

# Metal Sculptors: Occupational Environment and Risk Factors

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# Introduction

- ★ About 452,000 US workers employed as welders, cutters, solderers, and brazers in 2002 (BLS 2004)
- ★ Artists in the US held about 149,000 jobs in 2002 (BLS 2004)
- ★ Significant effort to understand exposures of industrial welders since 1970s
- ★ Artist welders and/or metal sculptors have been overlooked as a subpopulation of interest.
- ★ Health hazards/exposures in arts literature is scarce and is, in general, qualitative.

# Study Goals

- ★ The goals of this descriptive study are to develop knowledge base on:
  - Demographics
  - Exposure Parameters/Risk Factors
    - Exposure time (ET)
    - Exposure frequency (EF)
    - Exposure duration (ED)
  - Exposure Attributes
    - Type of welding process employed
    - Type of consumables (base metal/electrode/wire) used
  - Work Environment
    - Location of workspace
    - Use and type of ventilation
  - Exposure Control Measures
  - Health Hazard Awareness

# Study Methods

- ★ A questionnaire consisting of 26 questions
- ★ This questionnaire was administered to two sample populations:
  - Database of artist welders/sculptors across the U.S. (173 entries  114 entries)
    - **GROUP 1 – NATIONAL RESPONDENTS**
    - Personal contact at least three times
    - Questionnaire administration via telephone
  - 44 attendees of a workshop on welding safety and hazards for artists/sculptors in the tri-state area of VA, SC, and NC. (23 experienced; 12 novice)
    - **GROUP 2 – REGIONAL RESPONDENTS**
    - Questionnaire administration in a session in the workshop

# Demographic and Sample Population Data

Artist Welder	Response Rate (%)	Number of Males (M)	Number of Females (F)	Age Mean Range	Welding Experience Mean (Range) (years)
Group 1	81.6 (93/114)	69	24	F: 44.1 (28-65) M: 52.2 (22-76) M+F: 50.1 (22-76)	F: 13.7 (2.5-33) M: 25.6 (5-60) M+F: 22.6 (2.5-60)
Group 2 <sup>1</sup>	79.5 (35/44)	19	4	F: 40.0 (26-49) M: 31.8 (17-70) M+F: 33.2 (17-70)	F: 13.8 (3-25) M: 7.7 (2-36) M+F: 8.7 (2-36)

<sup>1</sup> The response rate for Group 2 includes novice (n=12) and experienced metal sculptors (n=23). The demographic information for Group 2 is provided for experienced metal sculptors (n=23) only.

# Significance of Exposure Parameters

## Exposure Time, Frequency, and Duration

### ★ Average Daily Dose Estimation:

$$ADD = \frac{C \times IR \times ET \times EF \times ED}{BW \times AT}$$

Here, ADD = Average Daily Dose (mg/kg-day)

C = Exposure concentration in air (mg/m<sup>3</sup>)

IR = Inhalation rate (m<sup>3</sup>/hr)

ET = Exposure time (hr/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

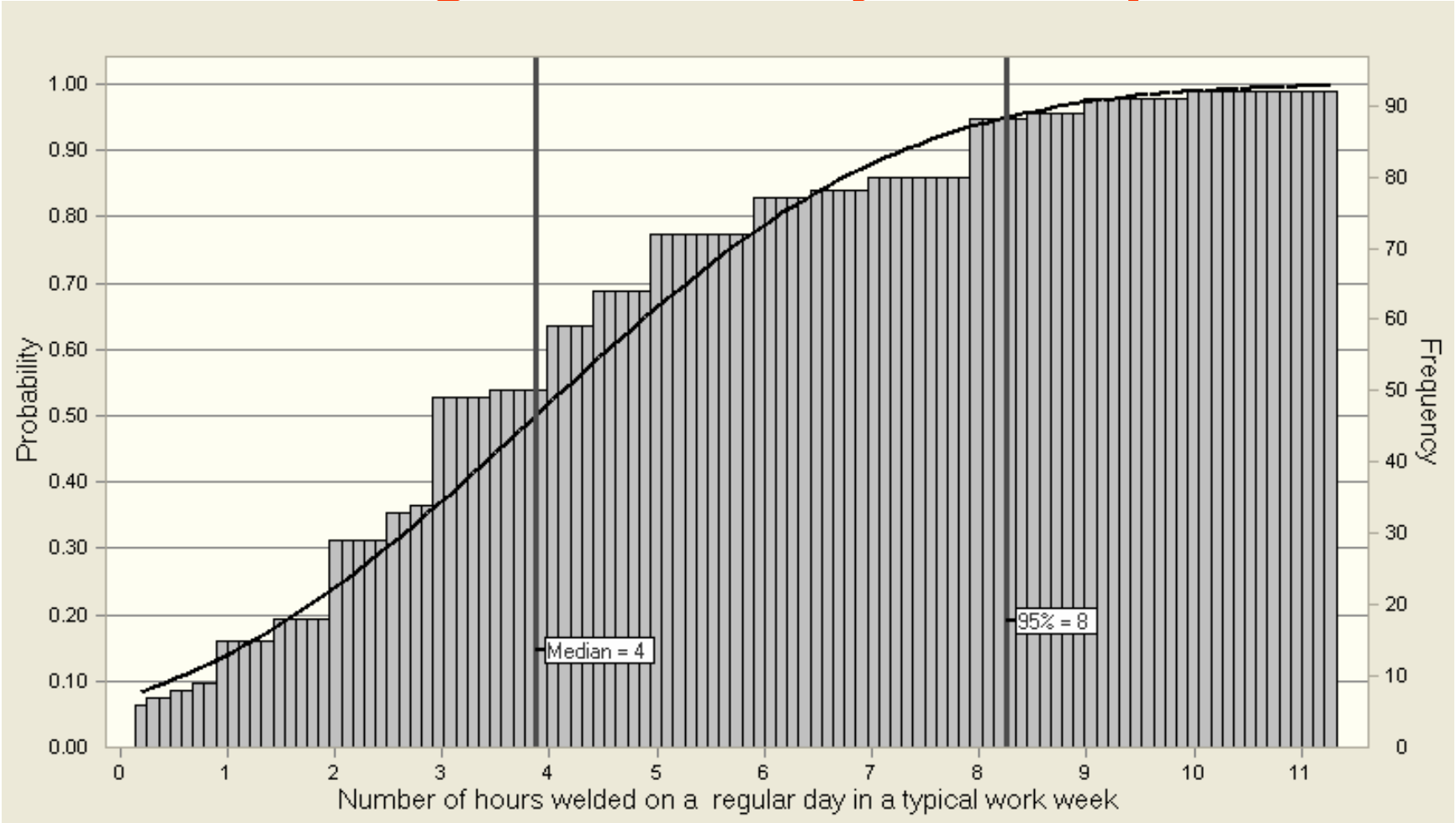
BW = Body weight (kg)

AT = Averaging time (days) (=ED (years)\*365 d/year)

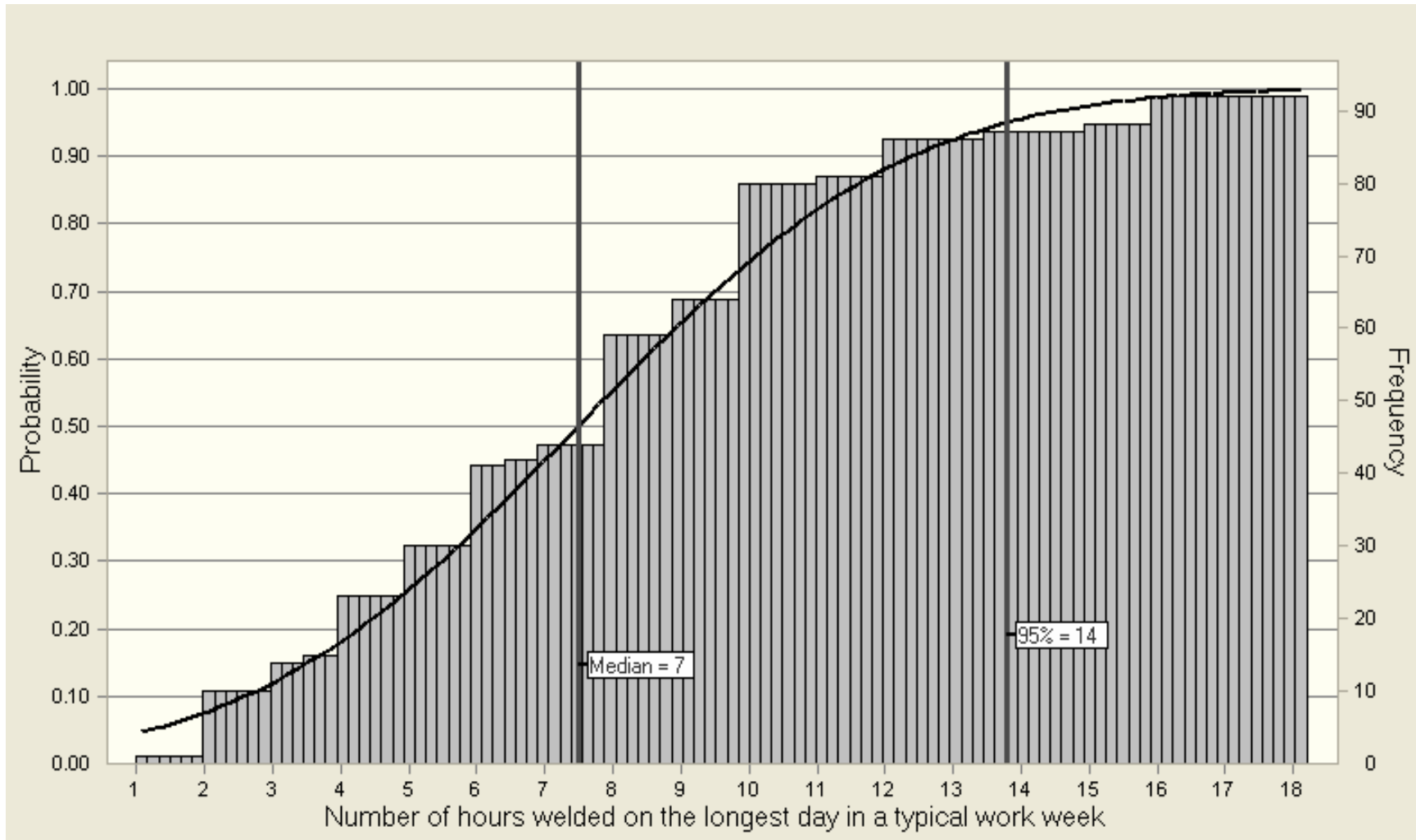
# Exposure Time, Frequency, and Duration Data

Descriptive Statistics			Mean	Median	SD	95th
ET (h/d) – typical work week	Typical	Group 1	3.9	3	2.66	8.3
		Group2	4.5	3.5	2.7	8.9
	Longest	Group 1	7.5	8	3.82	13.8
		Group 2	9.1	8	5.25	17.8
EF (d/y)	Ave	Group 1	140	140	101.48	292.2
		Group 2	63.4	38	75.68	195.9
	Max	Group 1	231.3	252	115.3	309.7
		Group 2	174.6	200	111.2	316
ED (y)		Group 1	22.6	22.5	13.07	44.1
		Group 2	9.6	5	9.42	25.2

# Cumulative Frequency Distribution Exposure Time Data - Typical Work Week Average Hours/Day - Group 1



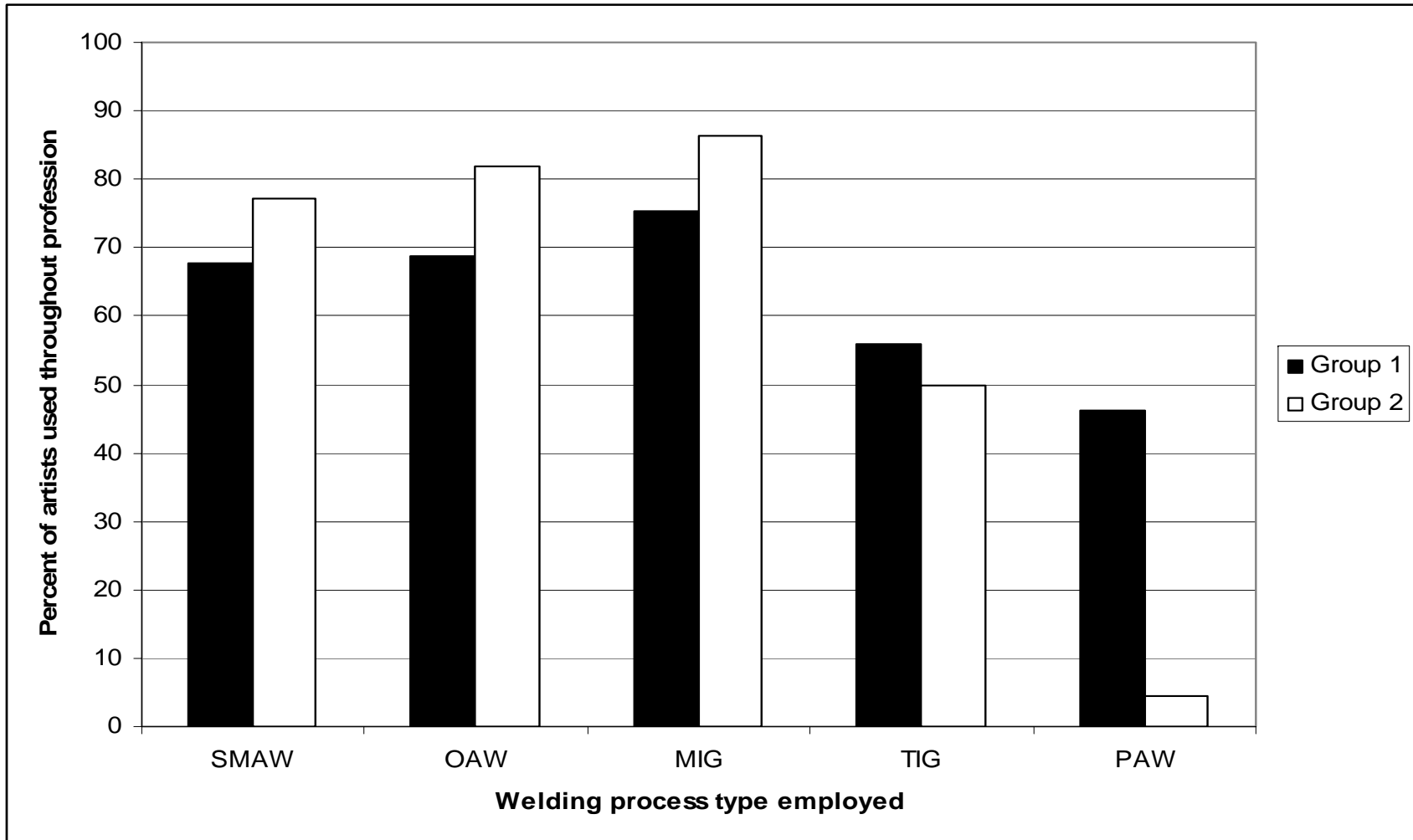
# Cumulative Frequency Distribution Exposure Time Data - Typical Work Week Longest Hours/day - Group 1



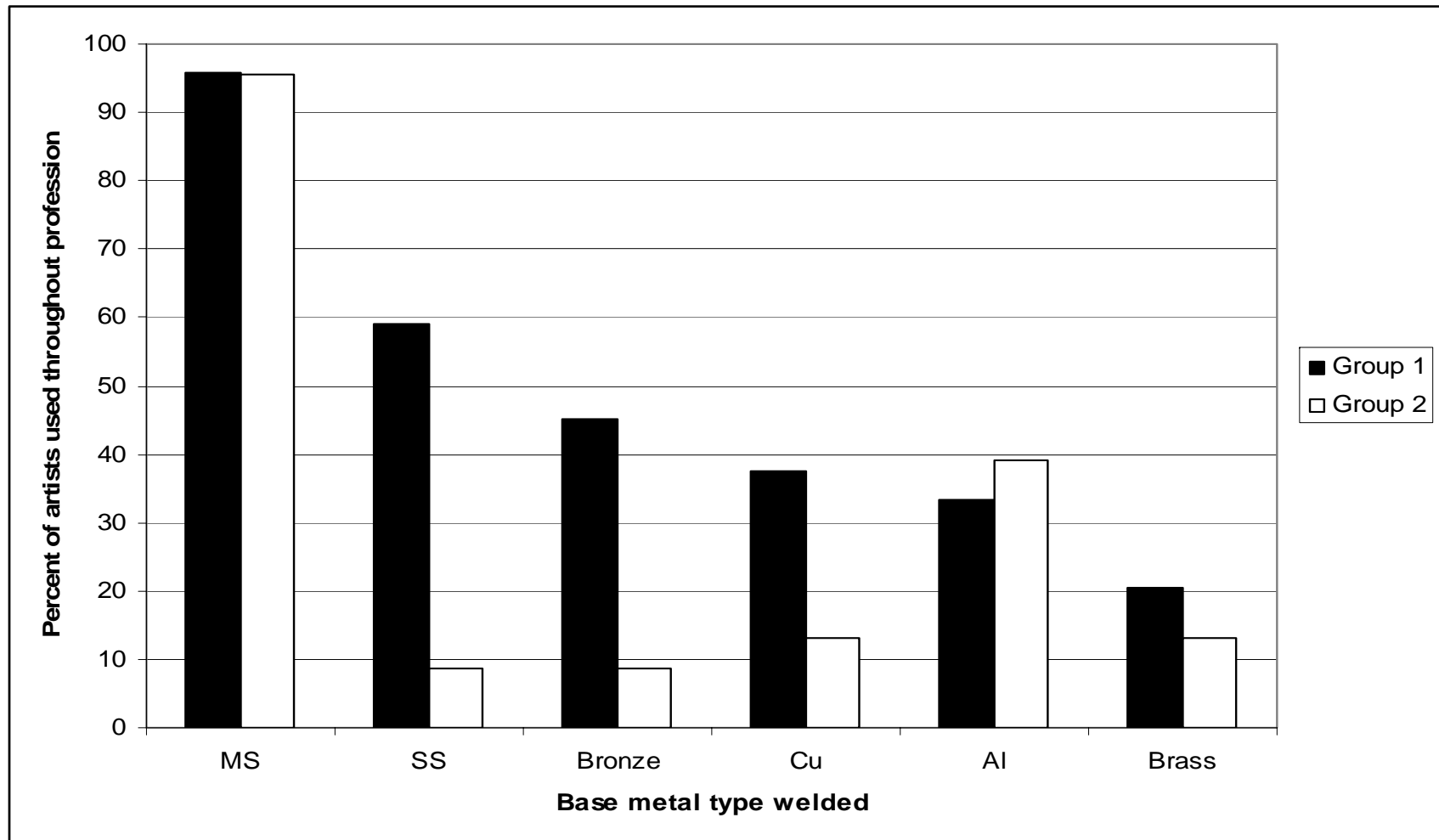
# Statistical Distributions - Exposure Time, Frequency, Duration - Group 1

Exposure Parameter	Statistical Distribution
ET-average day-typical week (h/d)	Normal (Mean = 3.87, SD = 2.66)
ET-longest day-typical week (h/d)	Normal (Mean =7.49, SD = 3.82)
EF-average (d/y)	Normal (Mean = 140.00, SD = 101.48); or Beta (Min=1, Max=364, $\alpha=1.1354$ , $\beta = 1.74099$ )
EF-maximum (d/y)	Normal (Mean = 231.33, SD = 115.30)
ED (y)	Normal (Mean = 22.56, SD = 13.07); or Beta (Min=2, Max=60, $\alpha=1.3077$ , $\beta = 2.35638$ )

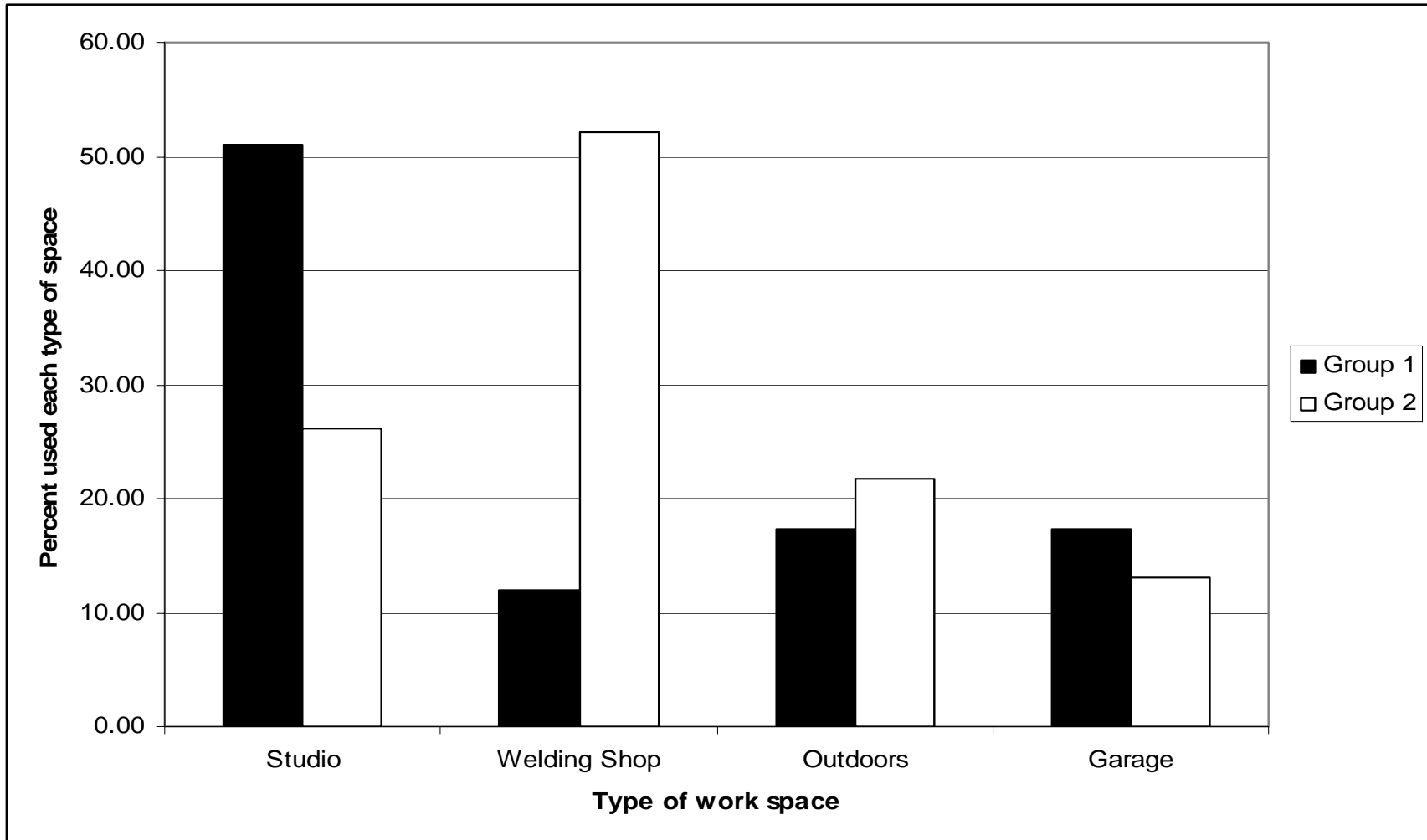
# Welding Processes Used throughout Profession



# Types of Base Metals Used for Art Objects/Sculptures



# Type of Work Spaces Used for Welding



# RESULTS

- ★ **VENTILATION USE AND TYPE:** About half of the artists had some type of engineering control in their workspaces and the other half relied on natural ventilation based on air dispersion. It was not clear if the ventilation used was adequate for removing welding fumes from the workspace to levels below regulatory limits.
- ★ **PERSONAL PROTECTION:** Although welding helmets and gloves were uniformly used by artists in both groups, the use of respiratory and hearing protection was largely process-dependent and not that prevalent. Respiratory protection was often limited to non-welding activities.

# RESULTS

## ★ EXPOSURE PARAMETERS/RISK

**FACTORS:** 53% of Group 1 and 63% of Group 2 artists reported welding 8 or longer hours per day when they worked at full capacity. Although artists do not appear to weld every workday, some artists may work more than 8 hours per day for more than five days a week throughout 60% of the year, as evidenced by 30% of Group 1 artists.

# RESULTS

★ **HEALTH HAZARD AWARENESS:** About 35.5% of Group 1 artists were not concerned about their exposure to welding fumes, while the remaining was concerned. The artists were split in their perception about whether artist communities receive adequate and proper education about controlling welding fume exposures in their workspaces. The majority was cognizant of a lack of occupational health and safety training tailored for artist welders and a resultant lack of health hazard awareness.

# CONCLUSION

- ★ Our data for exposure time, exposure frequency, ventilation use and type, and PPE use and type indicate that a segment of the artist welder population may potentially be a high-risk population due to longer work hours and a lack of proper ventilation and exposure control measures.
- ★ It is essential to reach the artist welder community with occupational health and safety training programs specifically tailored to their needs, in order to reduce their health risks and to increase health hazard awareness related to their work practices.
- ★ Occupational health and safety training must also be an integral part of arts and welding education in schools.
- ★ The health care personnel treating artists should acquire information about exposure/work conditions and materials used.
- ★ The development of safer materials and user-friendly MSDS information by the industry should also be a priority.

# Acknowledgments

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