficient number of participants (34 subjects). Habibi et al. [2] stated that the standard deviation of job stress in a previous field study was 6.52 and that the appropriate sample size was 171 subjects. For the final variable (psychosocial factors), the standard deviation was 4.5, and the sample size was 155 male subjects [20]. The demographic characteristics of the participants are provided in table I. All participants had at least one year of experience in the factory, the objectives of the study were explained to the participant as well as the informed consent was observed from all of them.

TABLE I. Demographic characteristics of the participant groups.

Variables	Employees (n=43)	Maintenance & Workshop Workers (n=63)	Operation Workers (n=72)
Age (year)	35.8±4.2	36.1±7.1	36.2±4.8
Period of employment in years (Mean ± SD)	3.1±2.3	4.2±3.4	4.9±2.7
Marital status n (%)			
-Single	19(44.2)	28(44.4)	38(52.8)
-Married	31(55.8)	35(55.5)	34(47.2)
Education Degree n (%)			
-High school	3 (6.9)	38 (60.3)	47 (65.3)
-Diploma	5 (11.6)	14 (22.2)	23 (31.9)
-BSc	27 (62.8)	11 (17.5)	9 (12.5)
- MSc	8 (18.6)	0 (-)	1 (1.4)

C. Questionnaires and Data Collection

Three types of questionnaires were used. First, an occupational stress questionnaire similar to that used by Fam et al. [12] was used. According to Phillip [27], the survey divides the factors leading to occupational stress into three

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categories: physical demands, interpersonal relationships and job interest. There were a total of 57 questions in the questionnaire. These were divided into the three above categories; the first 26 questions related to interpersonal relationships, physical demands and hazards were covered in questions 27 to 48, and the remaining questions related to job interest. Five scale terms (never, seldom, sometimes, often and most times) were used to respond to the questionnaire [27]. Habibi et al. [2] stated that this task stress questionnaire has been used widely to assess the job stress in different types of workplaces and in various tasks.

The work ability of different groups of workers was assessed by the WAI, which is an assessment tool that has been widely used to measure the ability of a worker to perform his/her task [16], [28]. This assessment tool covers different task- and worker-related factors, such as worker physical and cognitive limitations, physical task factors and worker health status [28]. The WAI comprises 7 sections of questions: questions related to the physical and mental loads required by a task, decrease in work due to illness, work ability prediction, and psychological resources. The WAI has been used to assess the work ability of various occupation groups [15]. The total WAI score is 49, and it is classified into four levels of scoring: scoring between 7 and 27 indicates poor work ability, 28-36 indicates intermediate work ability, 37-43 indicates good work ability and 44-49 indicates excellent work ability [5], [29].

As noted previously, the majority of the previous studies focused on the effect of task stress on work ability and neglected the psychosocial variables (e.g., worker decision capability, co-worker and supervisor support at a workplace) [30]. According to Lin et al. [20], high psychosocial stress at a workplace can lead to reduced performance as well as safety and health problems (e.g., accidents, psychological illness and physical pain). Psychosocial issues involve various items: physical task workload, cognitive workload, social support and workplace physical hazards [19], [31]. The Job Content Questionnaire (JCQ) tool was used in the study to measure the impact of occupational stress on psychosocial factors. Karasek et al. [31] noted that the JCQ has been widely used in studies to determine the effect of occupation physical load, stress and work environment on psychosocial issues. The JCQ assessment tool evaluates 5 main factors (decision latitude, physical job demands, psychological job demands, occupational physical hazards and social support) [32]. Decision latitude and physical job demands factors include 9 and 5 sub-factors, respectively. Psychological demands, occupational physical hazards and social support factors include 9, 8 and 8 sub-factors, respectively [20], [31]. In this tool, a 4-point Likert scale was used: strongly disagree, disagree, agree and strongly agree represented 4, 3, 2, and 1 points, respectively.

D. Data Analysis

The differences between the three groups of workers (office employees, production workers and maintenance and workshop workers) as measured by the stress questionnaire, WAI and JCQ assessment tools were determined by the Wilcoxon (signed-rank) test. The Kruskal-Wallis test was used to find the difference between the ages of these three study groups. The differences between the education levels of workers with respect to occupation stress and WAI was obtained by the Kruskal-Wallis test. The Pearson correlation coefficient was applied to determine the relationships between occupation stress, WAI and JCQ in all worker groups. The analyses were performed using statistical analysis SPSS (Version 22) software. A statistically significant level of $p < 0.05$ was applied in the analysis.

III. RESULTS

There were a total of 178 male participants in the study, and the age of participants ranged from 24 to 58 years old. According to the Kruskal-Wallis test, there was no significant difference in age among the three groups (maintenance workers, office workers and production workers; chi-square = 5.31, $p > 0.05$). The analysis results showed that high occupation stress was associated with low education levels among all worker groups. Higher WAI scores were obtained by workers with BSc degrees (43.8±4.1), followed by those with MSc degrees (42.1±3.3). The Wilcoxon test results indicated that the differences in the occupation stress scores between the MSc group and the high school group and between the BSc group and the high school group were significant ($p < 0.05$), as presented in figure 1. The MSc and BSc groups were observed to have significantly higher WAI scores than the high school group (31.8±3.8) (chi-square = 16.32, $p < 0.05$ and chi-square = 14.82, $p < 0.05$, respectively). The difference in the WAI scores between the MSc and BSc groups was not significant (chi-square = 3.18, $p = 0.126$). Also, the differences between high school group and diploma group (34.6±3.6) was not significantly (chi-square = 4.09, $p = 0.213$). However, the occupation stress questionnaire results showed that 83% of the workers scored a high level of stress at their job, whereas 13% of the total workers recorded intermediate levels of stress. Only 4% of workers scored a low score of 80.9, placing them in the low stress range.

Fig. 1. Occupation stress scores by level of education.

There were significant differences between workers groups in the factors assessed by the occupational stress questionnaire (interpersonal relationships, physical demands and hazards and job interest sub-scales). Job interest was the main factor that impacted employees, followed by the interpersonal relationship factor. Physical demands and hazards were

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considered a main factor among maintenance and workshop workers and production workers, as presented in table II. In general, maintenance and workshop workers had the highest levels of occupation stress, followed by production workers. In contrast, the office employees had the lowest occupation stress. Total occupation stress scores for the maintenance workers, production workers and office employees were 161.3, 159.7 and 155.1, respectively. Maintenance and workshop workers had the highest total occupation stress score. However, the scores of all groups were in a high stress range. The significant difference in the occupational stress scores of the maintenance workers group and employees appeared in the physical demands and hazards sub-scale ($p < 0.05$) and in the job interest sub-scale ($p < 0.05$) based on the Wilcoxon test analysis. There was no significant difference between the maintenance workers group and employees in terms of interpersonal relationships ($p = 0.081$). The Wilcoxon (signed-rank) findings showed that there were significant differences between the production workers group and employees in terms of physical demands and hazards ($p < 0.05$). However, the differences between the production workers group and maintenance workers group in all sub-scales of the occupation stress questionnaire were not significant ($p = 0.173$, $p = 0.094$ and $p = 0.106$ for interpersonal relationships, physical demands and hazards and job interest, respectively; see table II).

The WAI scores of the maintenance workers were the lowest, followed by those of production workers, as shown in table II. In contrast, the employees (office workers) had the highest WAI score, indicating that they have better work ability than the other groups. The Wilcoxon test results indicated that the significant difference in the WAI between workplace groups (maintenance workers and production workers) was not significant ($p = 0.124$). There was a significant difference between the maintenance workers and office employees and between the production workers and office employees ($p < 0.05$).

The JCQ assessment tool analysis indicated that the maintenance worker group obtained the highest psychosocial factor score, with a mean and standard deviation of 132.8 ± 3.3. The office employees had the lowest psychosocial score. According to the Wilcoxon (signed-rank) results, the physical job demands, psychological job demands and occupational physical hazards were the main psychosocial sub-factors in the maintenance workplace group. The significant differences in JCQ between groups were in the decision latitude sub-scale (office employees vs. maintenance workers and office workers vs. production workers; $p < 0.05$) and in the physical job demands, psychological job demands and occupational physical hazards sub-scales between the maintenance workers vs. office workers and production workers vs. office workers ($p < 0.05$) (see Table II). In contrast, the difference between maintenance workers vs. production workers was not significant for the physical job demands, psychological job demands and occupational physical hazards ($p = 0.117$, $p = 0.108$, and $p = 0.251$, respectively). There were no significant differences between the work groups in the social support sub-scale.

The Pearson correlation analysis indicated a significant negative correlation between the total occupation stress score and WAI ($r = -0.406$). The highest correlation coefficient between the occupation stress sub-scales and WAI was obtained in the physical demands and hazards sub-scale ($r = -0.548$), and it was negative. The correlation between the WAI and JCQ factors was significant. The physical job demands, psychological job demands and occupational physical hazards in JCQ were negatively correlated with the WAI (see Table III). There was a positive correlation between the factors in the JCQ (decision latitude and social support) and WAI. Total occupation stress was significantly positive correlated with the following JCQ factors: physical job demands, psychological job demands, and occupational physical hazards ($r = 0.362$, $r = 0.245$, and $r = 0.218$, respectively).

TABLE II. Mean (± SD) of all output measures (occupation stress, WAI and JCQ) for the three groups of workers.

Measures	Employees (n=43)	Maintenance & Workshop Workers (n=63)	Production Workers (n=72)
1.Occupation Stress			
-Interpersonal relationship	72.8±8.4	68.4±7.4	69.2±9.6
-Physical demands and hazards	52.4±5.8	69.5±8.4	65.7±10.01
-Job interest	29.9±4.6	23.4±5.1	24.8±5.6
2.Work ability index (WAI)	42.2±4.2	35.8±3.9	36.3±4.9
3.JCQ factors			
- Decision latitude	67.7±5.8	62.1±4.6	63.4±5.2
- Physical job demands	9.1 ± 3.1	15.4 ± 2.8	14.1 ± 3.8
- Psychological job demands	10.9 ± 2.8	16.4 ± 3.1	15.8 ± 3.7
- Occupational physical hazards	12.5 ± 2.9	20.4 ± 3.7	19.6 ± 3.2
- Social support	23.9 ± 2.3	21.1 ± 3.4	21.9 ± 4.1

IV. DISCUSSION

This study was conducted to investigate the relationship between occupation stress, work ability and psychosocial factors among industrial workers. It is considered unique in that it examines these correlations in Saudi Arabia. The results of the current study in the assembly industry indicate that a large percentage (83%) of all work groups was observed to have high occupational stress scores. This finding was consistent with the results of previous studies that showed a high stress level among automobile manufacturing workers [12]. In this study, subjects with higher levels of education had lower occupation stress in the three work groups (office employees, maintenance and workshops workers and production workers). Workers with higher degrees (MSc and BSc degrees) had significantly lower stress scores than workers with only a diploma and high school degree. The reason for this difference is that the employees with higher levels of education had the opportunity to make decisions, which reduces job stress. The high school work group recorded a higher level of stress than the diploma work group. These results are similar to those of several studies that stated

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that the impact of academic qualification on job stress and satisfaction of workers in different jobs (healthcare) is significant [5], [15]. The difference between the WAI of workers with BSc and MSc degrees was not significant, possibly because the number of workers with MSc degrees is low (9 out of 178). Numerous authors have stated that high work ability is associated with a high level of education among workers in various tasks [22]. The current study concludes that WAI and occupation stress scores were strongly affected by education levels among the worker groups.

The findings of this research study indicated that the three groups of workers displayed differences in occupation stress scores. The highest occupation stress score appeared in the maintenance and workshop work group, followed by the production work group. Physical demands and hazards area main stress sub-scale for the maintenance and workshop workers and production workers. Because the results showed no significant differences between the maintenance and productions groups in terms of physical demands and hazards sub-scale, the maintenance and workshop workplace and production area may involve a number of hazards, such as noise, temperature, heavy physical loads and chemical hazards. The findings of this study are consistent with an earlier study that concluded that physical loads and hazards are a main stress factor for workers in the maintenance section in a refinery industry [2]. Maintenance workers in the car manufacturing industry had a high task stress score [12]. In the present study, the employees work group scored the lowest in total occupational stress. Interpersonal relationships and job interest were considered as the main sub-scales for this work group. Habibi et al. [2] found that office workers, who were classified at the top level of the organization structure, have low levels of stress. Workers at a higher level of management are able to focus more on their tasks because they have the personal freedom to make decisions, low physical activity and a better environment than the other groups [3], [33].

The current WAI was significantly influenced by the type of work group; namely, the workers with higher levels of education had higher work ability than the other workers. The average total WAI of all workers was 38.1, which is in the "good" range of WAI score classification. This result is consistent with a number of previous research studies that observed a similar range of WAI scores in various tasks, such as fire fighters [34], construction [35] and the refinery industry [2]. According to the results of this study, the best WAI was associated with employees, and the lowest appeared in the maintenance and workshops work group. The characteristics of the office work environment, where heavy physical demands and physical safety hazards (noise, thermal conditions and lighting) are not present, as in maintenance and production workplaces, affect the work ability level of office workers. Increasing levels of physical loads and safety hazards at the workplace lead to reduced work ability [12]. As expected, the correlation between occupation stress and WAI was significant and harmful. This result is consistent with numerous research studies that demonstrate that the high stress levels at a workplace lead to poor work ability [10], [15].

Psychosocial factors were impacted by the type of work group. The maintenance and workshop group recorded the highest mean JCQ score (27.08 ± 3.8). The JCQ score of the production workers group was lower than that of the maintenance group, but there was no significant difference between the maintenance and production groups. The reason for this lack of significant difference may be that the maintenance and production workplaces involve heavy manual activities and a high likelihood of safety hazards. The employees group observed the lowest JCQ score (24.82 ± 3.3). In terms of JCQ sub-factors, decision latitude affected psychosocial status the most among office workers. In contrast, the major factors that affected psychosocial status among manufacturing and production worker groups were occupational physical hazards, psychological job demands and physical job demands. van den Berg et al. [16] stated that high physical workload at the workplace leads to poor psychosocial impact and poor mental health, which lead to unacceptable work ability. Increasing levels of stress are significant associated with poor relationships between workers and work advisors, a poor physical work environment and low job control [33]. Increasing the level of interpersonal relationships as a psychosocial sub-factor contributes significantly to WAI improvement [16]. High job load, awkward postures, unergonomic workplace design, and poor safety conditions lead to reduced work ability and negative psychosocial effects [20], [30], [36], [37]. The relationship between psychosocial factors and WAI has been proven. There was a highly negative correlation between physical job demands sub-factor in the JCQ and WAI (r = -0.362), followed by occupational physical hazards and the WAI (r = -0.267). These results are consistent with previous authors' findings that physical workload is one of the major factors impacting the WAI due to the increased levels of psychosocial stress [20], [35]. One study performed in a petrochemical factory showed that poor WAI resulting from high stress job demands damage the physical and mental ability of an individual in the long term [27].

V. Limitations of this Study

One of the major limitations of this research study was that the analysis of differences between genders was not considered. Because all of the workers are male, the results cannot be generalized to female workers. The impact of stress and differences between groups of workers (office employees, production workers and maintenance and workshop workers) was not considered in other outcome measures, such as job satisfaction, early retirement and loss of days among different groups of workers. According to previous research studies, few studies have investigated task stress and psychological demand among different tasks and the WAI in the industrial sector [2]. The correlation between psychosocial stress in different tasks and individual health and ability is not considered widely, as some studies consider semiconductor manufacturing and other studies consider office workers only (e.g., call center employees) [20]. Therefore, the current study considers the importance of examining the correlation of occupation stress, psychosocial factors and WAI in different

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task settings. This consideration will increase the reliability of these correlations in different types of work conditions.

VI. Conclusion

In conclusion, the present study determines the correlation between occupation stress, psychosocial factors and work ability in various workplace settings. Workers with higher levels of education had lower perceived occupational stress and higher WAI. Among air conditioning assembly workers, factors related to workplace type strongly influence stress level. A high level of WAI among workers was associated with lower occupation stress. Higher levels of occupation stress and lower WAI were observed among maintenance and workshops workers. In contrast, employees (i.e., office workers) had lower stress scores and higher work ability scores. Psychosocial variables were sensitive to workplace types, as high JCQ scores were reported in the maintenance workplace, whereas the office workplace had the lowest JCQ score. The difference in JCQ scores between the maintenance and production groups was not significant. High psychosocial factor scores significantly impacted the WAI. A relationship between JCQ score and occupation stress score was observed. The findings of this study suggest that the management of factories is required to establish a strategic plan to reduce heavy physical demands and improve safety conditions at maintenance and production workplaces. To increase the level of work ability among its employees, the management should consider specific training programs, especially those targeting office workers, to improve communication awareness and skills among all its employees.

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