

**HAND ARM
VIBRATION**



International conference
6-9 JUNE 2023
Espace Prouvé,
Nancy, France

Onset of Vibration-Induced White Finger: Insight Derived from a Meta-Analysis of Exposed Workers

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Outline

- Motivation
- Meta-Analysis by Nilsson et al. [1]
- Models and Results
- Issues
- Next Steps

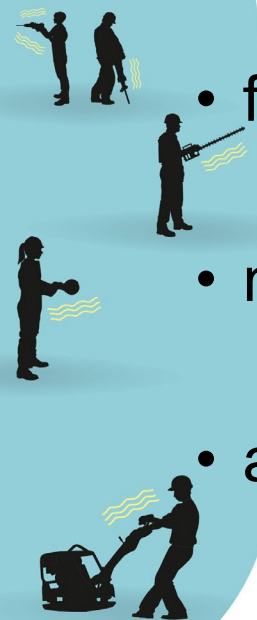


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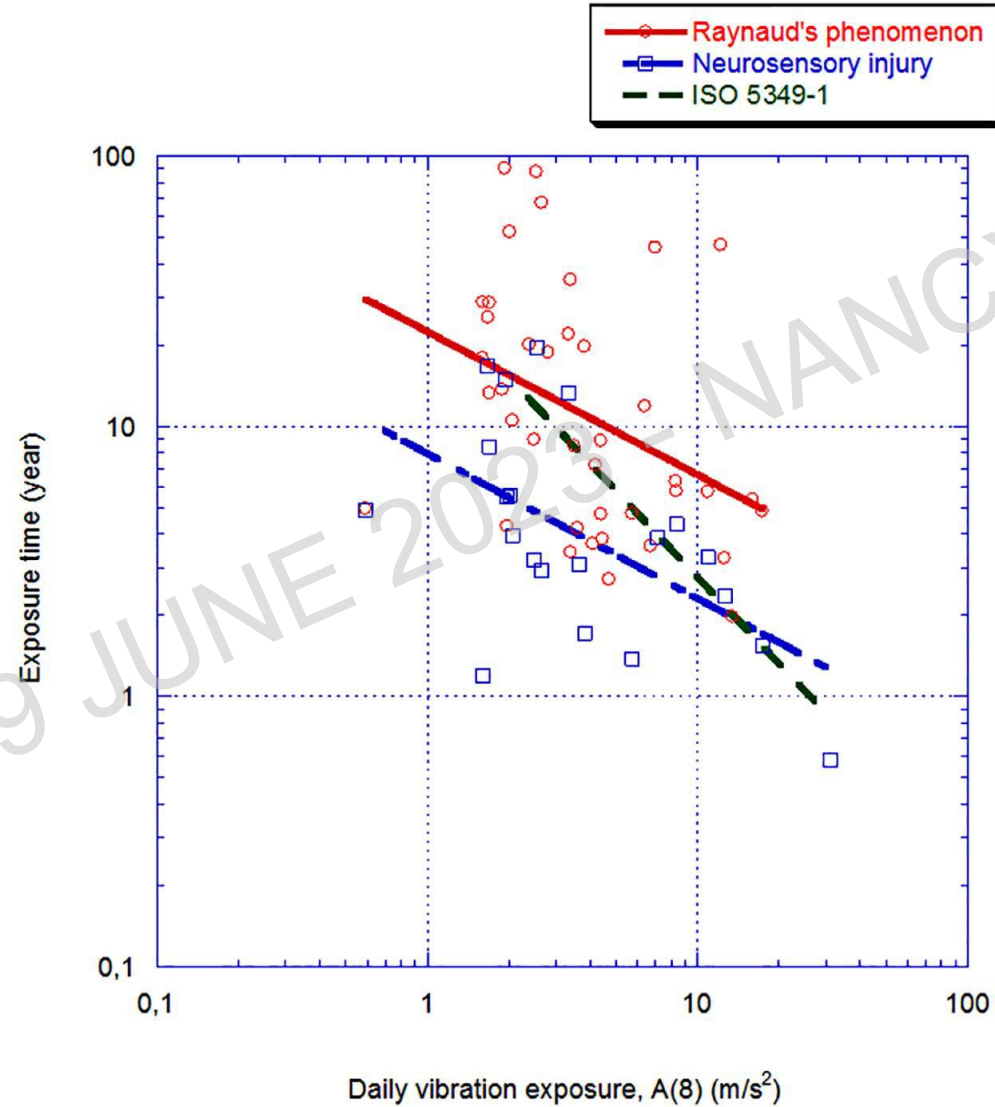
Motivation

Based on meta-analysis by Nilsson et al. [1]:

- correct prediction for 10% prevalence of VWF by ISO 5349-1?
- fitting for percussive tools?
- multiple tools used per day equally well predicted as one tool per day?
- all necessary aspects considered in [1]?



Meta-Analysis by Nilsson et al.



[1]

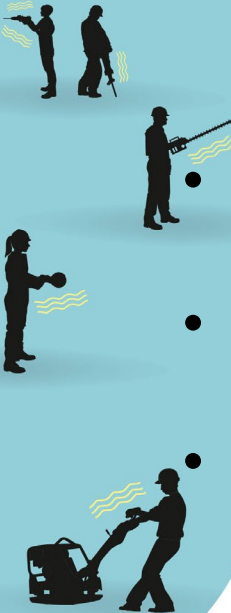
Literature Analysis

- Studies used by Nilsson et al.
- Participants
- Evaluation methods
- Health issues
- Exposure time and latency
- Tools used – impact and non-impact tools
- Vibration data

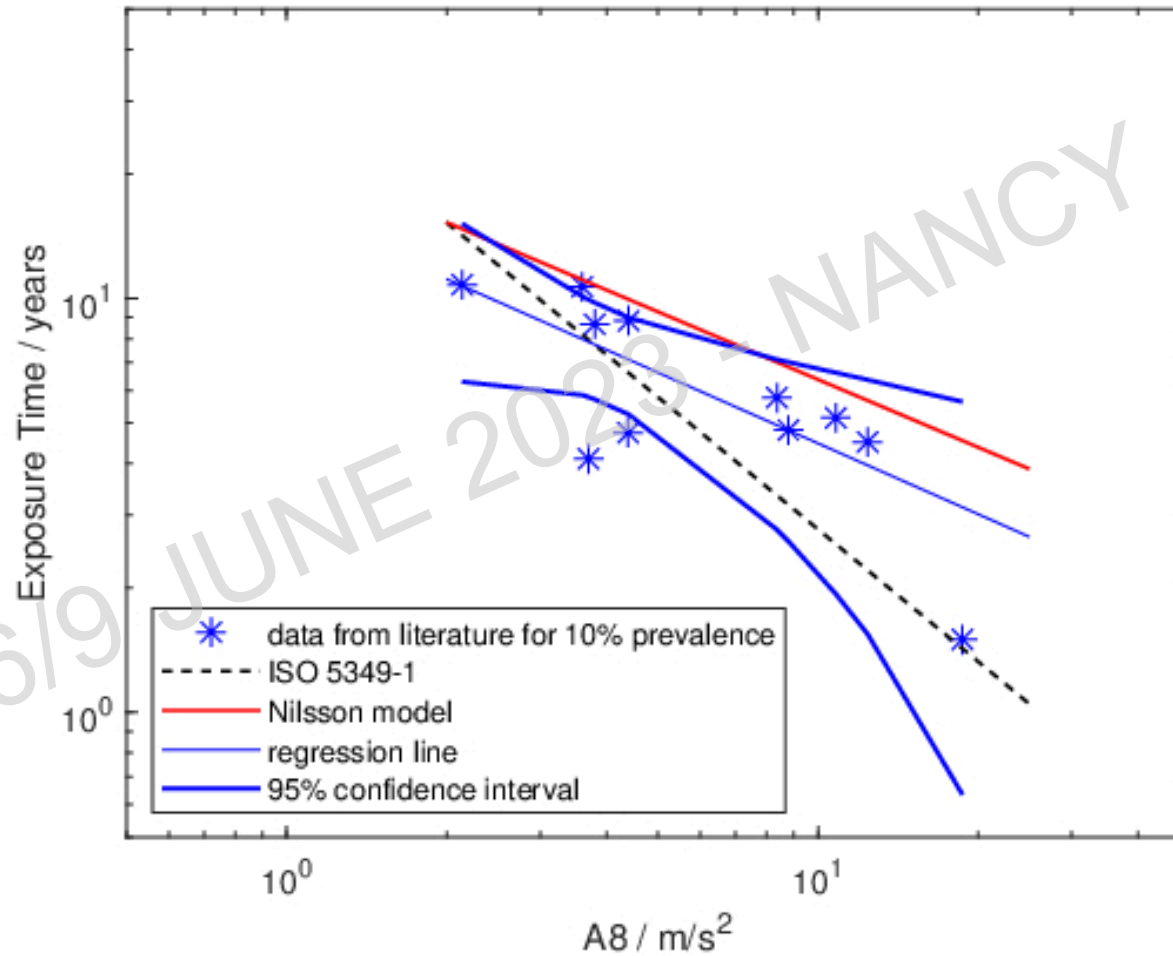


Analysis – First Data Set

- Include all studies reporting values for prevalence of VWF (>10%), duration of exposure D_y (years) & $A(8)$
- Linear interpolation to exposure time at 10% prevalence assuming 0% prevalence at 0 exposure time
- Plot of exposure time versus $A(8)$
- Regression analysis: $D_{y,10} = a \cdot A(8)^b$
- 95% confidence intervals for regression line



Regression Analysis – First Data Set



[2]

Analysis – Additional Data

Total operating time in h:

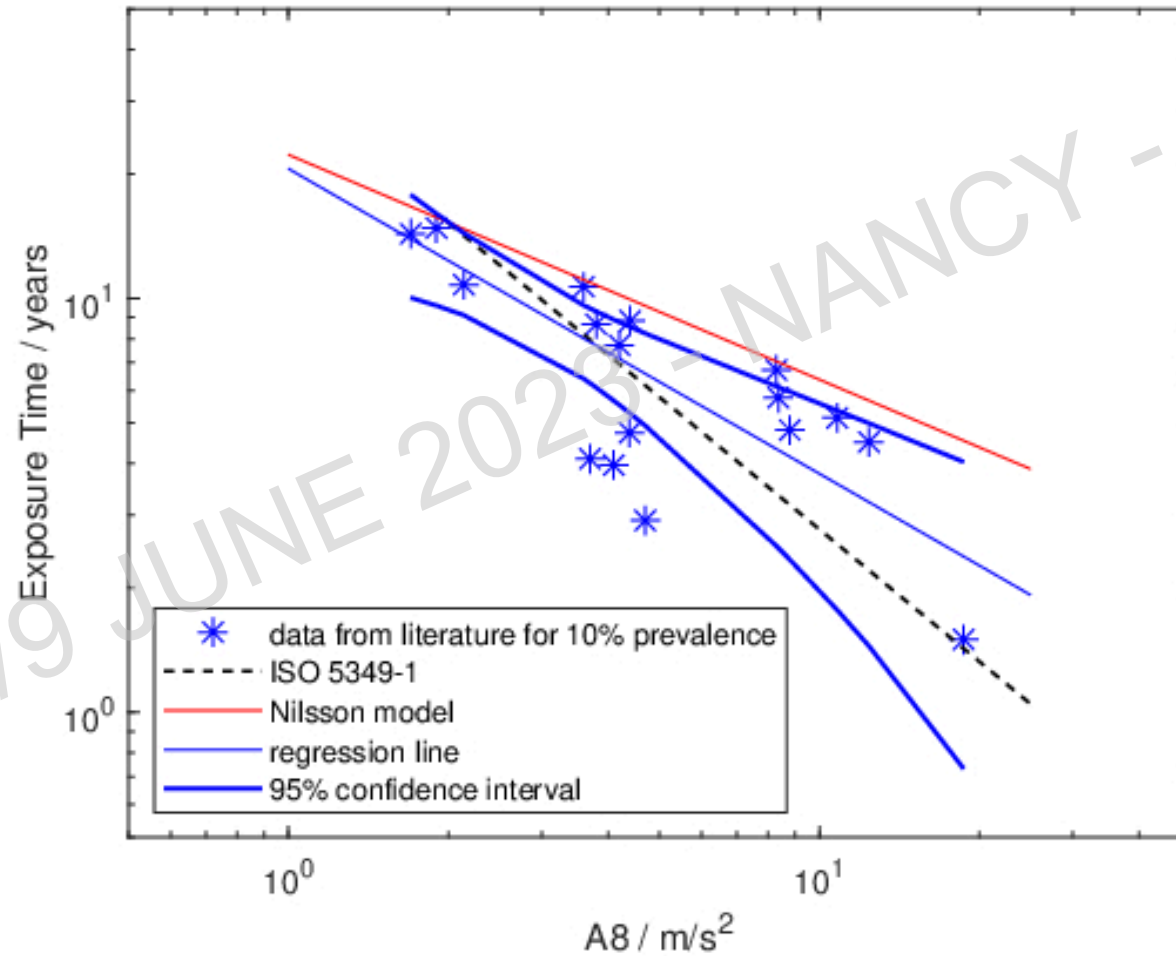
$$t_{exposed} = N^{\circ} \text{ of } \frac{h}{\text{day}} (t_{workday}) \times \text{days exposed } (N_{workdays})$$

Exposure time in years:

$$D_y = \frac{t_{exposed}}{t_{workday}} \div N_{workdays \text{ per year}}$$



Regression Analysis – Additional Data



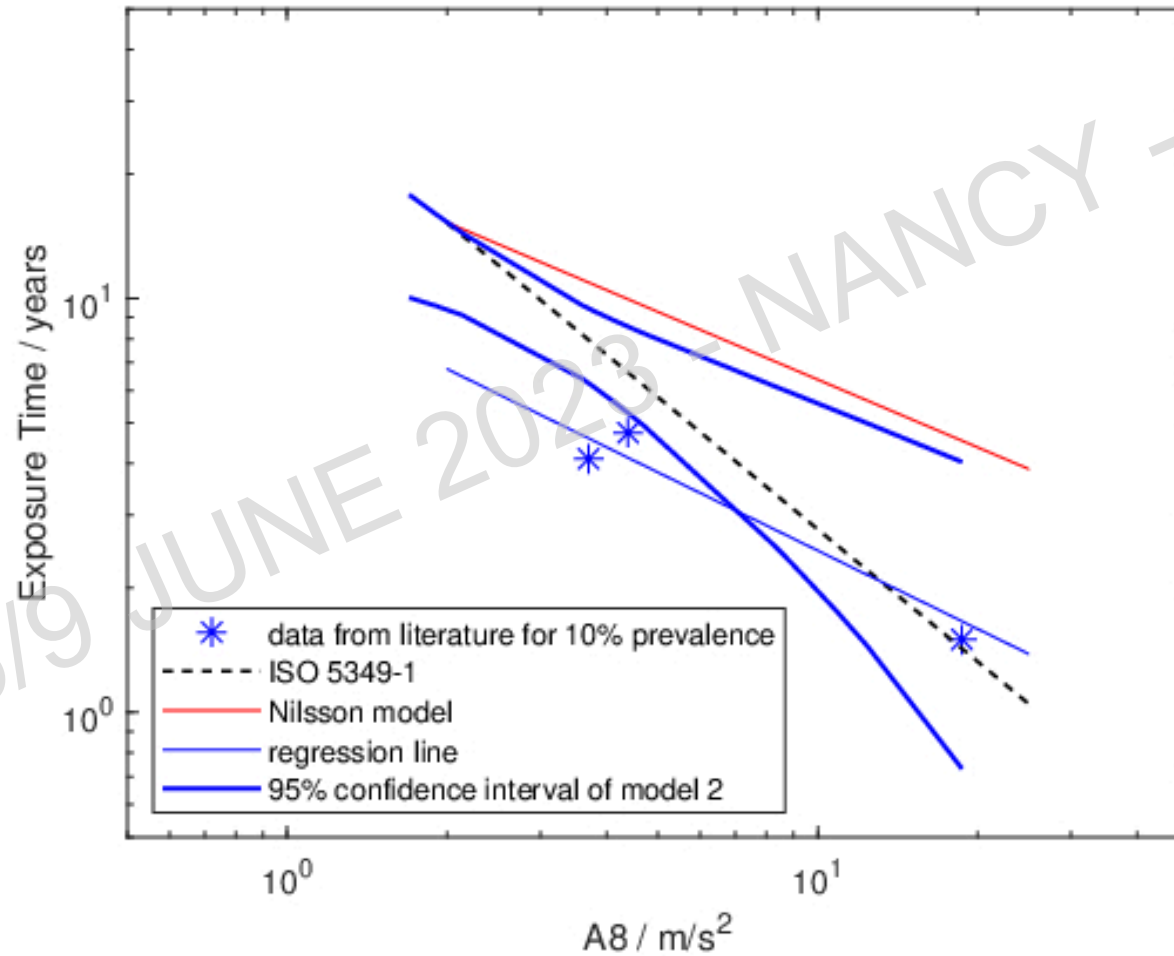
[2]

Comparison

	present analysis	ISO 5349-1 [3]	Nilsson et al. [1]
parameter a	20.6	31.8	≈ 22
parameter b	-0.74	-1.06	≈ -0.54
studies used	single & multi tool studies	single tool studies	single & multi tool studies
interpolation / extrapolation	interpolation	-	both

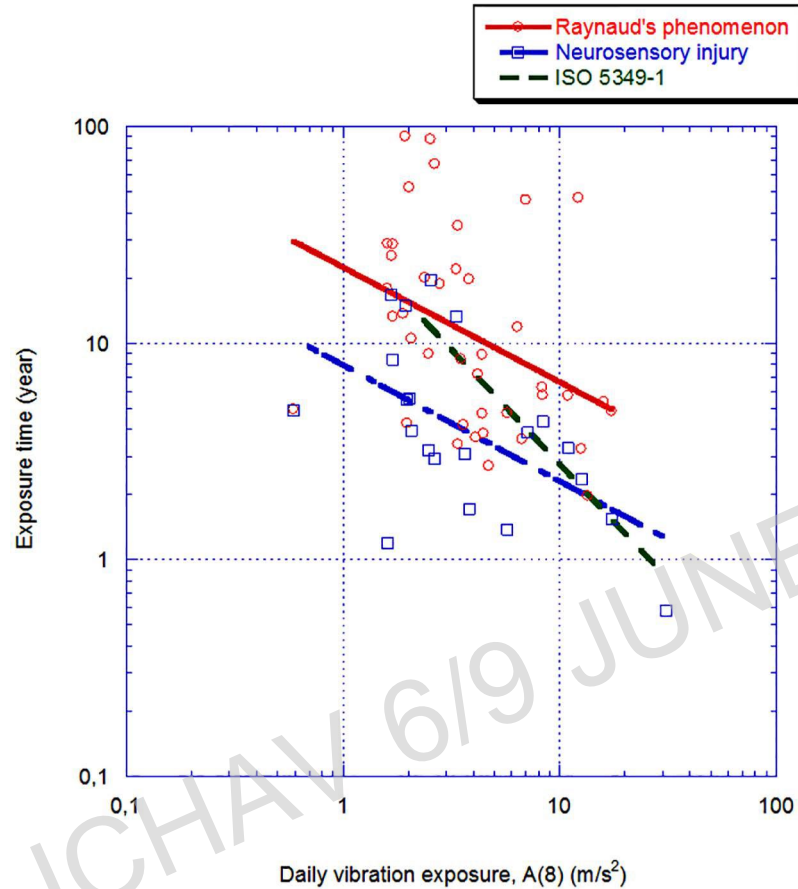
$$D_{y,10} = a \cdot A(8)^b$$

Regression Analysis – Single Tool Studies

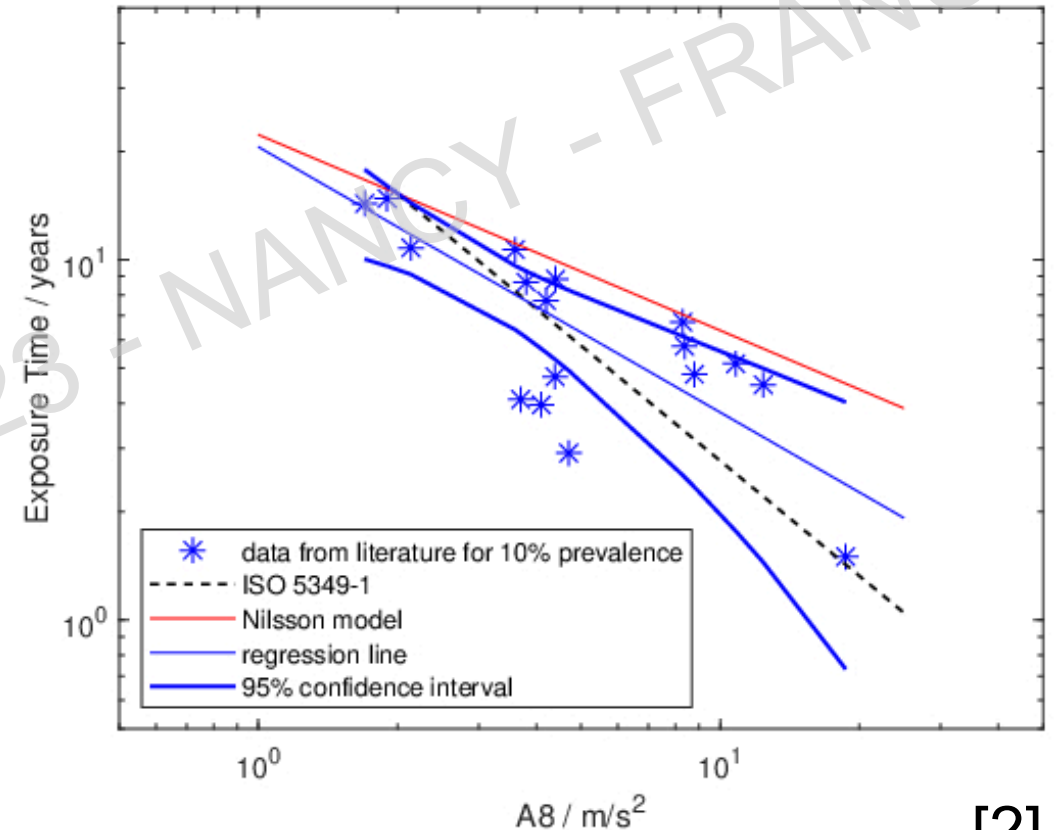


[2]

Conclusion – Part 1



[1]



[2]

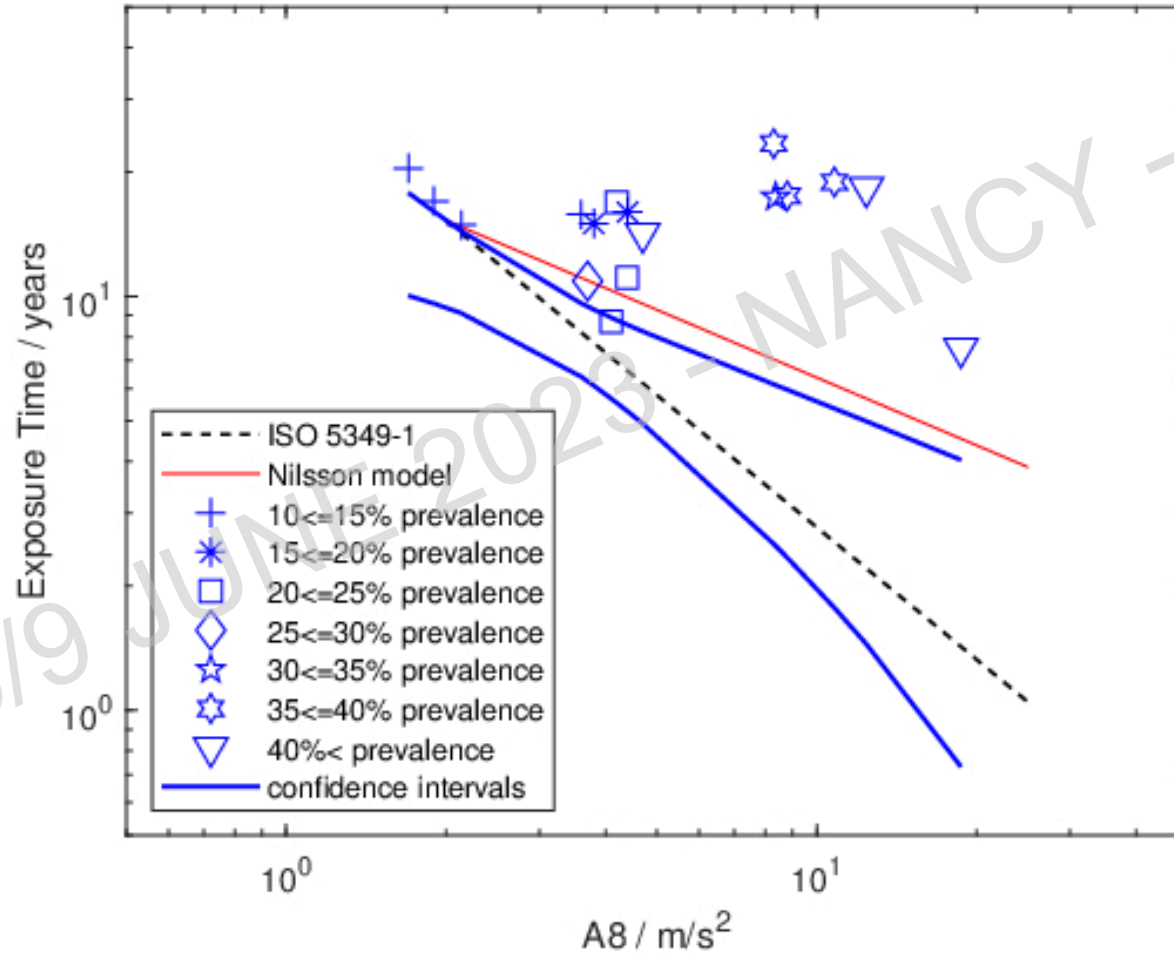
several issues have been uncovered by this analysis

Issues

- large data spread
- interpolation versus extrapolation
- determination of daily & lifetime exposure
- measurement of vibration
- characterization of exposure
- different information in papers used



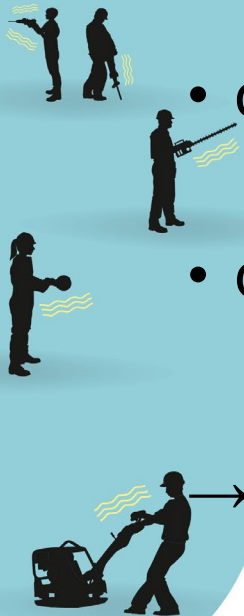
Conclusion – Part 2



[2]

Next Steps

- extend data set using studies not used by Nilsson et al.
- **different interpolation than linear**
- other metrics of exposure (vibration magnitude & duration)
- different frequency weighting (e.g. ISO/TR 18570 [4])
- unify health effects from exposure to single and multiple tools



Sources

[1] Tohr Nilsson, Jens Wahlström, and Lage Burström. "Hand-arm vibration and the risk of vascular and neurological diseases—a systematic review and meta-analysis." *PloS one* 12.7 (2017): e0180795.

[2] Magdalena F. Scholz, Anthony J. Brammer & Steffen Marburg. " Exposure–response relation for vibration-induced white finger: inferences from a published meta-analysis of population groups. " *Int Arch Occup Environ Health* (2023). <https://doi.org/10.1007/s00420-023-01965-w>

[3] ISO 5349-1 (2001). Mechanical vibration - Measurement and evaluation of human exposure - Part 1: General requirements. Geneva, International Organization for Standardization.

[4] ISO/TR 18570 (2017). Mechanical vibration - Measurement and evaluation of human exposure to hand transmitted vibration - Supplementary method for assessing risk of vascular disorders. Geneva, International Organization for Standardization.