

## **Task Analysis, Risk Assessment and Clinical Evaluation of Work Related Musculoskeletal Disorders in Viticulture and Olive Culture Farming**

Montomoli L.<sup>1</sup>, Ardisson S.<sup>2</sup>, Colombini D.<sup>3</sup>, Fanti M.<sup>4</sup>, Ruschioni A.<sup>5</sup>, Sartorelli P.<sup>1</sup>

<sup>1</sup>*Section of Occupational Medicine, Dept of Clinical Medicine and Immunological Sciences, University of Siena, Italy+39 0577 586768 lorettamontomoli@katamail.com*

<sup>2</sup>*SPRESAL ASL 19 Asti, Italy*

<sup>3</sup>*Research Unit EPM, Ergonomic of Postures and Movements, Policlinic Foundation, Don Gnocchi Foundation, University of Milano, Italy*

<sup>4</sup>*Studio Fanti, Siena, Italy*

<sup>5</sup>*ASUR Ancona, Italy*

### **Abstract**

**Introduction:** in international literature the clinical data regarding results of specific epidemiologic studies on prevalence of musculoskeletal disorders in agriculture are not so numerous. This study carried out an evaluation of risk in some viticulture and olive culture farms in Italy. **Methods:** to obtain an exposure index in vine-growing the work organization was previously analysed and all working tasks were video recorded. Then the ergonomic analysis using OCRA check-lists and NIOSH method was performed. In Tuscany the workers were submitted to a clinical examination especially finalized to study the spine and upper limb work-related musculoskeletal disorders. **Results:** in vine-growing each tasks analysed showed a high risk of biomechanical overload of the upper extremities. Regarding the manual material handling in the grape-harvest, band of risk changed from yellow to green. Considering the total number of the exposed workers studied in risk assessment (no=125), only 42 of them were allowed to submit to a clinical examination by a specialist in rheumatology. The most relevant pathologies were the wrist and fingers tendinitis and the carpal tunnel syndrome. **Discussion:** the agricultural work certainly causes a marked risk of musculoskeletal disorders as confirmed by our study. Also considering the first results of this clinical examination it is possible to conclude that this specific working population, show a specific occupational musculoskeletal hand disease that we can perhaps call “the pruning hand”.

**Keywords:** wine-growers, manual material handling, musculoskeletal disorders of the upper extremities, physical risk factors, farming, clinical evaluation

### **Introduction**

Work-related musculoskeletal disorders of the upper limbs (WMSDs) and spinal disorders reported in the past by the pioneers of occupational medicine have, in the last 35 years, become extremely widespread, reaching epidemic levels, in all advanced industrialised countries [1]. Up to recent times in Italy, no particular attention was paid to these disorders even among occupational health specialists. However some occupational health professionals began to suspect that the situation was very much the same as that reported in other western countries [4].

Some biomechanical factors (frequency and repetitiveness of movements, use of force, type of posture and movements, distribution of recovery periods) are determining factors for

WMSD. There are also other risk factors (complementary factors) that by themselves do not cause these diseases but may be of importance.

In international literature the frequency of WMSDs and spinal disorders are not well investigated in farmers.

A cross sectional study conducted among 537 workers pruning grapevines in the region of Champagne emphasized a prevalence of nocturnal hand paresthesias and hand wrist pain (37 and 12% respectively). All workers completed a questionnaire about nocturnal hand paresthesias and musculoskeletal pain during a period of 12 months [2]. Risk factors associated with hand paresthesias were: female gender, being overweight, payment on a piecework basis and traditional blade sharpening method. The development of hand paresthesias, which affected a third of employees, was different from hand paresthesias observed in industrial workers since most vineyard workers recovered without medical treatment after the pruning season. In a another study [3] the same authors evaluated biomechanical strains on the hand-wrist system during grapevine pruning through surface electromyography activity of the right flexor digitorum muscle and wrist posture. In this way the authors emphasized high biomechanical strain with maximal voluntary handgrip contraction of 23,5 %. Numerous cuts required moderate or extreme ulnar deviation.

This paper reports an evaluation of risk on farms in Italy (Tuscany, Piedmont and Marches) adopting different growing systems, to point out the most dangerous activities for biomechanical overload. Limited to the Tuscany case the workers were submitted to a clinical examination especially finalized to study the spine and upper limb work-related musculoskeletal disorders. The results were inserted in a dedicated software.

## **Materials and Methods**

### *Risk assessment*

To obtain an exposure index in vine-growing the study was conducted in three phases: 1)analysis of work organization, 2)analysis of each working task and 3)ergonomic analysis using OCRA check-lists and NIOSH method [5].

1) To analyse the work organization farms were previously selected and relevant data (number of workers, working tasks and hours/months for each task) collected in a data base. After that the production methods and working tasks were analysed and a “list of tasks yearly distributed” was created. (see Table 1).

2) To identify working tasks characterized by repetitive movements the “yearly job description” was used. The following working tasks were identified: cut of mother vine, “tendifili: wire straining ”, pruning (dry and green part), grape harvest.

3) All working tasks were videorecorded and ergonomic analysis using OCRA check-lists for repetitive movements of the upper extremities and NIOSH method for manual material handling were performed.

Table 1 Working tasks carried out in vine-growing during the year

Working tasks	January	February	March	April	May	June	July	August	September	October	November	December
Soil preparation (trenching)												
Preparation and maintenance of vineyard frame												
Soil dressing												
Treatment with plant protection product												
Cut of mother vine												
Vine plantation												
Pruning (dry part)												
Green pruning												
Grape harvest												

### *Clinical evaluation*

The percentages of the pathologies were estimated on the total number of the exposed workers at the beginning of the clinical examination (No= 125) even if it was not possible to visit all the workers Only 42 of 125 exposed workers were allowed to submit to a clinical examination by a specialist in rheumatology.

The medical doctor did only clinical diagnosis (without instrumental clinical tests) deriving the information in Table 2: in the future the clinical diagnosis will be completed by means of more objective and specific instrumental tests

## **Results**

### *Risk assessment*

Table 3 shows that the greater part of the tasks analysed are included in red-violet band of OCRA check list, confirming that there is a high risk of biomechanical overload of the upper extremities for farmers.

Green pruning – pinching out (left hand) is included in the green band (acceptable risk) whit a value of 5 Check List OCRA. Green pruning – polling (right hand) and green pruning – stripping of leaves (left hand) are included in the yellow band (borderline risk) with a value of 9.5 and 11 respectively.

The greater part of the tasks analysed, [vine plantation (left/right hand), “tirafili: wire straining” with tool (left/right hand), pruning (dry part) – Tuscany (left/right hand), pruning (dry part) – Piedmont (left hand), green pruning polling (left hand), green pruning – stripping of leaves (right hand), grape harvest – Tuscany, Piedmont, Marches (left/right hand)], are included in the red band (middle –light risk) whit a value of between 13.5 to 22. In these tasks the middle – light risk could produce a high incidence of pathologies.

Table 2 List of clinical terminology used to define the musculoskeletal disorders showed by “pruning workers”

List of main clinical musculoskeletal disorders	MALE		FEMALE	
	N.	%	N.	%
Myofascial opponens right pollicis syndrome	9	15,8%	18	20,7%
Myofascial brachioradialis syndrome	8	14,0%	14	16,1%
Carpal tunnel syndrome	2	3,5%	12	13,8%
Myofascial flexor carpi radialis syndrome- enthesitis	2	3,5%	11	12,6%
Myofascial extensor carpi radialis syndrome	6	10,5%	9	10,3%
Metacarpophalangeals synovitis (hypertrophy of Metacarpophalangeals synovitis)	7	12,3%	7	8,0%
Flexor 3 and /or 4 digitorum tenosynovitis	2	3,5%	6	6,9%
Proximal and/or distal interphalangeal arthrosis	3	5,3%	3	3,4%
Caput longum musculi bicipitis tenosynovitis	2	3,5%	0	0,0%
Acromiohumeral conflict syndrome	2	3,5%	2	2,3%
Vagina tendinum musculi flexori hypertrophy	1	1,8%	0	0,0%
Thenar eminence hypotrophy	2	3,5%	0	0,0%
Dupuytren syndrome	3	5,3%	0	0,0%
Trigger finger	1	1,8%	0	0,0%
Guyon’s syndrome	0	0,0%	1	1,1%
Subacromial bursitis	1	1,8%	0	0,0%
Metacarpophalangeals arthrosis	1	1,8%	0	0,0%
Trapeziometacarpal arthrosis (rhizoarthrosis)	1	1,8%	1	1,1%
Epicondylitis	2	3,5%	0	0,0%
Abductor right pollicis Myofascial syndrome	2	3,5%	0	0,0%
De Quervain	0	0,0%	1	1,1%
M.of Duplay	0	0,0%	1	1,1%
Compression of nervus ulnaris in elbow	0	0,0%	1	1,1%
<b>TOTAL</b>	<b>57</b>		<b>87</b>	

Mother vine (left/right hand), manual “tirafili: wire strianing” (left/right hand), pruning (dry part) – Piedmont (right hand), pruning (dry part) – Marches (left/right hand), green pruning – pinching out (right hand) are included in the violet band (very high risk) whit a value of more than 25.5.

These results evidence the same risk, of biomechanical overload of the upper extremities, for female and male.

Regarding the manual material handling in the grape-harvest, the band of risk changed from yellow for farmers (male and female) who worked on farm tractor (I.S.C. respectively 0.82 and 0.99) to green for farmers on the land (I.S. 0.73).

*Clinical evaluation*

The total exposed population was composed by 125 workers: 82 male and 43 female: they operated in 4 farms in Tuscany. Only 42 of them were allowed to submit to a clinical examination by a specialist in rheumatology: 22 male and 20 female. The average age of the group is 49 (range 23 – 77) for male and 44 for female (range 27 – 59); the average working time in pruning 10 years (range 1 – 42) for male and e 5 years (range 0,5 – 15) for female.

In Table 4 the percentage of the affected workers are reported.

Table 3 Results of OCRA Check list for each of the working task analysed

Working tasks	Side	Recovery	Frequency	Force	Total of posture	Additional factors	Value of Check list
Mother vine	dx	4	9	7	9,5	2	31,5
Mother vine	sx	4	3	7	9,5	2	25,5
Vine plantation	dx	4	4,5	0	5	0	13,5
Vine plantation	sx	4	2	0	9	0	15
Manual “tirafili”	dx	4	8	11	10	2	35
Manual “tirafili”	sx	4	6	11	10	2	33
“Tirafili” with tool	dx	4	5	2	7	2	20
“Tirafili” with tool	sx	4	5	2	7	2	20
Pruning (dry part) - Tuscany	dx	4	7	2	7	2	22
Pruning (dry part) - Tuscany	sx	4	1	1	5,5	2	13,5
Pruning (dry part) - Piedmont	dx	4	7	2	13	2	28
Pruning (dry part) - Piedmont	sx	4	1	1	13	2	21
Pruning (dry part) - Marches	dx	4	7	3	17	2	33
Pruning (dry part) - Marches	sx	4	7	1	17	2	31
Green pruning - polling	dx	4	1	1	3,5	0	9,5
Green pruning - polling	sx	4	8	2	5,5	0	19,5
Green pruning – pinching out	dx	4	8	6	9	0	27
Green pruning – pinching out	sx	4	0	0	1	0	5
Green pruning – stripping of leaves	dx	4	5	2	3,5	0	14,5
Green pruning – stripping of leaves	sx	4	2	2	3	0	11
Grape harvest - Tuscany	dx	4	3	1	6	0	14
Grape harvest - Tuscany	sx	4	6	1	6	0	17
Grape harvest - Piedmont	dx	4	3	1	6	0	14
Grape harvest - Piedmont	sx	4	6	1	6	0	17
Grape harvest - Marches	dx	4	3	1	9	0	17
Grape harvest - Marches	sx	4	6	1	9	0	20

In Figures 1 the different distributions for joint of the UL-WMSDs and Figure2 the prevalence of UL-WMSDs for number of pathologies/person are reported for males and females

In the diagrams the presence of high percentages of right wrist tendinitis and Carpal tunnel syndroms is evident both in males and females.

Table 4. Percentage of workers affected by UL-WMSDs for gender

FARMS	% UL-WMSDs		
	MALE	FEMALE	TOTAL
A	25,0%	55,0%	33,8%
B	28,6%	44,4%	34,8%
C	25,0%	0,0%	18,2%
D	33,3%	45,5%	39,1%
<b>TOTAL</b>	<b>26,8%</b>	<b>46,5%</b>	<b>33,6%</b>

Figure 1. Distribution of the different UL-WMSDs for each joint and for gender

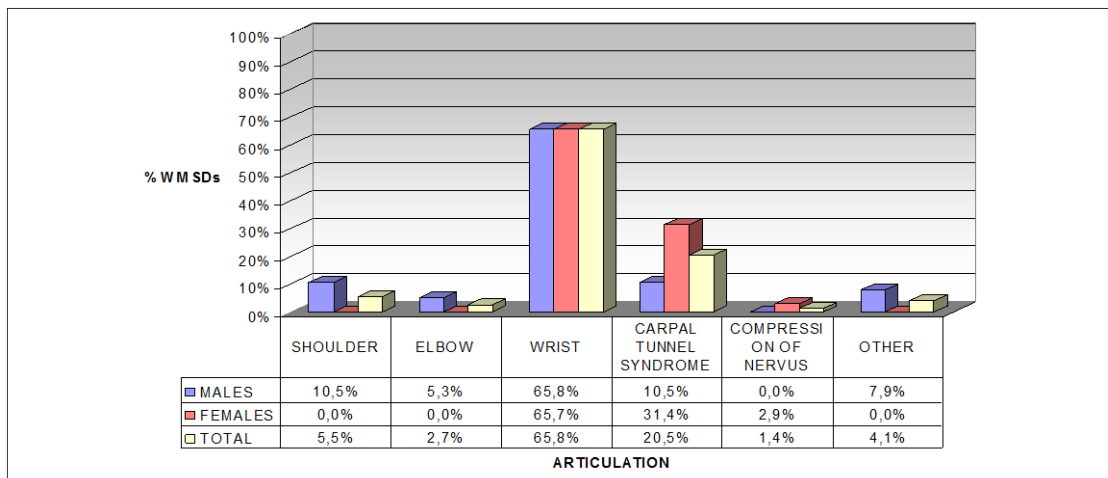
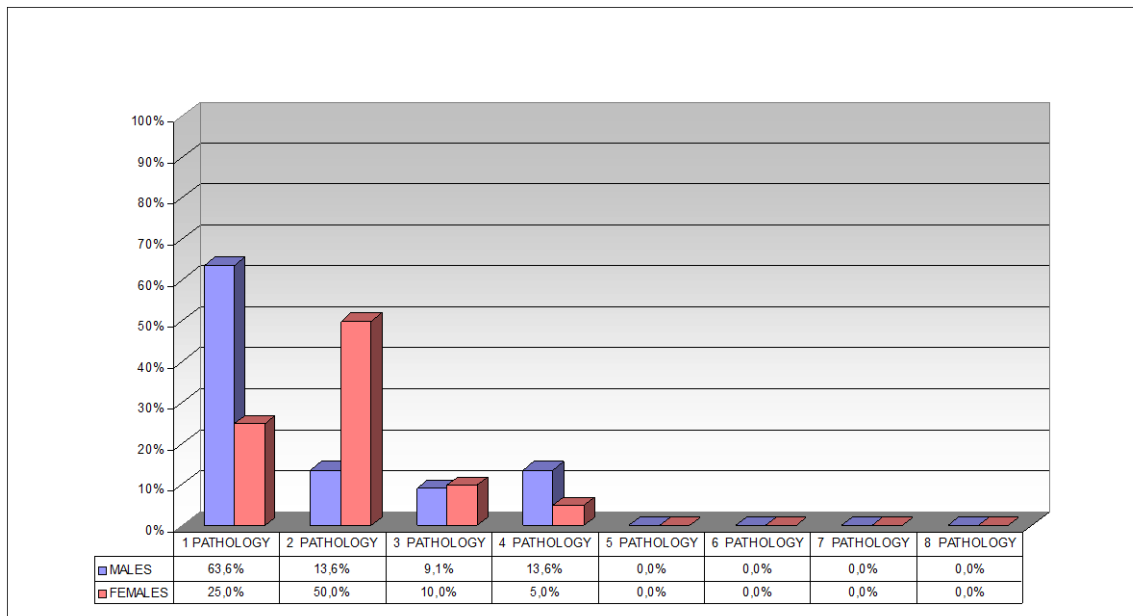


Figure 2. Prevalence of UL-WMSDs for number of pathologies/person for males and females



## **Discussion**

In vine-growing there is a medium-high risk for repetitive movements of the upper extremities, indicating the need to begin actions to improve the work.

The same holds for the manual material handling in the grape-harvest, especially for farmers who work on farm tractor.

The results of vine growing is used to evaluate the risk of each worker based on the task and the hours worked.

The agricultural work is certainly implies a marked risk of musculoskeletal disorders as confirmed by our study. Clinical examination, even if preliminary, indicates that this specific working population, spending many months a year in pruning vine and olive, show a specific occupational musculoskeletal hand disease that we can perhaps call “the pruning hand” characterised by Myofascial opponens right pollicis, Myofascial brachioradialis syndrome, Carpal tunnel syndrome syndrome, Myofascial flexor and extensor carpi radialis syndrome.

Instrumental clinical tests will be carried in the future out to get a further confirmation of the preliminary clinical examination.

## **Acknowledgements**

Help and collaboration of the Research Unit EPM (Ergonomic of Postures and Movements) is deeply acknowledged.

## **References**

1. Hagberg, M., Silvestrin, B., Wells, R., Smith, M.S., Hendrich, H.W., Carayon, P., Perusse, M., (1995) Work-related musculoskeletal disorders: a reference book for prevention. In: *Taylor and Francis (Ed.), London*.
2. Roquelaure, Y., Gabignon, J.C., Delaliux, P., Ferrari, C., Mea, M., Fanello, S., Penneau-Fontbonne, D., (2001) Transient hand paresthesias in Champagne vineyard workers. *Am J Ind Med* 40(6): 639-645.
3. Roquelaure, Y., Dano, C., Dusolier, G., Fanello, S., Penneau-Fontbonne, D., (2002) Biomechanical strains on the hand-wrist system during grapevine pruning. *Int Arch Occup Environ Health* 75: 591-595.
4. Colombini, D., Grieco, A., Occipinti, E., (1996) Occupational musculo-skeletal disorders of the upper limbs due to mechanical overload: methods, researches, experiences, criteria for prevention. *Med Lav* Vol 87 n.6.
5. Colombini, D., Occhipinti, E., Fanti, M., (2005) Il metodo OCRA per l'analisi e la prevenzione del rischio da movimenti ripetuti. In: *Franco Angeli (Ed), Milano*.