



# Association between pain intensity, neck disability index, and working conditions among women employed in horticulture

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## Abstract

**Introduction and Objective.** One of the most frequent musculoskeletal disorders is neck pain (NP). NP can be associated with occupational activities and is more common among females than males. Horticulture is a branch of agriculture in which work is intensively manual, and characterized by repetitive tasks. The aim of the cross-sectional study was to analyze the association between pain intensity, neck disability index (NDI), and working conditions in terms of selected factors related to work in horticulture.

**Materials and method.** 44 women employed in horticulture met eligibility criteria (experienced necked pain). Five factors related to working conditions were investigated: work experience, upper extremity position, head position, prophylaxis, and stress frequency. NDI and visual analog scale (VAS) were used to investigate pain intensity and disability.

**Results.** It was found that the position of the upper limb at work and the frequency of stress were significantly associated with the VAS score ( $p=0.046$  and  $p=0.02$ , respectively). With regard to NDI total score, a statistically significant association was found between work experience and stress frequency ( $p=0.02$  and  $p=0.01$ , respectively). Analysis of the relationship between VAS and NDI total score showed a statistically significant weak positive correlation ( $R=0.39$ ;  $p=0.01$ ).

**Conclusions.** NP and NDI are related to the activities that women working in horticulture have to perform. Stress seems to be an important factor in cervical problems among female workers leading to an increase in NP and disability

## Key words

neck pain, horticulture, disability

## INTRODUCTION

Neck pain (NP) is a common symptom of the musculoskeletal system present in many occupations, creating serious health and economic problems [1]. NP symptoms are quite common in the general population. It affects people of all ages, regardless of gender [2]; however, one of the factors predisposing to the occurrence of pain syndromes in this area is the female gender [3]. Studies also show that NP is more common among older workers [4].

Data from the Global Burden of Disease (GBD) study shows that NP is an increasing rising problem with a 21% rise in the population prevalence of pain lasting more than 3 months between 2006 – 2016 [5]. Lifetime prevalence of NP ranges from 14% – 71% [6]. The main non-traumatic causes of NP are inappropriate working conditions and sitting position. Functional changes located in the cervical part of the spine may also be caused by factors such as stress or static body positions that cause the head to be in a forced flexion or extension position [7]. Disorders like chronic NP result in reduced productivity, lost workdays, reduced productivity, and financial burdens as a result of treatment

[6]. NP is presently high among workers in industrial countries [8]. Workers who perform more physical work have been shown to be more likely to develop a work-related disability, compared to those who perform less physically demanding work [9]. Recent studies show that workers suffering from pain report lower work capacity as well as lower productivity and efficiency, compared to workers without pain [10].

Horticulture is a branch of agriculture. In this study, horticulture is understood as dealing with the care and cultivation of various types of plants (garden plants, flowers, greenhouse plants), as well as floriculture, planting and caring for shrubs and trees. Work in horticulture is intensively manual and characterized by repetitive tasks. Most tasks require a high biomechanical load on the upper limbs and the spine, causing significant risk of work-related development musculoskeletal disorders [11]. The nature of work in horticulture consists of many different activities, such as lifting, performing the same repetitive activities and working in an uncomfortable position, to which women are exposed while working in this profession. Women working in horticulture sometimes adopt an unnatural body posture during various activities related to the cultivation of flowers and plants, as a result of which they may experience various ailments of the musculoskeletal system, which increases their physical strain [12].

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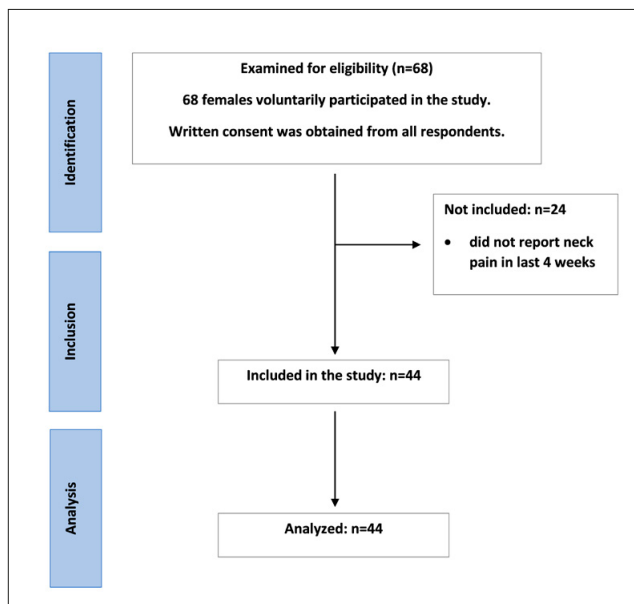
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The aim of the study was to analyze the association between pain intensity, neck disability index (NDI), and working conditions in terms of selected factors related to work in horticulture. It is hypothesized that there is a relationship between working conditions and severity of symptoms and disability due to NP.

## MATERIALS AND METHOD

**Study design.** A cross-sectional study was designed according to The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Females employed in horticulture in the Lublin Province of eastern Poland were asked to complete the survey in September 2022. The sample size was based on availability and voluntary character participation in the study.

**Participants.** The numbers of individuals at each stage of the study (numbers potentially eligible and included in the study according to eligibility criteria) are presented in a flow chart (Fig. 1).



**Figure 1.** Flow diagram of participant selection

This study involved 44 women between 18–60 years old employed in horticulture and experiencing NP. Details of age, height, weight, Body Mass Index (BMI), and visual analogue scale of pain intensity (VAS) are presented in Table 1. The mean VAS score indicates moderate NP in the last 4 weeks (VAS=5.27±2.07). The study was approved by the Bioethics Committee (KE-0254/93/2020) and was carried out in accordance with the ethical principles of the Declaration of Helsinki. All workers (N=44) agreed to participate in the study and answered the questionnaire.

The descriptive statistics of the NDI results are presented in Table 2. Eight women did not have disabilities due to NP (total NDI score: 0–4). Most women (N=29) declared mild disability (total NDI score: 5–14). Moderate disability was declared by 5 women (total NDI score: 15–24), and 2 women declared severe or complete disabilities (total NDI score: 25–34 and above 34, respectively). According to detailed

**Table 1.** Anthropometric characteristics of the study group and VAS score

Variable	Mean	Std.Dev.	Median	Minimum	Maximum
Age (years)	39.48	12.56	40.50	18.00	60.00
Height (m)	1.65	0.05	1.64	1.53	1.77
Weight (kg)	64.32	10.95	61.50	50.00	100.00
BMI	23.74	3.81	23.04	17.86	38.10
VAS (last 4 weeks)	5.27	2.07	5	2	10

**Table 2.** Descriptive statistics of the NDI results

Variable	Mean	Std.Dev.	Median	Minimum	Maximum
NDI total score	10.57	7.37	10.5	1	40
Pain intensity	1.36	1.35	1	0	5
Personal care	0.43	0.90	0	0	4
Lifting	0.86	0.80	1	0	4
Reading	0.84	0.81	1	0	3
Headaches	2.25	1.24	2	0	5
Concentration	1.18	1.06	1	0	4
Work	1.05	1.01	1	0	4
Driving	0.75	0.94	1	0	4
Sleeping	0.95	1.18	1	0	5
Recreation	1.00	1.06	1	0	5

results of the NDI score, the greatest disability with a mean score of 2.25 was related to headaches.

**Method.** To assess NP, an original questionnaire was used which consisted of questions regarding work experience, upper extremity position, head position, prophylaxis, and stress frequency. The question regarding work experience was: ‘How long have you been working in horticulture?’ The question regarding the upper extremity position provided information about whether the work requires the use of 2 or 1 hand, whether the hands are raised most of the time or kept in front of the body; also, the position of the head at work, whether tilted, raised, turning sideways or holding straight most of the time at work. The question about prophylaxis was: ‘Do you know and use forms of prophylaxis (proper lifting and handling, workstation, preventive exercises)?’ The question about stress concerned the frequency of occurrence of stressful situations in life in the last year.

The average pain intensity over the last 4 weeks was measured using the visual analog pain scale (VAS) [13]. The respondents were asked to give a score between 0–10 cm (0 point indicates no pain and 10 points indicate highest pain). The Polish version of the Neck Disability Index (NDI–Polish Version) questionnaire was used to assess the degree of disability. NDI is the most commonly used questionnaire to measure disability related to NP [14]. The items in the questionnaire are: pain intensity, personal care, lifting, reading, headache, concentration, work, driving, sleeping and recreation. The participant is instructed to circle the answer that best describes her condition (0–5). The higher the score, the greater the disability in the neck area.

**Data analysis.** Statistical analyses were performed using Statistica software (ver. 13.1, TIBCO Software Inc., Palo Alto (CA), USA). Normal distribution of the data was verified with the Shapiro-Wilk test. Results were presented using the

mean, standard deviation, median, and range of maximum-minimum. The level of significance for all results was set at  $p$ -value  $< 0.05$ . Changes in the dependent variable between the 2 groups were analyzed using the Mann-Whitney U-test, and changes between 3 or more groups were analyzed using the Kruskal-Wallis ANOVA for the main effect. In order to test the relationship between the quantitative variables, the Spearman R rank order correlation was used.

## RESULTS

Analysis of the relationship between scores (VAS and NDI) and age showed that there was a significant positive weak correlation between age and VAS and NDI ( $R=0.35$ ;  $p=0.02$ ;  $R=0.30$ ;  $p=0.045$ , respectively). There was also a significant weak correlation between BMI and NDI ( $R=0.31$ ;  $p=0.04$ ) (Tab. 3).

**Table 3.** Correlation between age, BMI and VAS and NDI score

Pair of variables	Spearman R	t(N-2)	p-value
Age & VAS	0.35	2.41	<b>0.02</b>
BMI & VAS	0.20	1.31	0.20
Age & NDI TS	0.30	2.06	<b>0.045</b>
BMI & NDI TS	0.31	2.09	<b>0.04</b>

NDI TS – Neck disability index total score.

Among the 5 analyzed independent variables (work experience, upper extremity position, head position, prophylaxis, and stress frequency) it was found that only the position of the upper limb at work and the frequency of stress were significantly associated with the VAS score ( $p=0.046$  and  $p=0.02$ , respectively). The symmetrical position of the hands in front of the body was related to the greatest NP (mean VAS= $5.94\pm 2.48$ ), and more frequent stress was related to greater NP than rarely perceived stress (VAS= $5.89\pm 2.14$  vs. VAS= $4.29\pm 1.57$ , respectively). It may be noticed that there is a difference in NP according to head position. Posture with the head up or with the asymmetrical turning of the head to the one side seems to be connected to greater pain. However, this result was not statistically significant ( $p=0.09$ ) (Tab. 4).

In regard to NDI total score, a statistically significant association was found between work experience and stress frequency ( $p=0.02$  and  $p=0.01$ , respectively). Women who worked longer than 5 years had greater NDI scores than women who had worked shorter (NDI =  $12.17\pm 5.26$  vs. NDI= $9.46\pm 8.46$ ). More frequent stress was related to greater disability scores than rarely perceived stress (NDI= $11.85\pm 5.76$  vs. NDI= $8.53\pm 9.21$ , respectively). Head position during working seems to be also linked to disability. However, this result was not statistically significant ( $p=0.07$ ). Detailed results are presented in table 5.

Analysis of the relationship between VAS and NDI total score showed a statistically significant weak positive correlation ( $R=0.39$ ,  $p=0.01$ ) (Fig. 2).

**Table 4.** VAS score according to work conditions

Variable		N	M	SD	Me	Min	Max
Work experience (years)	<5	26	4.81	1.77	4	2	10
	>5	18	5.94	2.34	6.5	2	10
U=164.5, Z=-1.67 p=0.10							
Upper extremity position	Both arms symmetrically raised	16	5.31	1.66	5	2	8
	Both hands symmetrically in front	18	5.94	2.48	5.5	2	10
	Asymmetrical, using mainly one hand	10	4.00	1.25	4	3	7
H (2, N= 44) = 6.16 p=0.046							
Head position	Down	18	4.56	1.65	4	2	8
	Up	5	6.20	2.77	7	3	10
	Turning to one side	17	6.06	2.14	6	3	10
	Straight	4	4.00	1.15	4	3	5
H (3, N= 44) = 6.45 p=0.09							
Use of prophylaxis	Yes	13	5.23	1.92	5	3	8
	No	31	5.29	2.16	5	2	10
U=201.0, Z=0.001 p=1.00							
Stress frequency	Often	27	5.89	2.14	5	3	10
	Rarely	17	4.29	1.57	4	2	7
U=131.0, Z=2.40 p=0.02							

**Table 5.** NDI total score according to work conditions

Variable		N	M	SD	Me	Min	Max
Work experience (years)	<5	26	9.46	8.46	8	1	40
	>5	18	12.17	5.26	12	2	23
U=139.0, Z=-2.26 p=0.02							
Upper extremity position	Both arms symmetrically raised	16	12.56	10.68	9	1	40
	Both hands symmetrically in front	18	9.67	4.04	11	2	15
	Asymmetrical, using mainly one hand	10	9.00	5.21	7	3	19
H (2, N= 44) = 0.56 p=0.75							
Head position	Down	18	11.17	8.24	11	2	40
	Up	5	11.40	8.02	12	1	23
	Turning to one side	17	11.35	6.61	11	2	29
	Straight	4	3.50	1.29	3.5	2	5
H (3, N= 44) = 6.99 p=0.07							
Use of prophylaxis	Yes	13	10.23	10.37	6	1	40
	No	31	10.71	5.90	11	2	29
U=161.0, Z=-1.03 p=0.31							
Stress frequency	Often	27	11.85	5.76	11	2	29
	Rarely	17	8.53	9.21	5	1	40
U=124.0, Z=2.54 p=0.01							

## DISCUSSION

This study was conducted to determinate the relationship between selected factors (work experience, upper extremity position, head position, use of prophylaxis, and stress frequency) and NP symptoms and disability. It was found

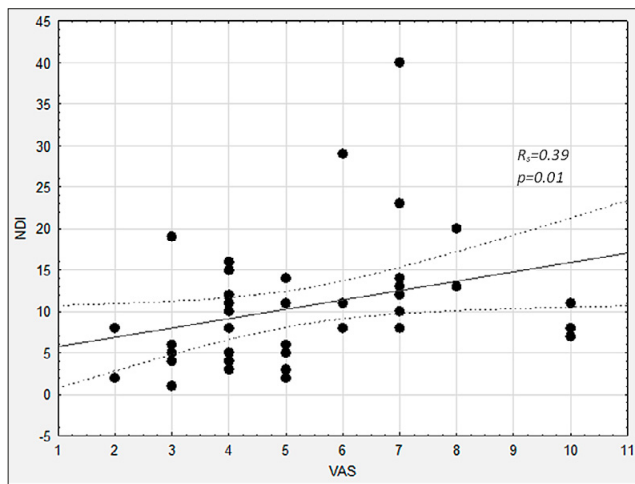


Figure 2. Correlation of NDI total score and VAS score

that there is an association between pain intensity and upper extremities position and stress frequency. There was also relationship between work experience and stress frequency and NDI total score. These findings only partially support the hypothesis due to lack of relationship between other factors and NP symptoms.

Work-related risk factors in floriculture are primarily the position that workers assume, i.e. squatting and bending posture for long hours while transplanting, hoeing, weeding and harvesting, which cause musculoskeletal problem (18). There is also evidence of some risk factors for NP, such as physical activity, perceived stress, and being a woman [15]. The GBD study shows that in 2017, the burden of NP was higher in women than in men [5]. However, diagnosing 'work-related' NP and determination of the exact work contribution to beginning NP is difficult [16].

The results obtained demonstrate that the symmetrical position of the hands in front of the body was related to the greatest NP. Perhaps this is related to the static position of the head during this kind of work. Working in different professions requires a certain position of the head. There is a relationship between head position at work and NP (1,18). In the current study, posture with the head up or with the asymmetrical turning of the head to one side, seems to be connected to VAS and ND; however, the result was not statistically significant.

Studies conducted on a group of 120 women working in horticulture in India evince that 50% of them suffered from cervical musculoskeletal disorders [17]. Another research by the same authors concerning female workers during flower cultivation, showed that at work the women maintained an unnatural body posture, which led to various postural and musculoskeletal disorders, including of the neck [12].

The most common musculoskeletal symptoms in agricultural workers in Spain are neck, upper back, shoulders, lower back, hips/thighs and knees. More than half of the employees have had to change jobs or tasks on occasion due to discomfort and pain in the neck [18]. A study by Sabino et al. indicates that in terms of intensity, the regions severely affected (50%) were the cervical spine, the right knee, left foot and both thighs [19]. The cross-sectional study was conducted in plant nurseries of a Portuguese municipality, and the results were most likely due to work demands and postures adopted removing weeds, taking plant cuttings and planting.

Different research shows that stress is associated with pain and disability [20] and acts as a mediator between pain and disability [21]. This is consistent with the results of the current study, in which more stress is associated with higher VAS and NDI scores. The cause of exposure to stress related with work in agriculture and horticulture is the climate. Frequent outdoor work can involve problems with high and low temperatures, as well as solar radiation, moisture and drafts. This can cause temperature change stress, with women more sensitive to an increase in ambient temperature than men [22].

Shahrokhi et al. emphasize in their research that there is a significant relationship between aging and the occurrence of musculoskeletal disorders in the neck and wrist areas [23]. Results obtained in the current study show that there is a significant positive weak correlation between age and VAS and NDI; however, women who worked for more than 5 years had greater NDI scores than women who had worked for a shorter time.

In the current study it was also found that NP and disability are correlated. The relationship between the frequency of experienced stress and both, disability and pain, may suggest the need to consider stress reduction as a leading factor of working conditions in the prevention of musculoskeletal disorders. Similar conclusions were drawn from previous studies of office workers and students [24, 25].

Stress reduction beyond head and shoulder ergonomics is probably the most underestimated in NP prevention programmes among blue-collar workers [26]. Thus, relaxation techniques and education about methods of stress reduction can be recommended next to the ergonomics and physical activity as a prophylaxis of NP, and should be included in therapy by physical therapists working with women employed in horticulture.

The limitation of this study was the small study group. It would be interesting to repeat the study and compare the incidence of pain occurring in different parts of the body.

## CONCLUSION

NP and NDI are related to the activities that women working in horticulture have to perform. Stress seems to be the biggest factor in cervical problems. It is important to identify risk factors to allow for prevention and early diagnosis to help reduce the incidence of NP.

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