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Hand-Arm Vibrations' Association with Myocardial Infarction †

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Abstract: This study found no association between exposure to hand-arm vibrations (HAV) and myocardial infarction. Data was gathered from the Swedish National Cohort on Work and Health and consists of all individuals born in Sweden from 1930 to 1990, with demographic, occupational, and MI data available between 1968 and 2017. All workers in Sweden with an occupational code between 1985 and 2013 were matched to the job-exposure matrix on occupational exposures. The model was adjusted for demographic data and other occupational exposures. The hazard ratio with a 95% confidence interval was 1.01 (0.92–1.11) for those exposed above the daily equivalent HAV level of 5 m/s^2.

Keywords: hand-arm vibration; myocardial infraction; job-exposure matrix

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1. Introduction

Cardiovascular disease may be deadly or greatly affect people's lives, and one of the most important subgroups is ischemic heart disease, where myocardial infarction (MI) is the most common diagnosis. Many occupational exposures may affect the risk of MI, but less is known of Hand-Arm Vibrations (HAV) effect on this disease [1,2]. Experimental studies have found acute effects of HAV on heart rate variability [3]. Epidemiological studies on HAV effects on ischemic heart disease and myocardial infarction are few [4,5]. Miners exposed to HAV had a higher prevalence of ischemic heart disease and an increased risk of MI when exposed to HAV and WBV [4,5]. The SWE-JEM project has developed job-exposure matrices (JEM) on common occupational exposures, including HAV, to be used for studies on HAV exposure and its effect on the risk of myocardial infarction. This paper studied the association between HAV exposure and the risk of first-time myocardial infarction, with adjustment for other occupational exposures.

2. Materials and Methods

This study gathered data from the Swedish National Cohort on Work and Health (SNOW), created using Swedish registers. SNOW consists of all individuals born in Sweden from 1930 to 1990 and living in Sweden between 1968 and 2017, with demographic, occupational, and MI data available between 1968 and 2017. All workers in Sweden with an occupational code between 1985 and 2013 were matched to job-exposure matrix on HAV and other occupational exposures known to affect the risk of MI. Every participant's occupation has been coded according to the occupational classifications of the National Labour Market Board (Arbetsmarknadsstyrelsens yrkesklassificering). The occupational classification code is built on the International Standard Classification of Occupations (ISCO-88-code system) and has been described elsewhere [6]. The classification of occupations used was FOB 1980, 1985, 1990 (FOB 80 and FOB 85), and SSYK 96 and SSYK 12. Each code for every classification was given the calculated eight hour daily equivalent HAV exposure level A(8). The A(8) value was calculated from the HAV exposure from hand-held vibrating machines used by workers in each occupation and the daily duration of operating each machine according to international standard ISO 5349-1. All HAV exposure levels were calculated or gathered from earlier measurements and calculations from vibration databases, measurement reports, and scientific articles (N = 90). The A(8) exposure was categorised as 0 m/s^2 or no HAV exposure, above 0 up to 1 m/s^2, above 1 up to 2.5 m/s^2, above 2.5 up to 5 m/s^2 and above 5 m/s^2. In the SWE-JEM project, a JEM for occupational noise, demands, decision authority, physical workload index, and chemical/particle exposures has been constructed and used in the analysis. The chemical and particle exposures included were carbon monoxide, diesel exhaust, oil mist, polycyclic aromatic hydrocarbons, pulp and paper particles, silica, and welding fumes. Information on MI was gathered from the national patient registry and coded using the International Classification of Diseases, 7th, 8th, 9th, and 10th revisions (ICD-7, ICD-8, ICD-9, and ICD-10).

In the analysis, we first constructed a model of HAV exposure and MI, adjusting for year, age, gender, income, country of birth, and marital status. The second model also adjusted for occupational exposure to noise, demands, decision authority, physical workload index, and chemical exposure. The hazard ratio and a 95% confidence interval were calculated.

3. Results

Characteristics of the SNOW cohort in 2010 are gathered in Table 1. In 2010, the SNOW cohort had a total of 3,450,962 individuals (1,819,455 males/1,721,590 females), with an age median of 44 (51.4 males/48.6 females) included. Most individuals were born in Sweden (3,093,677, 87.4%) or the rest of Europe (7.3%). There were 1,921,575 individuals not married or in a registered partnership and 1,921,575 married or in a registered partnership. There were 157,510 males and 6208 females HAV exposed above <2.5 m/s^2.

Table 1. Characteristics of the cohort for working individuals by hand-arm vibration exposure included in the study for the year 2010.

		Hand-Arm Vibration (m/s^2) N (%)				
Descriptive Data		**Unexposed**	**>0–1**	**>1–2.5**	**>2.5–5**	**>5**
Age (median)		44	43	43	42	43
Gender	Male	1,266,881 (44.3)	154,448 (63.5)	240,616 (88.4)	155,066 (96.2)	2444 (94.4)
	Female	1,594,789 (55.7)	88,913 (36.5)	31,680 (11.6)	6062 (3.8)	146 (5.6)
Country of birth	Sweden	2,518,753 (88.0)	184,705 (75.9)	238,681 (87.7)	149,063 (92.5)	2475 (95.6)
	Nordics	72,582 (2.5)	6709 (2.8)	7703 (2.8)	3358 (2.1)	80 (3.1)
	Europe	126,111 (4.4)	23,170 (9.5)	14,058 (5.2)	5752 (3.6)	24 (0.9)
	Rest of the world	144,170 (5.0)	28,758 (11.8)	11,844 (4.4)	2955 (1.8)	11 (0.4)
Martial Status	Married or in a partnership *	1,352,696 (47.3)	100,035 (41.2)	101,424 (37.3)	59,707 (37.1)	848 (32.8)
	Not married or in a partnership *	1,505,054 (52.7)	142,950 (58.8)	170,555 (62.7)	101,278 (62.9)	1738 (67.2)

* Registered partnership.

The hazard ratio (HR) with a 95% confidence interval (CI) in the first model was above one unit for any exposure to HAV (HR 1.08–1.22) (Table 2). In the second model, also adjusted for occupational exposures, the HR and 95% CI were 0.91 (0.88–0.95) for those exposed above the action value of >2.5–5 m/s^2 and 1.01 (0.92–1.11) for those exposed above 5 m/s^2, respectively (Table 2).

Table 2. Association between occupational exposure to hand-arm vibration and first-time myocardial infarction one year later (Sweden, 1985–2013). Hazard Ratio (HR); 95% Confidence Interval (CI).

Hand-Arm Vibrations (m/s^2)	Exposed Cases	Model 1 [a]	Model 2 [b]
0	52,622	1.00 (ref)	1.00 (ref)
>0–1	6524	1.13 (1.10–1.16)	0.98 (0.96–1.01)
>1–2.5	10,471	1.21 (1.19–1.24)	1.02 (1.00–1.05)
>2.5–5.0	5258	1.08 (1.05–1.11)	0.91 (0.88–0.95)
>5.0	562	1.22 (1.12–1.33)	1.01 (0.92–1.11)

[a] year, age, gender, income, country of birth, and marital status. [b] year, age, gender, income, country of birth, marital status, noise, decision authority, physical workload, carbon monoxide, diesel exhaust, oil mist, polycyclic aromatic hydrocarbons, pulp and paper particles, silica, welding fumes.

4. Discussion

This study found no association between exposure to hand-arm vibrations (HAV) and a first-time myocardial infarction one year later. A JEM on HAV and other occupational exposures within the SWE-JEM project was used to adjust for other occupational exposures that may be associated with MI. By using a JEM, this study was able to gather a large number of individuals over several decades to study the risk of a first-time MI.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethical Review Board in Stockholm (Protocol code: 2018/1298-31/2).

Informed Consent Statement: Subjects consent was waived due to the use of Swedish public register data, which allows universities in Sweden to do their own evaluation regarding consent and use of data without consent from subjects if it will benefit the citizens.

Data Availability Statement: Information and data from the job-exposure matrix used will be available from February 2023 on the Karolinska Institute homepage.

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