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Assessment of Musculoskeletal Loads of Electric Factory Workers by Rapid Entire Body Assessment

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ABSTRACT

***Background**:* Work-related musculoskeletal disorders (WMSDs) are a leading cause of disability and workers compensations.
Objectives: The research was done in Tehran Pars-electric factory to prevent inducing WMSDs. Rapid entire body assessment (REBA) was carried out to assess musculoskeletal loads on workers due to their postures, repetition, and force. Nordic musculoskeletal questionnaire (NMQ) was also used to obtain prevalence of entire body disorders.
Patients and Methods: All 673 workers aged 19-49 with mean age of 32. 3 (SD = 11. 9 years): 355 males aged 25-49 with mean age of 38. 9 (SD = 7. 3 years); 318 females aged 19-33 with mean age of 25. 6 (SD = 9. 8 years) were examined. Total prevalence's wrists, lower arms, upper arms, neck, trunk and legs disorders were gained 606 (90%), 532 (79%), 472 (70. 1%), 345 (51. 3%), 243 (36. 1%), and 404 (60%) respectively (P = 0. 012).
Results: The number of tasks located in action levels of 2, 3 and 4 were 9, 11 and 12 tasks correspondingly. No tasks were placed in action level of 0 and 1. Thereby, further actions, ergonomic designing solutions, and multiple preventions are necessary.
ConclusionS: REBA tool is a useful and an applicable tool for assessing risk factors producing entire body disorders on workers performing various tasks in electric factory.

Implication for health policy/practice/research/medical education:

This article was aimed to assess the musculoskeletal loads of electronic factory workers by an ergonomic risk factors assessment tools so-called "Rapid Entire Body Assessment (REBA)". This technique can be used for evaluation of the dynamic tasks in ergonomics field that can be useful for ergonomists, occupational hygienists, occupational therapists, industrial designers, physiotherapists, rehabilitation specialists, and anthropologists.

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1. Background

Work-related musculoskeletal disorders (WMSDs) are attributed as the most prevalent disorders in many Iranian industries (1). Today, 67 percent of all Iranian workers have reported that they suffer from back pain; 46 percent from the upper limbs; and also 49 percent of them have reported that they are working in tiring or awkward positions (2). WMSDs is a term given to a group of disorders involving the muscles, joints, nerves and vascular compartments of the body, where certain jobs or work related factors have been shown to be associated with an increased risk of developing these disorders (3, 4). WMSDs are, by definition, a work-related phenomenon (5). Mus-

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culoskeletal disorders (MSDs) are the most common type of work-related ill-health problem in Great Britain. MSDs are defined as inflammatory disorders of the various body parts resulted in painful (6). Work-related MSDs as a commonly kind of MSDs are resulted from exposure to awkward postures (6). Besides of health effect of WMSDs, they can affect the productivity, efficiency and effectiveness of human work-forces as enhanced absence (4,6). However, a little attention has been made on the study of WMSDs on the workers' performance (4,6). Furthermore, WMSDs can influence on the well-being of workers as decreased work quality and performance (7, 8). Musculoskeletal diseases of the entire body that are considered to be 'work-related' (WMSDs) are generally multi-factorial in character (9). Work may significantly contribute to the onset of these diseases, but there may be other triggering causes (9). Disorders of the neck, upper limbs, back, and lower limbs are common problems in the general population as well as among industrial workers (10). In the general working populations, as many as one-third of women and one-quarter of men reported pain in the neck and shoulders which was present every day or every other day (10). Muscoloskeletal disorders mainly occur due to highly lads on body parts anatomical structures excessive the body structure strenght (11). Most studies reported that main generic physical risk factors involving in muscoloskeletal disorders are force, posture, repetition, contact stress and temperature (12). Certain jobs and certain work related factors are associated with a significant risk of predisposing a WMSD when compared with other population groups or groups not exposed to these risks (13). It is assumed that repeated movements and postures, static works, continuous loading on tissue structures or lack of recovery times can trigger or cause a pathological process that then manifests itself as a WMSD (12, 13).

Each exposure factor can be assessed if the magnitude/intensity, duration and frequency are known (11, 12). Repetition as a generic exposure factor for producing WMSDs should be considered in ergonomic risk assessment process (11,13). Some other generic exposure factors related to neck and upper limbs disorders include material handling, vibration, and task invariability (11, 13). The outcome of the generic exposure factor can be determined by knowing the magnitude and duration of exposure to that risk factor (4,7,12,14). This study was conducted to assess the entire body muscoloskeletal loads on workers of the electric factory doing various tasks by the rapid entire body assessment (REBA). Thereby, the final goal of the research was to classify various tasks on the basis of different actions levels and finally, to submit and suggest recommendations for correction of presenting workplace situations.

2. Materials and Methods

All 673 workers performing 32 various tasks in Tehran Pars-electric factory, which were potentially at ergonomic risk of entire body injuries, were investigated under an analytical-descriptive study. Time study was set on 13 May to 17 august 2011. Research participants were from administrative or operational jobs, all of them underwent a pre-interview for obtaining some information's about their job characterizations. Standardized Nordic musculoskeletal questionnaire (NMQ) was used to obtain the prevalence of subjects with various joint disorders include trunk, neck, legs, lower arms (forearms), upper arms, and wrists. Also the Rapid Entire Body Assessment (REBA) tool was applied for assessing workers entire body musculoskeletal risk factors associated with various tasks. Three expert occupational hygienists with 5-8 years' experience in ergonomic risk assessment were contributed in the study design and implementation.

2. 1. Nordic Musculoskeletal Questionnaire (NMQ)

There are several musculoskeletal questionnaires that can be used for achieving to the data and information about musculoskeletal disorders and their symptoms (12). Questionnaire-aided data gathering is inexpensive, quick and easy (12). Nordic musculoskeletal questionnaire (NMQ) is most currently used questionnaire for this purpose that has been proposed by Kuorinka and his colleagues in 1987 (12,15). It can also be used for determining incidence, prevalence, or occurrence rates and epidemiology of body regions musculoskeletal disorders resulted from un-ergonomic work situations and conditions and awkward postures. NMQ was used for detecting MSDs prevalence and symptoms. NMQ comprises questions about problems on the whole body and body part-specific questions (wrist, upper and lower arms, neck, trunk, and legs). A body "map" was also used to make it easier for workers to pinpoint to their problems in each body area. The reliability and validity of the standardized NMQ has been proved frequently in different studies from 1987 up to now.

2. 2. Rapid Entire Body Assessment (REBA)

REBA tool proposed by Lynn Mc Atamney and Sue Hignett (1995) provides a relatively simple means of assessing the risk of entire body disorders associated with a task (11, 13, 14). Thereby the tool combines posture and force assessments to provide a single score (11, 13, 14). Some advantages of REBA are:

- REBA is a sensitive tool for musculoskeletal risks by classifying the bodies to the parts (wrist, upper arm, lower arm, neck, trunk, and legs)
- REBA is useful for manual tasks risk assessment
- REBA proposes the prioritization for corrective measures according to risk assessment and risk level (11,13,14)

But some limitations, shortages and disadvantages of REBA are:

- REBA does not provide an integrated assessment of biomechanical risk factors;

• REBA can not steer to the effective controls as the function of severity of various risk factors present in different tasks or jobs (11, 14).

Therefore, REBA tool can be used for rapid assessment of entire bodies as evaluation of musculoskeletal loads due to posture, repetition and force (13, 14). It aids in evaluating jobs or tasks that may expose workers to entire body disorders (wrist, upper and lower arms, neck, trunk, and legs) (11, 13). In the REBA tool, the whole body parts are classified into two groups A and B (13, 14). The group A consisted of neck, legs, and trunk; and group B comprised of lower arms, upper arms, and wrist (13, 14). Initially, for anybody region, the corresponding score is obtained with respect to positions, movements, and gestures of each body region from the relative table (11, 13, 14). On the one hand, by knowing the group A score obtained from table A and the FORC/LOAD score, the final group A score is calculated; and on the other the final group B score is calculated by knowing the group B score gained from table B and the COUPLING/GRIP score (11, 13, 14). Also the score C is obtained from table C and knowing the final groups A and B scores. As there is a static posture, or action repetitiveness (more than 4 times per minute), or rapid posture changings or instability, a score 1 is added to the score C as and ACTIVITY score. Finally, the REBA score is calculated by adding score C to the “ACTIVITY score”. REBA accomplishes the aforementioned goals by providing a “Grand Score” which can be compared to five Action Levels (11, 13, 14). Many studies reported an acceptable reliability and validity of the REBA tool in various tasks or different jobs and found a good correlation between the REBA scores and NMQ results (11, 13, 14).

2. 3. Statistical Analysis

NMQ were completed through structured interview and then analyzed with SPSS v. 18. Besides NMQ analysis, the REBA tool was used to identify and evaluate harmful working postures. Two-sample Kolmogorov-Smirnov was served to determine the normality of collected data. One-way analysis of variance (ANOVA) was applied to multiple comparisons of NMQ prevalence or REBA scores between different tasks. Tukey’s honestly significant difference was used as a post hoc multiple comparison for seeking the differential NMQ prevalence or REBA scores. $P < 0.05$ was considered as statistically significant.

3. Results

The sample population consisted of 673 subjects, of whom 355 (52. 7%) were males with a mean age of 38. 9 (SD = 7. 3 years), minimum age of 25 years, and maximum age of 49 years, and 318 (47. 3%) were females with a mean age of 25. 6 (SD = 9. 8 years), minimum age of 19 years, and maximum age of 33 years (*Table 1*). The male/female ratio was 1:1. 1. Mean age (SD), minimum age, and maximum age of all working populations of the factory without discriminating by gender were obtained 32. 3 (11. 9), 19, and 49 years respectively ($P = 0.012$). The list of tasks assessed by REBA tool and NMQ method has been shown in *Table 2*. It was considered that the most population concentration was related to the task of chassis control aided monitor with a total frequency of 31 subjects (of whom 15 were males and 16 were females), and the least population concentration was related to the task of tape assembling with a total frequency of 14 subjects (of whom 8 were males and 6 were females). Also the table shows that the highest and the lowest mean age in male populations were related to the tasks of bobbin wrapping and placing TV image lamps in cabin correspondingly. On the other hand, the highest and the lowest mean age in female populations were related to the tasks of radio assembling and TV canal regulating respectively. The prevalence of subjects with entire body regions disorders divided by task type has been shown in *Table 3*. It was considered that the highest prevalence rate was corresponded to wrists regions and after that, the higher prevalence were allocated to lower arms (forearms), upper arms, legs (feet), neck, and trunk regions orderly. It was also observed that the highest (4. 3%) and the least (1. 9%) prevalence of wrists disorders were related to the tasks of chassis control aided monitor and tape assembling correspondingly ($P = 0.001$). The highest (3. 7%) and the least (1. 5%) prevalence of lower arms (forearms) disorders were allocated to the tasks of TV canal regulating and tape assembling respectively ($P = 0.037$). The highest (3. 4%) and the lowest (1. 5%) prevalence’s of upper arms disorders were related to the tasks of TV frame preparing and tape assembling correspondingly ($P = 0.006$). The highest (3. 1%) and the lowest (1%) prevalence’s of legs (feet) disorders were corresponded to the tasks of TV frame repairing and placing radio back cover respectively ($P = 0.023$). It was also considered that the highest (2. 5%) and the lowest (0. 9%) prevalence’s of neck disorders were related to the tasks of TV frame repairing and placing radio back cover orderly ($P = 0.008$). The highest (2. 1%) and the least (0. 3%) prevalence’s of trunk disorders were also allocated to the tasks of chassis control aided monitor and radio final control respectively ($P = 0.020$). Finally, it was quantified that the total prevalence’s of wrists, lower arms (forearms), upper

Table 1. Subdivision of the Population Samples by Gender and Other Characteristics

	Workers, No. (%)	Minimum Age, y	Maximum Age, y	Mean Age, y	Standard Deviation
Male	355 (52. 7)		49	38. 9	7. 3
Female	318 (47. 3)	25	33	25. 6	9. 8
Total	673 (100)	19	49	32. 3	11. 9

Table 2. List of Tasks Assessed With Two Mentioned Methods (REBA and NMQ [a])

	Code	Number of Workers			Mean Age, y	
		Male	Female	Total	Male	Female
Radio chassis assembling	T_1	10	11	21	38.3	29.7
TV chassis assembling	T_2	14	8	22	39.6	26.3
Electrical parts soldering	T_3	9	10	19	31.8	22.9
Observational chassis control	T_4	13	12	25	36.2	28.3
Chassis control aided ACT computer	T_5	8	11	19	30.8	24.1
Chassis control aided monitor	T_6	15	16	31	35.9	23.7
Tuner production	T_7	13	9	22	40.1	22.2
Bobbin wrapping	T_8	8	13	21	30.3	20.5
Loud speaker production	T_9	9	11	20	37.7	25.5
Coil Gaznik production	T_{10}	9	10	19	40.3	23.7
Electric parts repairing	T_{11}	12	13	25	37.1	26.3
TV frame preparing	T_{12}	13	15	28	41.6	26.2
TV image lamp preparing	T_{13}	16	11	27	33.7	22.7
Placing TV image lamp in cobin	T_{14}	9	12	21	45.1	28.9
Placing chassis in cabin	T_{15}	11	10	21	36.2	27.1
TV technical control	T_{16}	11	8	19	43.2	23.1
Radio technical control	T_{17}	13	10	23	1.1	28.1
Placing radio back cover	T_{18}	8	9	17	9.6	24.3
Placing TV back cover	T_{19}	10	9	19	40.8	26.1
Manual controlling & tapping	T_{20}	7	10	17	41.2	25.9
TV cabin preparing	T_{21}	10	11	21	40.6	23.7
Radio & tape record production	T_{22}	13	8	21	35.4	30.1
Resistance inserting	T_{23}	11	7	18	38.9	21.3
Wires connecting	T_{24}	12	9	21	35.3	20.9
IC_S inserting	T_{25}	9	8	17	32.7	29.1
TV assembling	T_{26}	9	8	17	30.5	31.3
Radio assembling	T_{27}	10	11	21	38.8	33.7
Radio waves regulating	T_{28}	13	8	21	38.3	23.5
TV canal regulating	T_{29}	16	10	26	33.4	20.1
Tape assembling	T_{30}	8	6	14	39.7	27.2
Radio final control	T_{31}	12	8	20	39.1	26.2
TV final control	T_{32}	14	6	20	43.1	27.1

[a] Abbreviations: NMQ ; Nordic musculoskeletal questionnaire, REBEA; Rapid Entire Body Assessment

Table 3. Prevalence of Subjects With Entire Body Regions Disorders Divided by Task Types

	Wrists		Lower Arms (Forearms), No. (%)	Upper Arms, No. (%)	Neck, No. (%)	Trunk, No. (%)	Legs (Feet), No. (%)
Radio chassis assembling	19	2. 8	18 (2. 7)	17 (2. 5)	13 (1. 9)	10 (1. 5)	15 (2. 2)
TV chassis assembling	21	3. 1	20 (3)	18 (2. 7)	15 (2. 2)	9 (1. 3)	17 (2. 5)
Electrical parts soldering	16	2. 4	13 (1. 9)	12 (1. 8)	11 (1. 6)	8 (1. 2)	11 (1. 6)
Observational chassis control	23	3. 4	23 (3. 4)	22 (3. 3)	17 (2. 5)	13 (1. 9)	20 (3)
Chassis control aided ACT computer	17	2. 5	15 (2. 2)	15 (2. 2)	12 (1. 8)	10 (1. 5)	14 (2. 1)
Chassis control aided monitor	29	4. 3	21 (3. 1)	19 (2. 8)	15 (2. 2)	14 (2. 1)	18 (2. 7)
Tuner production	21	3. 1	20 (3)	17 (2. 5)	14 (2. 1)	10 (1. 5)	15 (2. 2)
Bobbin wrapping	19	2. 8	17 (2. 5)	15 (2. 2)	11 (1. 6)	7 (1)	12 (1. 8)
Loud speaker production	18	2. 7	12 (1. 8)	12 (1. 8)	9 (1. 3)	5 (0. 7)	11 (1. 6)
Coil Gaznik production	17	2. 5	15 (2. 2)	13 (1. 9)	5 (0. 7)	3 (0. 4)	10 (1. 5)
Electric parts repairing	23	3. 4	20 (3)	18 (2. 7)	14 (2. 1)	4 (0. 6)	16 (2. 4)
TV frame preparing	25	3. 7	23 (3. 4)	23 (3. 4)	17 (2. 5)	13 (1. 9)	21 (3. 1)
TV image lamp preparing	23	3. 4	20 (3)	17 (2. 5)	14 (2. 1)	12 (1. 8)	14 (2. 1)
Placing TV image lamp in cobin	17	2. 5	17 (2. 5)	15 (2. 2)	10 (1. 5)	9 (1. 3)	13 (1. 9)
Placing chassis in cabin	18	2. 7	16 (2. 4)	14 (2. 1)	10 (1. 5)	8 (1. 2)	12 (1. 8)
TV technical control	17	2. 5	15 (2. 2)	13 (1. 9)	8 (1. 2)	4 (0. 6)	11 (1. 6)
Radio technical control	21	3. 1	17 (2. 5)	13 (1. 9)	8 (1. 2)	5 (0. 7)	10 (1. 5)
Placing radio back cover	16	2. 4	13 (1. 9)	11 (1. 6)	6 (0. 9)	3 (0. 4)	7 (1)
Placing TV back cover	17	2. 5	14 (2. 1)	12 (1. 8)	10 (1. 5)	6 (0. 9)	11 (1. 6)
Manual controlling & tapping	15	2. 2	14 (2. 1)	11 (1. 6)	8 (1. 2)	5 (0. 7)	9 (1. 3)
TV cabin preparing	20	3	18 (2. 7)	15 (2. 2)	12 (1. 8)	8 (1. 2)	13 (1. 9)
Radio & tape record production	19	2. 8	16 (2. 4)	14 (2. 1)	9 (1. 3)	8 (1. 2)	10 (1. 5)
Resistance inserting	17	2. 5	14 (2. 1)	11 (1. 6)	8 (1. 2)	6 (0. 9)	10 (1. 5)
Wires connecting	20	3	17 (2. 5)	15 (2. 2)	11 (1. 6)	8 (1. 2)	13 (1. 9)
IC_S inserting	15	2. 2	14 (2. 1)	12 (1. 8)	10 (1. 5)	9 (1. 3)	10 (1. 5)
TV assembling	14	2. 1	12 (1. 8)	11 (1. 6)	8 (1. 2)	3 (0. 4)	11 (1. 6)
Radio assembling	19	2. 8	18 (2. 7)	18 (2. 7)	13 (1. 9)	12 (1. 8)	16 (2. 4)
Radio waves regulating	18	2. 7	15 (2. 2)	13 (1. 9)	10 (1. 5)	8 (1. 2)	11 (1. 6)
TV canal regulating	24	3. 7	25 (3. 7)	18 (2. 7)	10 (1. 5)	9 (1. 3)	13 (1. 9)
Tape assembling	13	1. 9	10 (1. 5)	10 (1. 5)	8 (1. 2)	5 (0. 7)	9 (1. 3)
Radio final control	18	2. 7	16 (2. 4)	16 (2. 4)	9 (1. 3)	2 (0. 3)	10 (1. 5)
TV final control	17	2. 5	14 (2. 1)	12 (1. 8)	10 (1. 5)	7 (1)	11 (1. 6)
Total	606	90	532 (79)	472 (70. 1)	345 (51. 3)	243 (36. 1)	404 (60)

Table 4. Prevalence of Subjects With Entire Body Regions Disorders Divided by Task Types

	Group A Score				Group B Score				
	Trunk	Neck	Legs	Force/Load	Upper Arms	Lower Arms	Wrists	Coupling/Grip	Activity Score
Radio chassis assembling	3	2	3	2	6	2	2	0	
TV chassis assembling	2	3	4	0	4	1	3	1	0
Electrical parts soldering	5	2	1	1	2	2	2	2	1
Observational chassis control	4	2	2	2	1	2	1	3	1
Chassis control aided ACT computer	1	1	3 3	2	2	1	2	2	2 0
Chassis control aided monitor	1	3		2	2	1	3	3	0
Tuner production	3	2	4	3	3	2	1	1	0
Bobbin wrapping	2	3	4	1	3	2	2	0	1
Loud speaker production	1	1	2	2	1	2	2	2	2
Coil Gaznik production	4	3	2	3	2	1	1	2	1
Electric parts repairing	3	3	1	1	2	1	2	0	2
TV frame preparing	1	2	3	3	1	1	2	1	0
TV image lamp preparing	2	3	2	2	4	2	1	3	1
Placing TV image lamp in cobin	2	3	2	1	4	1	3	3	3
Placing chassis in cabin	2	2	2	3	5	2	3	3	0
TV technical control	1	2	1	2	4	2	3	3	1
Radio technical control	5	1	3	0	3	2	2	0	1
Placing radio back cover	3	1	2	1	2	1	1	1	0
Placing TV back cover	1	3	2	3	5	2	2	2	2
Manual controlling & tapping	2	2	2	2	4	2	1	2	1
TV cabin preparing	3	3	3	0	3	2	2	1	2
Radio & tape record production	2	3	3	1	2	2	3	1	0
Resistance inserting	4	2	4	2	6	1	3	3	1
Wires connecting	2	1	2	2	1	1	3	3	2
IC_s inserting	5	1	1	1	2	1	3	2	3
TV assembling	4	1	4	0	3	2	3	1	0
Radio assembling	4	3	4	3	1	2	1	1	1
Radio waves regulating	3	2	1	2	2	1	1	1	0
TV canal regulating	1	2	1	1	3	2	2	3	1
Tape assembling	2	2	3	3	1	1	1	2	2
Radio final control	2	2	4	0	4	2	2	0	0
TV final control	2	1	2	2	5	1	3	1	0

Table 5. Determining Grand Score, Risk Level, Action Level and Further Actions of Various Tasks Presented

	Final Group A Score	Final Group B Score	Score C	Activity Score	Grand Score	Action Level	Risk Level	Further Actions
Radio chassis assembling	8	9	10	1	11	4	Very high	Necessary Now
TV chassis assembling	7	6	9	0	9	3	High	Necessary Soon
Electrical parts soldering	7	5	9	2	11	4	Very high	Necessary Now
Observational chassis control	8	4	9	1	10	3	High	Necessary Soon
Chassis control aided ACT computer	5	4	5	2	7	2	Medium	Necessary
Chassis control aided monitor	7	6	9	0	9	3	High	Necessary Soon
Tuner production	10	5	11	1	12	4	Very high	Necessary Now
Bobbin wrapping	8	5	10	2	12	4	Very high	Necessary Now
Loud speaker production	4	4	3	3	6	2	Medium	Necessary
Coil Gaznik production	10	1	10	0	10	3	High	Necessary Soon
Electric parts repairing	6	3	6	1	7	2	Medium	Necessary
TV frame preparing	6	1	6	0	6	2	Medium	Necessary
TV image lamp preparing	7	8	10	1	11	4	Very high	Necessary
Placing TV image lamp in cobin	6	8	9	2	11	4	Very high	Necessary
Placing chassis in cabin	7	11	11	0	11	4	Very high	Necessary
TV technical contro	3	10	8	0	8	2	Medium	Necessary
Radio technical control	7	5	6	0	9	3	High	Necessary Soon
Placing radio back cover	5	2	4	1	5	2	Medium	Necessary
Placing TV back cover	6	10	10	1	11	4	Very high	Necessary Now
Manual controlling & tapping	6	7	9	2	11	4	Very high	Necessary Now
TV cabin preparing	7	6	9	0	9	3	High	Necessary Soon
Radio & tape record production	7	5	9	0	9	3	High	Necessary Soon
Resistance inserting	10	12	11	0	11	4	Very high	Necessary Now
Wires connecting	5	5	6	1	7	2	Medium	Necessary
IC_S inserting	5	5	6	2	8	3	High	Necessary Soon
TV assembling	7	6	9	1	10	3	High	Necessary Soon
Radio assembling	12	2	12	2	14	4	Very high	Necessary Now
Radio waves regulating	6	2	6	0	6	2	Medium	Necessary
TV canal regulating	2	8	6	1	7	2	Medium	Necessary
Tape assembling	8	3	8	3	11	4	Very high	Necessary Now
Radio final control	6	6	8	0	8	3	High	Necessary Soon
TV final control	5	9	9	1	10	3	High	Necessary Soon

arms, legs (feet), neck, and trunk disorders were obtained 606 (90%), 532 (79%), 472 (70. 1%), 404 (60%), 345 (51. 3%), and 243 (36. 1%) respectively (P = 0. 039).

Personal data of workers performing tasks examined by study and assessment of risk factors for WMSDs has been shown in *Table 4*. As it shows, group A and group B scores were calculated separately. *Table 5* represents final group A and group B scores, and score C was calculated from aforementioned procedure, and activity score to obtain REBA or Grand score and its action level, risk level and further actions that are necessary for correcting tasks to prevent from exacerbating and inducing WMSDs. It is seen from the *Table 5* that the highest (12) and the lowest (2) of final group A score were corresponded to the tasks of radio assembling and TV canal regulating correspondingly. Also the highest (12) and the least (1) of final group B score were related to the tasks of resistance inserting and TV frame preparing. Also it was observed that the highest (12) and the lowest (3) of score C were allocated to the tasks of radio assembling and loud speaker production. The activity scores were varied depending on various workplace situations. Finally, the sixth column shows the Grand score calculated from adding up the score C and activity score, and the highest Grand score (14) was obtained for the task of radio waves regulating. Also the least Grand score (5) was gained for the task of placing radio back cover. Thereby, 9 tasks were located in action level 2 with medium risk level; 11 tasks were posed in action level 3 with high risk level; 12 tasks were placed in action level 4 with very high risk level; and neither of tasks were placed in action levels 0 and 1 (*Table 5*).

4. Discussions

Compared to epidemiologic researches on some other chronic diseases, such as malignancies or coronary heart diseases, epidemiology of musculoskeletal disorders has relatively short tradition (9, 16). Interest in this area of research has increased only during the past twenty years, although some of the classic studies data, back to the 1950s (9, 16). One explanation is that only during the past 20 years musculoskeletal diseases have started to be considered as a major public health problem. Another possible issue is that a researcher in this field is facing some particularly difficult problems. As it was observed, the research showed that prevalence of entire body musculoskeletal disorders were very high and most of the present tasks were needed to exert further actions and ergonomic designing solutions to correct situations or eliminate presented risk factors for preventing WMSDs. Therefore, knowledge about the epidemiology of work-related musculoskeletal disorders of the whole body is important for different types of prevention as well as for handling medical issues (10, 16, 17, 18). Redesigning the workplaces or work systems for promoting and improving worker health via knowing the risk factors of entire body disorders is primary prevention of REBA risk level control (17, 18). By using epidemiological methods, there can be identified the risk factors and their magnitude that can be used for prioritization of where initiation and implementation of change at work is most needed (18, 19). Early workplace rehabilitation via knowledge of the diagnosis of different entire body segments is secondary prevention of REBA risk level control (10, 19). Knowledge about risk factors for preventing disability is essential issue for fitness of injured workers with workplace and their assigned works (18, 19). Considering the high prevalence of WMSDs in exposed individuals, it is possible to conclude that it could be a sign of the presence of especially occupational risk factors presence (9). Three categories of preventive measures including structural, organizational, and educational measures can be proposed for minimizing WMSDs in REBA technique (19). Structural measures can be referref to modifying the layout of the work equipment that can be associated to improve the ergonomic layout of the work tools and equipment (9, 19). While organizational measures can be attributed to job design that can be accompanied by adequate recovery periods (19). Educational and training programs for the workers and supervisors made it possible to identify a suitable plan and schedule of measures taking into due consideration the impact of the plan on production levels and costs (16,19, 20). Analysis and re-design of tasks and training, matching tasks with WMSDs, timetable for returning WMSD- affected workers to the workforce, and enhancing worker awareness can steer us to prevent WMSDs of the upper limbs and the relative subsequent effects on working populations and to enhance workers efficiency, productivity and health (19, 20). Therefore, it is quantified that the REBA tool is a useful and an applicable tool for assessing risk factors producing entire body disorders on workers performing various tasks in the electric factory and the results obtained from NMQ method verify the mentioned expressions (13, 14). Also, the REBA seems to be a useful tool for assessment of musculoskeletal loads and classifying different tasks on various action levels (13, 14). This study showed that REBA is a practical tool for rapid entire body assessment, but it does not propose the preventive solutions for controlling ergonomic exposure factors. Therefore, auxiliary methods (such as OWAS, NIOSH, and Posture targeting, Biomechanical models) can be helpful for achieving to further information about preventive ergonomic solutions (20).

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Authors' Contribution

Authors work equally.

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