Occupational exposure to noise and myocardial infarction risk one year later in Sweden.

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ABSTRACT

Objective: To explore the association between occupational noise exposure and myocardial infarction (MI) one year later.

Methods: Data came from the Swedish National Cohort on Work and Health (SNOW) cohort, comprised of all individuals born between 1930 and 1990 in Sweden, with demographic, occupational, and outcome data available from 1968 until 2017. In this study, we included working individuals with at least one occupational code between 1985 and 2013. These were matched to a job exposure matrix (JEM) in five categories (LAeq8h): <70, 70-74, 75-79, 80-84, ≥85 dB(A). MI status in the year following exposure was ascertained using the patient register. To account for time-varying occupational data, we utilized a discrete-time

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proportional hazards model adjusted for individual confounders and other occupational exposures.

Results: Preliminary results show that exposure to over 75 dB(A) of occupational noise is associated with a 14-24% increased risk for MI one year later after adjusting for age, sex, and income.

Conclusion: Exposure to noise was associated with an increased risk for MI one year later after adjusting for individual confounders among this younger, working population. Additional in-depth analyses are ongoing in which we plan to adjust for other occupational exposures.

1. INTRODUCTION

Ischemic heart disease (IHD) is a leading contributor to the global disease burden (1). Though there is an overall decreasing trend in the incidence of myocardial infarctions (MI), younger individuals are not showing similar trends (2). Therefore, it is imperative to identify risk factors for prevention among this group. The work environment is one area that has been implicated in MI development.

Noise is a common exposure in the occupational setting in both developed and developing countries. Though the auditory hazards of occupational noise exposures have long been established, studies have shown a possible association with CVD development. According to a meta-analysis, noise is associated with a 68% increased risk of hypertension and a 34% increase in CVD (3). The WHO the International Labour Organization (ILO) have recently attempted to summarize the body of knowledge regarding occupational noise exposure and IHD (4). Though the results corroborate previous findings of an increased risk of occupational noise on IHD, the authors conclude that quality of evidence is low, which was partially due to studies being limited to men and differences in exposure level cut-offs across studies (4).

One additional limitation of previous research is that, for the most part, it does not consider concomitant work exposures. Two studies investigated the impact of occupational exposure to both noise and job strain (5, 6). Both found an increased risk of MI for those exposed to high levels of both job strain and noise (5, 6). Neither, however, investigated the independent impact of noise on MI.

This study aims to investigate whether noise exposure affects the incidence of MI one year later in a large, population-based cohort of working individuals in Sweden, while exploring adjustments for individual, socioeconomic, and other occupational exposures.

2. METHODS

2.1 Data sources

For this study, we utilized the Swedish National Cohort on Work and Health (SNOW) cohort, which was created using the Swedish registers. Data were extracted from the Total Population Register for all persons born between 1930 and 1990 and residing in Sweden between 1968 and 2017. From this register, we obtained data on birth year and month, sex, country of birth, and yearly marital status among others.

Individuals were then matched to various other register sources by their personal identification number. Time span of data varies for each register depending on individual variable availability, however general years are described. From the Income and Taxation Register, we obtained yearly data from 1968 until 2017 on total taxable income, income from work, and pension. Data from the National Patient Registers were used to obtain diagnosis received between 1964 and 2017 from in-and out-patient clinics; however, diagnostic codes from primary care providers are not included in this register.

Finally, data were also matched to the Swedish Census between 1960 and 1990, as well as to the Longitudinal Integration Database for Health Insurance and Labor Market Studies (Swedish acronym LISA) between 1990 and 2017, to obtain occupational data. From LISA, we also obtained educational data.

2.2 Occupational data

Because some JEMs used in this study are not available in all coding systems, we restricted work exposure data to 1985-2013. Occupational data availability differed based on the source. The census was collected every 5 years; therefore, to ensure complete working history, we carried forward job codes to all years in between each census. For instance, the job codes reported in 1985 were used for the period from 1985-1989. Starting in 1997, some occupational codes were already available in LISA, with more complete data starting in 2005. Additionally, individuals' job data were not collected yearly. Therefore, we also had to impute values to obtain complete work history. For LISA, we obtained job data based on the closest available job code, looking backwards and forwards up to 5 years. To ensure that job codes were not given to those who did not work, we excluded job codes for those who had no taxable income reported in the Income and Taxation Register. Lastly, to account for those who were partially retired, but may still have an occupation reported, we removed job codes for those whose income from pension accounted for over 50% of their total income.

2.2.1 Noise exposure

To estimate noise exposure, we utilized a job exposure matrix (JEM) matched to the occupational codes from the register. This JEM was developed based on measurements from occupational health services, clinics, and large companies throughout Sweden. The original JEM was developed using the 1995 modification of the 1983 version of the Nordic

Occupational Classification (NYK83) coding system and included 321 occupational groups. This version included annual averages of the daily 8-hour equivalent A-weighted sound pressure level in three exposure classes (LAeq8h) encompassing the time span from 1970 to 2004 and was shown to be valid (Sjöström 2013). It has since been updated to include newer measurements and was expanded to five exposure classes, <70, 70.74, 75-79, 80-84, ≥85 dB(A), available from 1970-2014 in five-year intervals. This JEM was then translated into different coding systems to reflect the availability of job codes throughout the years in the Swedish registers.

Occupational information was available from the Swedish Census from 1960 to 1990 and from LISA from 1997 until 2017. In the census, variations of the NYK coding system were used. In LISA the Swedish occupational classification versions 1996 and 2012 were available (SSYK96 and SSYK2012, respectively); however, for this study we only use the SSYK96 coding system available until 2013.

2.3 Outcomes

We obtained outcome data from the National Patient Register. These were coded using the International Classification of Diseases, 7th, 8th, 9th and 10th revisions (ICD-7, ICD-8, ICD-9, and ICD-10). Codes for MI were extracted starting in 1968 until 2014. For this study, we only included the first MI occurrence. If an individual had no previous MI history in the register, but were given a recurrent MI ICD code, they were also excluded.

2.4 Covariates

Covariates considered were based on availability in the registers and the logic model specified in Teixeira et al (4). Individual confounders considered were age, sex, income, and education. Apart from education, all variables were available for the entire study period, with education being available starting in 1990. Income and education were treated as time-varying confounders.

In addition to individual covariates, we also wanted to explore the independent effect of noise on MI; therefore, we also included occupational exposures from other JEMs. Occupational exposures considered were physical workload, decision authority, whole-body vibrations, hand-arm vibrations, particles, and chemicals. Based on previous evidence (5, 7-9), we chose to consider physical workload, decision authority, whole-body vibrations, lead, carbon monoxide, diesel exhaust, polycyclic aromatic hydrocarbon (PAH), and welding fumes. Work is ongoing to investigate the possible pathways and potential interactions between noise and these other occupational exposures.

2.5 Analyses

For each year between 1985 and 2013, we compiled the set of individuals who had no history of MI up until that point. Thus, once individuals have a MI, they were no longer considered at risk. Exposure ascertainment occurred on a yearly basis based on available data. The SNOW cohort is an open cohort; thus, individuals could enter the cohort at any point in the study period. For each year, MI was ascertained for the year after noise exposure and covariate measurement. In this study, inclusion criteria were as follows: 16 years of age or older, received some income in the previous year, have received less than 50% of income from pension sources.

To assess the impact of noise exposure on MI risk, we used a discrete time proportional hazards approach. Two models have currently been created, a minimally adjusted model, which includes year as the underlying time variable and adjusted for individual risk factors (age and gender), and a second model in which we also adjust for income. We have also created models stratified by sex. Work is currently underway to explore how to adjust for other work exposures. All statistical analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA).

We obtained approval from the regional ethical review board in Stockholm, Sweden.

3. RESULTS

A total of 6,675,938 individuals with at least one job code during our study period were included in this study, of which 3,408,002 (51%) were men. Figure 1 shows the number of individuals at risk in each exposure year by gender.

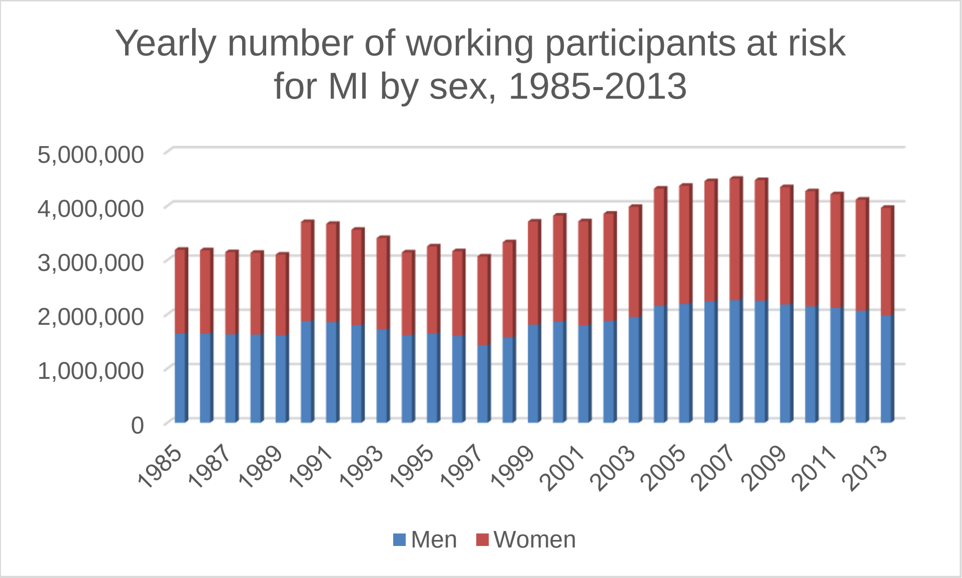

Figure 1: Yearly number of participants with an occupational code by sex from 1985-2013.

Table 1 shows the hazard ratios (HR) and 95% confidence intervals (95% CI) for the entire population and stratified by sex. After adjustment for individual risk factors, exposure to noise levels between 70-74 dB(A) was associated with an increase of 1.21 (95% CI: 1.18 - 1.23), 75-79 dB(A) with an increase of 1.31 (95% CI: 1.28 - 1.33), 80-85 dB(A) with an increase of 1.30 (95% CI: 1.27 - 1.33), and 85 dB(A) and over with an increase of 1.30 (95% CI: 1.27 - 1.34). When including income, results were slightly attenuated. Results stratified by sex show that for the highest level of occupational exposure, women are at a higher risk than men, even after adjusting for income. Results are preliminary and current work is ongoing to investigate how to appropriately adjust for socioeconomic confounders.

Table 1: One year risk of myocardial infarction (MI) according to noise exposure assessed by an job exposure matrix (JEM) [HR=hazard ratios; CI=confidence intervals.]

Exposure	**Model 1[a]**		**Model 2[b]**	
Noise	**HR**	**95% CI**	**HR**	**95% CI**
All				
<70	1 (ref)		1 (ref)	
70-74	1.21	1.18 - 1.23	1.14	1.12 - 1.16
75-79	1.31	1.28 - 1.33	1.23	1.21 - 1.26
80-84	1.30	1.27 - 1.33	1.22	1.20 - 1.25
≥85	1.30	1.27 - 1.34	1.24	1.20 - 1.27
Men				
<70	1 (ref)		1 (ref)	
70-74	1.24	1.21 - 1.26	1.17	1.15 - 1.20
75-79	1.34	1.31 - 1.37	1.27	1.24 - 1.30
80-84	1.36	1.33 - 1.39	1.28	1.26 - 1.32
≥85	1.31	1.28 - 1.35	1.25	1.22 - 1.29
Women				
<70	1 (ref)		1 (ref)	
70-74	1.11	1.07 - 1.16	1.06	1.02 - 1.11
75-79	1.24	1.18 - 1.31	1.18	1.12 - 1.25
80-84	1.05	1.00 - 1.10	0.96	0.91 – 1.00
≥85	1.53	1.33 - 1.77	1.45	1.26 - 1.67

[a] Model 1: adjusted for age and sex
[b] Model 2: adjusted for age, sex, and income

4. CONCLUSIONS

In this nationwide, prospective cohort of all Swedish individuals, exposure to noise was associated with an increased risk with a 14-24% increased risk for MI one year later. Results when stratified by sex show that women exposed to the highest noise category have higher risks than men. This is the first large-scale study to investigate the exposure to noise on MI while accounting for sex.

Our preliminary results corroborate previous findings. Teixeira et al obtained an estimate of 1.29 (95% CI: 1.15-1.43) increased risk of incident IHD for noise levels above 85 dB(A) in prospective studies (4). Our results are pertinent to MI only and reflect acute exposures to noise since outcome was ascertained one year later. Additionally, our results apply to younger individuals who received at least 50% of their income from work in the previous year.

Analyses are ongoing to disentangle the relationships between noise and MI independent of other work exposures. Further work is being conducted to investigate the optimal way of adjusting for socioeconomic status.

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