Access to Properly Fitting Personal Protective Equipment for Female Construction Workers

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Background *Previous literature suggests that most personal protective equipment (PPE) for construction is designed for males and does not accommodate female anthropometry. We conducted a pilot study to identify whether female construction workers currently have adequate access to properly fitting PPE.*

Methods *Semi-structured focus group interviews were conducted with union female carpenters, laborers, and ironworkers. Researchers coded focus group transcriptions and extracted major themes using thematic framework analysis.*

Results *Participants (n = 23) had a mean of 15.1 years of construction experience (range 3–34.5 years). A majority reported fit problems for many types of PPE (gloves, harnesses, safety vests, work boots, outerwear), generally noting that the equipment provided by contractors was too large. Other emergent themes included female workers purchasing their own PPE, exposure to various safety hazards from poorly fitted PPE, and perceived indifferent safety culture.*

Conclusions *Female construction workers continue to have difficulty accessing properly fitting PPE.* Am. J. Ind. Med. 59:1032–1040, 2016. © 2016 Wiley Periodicals, Inc.

KEY WORDS: focus groups; construction industry; female; anthropometry; safety

INTRODUCTION

Construction is one of the largest industries in the United States (US), with a total workforce of approximately 6.5 million workers [Bureau of Labor Statistics, 2015a]. Construction workers have among the highest work-related injury rates. In 2014, the incidence rate for nonfatal injuries in construction was 3.5 injury cases per 100 full-time workers, a rate higher than all other sectors except transportation, health care, and agriculture [BLS, 2015b]. Construction fatalities account for nearly 20% of all deaths in private industry [BLS, 2015c].

Historically, women have comprised a small percentage of the US construction workforce, currently 2.2% of production personnel, or roughly 200,000 workers [The Center for Construction Research and Training, 2013a]. Female construction workers face a number of challenges in the traditionally male-oriented work environment including harassment, inadequate sanitary facilities, ergonomic hazards, and lack of access to well-fitting personal protective equipment (PPE) [Goldenhar and Sweeney, 1996; Goldenhar et al., 1998; Welch et al., 2000; Moir et al., 2011]. PPE is intended to protect workers in areas when more efficacious means of exposure control, such as process substitution or ventilation, have not eliminated the hazard, or other controls

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Accepted 8 June 2016
DOI 10.1002/ajim.22624. Published online 27 June 2016 in Wiley Online Library (wileyonlinelibrary.com).

are not feasible [The National Institute of Occupational Safety and Health, n.d.]. Poorly fitting PPE may lead to serious injury or death for the worker. For example, respirators that do not fit correctly may expose workers to airborne contaminants; oversized protective clothing presents a tripping hazard; improperly fitting gloves can be caught in moving parts of machinery or expose skin to chemicals.

Previous literature suggests that most PPE currently available in construction is designed for the male worker's body habitus and does not accommodate female anthropometry [Occupational Safety and Health Administration [OSHA], 1999; Hsiao et al., 2007; Wagner et al., 2013]. Participants in a prior focus group study of female construction workers reported being given improperly fitting boots, hardhats, and overalls, leading to concerns about potential safety hazards [Goldenhar and Sweeney, 1996]. A 2006 Canadian study found that although some manufacturers were producing construction grade equipment designed for women, many female workers were unaware of its existence and instead were altering their PPE for a better fit [Ontario Women's Directorate]. The lack of access to properly fitting PPE for women may be due to lack of availability (e.g., manufacturers not producing equipment), limited distribution, employers' or workers' lack of knowledge about specifically designed PPE, or an indifferent safety culture in which the employer chooses not to purchase the proper equipment [OSHA, 1999; Ontario Women's Directorate, 2006].

Changing demographics of the working population in the US have led to increased workforce diversity [United States Department of Labor, n.d.; American Federation of Labor and Congress of Industrial Organizations, 2015]. Thus, it is important to recognize the wide range of worker anthropometrics to enable all workers to be supplied properly fitting PPE. There have been very few studies documenting and addressing PPE fit for women. Moreover, these studies may be outdated, as it seems the most recent study was published almost a decade ago [Ontario Women's Directorate, 2006]. We, therefore, undertook to examine current access to PPE for female construction workers in New York City and update the current body of knowledge. We report on a qualitative pilot study identifying whether female construction workers currently have adequate access to properly fitting PPE.

MATERIALS AND METHODS

Semi-structured focus group interviews were conducted with union female construction workers in New York City. Laborers, carpenters, and ironworkers were interviewed for this study. Among construction occupations, laborers and carpenters have the highest and third-highest number of fatalities and injuries, respectively. Ironworkers have the second highest rate of fatalities among construction trades [The Center for Construction Research and Training, 2013b]. Focus group interviews were chosen as the method of data collection over other qualitative methods because they allow the research team to explore the complexities of various opinions and perspectives as well as examine the social interaction among participants [Hughes and DuMont, 1993; Rabiee, 2004]. Thematic framework analysis was used to analyze the data to identify emergent themes and patterns, compare and contrast data by themes across many cases, and take the participant's perspective into account [Attride-Stirling, 2001; Braun and Clarke, 2006; Srivastava and Thomson, 2009; Gale et al., 2013]. This study received exemption from the Mount Sinai Institutional Review Board since no personal identifiers were collected.

Sample and Recruitment

Purposive sampling was used to recruit participants from three construction trade unions. We sought female construction workers currently employed with at least 2 years of experience. Participants were contacted by their respective training facilities through flyers, emails, and word of mouth. The unions selected the participants for this study. We conducted three focus groups with laborers, carpenters, and ironworkers, respectively. Focus groups consisted of 6–8 participants to facilitate an in-depth discussion. All participants spoke fluent English. Demographic information including ethnicity, trade, and years of experience was collected. Participants were reimbursed $25 for transportation and provided with refreshments for their participation.

Data Collection

Three focus groups were conducted from April to July 2014 at the workers' union local headquarters. A series of focus group questions were developed by the research team and reviewed by experts knowledgeable in the field of construction safety and occupational health. Questions were designed to obtain information on three topics: (1) access to properly fitting PPE; (2) effect of PPE on safety; and (3) effect of PPE on work productivity. Based on these topics, all participants were asked questions, such as:

> *What has been your experience in getting PPE that is designed for women that fits you properly?*
>
> *What have you found to be the major issues with PPE fit, and does it affect your safety and work productivity?*

Based on your knowledge, what has the union and/or contractors done to ensure there is appropriate PPE available for women?

We did not distinguish between PPE that contractors are required to provide (e.g., harnesses, hardhats) under the OSHA construction standard versus PPE not required to provide (e.g., boots, outerwear). All focus groups were administered in English. All questions asked during the focus group session were open-ended to elicit the specifics of participants' responses. The principal investigator (NZ) served as the moderator, and two other members of the research team (AF, JD) served as assistant moderators. The moderator explained the purpose of the study, asked questions, and facilitated the focus groups. The assistants did not take part in the discussion, but recorded notes. Each focus group was limited to approximately 120 min. The focus group discussions were audio recorded with permission of participants and transcribed verbatim.

Data Analysis

Researchers coded focus group transcriptions and extracted major themes using thematic framework analysis [Krueger and Casey, 2000; Rabiee, 2004]. The principal investigator (NZ), along with two research assistants (LO, DP) not present at the focus group meetings, conducted the qualitative data analysis. After reading through each transcript and becoming familiar with the content, each researcher independently created a codebook by assigning a numbered code and description for each line of data. Codes were developed at the time of transcript review rather than being created a priori, allowing the data to dictate the emerging themes. After independently coding the transcripts, the researchers met to compare their applied codes and agree on a final codebook. Disputes and tiebreaks were left to the discretion of the principal investigator. Subsequently, the team compared codes within and across interviews to elucidate overarching themes for all three focus groups.

RESULTS

A total of 23 female construction workers participated in the three focus groups. The focus groups were composed of eight laborers, eight carpenters, and seven ironworkers. Participants had a mean of 15.1 years of experience in the construction industry (range 3–34.5 years). Of those who completed a demographics questionnaire (n = 21), 43% were Black, 24% White, 19% Hispanic. Seventy-six percent (n = 16) reported that they were not familiar with any safety equipment designed for women.

Six themes emerged from the focus groups: (1) difficulty obtaining properly fitting PPE; (2) purchasing of their own PPE; (3) safety; (4) productivity; (5) safety culture; and (6) workplace culture.

(1) Difficulty obtaining properly fitting PPE

Almost all participants stated that they had difficulty obtaining properly fitting PPE in the workplace. Employers rarely provided PPE designed for women; instead, they often offered equipment that was "one size fits all" and female workers would sometimes have to make adjustments for the PPE to fit better.

(1.1) One size fits all

Most focus group participants stated that the equipment provided was intended to fit the majority of male workers; however, it was generally too large and not proportioned for female workers. Problematic equipment included harnesses, gloves, boots, outerwear, eye protection, and hardhats. Due to the small number of women in the construction industry, some participants felt that employers did not want to address this issue. One participant stated:

Generally, [employers] get one size—large. And then I have to . . . beg them "Can I get a small [harness]?" And it just never happens. . .

Another said:

. . . [Employers] don't consider us, period. What they order, they've done forever . . . they place an order and it's for the men. And they don't stop to say "You know, we have two [women] on this job, let's order a little something different for them." They don't think of us, we're not here. There could be 20 women on the job and [they] still [won't order for us].

While the majority of the focus group participants experienced issues with PPE, not everyone did. For example, a laborer stated that her harness is adjustable and does not cause problems when she is wearing it.

(1.2) Making adjustments to PPE

Due to the inadequate fit of the equipment, participants stated they sometimes needed to make adjustments to ensure they could use it.

Examples of adjustments included leaving open the chest straps of a harness to accommodate breasts, placing rubber bands over boots for tighter fit, or cutting the bottoms of outerwear to make them shorter. An ironworker said:

> *[This harness is] not made right and . . . you [have] to duct tape it so . . . the chest [strap] doesn't slide up every 30 seconds and choke you. [The safety officers say], . . . "you can't use that harness anymore because you might be hiding a rip or a tear." I'm not hiding anything.*

A carpenter stated:

> *You have to adjust [the outerwear] . . . You have to cut part of the legs . . . or part of the arms off because they're just too big most of the time...*

(1.3) Inter-industry variability

Workers from all focus groups perceived differences between different employers in the construction industry in providing PPE that fit. Many believed that larger companies were more likely to provide properly fitting PPE because they had more financial resources. A laborer explained:

> *. . . [The big company] . . . want[s] to keep down insurance, . . . safety problems [and] citations. So they give [the equipment] to us, so we can . . . work safely. The smaller companies, a lot of [demolition] companies, . . . really just don't care. I've had a lot of problems with comfort and access.*

(2) Purchasing own PPE

As a result of not being able to obtain properly fitting PPE at the worksite, most participants said they often purchased their own, without reimbursement. One worker stated:

> *[Because] I've had a lot of gloves that were too big, I just go to [the store] and buy . . . a pack of gloves [in] my size. But for the most part, I'd have to say . . . probably about 95% of the time, everything that we need to fit us [women] and make us comfortable as we work, we have to buy . . . ourselves.*

Even then, some workers were unable to find the appropriate sizes. They would purchase equipment in men's sizes, which in addition to being generally larger than women's sizes, were not proportioned for them. One participant stated:

> *I've even gone to [the store] to purchase [overalls] and I had trouble finding a pair that fit me properly. . . . [B]ecause if you get something that fits your waist, it may not fit your hips and that was my problem. . . . So then I would end up having to buy a bigger size, but it was huge on my waist so when I bent over, my [underwear] was [showing].*

A laborer said:

> *"There is no women's construction stuff. There is just none . . . everything I get is in a man's size. It is not ergonomically fit for me. It is not female oriented and that's just what I found so far in my trade. . ."*

Some of the PPE (e.g., boots, outwear) did not offer the same functionality and protection as the construction-grade equipment that was available for men. One participant stated that a pink hard hat was the only piece of PPE she had ever seen that was specifically designed for women. As another participant put it, the equipment that was available for women was "Barbie-fied". A third stated:

> *Well I hate it when you go to the store and you're all excited because they started making [more] women's stuff, but they don't have any of the actual work gear. [They're] cute sweatshirts [with logos].*

(3) Safety

The majority of participants stated that the improperly fitting PPE they received at jobsites created potential safety hazards, such as gloves caught in machinery, chemical contact with exposed skin, burns caused by welding sparks, or trip and fall hazards. An ironworker stated:

> *[My glove] got caught in the choker. . . . [W]hen I got up, I went to move my hand, but it caught the tip of the glove . . . Now I have two sets of gloves—ones I use with chokers and my welding gloves. If [the glove] wasn't that big, it wouldn't have got caught, jammed in there . . . I could have lost my finger.*

Another ironworker described her experience with improperly fitting PPE:

> *The [safety] glasses . . . are too big. Our faces are narrower and [the glasses] wrap around your head*

and you get all this space and then all the sparks . . . [I] always [get things] in my eye and ear.

A carpenter said:

. . . I have ripped my pants a few times because they [were] caught on something. . . . I can't wear [them tightly either] . . . They don't fit me [correctly]. But I wear them because they're work clothes and they're men's pants. They don't have women's.

A few participants said they removed gloves at times in order to continue working, but at the perceived expense of their safety.

(4) Productivity

The majority of participants stated that inadequately fitting PPE interfered with work tasks, potentially affecting their productivity. Workers had to frequently tighten PPE that was too large (e.g., welding gloves, harnesses, safety vests) in order to continue working. A laborer stated:

. . . It impacts your productivity because . . . you're constantly in a state of trying to pull your glove up so you don't get the chemical on your skin . . . [and] clothing.

An ironworker commented:

You can't pick up the rod because [it's like] you're using oven mitts (in reference to welding gloves).

In some cases, productivity issues caused problems between labor and management. Another ironworker stated:

. . . [The employer] would give me . . . an extra-large [harness] . . . I can't even work in it . . . What am I supposed to do? . . . It's just in the way [and] it falls off. Then I get yelled at . . . 'Put your harness on!'

(5) Safety culture

Several participants from all focus groups suggested that many contractors were indifferent about their employees' safety, using words such as "lazy" and "bare minimum" to describe their safety attitudes. A few workers stated that they have asked for properly fitting equipment multiple times but never received it. A laborer said:

I have [asked] about four to five times [in my four years with this particular company] . . . can you please order me a pair of gloves that'll fit me so I won't have to worry about them slipping off or dipping my hand in these corrosive . . . chemicals. About the third or fourth time [I asked], the person . . . running the job in the office [said] . . . "You know [female name], I'm sorry I keep on forgetting." . . . Supply me with what I need! Not because OSHA says it's just the minimum, but because you [employ me to] be able to come back every day and continue [the] job.

Another laborer commented:

. . . It doesn't matter if you're a male or female, [the contractor] asked for a worker . . . They're just buying [PPE] because . . . [it's] . . . in the contract, so that [workers] can't complain. [They] give you rain gear. If it can't fit [sic], then that's on you. [Their attitude is]: "I provided you with it, so deal with it."

A few laborers doubted that employers were aware of the fit problems experienced by female construction workers and that appropriate PPE for women exists on the market. Others expressed that contractors were aware, but did not care.

As an ironworker put it:

I feel [that] [contractors are] just ignorant and . . . they don't think about it. [If they are aware of the issue], I feel they don't think it's important.

One participant recommended:

I believe that in order for [contractors] to be aware of [the PPE issue], they should have a department . . . [to] seek out diversity so they can bring it to their company, so [the] situation [can] . . . be taken into account. As far as PPE, if [they] want people to work at their best, [they] have to make them more comfortable. [They need to] stay abreast of the situation with women [and] make sure . . . [women] have things they need.

(6) Workplace culture

Related to safety culture was workplace culture, specifically how a male-dominated work culture contributed to limited women's access to adequately fitting PPE.

(6.1) Male-dominated culture

Focus group participants expressed that because of the construction industry being male dominated, employers did not take female workers' needs into consideration. Participants perceived that employers did not think that the

small number of women in the industry warranted a change in their PPE purchasing practices. Others said the companies do not want female workers at all because they are women. A laborer stated:

> *. . . Companies don't like women, especially on the demo job. . . . A lot of them are aware of [our problems], [but] they just don't care because they want to make it very uncomfortable for us so we'll give up.*

A carpenter said:

> *. . . They don't even want us there in the first place [because] we are women . . . It needs to be . . . thrown out there that this [culture] needs to be changed because we are here.*

The consensus among focus group participants was that accomplishing their job duties was the single most important aspect of their employment. While many participants said they brought up their PPE fit issues with contractors, a few mentioned that female construction workers knew what they were getting themselves into by joining a male-dominated industry and thus should make the best of the situation.

One laborer said:

> *I've been in the business for twenty-one years and I think you [should] build your body up, your stamina, . . . cut the nails, and you have to adjust . . . I've adjusted . . . If you can't do the job, then fine. Try it. Make it happen. If you can't, you go to the next one. But, go to the gym, work your body out. Work out ladies. This is a male dominated field, . . . but get used to working. . .*

Another laborer said:

> *. . . Everything in construction is not comfortable . . . If I wanted to be comfortable then I would have an office job. No? And I would have probably found something else that's comfortable. . .*

DISCUSSION

The goal of this pilot qualitative study was to examine current access to properly fitting PPE for female construction workers. The most common themes that emerged include lack of access to properly fitting PPE on the worksite, improperly fitting PPE leading to safety hazards and lower productivity, perceived indifferent safety culture, and PPE purchased in men's sizes because of a limited selection of construction-grade equipment designed for women. Overall, female construction workers are still experiencing difficulty in accessing PPE that fits them properly.

Participants reported fit problems for all of the common types of PPE, generally noting that the equipment was too large. They also talked about differing body proportions by sex, indicating that size is not the sole factor determining fit. A frequent theme was the employers' "one size fits all" approach toward providing PPE, a finding consistent with previous studies [Goldenhar and Sweeney, 1996; OSHA, 1999]. Traditional anthropometric data used to develop current PPE are based on older studies and military populations that were predominantly male. One study evaluated harness sizing schemes and anthropometric criteria suggesting that a system of sizes for men and women was more appropriate than a unisex, "one size fits all" approach for harnesses [Hsiao et al., 2007]. The current construction workforce is more diverse by sex and ethnicity than previous cohorts and thus mandates the importance of providing equipment that all workers can use to work safely and productively.

Inadequate fit and design of PPE can lead to serious safety hazards. For example, wearing a loose or poorly fitting safety harness may result in neck injuries and suspension trauma [Chi et al., 2005; Hsiao, 2011]. In this study, workers reported that the use of improperly fitting PPE hindered the worker in completing job tasks. Construction injuries and deaths are preventable, and therefore equipment manufacturers and safety researchers need to ensure that equipment is designed to fit and protect workers, and for employers to educate their workers on the importance of wearing properly fitting PPE and determining the correct fit.

An indifferent safety culture is another potential contributing factor to the lack of access to properly fitting PPE for females. In this study, the perception of the workers was that employers did not order small sizes even when they were commercially available. In a previous focus group study, construction managers representing firms of varying sizes reported that change in workplace culture was one of the most important factors in developing a successful safety program. Setting safety goals and acknowledging that workers could perform safely and be productive led to better safety practices on their worksites [Gillen et al., 2004]. Construction is a dynamic industry with a constantly changing workforce and worksite; thus, it presents a challenge for promoting a strong safety culture for both management and workers.

A unique finding of this study is that workers reported purchasing their own PPE, including OSHA-required

equipment such as safety vests and harnesses. Purchasing their own safety gear poses the risk of workers using PPE that may be subpar, inadequate for the job, worn, or past its manufactured life cycle, all of which may present a serious safety hazard. Many participants expressed how difficult it was for women to purchase construction-grade PPE, such as protective clothing or boots that are functional in the workplace. They reported that the commercially available equipment designed for women had more of an emphasis on fashion, using ostensibly feminine labels or colors, rather than function for the job. Although employees are required to provide items such as boots or outerwear, this does not diminish the need to have safe, properly fitting PPE.

The root cause of the difficulty that female construction workers experience remains unclear, whether it stems from underlying manufacturing, distribution, or safety culture factors. Though our project was able to identify some of the issues currently facing female construction workers, our pilot study was not designed to investigate all of the factors influencing the distribution and availability of PPE designed for women. The PPE supply chain is a feedback loop from the employer to the manufacturer. There are still many unanswered questions. Is the lack of PPE due to benign neglect or are employers unaware of the difficulty many female construction workers have with accessing properly sized PPE? How much of the PPE commercially available was designed using current anthropometric data? What factors go into employer PPE purchasing decisions? One factor we could identify is the lack of a regulatory incentive. The OSHA General Industry Standard requires that PPE fit the employee; the Construction Standard does not [OSHA Standard CFR 1926.28]. All workers, regardless of size or habitus, should receive properly fitting PPE that both protects and allows them to work safely and productively. Updating of the OSHA Construction Standard Criteria for PPE to mandate that PPE fit the worker would be an important step in ensuring that all workers are provided proper protection.

One key to solving this problem would be to promote awareness within the construction industry. Many of our participants thought that many supervisors, managers, and labor representatives were unaware of the issue. In order to increase recognition, contractors should conduct routine in-house surveys with their female employees to determine whether the protective equipment is fitting properly. Construction apprenticeship training curricula should be expanded to include formalized instruction regarding the importance of providing all construction workers with PPE that fits. Apprenticeship training programs that provide hands-on-training should have a selection of PPE available so new workers can learn to select and use PPE that fits correctly.

Based on the information we gathered from our participants and prior studies, some female construction workers continue to struggle to find equipment that fits correctly. It would be helpful if PPE manufacturers could develop a common sizing standard for women based on anthropometric data. Labor/management organizations, manufacturers, safety and health professionals, researchers, and OSHA can do a better job in raising awareness and in identifying and removing barriers such as simplistic one size fits all purchasing policies, adverse safety and workplace cultures, and limited availability of PPE designed for women.

A strength of this study was the gain of detailed information about properly fitting PPE in female construction workers from three different trades with high rates of injuries. Recruiting workers with substantial construction experience allowed us to obtain in-depth information about access to properly fitting PPE and see patterns and changes that have occurred over time. However, our findings must be taken within the context of the study design. Purposive sampling was used to recruit experienced workers and therefore selection bias cannot be excluded. This was a pilot study done in New York City with a small number of workers. It is important to gather national perspectives on this topic from construction workers in other trades and locations, labor unions, and management in the future. We only sampled union workers; therefore, a sample of non-union workers is likely required to determine similarities and differences with the findings we obtained from our sample. Future research is also needed for other populations, such as smaller and larger individuals, male or female, and pregnant women. Future research topics should also look at the influence of the manufacturing and distribution network on the availability of PPE.

CONCLUSION

This study indicates that female construction workers still have difficulty accessing properly fitting PPE that is designed for women. Improperly fitting PPE can be detrimental to safety, productivity, and the employer–employee relationship. Regulatory agencies, manufacturers, employers, and unions need to recognize the issue of inadequate fit and promote better design, distribution, purchasing, and supply of PPE for workers that require equipment that may be different than the traditional standardized models. A recommendation for improvement includes updating the OSHA Construction Standard Criteria for PPE to include a mandate that PPE fit the worker. We also recommend conducting a larger study that includes other construction trades, union and non-union workers, labor union representatives, and management personnel.

AUTHORS' CONTRIBUTIONS

Lynn C. Onyebeke conducted the qualitative data analysis and wrote the manuscript. Demetrios M.

Papazaharias conducted the qualitative data analysis and wrote the manuscript. Alice Freund, Jonathan Dropkin, and Michael McCann were involved in the conception, design, questionnaire development, data acquisition and analysis, and revision and critical final review of the manuscript. Sadie H. Sanchez conducted data analysis and acquisition, and revision and critical review of the manuscript. John D. Meyer assisted with the project design, drafting, and critical review of the manuscript. Dana Hashim provided critical revisions of the manuscript. Roberto G. Lucchini provided critical revisions of the manuscript. Norman C. Zuckerman served as the principal investigator. He was involved in the conception, design, questionnaire development, data acquisition and analysis, and revision and critical final review of the manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

ACKNOWLEDGMENTS

The authors would like to thank Sean Brennan of the Mason Tenders Training Fund; Elly Spicer, Tamara Rivera, and Vanessa Salazar of the United Brotherhood of Carpenters and Joiners of America; Bryan Brady of the Ironworkers Local 40 and 361 JAC; Sherry Baron, DPH of The Graduate Center City University of New York, and Linda Goldenhar, PhD of The Center for Construction Research and Training (CPWR) for their contributions to this work.

FUNDING

Funding was provided by the Pilot Projects Research Training Program of the NY/NJ Education and Research Center, National Institute for Occupational Safety and Health, Grant # T42 OH 008422.

INSTITUTION AND ETHICS APPROVAL AND INFORMED CONSENT

This work was performed at the Icahn School of Medicine at Mount Sinai, and the Mount Sinai Institutional Review Board determined that this study did not require IRB review.

DISCLOSURE (AUTHORS)

John D. Meyer is an Editorial Board member for the American Journal of Industrial Medicine. Roberto G. Lucchini is a Contributing Editor for the American Journal of Industrial Medicine.

DISCLOSURE BY AJIM EDITOR OF RECORD

Steven Markowitz declares that he has no competing or conflicts of interest in the review and publication decision regarding this article.

DISCLAIMER

None.

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