HAND ARM VIBRATION

International conference

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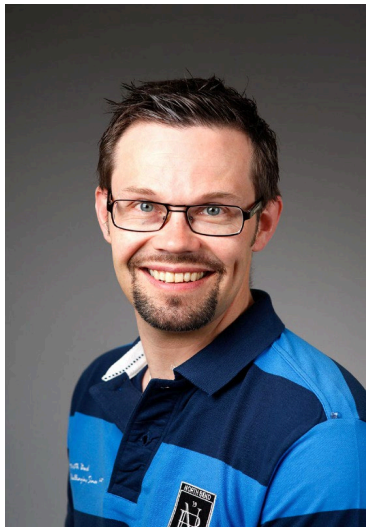
Radiographic Hand Osteoarthritis in Relation to Exposure to Hand-Transmitted Vibration:

A Systematic Review and Meta-Analysis



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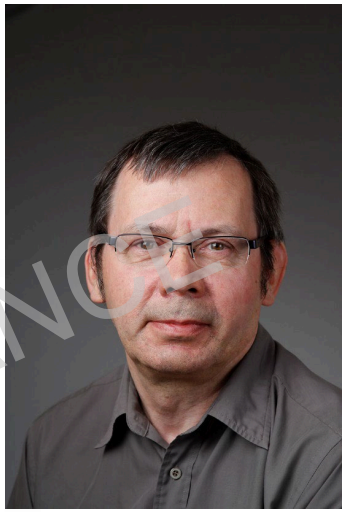

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Proceeding Paper

Radiographic Hand Osteoarthritis in Relation to Exposure to Hand-Transmitted Vibration: A Systematic Review and Meta-Analysis †

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† Presented at the 15th International Conference on Hand-Arm Vibration, Nancy, France, 6–9 June 2023.

Abstract: This systematic review on radiographic hand osteoarthritis (HOA) covering publications in the databases Medline and Embase for the period 1947 to April 2021, with a final selection of 10 studies, revealed a high prevalence of hand osteoarthritis among both vibration-exposed men and non-exposed. The results show a non-significant, unadjusted risk-increase of about 50% for X-ray-diagnosed hand osteoarthritis for those who work with vibrating machinery compared to referents. The risk estimate does not provide reliable support that working with exposure from vibrating machines increases the risk of radiographic changes in the hands.

Keywords: osteoarthritis; hand osteoarthritis; hand–arm vibration; systematic review; meta-analysis; vibration injury

check for updates

Citation: Nilsson, T.; Wahlström, J.; Reierth, E.; Burström, L. Radiographic Hand Osteoarthritis in Relation to Exposure to Hand-Transmitted Vibration: A Systematic Review and Meta-Analysis. *Proceedings* **2023**, *86*, 31. https://doi.org/10.3390/proceedings2023086031

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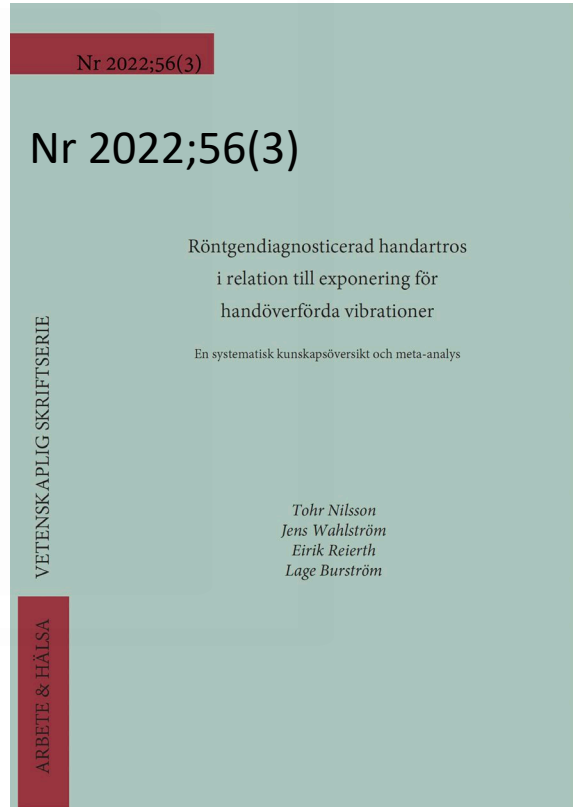
1. Introduction

Osteoarthritis is used as a collective term for joint failure that comes from disturbances in the balance between breakdown and new formation of the joint's various tissues (bone, cartilage, etc.). Osteoarthritis has historically been regarded as a disease of wear and tear. However, recent research shows that the disease has a complex background where a number of different causal factors work together to cause the disease. Disturbances in blood circulation, inflammatory and proinflammatory activity, mechanical stress, and trauma, as well as age-related processes, interact over time with hereditary disposition and occupational factors in the breakdown and deposits of bone and cartilage in joint structures. The results on cartilage and bone deposits are accompanied by pain, stiffness, and disability. Uneven bone turnover can cause changes in bone density with accompanying cavities (cysts) that are sometimes fluid-filled (vacuoles) and disturbed bone growth (osteophytes) or increased density (sclerosis), which can be depicted on plain film radiography (X-ray).

Early studies on workers exposed to primarily air-powered, striking machines reported injuries ("Die Presslufterkrankung") with skeletal changes in the form of bone cysts, skeletal changes in the bones of the hand, and joint osteoarthritis. The findings were deemed so unambiguous and extensive that bone loosening (malacia) of the lunate bone (Kienböck's disease) has been accepted since the 1930s as an occupational disease caused by vibration exposure and is included in the ILO's previous list of accepted occupational diseases (no. 505.01).

There is currently no recently updated evidence-based systematic review for the relationship between hand–arm vibration exposure and X-ray-diagnosed arthritis in the finger and wrist where the vibration exposure levels can be compared.

Abstract in English (p. 1-4)



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Nr 2022;56(3)

Röntgendiagnosticerad handartros
i relation till exponering för
handöverförda vibrationer

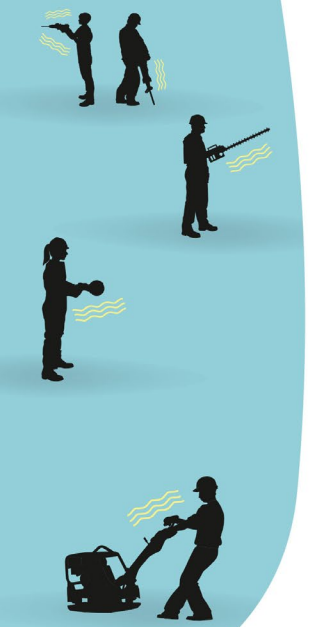
En systematisk kunskapsöversikt och meta-analys

Tohr Nilsson
Jens Wahlström
Eirik Reierth
Lage Burström

VETENSKAPLIG SKRIFTSERIE

ARBETE & HÄLSA

Original in Swedish (p.1 – 50)



Osteoarthritis
”joint failure”

Hand Osteoarthritis

Joint failure (separate from wear and tear)
as a result of several causal factors
which can cause an **imbalance** in the metabolism.

Causing disturbed bone-breakdown and
new bone-formation

Symptoms

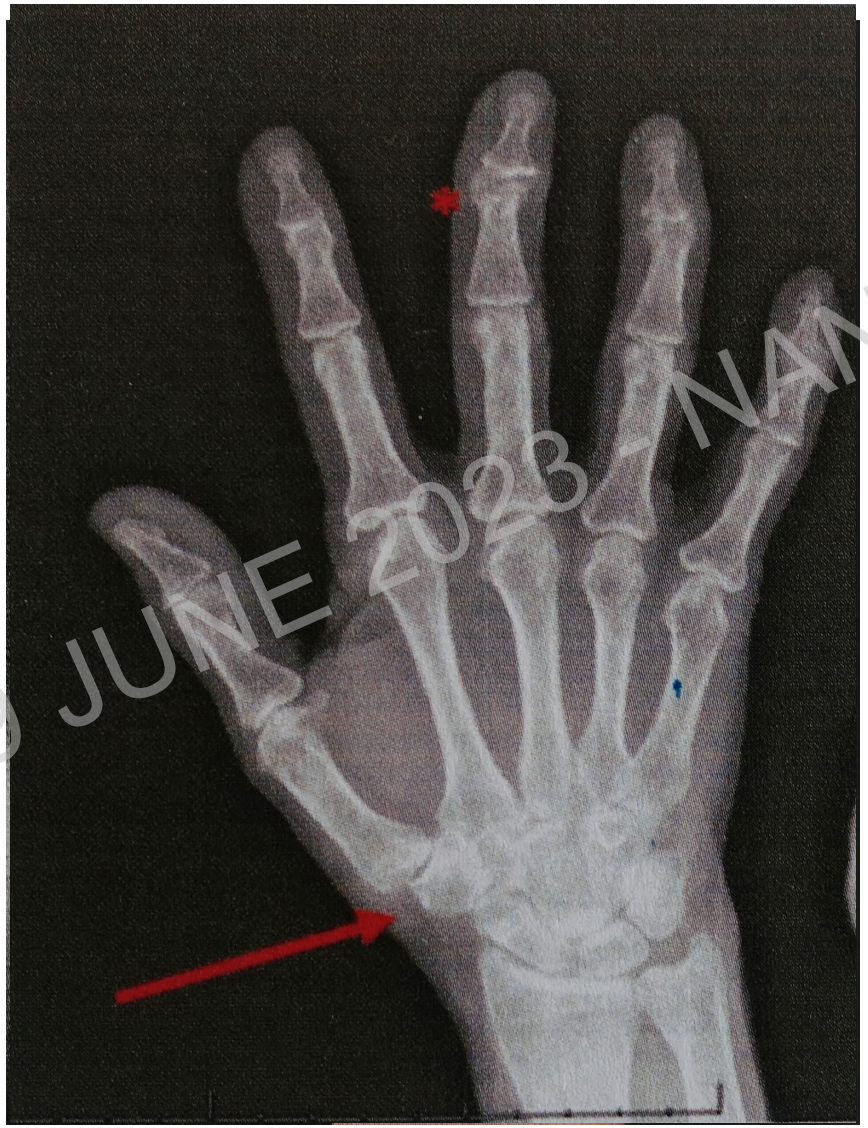
Swelling

Joint malposition

Pain

Functional limitation

Joints and radiographic findings



Reduced joint space

Osteophytes

Kienböck`s disease (Os Lunatum malacia)

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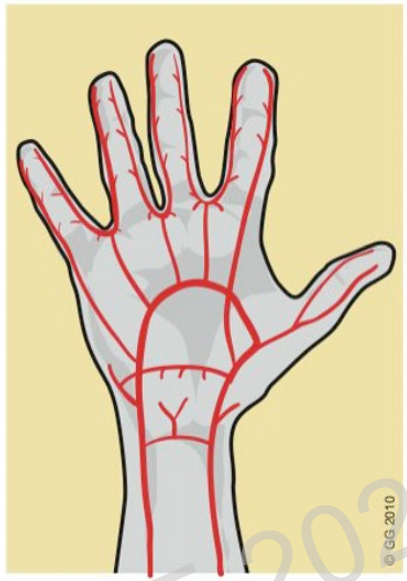
Os Lunatum malacia, cysts

Pathoetiology: Impaired vascular flow?

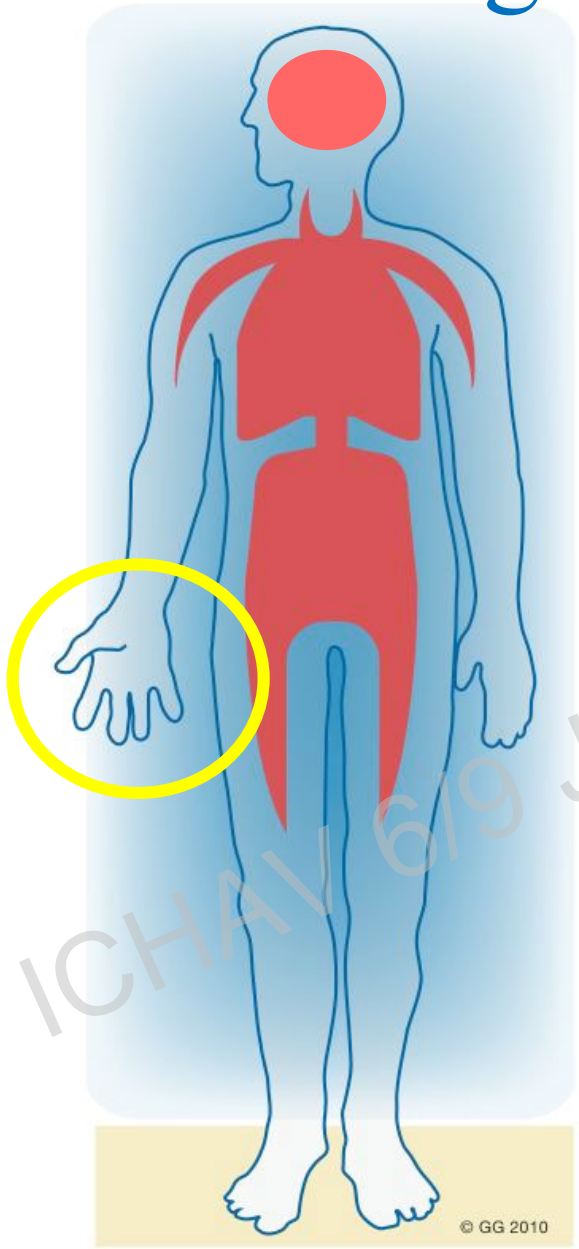


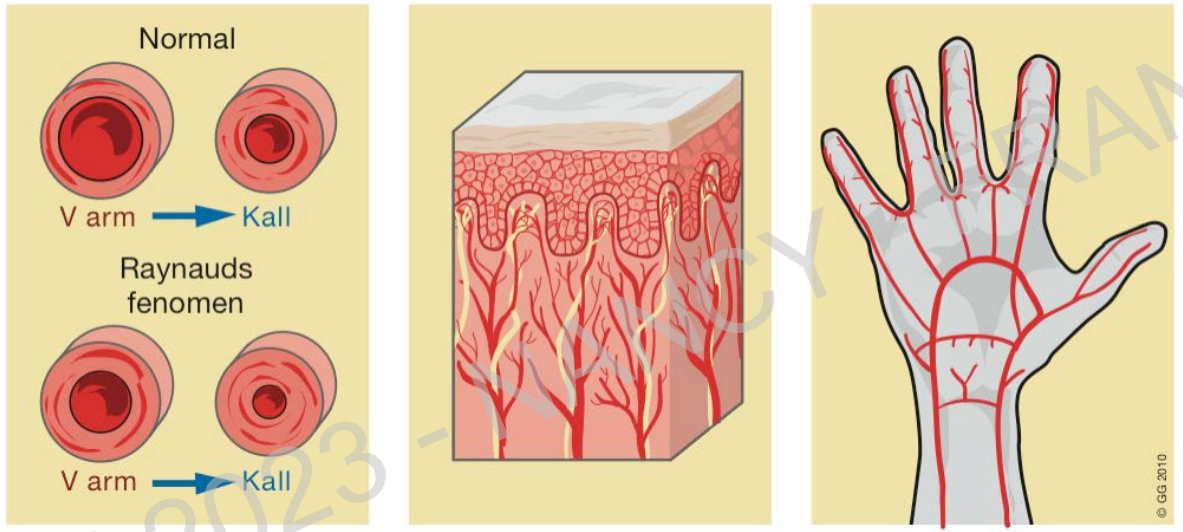
”Internal vasospasm White Fingers? ”

- Circulatory impairment, anatomical conditions
- Metabolic disorders. Bone- and cartilage breakdown and reformation?
- Immunological and inflammatory interactions

Prevailing notion: Wear and tear due to mechanical impact?

Biological, patophysiological risk factors





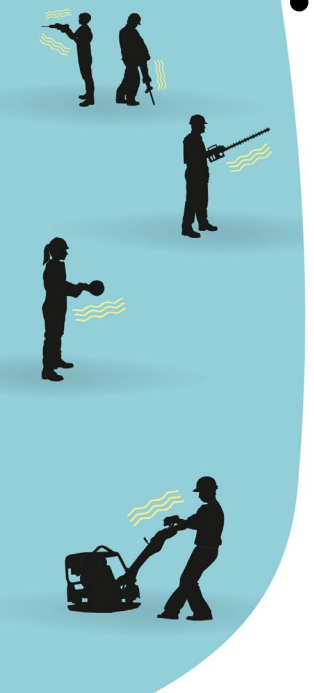
- Cold: vasoconstriction and disturbed circulation
- Other vascular interferences

Vibration and hand osteoarthritis?

ILO list of occupational diseases - Yes! 2010

Aims

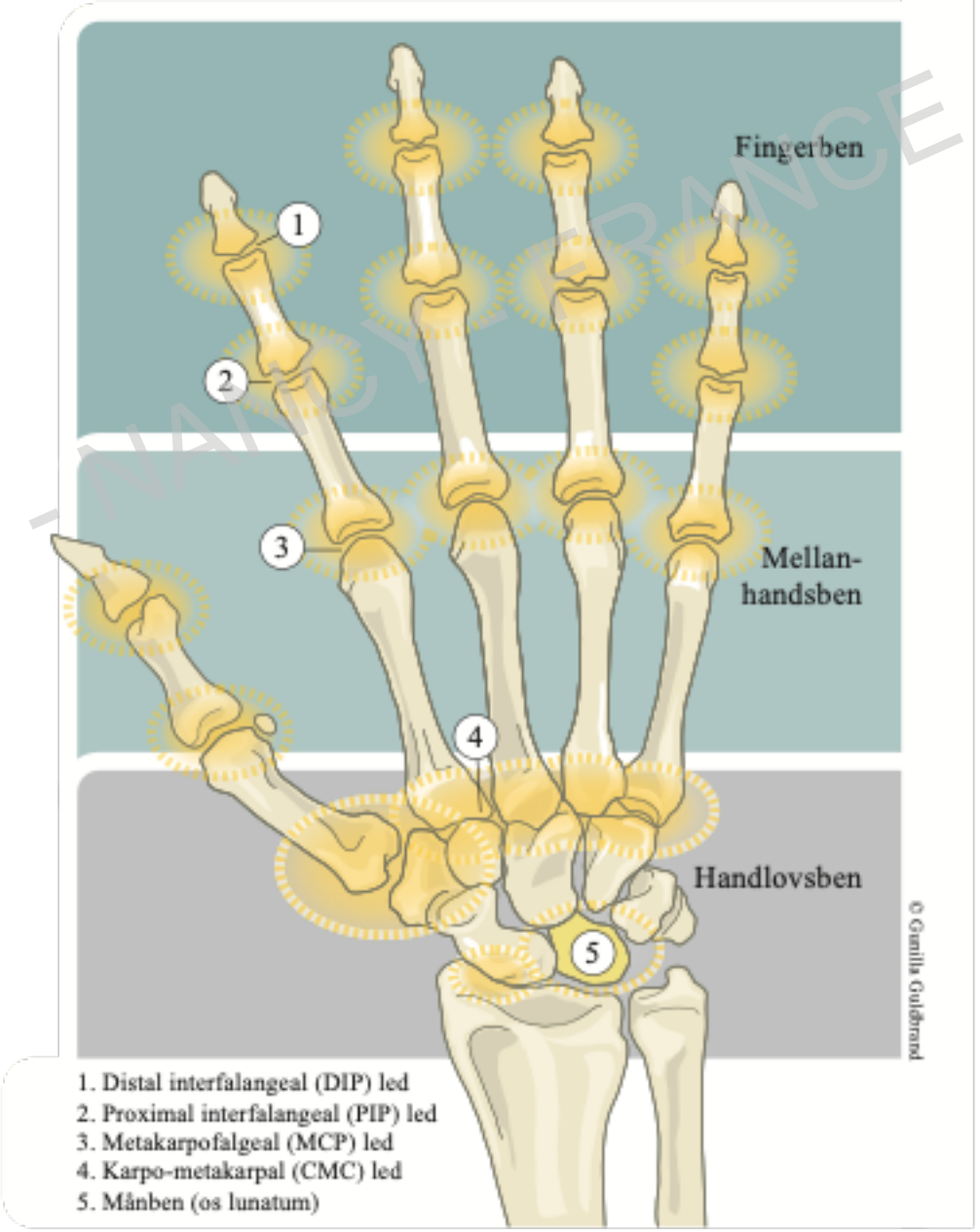
- To study the risk of X-ray-diagnosed Hand OsteoArthritis (HOA) in relation to exposure of hand-transmitted vibration.
- To estimate the magnitude of such a possible association using statistical synthesis (meta-analyses).



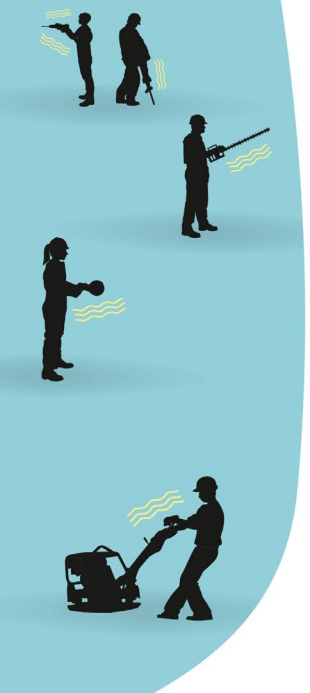
Case definition

Radiographic Hand Osteoarthritis

- Grading of X-ray-defined osteoarthritis according to The Kellgren Lawrence scale
- Kienböck's disease stage based on X-ray findings



PRISMA



Pubmed
Embase
Medline

1946 - 2021

	Identification of studies via databases and registers		Identification of studies via other methods	
Identification	Records identified from Medline (n = 23) EMBASE (n = 43)	Removed *before screening*: Duplicates (n = 23)	Records identified from: Citation searching (n = 48)	
Screening	Records screened (n = 43)	Records excluded Outcome (n = 22) Language (n = 14)	Records screened (n = 48)	Records excluded Outcome (n = 27) Language (n = 9)
	Reports sought for retrieval (n = 7)	Reports not retrieved (n =)		
	Reports assessed for eligibility (n = 7)	Reports excluded: Reviews (n = 6)	Reports assessed for eligibility (n = 12)	Reports excluded: Reviews (n = 3)
Include	Studies included in review Databases (n = 1) Citation search (n = 9)			

Old studies. Few new studies.

Risk of Bias assessment (reliability)

Exposure		
	Alternativ	**Points**
Current exposure level (m/s^2)	Objective measurements Subjective estimate Data missing	2 1 0
Previous acceleration level (m/s^2)	Objective measurements Subjective estimate Data missing	2 1 0
Previous exposure time (years)	Objective measurements Subjective estimate Data missing	2 1 0
Current exposure time (hours/day)	Objective measurements Subjective estimate Data missing	2 1 0
Previous exposure time (hours/day)	Objective measurements Subjective estimate Data missing	2 1 0

Reliability (Risk of Bias) sorted by descending reliability

Studie	Design	Diagnosis Min 2 max 8	Exposure Min 1 max 10	Methods Min 2 max 12	Total Min 5 max 30
Kivekas et al. 1994	Cohort	6	3	10	**19**
Bovenzi et al. 1987	Cross-section	7	5	4	**16**
Malchaire et al. 1986	Cross-section	6	5	4	**15**
Kumlin et al. 1973	Cross-section	4	2	2	8
Van den Bossche et al. 1984	Cross-section	3	3	2	8
Burke et al. 1977	Cross-section	4	1	2	7
Härkonen et al. 1984	Cross-section	4	2	5	7
Suzuki et al. 1978	Cross-section	4	1	2	7
Hellström & Andersen 1972	Cross-section	3	1	2	6
Laitinen et al. 1974	Cross-section	2	1	2	5

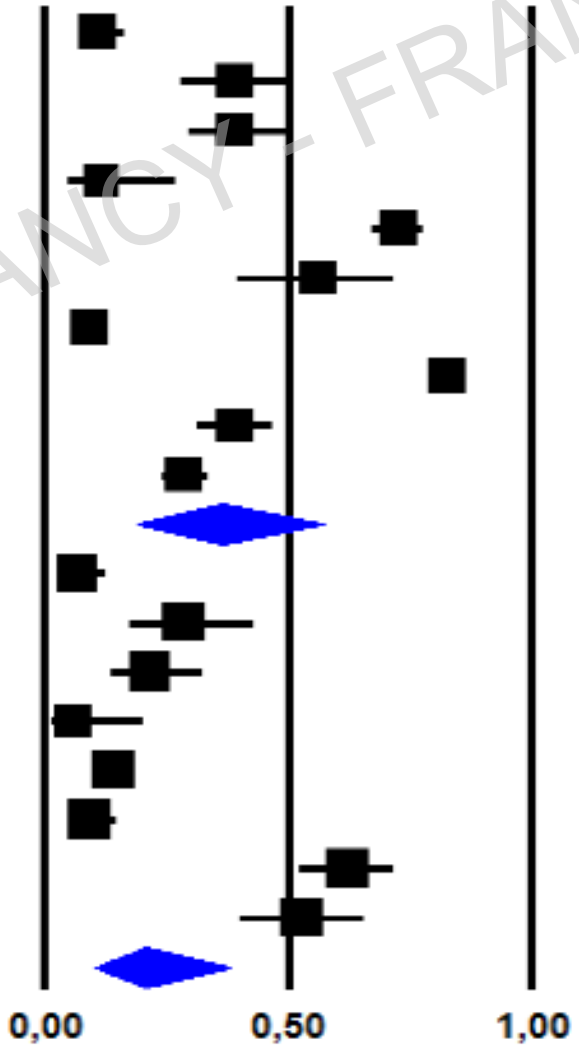
High prevalences of radiographic findings

sorted by descending reliability

Studie namn	Studiegrupp	Prevalens (%)	95% KI för prevalensen Undre gräns	Övre gräns
Kivekäs et al. 1994	Exponerade	11	7	16
Bovenzi et al. 1987	Exponerade	39	28	51
Malchaire et al. 1986	Exponerade	39	29	50
Kumlin et al. 1973	Exponerade	11	4	27
Van den Bossche et al. 1984	Exponerade	72	67	77
Burke et al. 1977	Exponerade	56	39	71
Härkonen et al. 1984	Exponerade	9	6	13
Suzuki et al. 1978	Exponerade	83	79	85
Hellström & Andersen 1972	Exponerade	39	31	47
Laitinen et al. 1974	Exponerade	28	24	33
Sammanvägt			19 *	57
Kivekäs et al. 1994	Inte exponerade	6	3	12
Bovenzi et al. 1987	Inte exponerade	28	17	43
Malchaire et al. 1986	Inte exponerade	21	14	32
Kumlin et al. 1973	Inte exponerade	6	1	20
Van den Bossche et al. 1984	Inte exponerade	14	10	18
Härkonen et al. 1984	Inte exponerade	9	6	14
Suzuki et al. 1978	Inte exponerade	62	52	72
Hellström & Andersen 1972	Inte exponerade	53	40	65
Sammanvägt			10 *	37

Total. Vibration exposed: High prevalences

Total. Not exposed: High prevalences

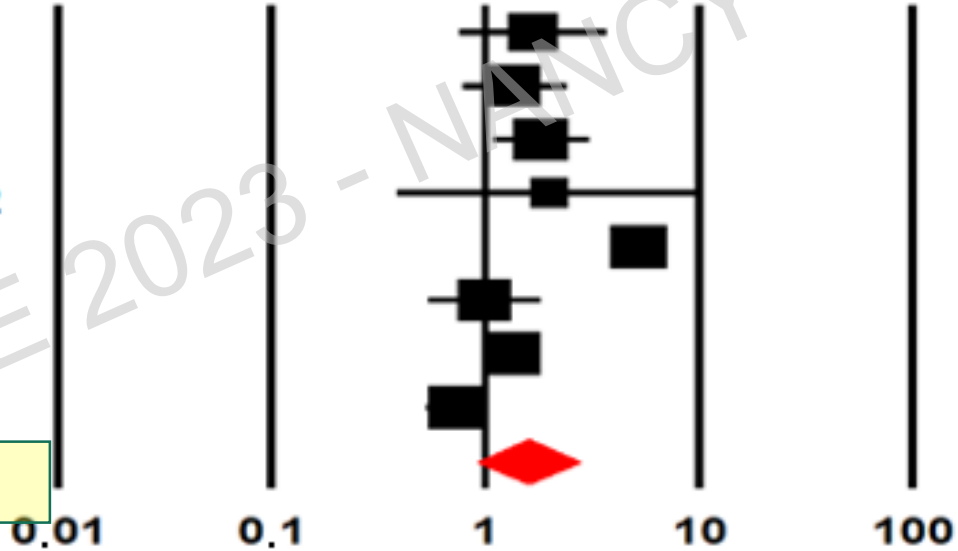


* Indicates effect size as RR should be used instead of OR

Risk (RR) för artros bland vibrationsexponerade

sorted by descending reliability

Study name	Risk ratio	95% CI for risk ratio Lower limit	Upper limit	Relative weight	A(8) m/s²
Kivekäs et al. 1994	1.68	0.76	3.69	11.38	≈ 5
Bovenzi et al. 1987	1.37	0.79	2.38	12.98	≈ 12
Malchaire et al. 1986	1.83	1.10	3.05	13.21	≈ 7.5
Kumlin et al. 1973	2.00	0.39	10.22	6.36	≈ 5
Van den Bossche et al. 1984	5.28	4.00	6.98	14.41	≈ 3.5
Härkonen et al. 1984	1.00	0.55	1.81	12.66	≈ 3.5
Suzuki et al. 1978	1.33	1.13	1.57	14.77	≈ 5
Hellström & Andersen 1972	0.73	0.53	1.01	14.24	≈ 5
Overall	1.59	0.92	2.73		



* Additional exposure assessment based on a Job-exposure matrix

Confounders: Vibration – Cold – Manual work

6 (10)

4 (10)

All studies entailed severe exposure to cold!

Confounders

Age

Sex

Heredity

Hand-intensive work

Other joint disease (arthritis)

Compare with ISO 5349-1 (Annex B) on guidance on health effects and (**Annex D)** factors likely to influence health effects

The following factors may specifically affect the circulation changes caused by hand-transmitted vibration **(Annex D):**

i) climatic conditions and other factors affecting the temperature of the hand or body;

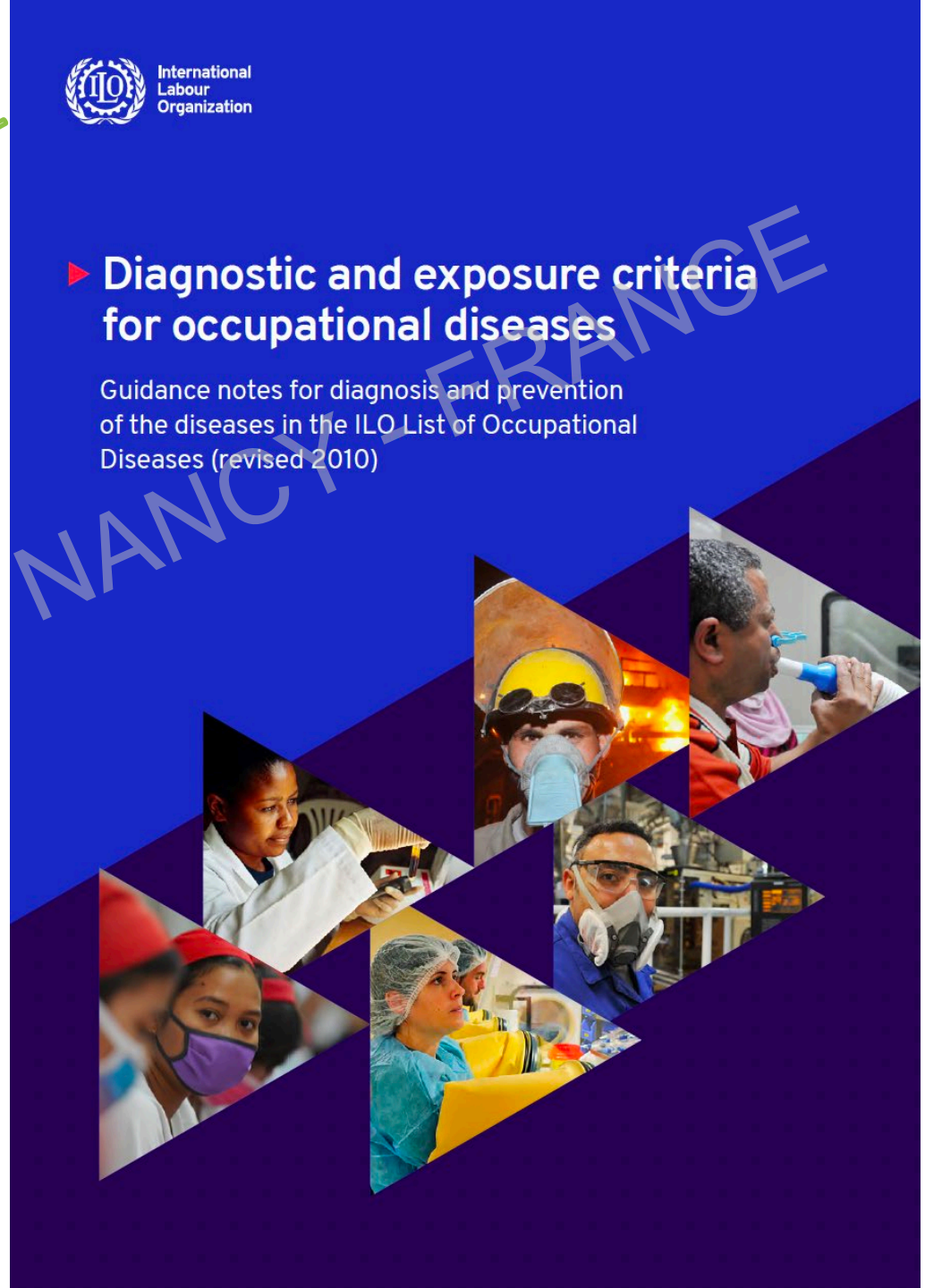
j) diseases which affect the circulation;

k) agents affecting the peripheral circulation, such as nicotine, certain medicines or chemicals in the working environment;

l) noise.

ILO list for occupational diseases „Supporting evidence is weak" 2022

- No significant relation to vibration
- Vibration dose was not related
- Restricted to radiographic osteoarthritis
- Mirrors work-risks 1972 – 1994
- Few studies – No modern studies
- Heterogenicity in studies



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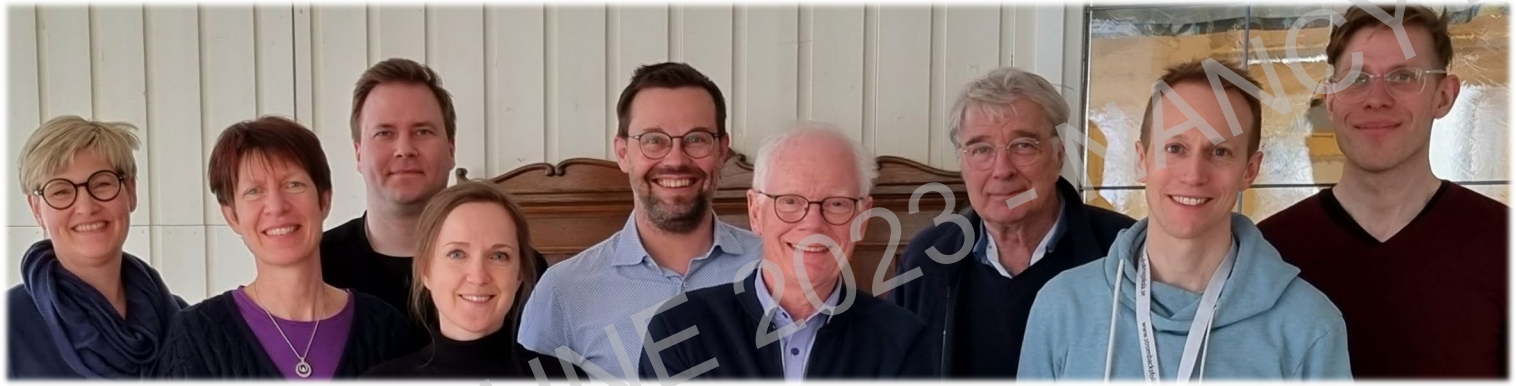

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Thank you!

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