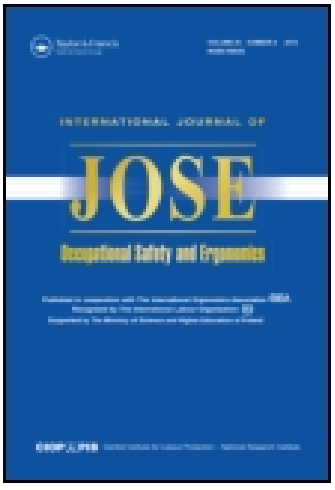

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Chronic Musculoskeletal Disorders as Risk Factors for Reduced Work Ability in Younger and Ageing Workers

Joanna Bugajska[a] & Adam Sagan[b]
[a] Central Institute for Labour Protection - National Research Institute (CIOP-PIB), Poland
[b] Cracow University of Economics, Poland
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Joanna Bugajska

Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland

Adam Sagan

Cracow University of Economics, Poland

Aims. *The aim of the study was to assess the occurrence and intensity of musculoskeletal pain as a risk factor for reduced work ability.* ***Methods.*** *In total, 1449 workers participated in the study, 64% were younger workers (<45 years old,* M *31.4); 36% were ageing workers (≥45 years old,* M *50.3), Their health condition was established on the basis of (a) subjective feeling of health on a 5-point scale, (b) pain in 6 parts of the body in the past year; and (c) intensity of pain on a 100-mm visual analogue scale (VAS). Work ability was assessed with the subjective work ability index (WAI).* ***Results.*** *The results of the study showed that although in the both groups, i.e., younger and ageing workers, the occurrence and intensity of pain in the hands/wrists, neck and lower back were a significant factor which decreased WAI, in ageing workers only the occurrence of pain in the lower back generated higher risk factors for reduced work ability (WAI < 37).* ***Conclusions.*** *Improving physical and psychosocial working conditions to reduce musculoskeletal complaints, and identifying individuals with such complaints are important in increasing workers' work ability and thus extending their occupational activity.*

ageing reduced work ability musculoskeletal disorders pain intensity

1. INTRODUCTION

Demographic changes in the society always entail epidemiological changes: in each ageing society, an increasing number of people suffer from chronic age-related diseases. Cardiovascular diseases and musculoskeletal disorders (MSDs) are the most common chronic age-related diseases; for years they have been the medical basis for workers being declared (for the first time) totally unable to work, regardless of the type of their work [1]. In 2013, nearly 1 million Polish workers complained of work-related muscle pain in the neck, shoulders, arms and hands [2]. MSDs, even if not work-related, are "one of the main causes of activity restriction, functional loss, and disability" (p. 3831) [3]. As many as 44% of workers experience muscle pain which impairs their ability to work [4]. A study of a representative sample of actively working Finnish adults showed that multisite pain generated considerable risk for reduced self-perceived work ability [5] and, additionally, multisite pain at baseline strongly predicts poor work ability after 4 years among industrial workers [6].

The paper was based on the results of a research task carried out within the scope of the third stage of the National Programme "Improvement of safety and working conditions" partly supported in 2014–2016—within the scope of research and development—by the Ministry of Science and Higher Education/National Centre for Research and Development. The Central Institute for Labour Protection-National Research Institute was the Programme's main co-ordinator.

Correspondence should be sent to Joanna Bugajska, CIOP-PIB, ul. Czerniakowska 16, 00-701 Warszawa, Poland. E-mail: jobug@ciop.pl.

It is, therefore, important to ask how musculoskeletal disorders, for which the most common symptom is pain, affect social activity and work ability, especially in ageing workers.

The aetiology of musculoskeletal pain is complex. It may be a symptom of serious MSDs, not related to the type of work, and it can result from excessive risk factors in the working environment. In both cases, musculoskeletal complaints affect workers' well-being and physical activity, thus deteriorating their quality of life and work ability. According to Salonen, Arola, Nygård, et al.'s prospective study, employees who retired before their statutory retirement age assessed their work ability as work ability index (WAI) = 34.9, i.e., *moderate*, while workers retiring at the statutory age or later evaluated their work ability as WAI = 39.3, i.e., *good* [7].

The relevant literature lists a number of work factors that cause musculoskeletal complaints. The main ones are physical: high repeatability of work tasks, prolonged awkward posture at work, considerable force developed at work and local vibration [8, 9, 10]. The risk for musculoskeletal pain also rises under conditions of psychosocial stress, e.g., time pressure, low level of job satisfaction, lack of control with high requirements, and insufficient social support. These factors enhance the adverse effect of excessive mechanical burden since they increase muscle tension and hinder co-ordination of movements [11, 12, 13, 14, 15, 16]. Many of those factors are also risk factors for decreased work ability [17, 18, 19, 20].

The aim of the study was (a) to assess the influence of health condition described with subjective feeling of health, and the occurrence and intensity of musculoskeletal pain on the work ability index (WAI) in younger and ageing workers, and (b) to assess the occurrence and intensity of musculoskeletal pain as a risk factor for reduced work ability (WAI < 37).

2. METHODS

2.1. Study Population

The questionnaire study was administered by occupational medicine personnel during periodic, preventive medical examination. Workers who reported successively for follow-up preventive examinations (and agreed to participate in the study) obtained a questionnaire to fill in.

In total, 1449 questionnaires with complete information on health condition and WAI were analysed. Thirty-six percent of total group were 45 or older. Most subjects had physically demanding work (64.3%), 25.8% had psychologically demanding work and 9.8% had work that was both physically and psychologically demanding.

2.2. Health Condition

Health condition was assessed on the basis of the following indices:

- subjective assessment of the feeling of health; the respondents were asked to assess their health on a 5-point scale, where 5 = *excellent*, 4 = *very good*, 3 = *good*, 2 = *moderate*, 1 = *poor*;
- assessment of the occurrence in the past year of pain affecting six parts of the body (shoulders/arms, hands/wrists, neck, upper back, lower back, legs), using the Nordic questionnaire [21];
- assessment of pain intensity; the respondents were asked to assess pain intensity on a 100-mm visual analogue scale (VAS) scale, where 0 mm = *no pain*, 100 mm = *very severe (unbearable) pain*.

2.3. Work Ability

Work ability was assessed with the subjective WAI [22]. The WAI questionnaire consists of seven questions. Five of them require subjective assessment: current work ability compared with the lifetime best, work ability in relation to the demands of the job, estimated work impairment due to diseases, own prognosis of work ability 2 years from now and mental resources. The other two questions require objective answers: number of current diseases diagnosed by a physician and sick leave during the past year. The score can be between 7 and 49, where 7–27 = *poor*; 28–36 = *moderate*; 37–43 = *good*; 44–49 = *excellent*.

The analysis of the relationships between health condition indices and WAI was carried out in two age groups. One group consisted of <45-year-old (younger) workers, the other of ≥45-year-old (ageing) workers.

2.4. Statistical Analysis

Statistical analysis was done with Statistica 9.2. An analysis of regression was carried out to assess the relationship between the occurrence of pain, its intensity and WAI score. Multivariate analysis of logistic regression was used to estimate the risk factors for (a) reduced work ability (WAI < 37); (b) reduced current work ability compared with the lifetime best (< 7 mm); (c) poor own prognosis of ability to perform current work in 2 years' time. In the model of multivariate analysis of logistic regression, the following were adopted as explanatory (independent) factors:

- subjective feeling of health, with two categories: good health and poor health. To this end, the answers were divided into two categories of health: good (*excellent, very good* and *good*) and poor (*moderate* and *poor*). *Good* health was the reference category;
- occurrence of pain in six parts of the body, with two categories: *no pain* and *pain*. *No pain* was the reference category;
- intensity of pain in six parts of the body, with two categories: *weak* (<30 mm VAS) and *severe* (≥30 mm VAS) pain. *Weak* pain was the reference category.

The significance level was set at $p \leq .05$.

3. RESULTS

3.1. Work Ability

Mean (*SD*) work ability measured with WAI was 38.4 (6.4) for female and 41.4 (5.7) for male workers; 37.4 (6.9) for ageing and 39.4 (6.2) for younger workers; 39.0 (6.4) for workers with physically demanding work, 40.4 (5.2) for workers with psychologically demanding work and 41.2 (4.6) for workers whose work was both physically and psychologically demanding. WAI was reduced in 33.1% of the whole group.

3.2. Health Condition

Seventy percent of workers assessed their health as *good* and *excellent*, 26% as *poor*, 4% did not answer this question. In all the workers who assessed their health as *good* and *excellent*, mean (*SD*) WAI was 41.2 (5.04), whereas in workers who assessed their health as *poor,* WAI was 33.6 (6.2); $p \leq .001$. In younger workers who assessed their health as *good*, mean (*SD*) WAI was 41.3 (5.1), whereas in those who assessed their health as *poor*, it was 33.9 (5.9); $p = .003$. In ageing workers who assessed their health as *good*, mean (*SD*) WAI was 40.1 (5.3), and in those who assessed their health as *poor*, it was 31.8 (6.7); $p = .034$.

3.3. Musculoskeletal Pain

Table 1 shows that the respondents from both age groups mostly reported pain in the legs and lower back. They also reported pain in the hands/wrists

TABLE 1. Characteristics of Subjects

	Age Group (years)	
Characteristic	**<45**	**≥45**
Age, *M* (*SD*)	31.4 (6.6)	50.3 (5.3)
WAI, %		
moderate/poor	32	43
excellent/good	68	57
WAI, %		
1: current work ability related to lifetime best (0–10) >7 mm	83	72
6: prognosis of work ability 2 years from now: unlikely	19	4
Occurrence of pain, %		
neck	46	52
shoulders/arms	28	36
hands/wrists	47	55
upper back	25	21
lower back	61	63
legs	64	62
Intensity of pain, *M* (mm)		
neck	37.4	37.9
shoulders/arms	27.9	32.1
hands/wrists	33.2	40.7
upper back	23.6	21.4
lower back	21.4	45.2
legs	41.5	42.5

Notes. WAI = work ability index.

and neck. The most intense pain both in younger and ageing workers was in the legs.

An analysis of regression of WAI and the occurrence of pain in six parts of the body showed a negative relationship between those factors. Pain in the hands/wrists, neck and lower back resulted in a statistically significant decrease in WAI for all subjects and for younger and ageing workers. Pain in the shoulders/arms resulted in a statistically significant decrease in WAI in all subjects and in younger workers. Pain in the legs, although the most frequently reported problem, only slightly affected a decrease in WAI; these changes were not statistically significant (Table 2).

An analysis of regression showed a statistically significant negative relationship between the intensity of pain in the neck and WAI for all subjects and for younger workers; between pain in the lower back and WAI for all three groups of subjects, whereas for pain in the upper back and legs only for all workers (Table 3).

3.4. Multivariate Logistical Analysis

The following factors were associated with an increased likelihood of reduced work ability: the subjective feeling of health being poor (*OR* 1.38, $p < .001$ in younger workers; *OR* 1.33, $p < .001$ in ageing workers); the occurrence of pain in the neck (*OR* 1.37), shoulders/arms (*OR* 1.41), hands/wrists (*OR* 1.38) and the lower back (*OR* 1.47) in younger workers, and the lower back (*OR* 1.67) in ageing workers; the occurrence of severe pain (>30 mm VAS) in the neck (*OR* 1.49) and lower back (*OR* 1.48) in younger workers, and in the lower back (*OR* 1.15) in ageing workers (Table 4).

Moreover, logistic analysis showed that pain in the hands in younger workers and in the lower back in ageing workers resulted in a higher risk factor for reduced current work ability compared with the lifetime best (*OR* 1.75 and *OR* 2.80, respectively). Similarly, severe pain in the upper back in younger workers and in the lower back in

TABLE 2. Analysis of Regression: Occurrence of Pain in 6 Parts of the Body in the Past 12 Months and WAI

	β			*p*		
	Age Group (years)			Age Group (years)		
Body Part	**All**	**<45**	**≥45**	**All**	**<45**	**≥45**
Shoulders/arms	–2.2	–2.4	–1.6	<.001	<.001	.143
Hands/wrists	–1.6	–1.5	–1.9	<.001	.001	.041
Neck	–1.3	–1.3	–2.8	.001	.011	.006
Upper back	–0.3	–0.3	–1.3	.491	.605	.297
Lower back	–2.1	–1.9	–2.5	<.001	<.001	.011
Legs	–0.00004	–0.00005	–1.3	.901	.851	.172

Notes. WAI = work ability index.

TABLE 3. Analysis of Regression: Intensity of Pain (in mm VAS) and WAI

	β			*p*		
	Workers			Workers		
Body Part	**All**	**<45**	**≥45**	**All**	**<45**	**≥45**
Shoulders/arms	–0.011	–0.010	–0.007	.349	.350	.784
Hands/wrists	–0.021	–0.008	–0.032	.068	.541	.307
Neck	–0.043	–0.050	–0.034	.000	.000	.336
Upper back	–0.028	–0.021	–0.043	.018	.052	.245
Lower back	–0.051	–0.053	–0.071	.000	.000	.007
Legs	–0.021	–0.011	–0.044	.034	.283	.143

Notes. VAS = visual analogue scale, WAI = work ability index.

ageing workers resulted in a higher risk factor for reduced current work ability compared with the lifetime best (*OR* 1.02 and *OR* 1.03, respectively) (Table 5).

There was no statistically significant relationship between the occurrence of pain or the intensity of pain and poor own prognosis of work ability in any group.

4. DISCUSSION

Occupational safety and health services pay special attention to MSDs, which are the most common occupational complaints. MSDs reduce work ability both among workers with psychologically demanding work and workers with physically demanding work. In a prospective

TABLE 4. Results of Multivariate Analysis of Logistical Regression for the Relationship Between Musculoskeletal Pain and Reduced WAI

	Workers <45 years old			Workers ≥45 years old		
Body Part	***OR***	**95% CI**	***p***	***OR***	**95% CI**	***p***
Occurrence of pain (reference category: *no pain*)						
Shoulders/arms	1.797	[1.242, 2.598]	.002	2.957	[1.484, 5.891]	.002
Hands/wrists	1.779	[1.244, 2.544]	.002	1.859	[0.949, 3.641]	.069
Neck	1.747	[1.219, 2.506]	.002	2.272	[1.150, 4.491]	.017
Upper back	1.041	[0.781, 1.388]	.784	1.157	[0.489, 2.734]	.737
Lower back	2.006	[1.389, 2.896]	<.001	3.177	[1.573, 6.418]	.001
Legs	1.797	[1.242, 2.598]	.002	0.995	[0.462, 2.145]	.989
Intensity of pain (reference category: *weak*)						
Shoulders/arms	1.004	[0.993, 1.015]	.467	1.009	[0.987, 1.032]	.415
Hands/wrists	1.003	[0.992, 1.014]	.593	1.006	[0.982, 1.029]	.602
Neck	1.009	[0.999, 1.019]	.055	1.005	[0.984, 1.026]	.7959
Upper back	1.008	[0.998, 1.018]	.109	1.011	[0.988, 1.034]	.349
Lower back	1.020	[1.009, 1.031]	<.001	1.030	[1.009, 1.051]	.003
Legs	1.001	[0.994, 1.011]	.535	1.003	[0.985, 1.021]	.722

Notes. WAI = work ability index; total WAI < 37; *OR* = odds ratio; CI = confidence interval.

TABLE 5. Results of Multivariate Analysis of Logistical Regression for the Relationship Between Musculoskeletal Pain and Reduced Current Work Ability Compared With the Lifetime Best

	Workers <45 years old			Workers ≥45 years old		
Body Part	***OR***	**95% CI**	***p***	***OR***	**95% CI**	***p***
Occurrence of pain (reference category: *no pain*)						
Shoulders/arms	1.400	[0.925, 2.121]	.111	1.029	[0.521, 2.034]	.933
Hands/wrists	1.759	[1.170, 2.643]	.007	1.334	[0.697, 2.549]	.381
Neck	1.275	[0.849, 1.917]	.241	1.333	[0.684, 2.599]	.396
Upper back	1.187	[0.882, 1.598]	.258	1.755	[0.816, 3.776]	.148
Lower back	1.261	[0.838, 1.897]	.285	2.804	[1.363, 5.771]	.005
Legs	1.038	[0.698, 1.543]	.852	0.989	[0.511, 1.916]	.975
Intensity of pain (reference category: *weak*)						
Shoulders/arms	1.002	[0.989, 1.014]	.759	0.998	[0.992, 1.007]	.062
Hands/wrists	0.999	[0.987, 1.012]	.944	1.021	[0.998, 1.044]	.072
Neck	1.006	[0.996, 1.018]	.225	1.002	[0.982, 1.022]	.867
Upper back	1.015	[1.004, 1.025]	.006	1.018	[0.997, 1.041]	.094
Lower back	1.011	[0.999, 1.023]	.052	1.032	[1.011, 1.054]	.003
Legs	1.003	[0.994, 1.012]	.539	0.996	[0.978, 1.015]	.702

Notes. OR = odds ratio; CI = confidence interval.

study of WAI in firefighters, Kiss, Walgraeve and Vanhoorne showed that work ability was determined by age, health, especially MSDs, followed by cardiovascular and respiratory diseases [23]. Other research studies showed MSDs also negatively affected work ability among agricultural machinery operators [24] and workers in cooled food-processing facilities [25]. According to Sjögren-Rönkä, Ojanen, Leskinen, et al., the high intensity of MSDs has a significant negative impact on work ability among workers with psychologically demanding work [26].

Low assessment of work ability was recognized as one of the main factors favouring early retirement over employment. The other factors were heavy physical work demands, stress and poor health [7]. According to Alavinia, de Boer, van Duivenbooden, et al., poor and moderate work ability were highly predictive for becoming disabled with hazard ratios 32 and 8, respectively [27]. A prospective study showed that WAI could predict early exit from the labour market for health reasons (total inability to work): 65% of men and 60% of women who at 50 had work ability defined as *poor*, at 62 were already on a disability pension. In comparison, only 18% of men and 13% women whose work ability at 50 was *excellent*, at 62 were on a disability pension [22]

In a prospective 10-year study involving 1033 employees working as executives, Feldt, Hyvönen, Mäkikangas, et al. observed that in patients whose work ability was *excellent* or *good* (WAI ≥ 37), the average exit age from the labour market was 61.3 years, i.e., significantly higher than in patients whose work ability was <36; 55.4 years [28].

Our study comprised multivariate analysis of logistical regression, where two categories of work ability were adopted as variables: 7–36 was defined as reduced work ability, whereas 37–49 as satisfactory work ability (i.e., work ability which is not a predictor of early retirement). The results showed a negative relationship between pain in the shoulders/arms, hands/wrists, neck and lower back in the past 12 months and WAI in all subjects. Also the intensity of pain was negatively correlated with WAI for pain in the neck, upper back, lower back and legs in all subjects. In ageing workers such a relation was observed only for pain in the lower back. This effect was confirmed by the results of multivariate analysis of logistic regression, which showed that in ageing workers pain as well as severe pain in the lower back increased the possibility of reduced work ability both in the total score and in current work ability as compared to the lifetime best. This data confirmed the results of a study of Finnish adults, according to which musculoskeletal pain was associated with reduced (*moderate/poor*) work ability (*OR* 2.9; 95% CI [2.0, 4.2]) [29].

Magnago, de Lima, Prochnow, et al.'s study among nursing workers also proved that employees who reported *strong/unbearable* (70–100 mm VAS) musculoskeletal pain were four times more likely to be classified as having reduced work ability [30]. In contrast, our research showed such association already for pain over 30 mm VAS.

According to Monteiro, Alexandre, Ilmarinen, et al., MSDs affect several aspects of work ability measured with WAI, the most important being that the presence of MSDs negatively influences own prognosis of work ability in 2 years' time, which is relevant in the context of staying at work until retirement age [31]. According to our study, the occurrence of pain or its intensity do not constitute higher risk factors for poor own prognosis of work ability in any of our study groups. This is consistent with de Vries, Reneman, Groothoff, et al.'s results, which showed that workers with chronic nonspecific musculoskeletal pain could stay at work with high work ability and performance, especially when they had high beliefs of pain self-efficacy [32]

Therefore, information on factors affecting reduced work ability and factors that allow employees with MSDs to remain active at work is crucial. They can be regarded as a measure preventing early termination of occupational activity, particularly in the context of increasing retirement age.

5. CONCLUSIONS

The cross-sectional character of this study is a limitation, which prevents strong conclusions. However, we can argue that prevention and early

diagnosis of MSDs are important in increasing work ability and thus extending workers' occupational activity. Further analysis of factors which make ageing workers consider their work ability satisfactory despite musculoskeletal complaints is necessary.

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