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Determining Functional Hand Capacity in Textile Workers in Different Departments

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Abstract: The aim of this study, which was carried out in the Textile Department of the Denizli Printing and Dyeing Industry Inc., was to compare ergonomic work analysis findings in which the functional hand capacity of workers and working conditions were evaluated.

A total of 225 textile workers (143 women and 82 men) were included in our study. The working conditions were evaluated by ergonomic work analysis. The functional hand capacities of the workers were evaluated by the Valpar Upper Extremity Range of Motion Test and the Purdue Pegboard Test. The results that were obtained were interpreted by the statistical methods of Pearson correlation analysis, step-wise regression analysis and Tukey's HSD. The results show that it is essential that both the standard tests that are to be applied and the ergonomic analysis play a role in the determination of work standards and in employing personnel.

Key Words: Textile Industry, Ergonomic Work Analysis, Functional Evaluation.

Introduction

The textile industry, in Turkey is of great value due to the work force it comprises and the income it generates. The excess of human resources in many different departments in the industry bring together the concepts of "Ergonomic Work Analysis" and "Functional Hand Capacity". It is without doubt that work output will be higher in workers employed by certain standard tests in a textile factory with ergonomic convenience, workers' musculo-skeletal complaints will decrease, and the quality and quantity of work will increase, as will income (1,2,3,4).

A full capacity textile factory mainly comprises the cutting, sewing, counting, first control check, second control, pressing, packaging, matching, labelling and sampling departments. Fabrics that enter the factory are cut in the cutting room according to the size of the textile products to be produced, sewn in the sewing department and then counted. Quality Control is the department where the completed textile products are classified into 1st, 2nd and 3rd quality and substandard. Faultless products are classified as 1st quality and following pressing and packaging are sent off as export goods or for superior presentation. Faulty products that can be corrected are returned to the production departments. In the final step, after pressing and packaging, the finished goods are matched and distributed.

In determining the work capacity a detailed ergonomic work analysis must be carried out (2, 3). The main point is the assesment of working conditions such as the amount of material being used, the suitability and size of the tools and equipment and the work room conditions (space, noise, light, size of work-benches and chairs) using a detailed work analyis. From the point of view of the workers, conditions such as the suitability of the individual's antropometric conditions to the work table, chair and work-benches, the suitability of the work room and working conditions, hand eye coordination, which affects working capacity, mathematical abilities, visual-auditory differentation, problem solving and psychological motivation are also evaluated within the work analysis (1,4,5).

In determining the work capacity of a working individual, some objective and standard tests are also used together with work analysis. The Valpar Upper Extremity Range of Motion Work Sample evaluates an

individual's ability to reach into 1-foot-square box and manipulate small and large nuts onto bolts. This work samples requires the individual to flex, extend, and radially and ulnarly deviate the wrist. The test requires manipulation of the small subjects with vision occluded. Therefore this test provides valuable information concerning the patient's ability to compansate for sensory deficits. The Purdue Pegboard Test was designed to test the dexterity needed for potential employees to perform jobs, such as assembly work, packing, or machine opperation. Tip-pinch dexterity and the ability to reach when seated at table height are assessed. The equipment needed includes a stopwatch, the testing board with the pieces, and the standardized instruction manual. The pegboard has a row of four recessed cups that contain pegs, washers, and collars. The latest normative data available are based on a one-trial procedure. The norms are categorized by sex, specific jobs, such as assembly workers, and hand dominance. Additional norms are available for children, for those who are mentally disabled, and for candidates for vocational rehabilitation. In countries where these tests are used, there are standard values belonging to these tests which have been obtained from various industrial work environments. These values enable ill or disabled individuals to be compared to normal workers and people according to work, sex, dominant hand and working habits (3,4,5).

Material and Method

The aim of this study, carried out on workers in the Textile Department of the Denizli Printing and Dyeing Industry Inc., was to compare the functional hand capacity of workers in 9 different departments within the Textile Department by ergonomic work analysis.

At the beginning of our study, the workers were examined according to work place and conditions. Included in the ergonomic work analysis were social security status, daily and weekly working periods, daily break periods, employment periods and insurance periods, and sizes of the the work-bench, material and equipment, along with employees' illnesses and operation cases. After this, a total of randomized 225 workers (143 women and 82 men) working in the Textile Department were put under detailed evaluation. 225 workers selected at random from nine departments in equality for convenient on statistical analysis. The total number of workers were 446. The workers' functional hand capacity values were obtained with the Valpar Upper Extremity Range of Motion Test and the Purdue Pegboard Test. For each test, a monthly average value was obtained from trials carried out three times a month. And the average values compared with individual's test scores obtained from each subtests in each departments. In table 1 and 2, comparison of values in each departments were presented. Results were interpreted by the statistical methods of the Pearson correlation analysis and step-wise regression analysis.

Findings

A total of 225 workers (143 women and 82 men) who work in the Textile Department of the Denizli Printing and Dyeing Industry Inc. were included in our study. The workers' average age was 18.22±3.01 years. As a result of the ergonomic work analysis we carried out, we found that, outside the sewing department, all workers worked standing up and that 83% used their right hands and 17% their left dominantly. The daily working time was 9 hours and daily breaks amounted to 1 hour and 20 minutes. 86.7% of the workers had previously worked in a different job and had been given no training before this employment. The findings obtained from the ergonomic work analysis are shown in Table 1.

At the end of our study, we interpreted the Valpar Upper Extremity Range of Motion Test results obtained from each department and the Ergonomic Work Analysis findings using Pearson correlation analysis, Turkey's HSD and step-wise regression analysis. Trial scores and average monthly test values were repeated three times and a significant relationship was found between these two values in the 1st quality, 2nd quality and sewing and cutting departments ($p<0.05$). Also, in terms of the average test values alone, a meaningful relationship was found in the 1st quality, sewing and cutting departments ($p<0.05$). When the ergonomic work analysis and sub-test values belonging to both tests were compared, a meaningful relationship was found between the working period in the job and all the Valpar Upper Extremity Range of Motion Test assembly-removal processes and all the Purdue Pegboard Test subtests ($p<0.001$). The findings of the Valpar Upper Extremity Range of Motion Test are shown in Table 2, and findings of the Purdue Pegboard Test are shown Table 3.

Discussion and Result

Our study was carried out on 225 workers selected at random from the Textile Department of the Denizli Printing and Dyeing Industry Inc. When the textile industry is examined, it is clear that most of the workers

are women likewise in the factory we studied most of the textile workers were women. As in almost every work place in our country, this factory was made to accommodate male workers, so it was difficult for female workers to reach over the work benches when using the material and equipment. Bullock has stated that women who work under non-ergonomic conditions do not have the necessary ability in stretching, grasping, lifting and holding activities in work rooms designed according to the size of male workers (6). Our results have been affected by the fact that 86.7% of the workers previously held different jobs, and by test values obtained from department workers whose working time was different from the others. The fact that all textile workers, except those in the sewing department, use the same upper extremity and hand movements, work in the same posture and have identical daily working periods, has not caused individual differences in our test results.

On the other hand, when the workers included in this study are examined in terms of working posture, it is interesting to see that these workers spend the whole of their 9-hour daily working time standing up, while having only 80 minutes' resting time. Colligan, Corlett and Hoffman (7, 8, 10) have stated that long working periods, combined with inadequate rest time, decrease motivation, ability and concentration.

In our study, we considered the use of various objective and standard tests in order to evaluate the speed, coordination, endurance and ability of the upper extremity. After our investigations were completed, we decided that the most suitable tests would be The Jebsen Hand Function Test, The Purdue Pegboard Test, Valpar Work Samples and the Minnesota Rate of Manipulation Test. Speed, coordination and dexterity are focused on in the Jebsen Hand Function Test, the Purdue Pegboard Test and the Minnesota Rate of Manipulation Tests, as well as the detailed time measurements made with a chronometer (9). The Purdue Pegboard Test was first used in 1948 to evaluate the ability necessary for workers in their upper extremity to enable them to do such jobs as assembling, packaging and sewing. The aim of the test is to assess grasping with three fingers and with the fingertips according to speed and coordination. The test has four subtests (11). The Valpar Work samples are a series of standardized tests that evaluate the patient's work abilities numerically. These standard tests have been organized to assess specific physical movements used in many industrial jobs, i.e., stretching, grasping and manipulating. Out of 19 tests designed for this purpose, the Valpar Upper Extremity Range of Motion Test, which we used in our study, is the most commonly used test and contains 8 subtests. Because of the test involving the grasping of two different types of object and dealing with speed, coordination and motor ability, it can be used for both job evaluation and education (11, 12, 13).

Table 1. Findings according to the Ergonomic Work Analysis.

	n	Upper&lower limits	median	x ± sd
Age (year)	25	14-23	19.02	18.22 ± 3.01
Working period in job (year)	25	2-7	4.23	4.27 ± 1.11
Daily working period (hour)	25	6-12	8.83	9.11 ± 2.02
Daily break (minute)	25	68-91	79.47	80.05 ± 3.24

Table 2. Comparison of the textile departments' results using the Valpar Upper Extremity Range of Motion Test.

	n	t	p
Cutting	25	2.77	< 0.01
Sewing	25	2.06	< 0.05
Counting	25	1.41	> 0.05
1st quality	25	2.20	< 0.05
2nd quality	25	2.47	< 0.05
Pressing	25	1.28	> 0.05
Packaging	25	1.34	> 0.05
Matching	25	1.88	> 0.05
Sample	25	1.75	> 0.05

Table 3. Comparison of the textile departments' results using the Purdue Pegboard Test.

	n	t	p
Cutting	25	2.26	< 0.05
Sewing	25	3.70	< 0.001
Counting	25	1.72	> 0.05
1st quality	25	2.06	< 0.05
2nd quality	25	1.96	< 0.05
Pressing	25	1.32	> 0.05
Packaging	25	2.36	< 0.05
Matching	25	1.63	> 0.05
Sample	25	1.31	> 0.05

On completion of our study, there was a meaningful relationship between all the subtest results in the monthly trial scores and average monthly test values in the 1st quality, 2nd quality and sewing departments, according to both standard test results, because the upper extremity movements of workers in these three departments are necessary movements for these tests. Workers making the same upper extremity movements during our study were successful in our tests. Workers employed in fabric cutting and machine using were successful in all our tests, especially in the Purdue Pegboard Test. As described in the the Dictionary of Occupational Titles, standard job evaluation tests are designed to assess the upper and lower extremity separately or together and are designed for all job groups (14). Because there are no standard test values for textile and sewing workers in our country, we were unable to compare the test scores we obtained with comparable values.

We attempted to create a source for future studies by offering factory management the necessary recommendations and cautions for determining specific qualifications when employing working standards to be adjusted according to certain norms and redesigning non-ergonomic working conditions. We also believe that the objective and standard tests used in our study should play a determining role in future job recruitment and that standard values for these tests should be determined for Turkey.

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