Women’s Accessibility to Properly Fitting Personal Protective Clothing and Equipment in the Australian Construction Industry

B L Oo* and T H B Lim

1 Faculty of Built Environment, UNSW Sydney, NSW 2052, Australia
*Corresponding author: bee.oo@unsw.edu.au

Abstract. With a growing diverse workforce in the construction industry, properly fitting personal protective clothing and equipment (PPE) is an essential component of safety for any worker. As a minority group in the industry, there is much anecdotal evidence of women’s difficulties in accessing properly fitting PPE. Based on a large-scale online survey, this study explores the difficulties experienced by women in the Australian construction industry in accessing properly fitting PPE. While PPE for women is available on the market, the results show that access to properly fitting PPE is still a major issue for women workforces in the industry. The problems they are facing include: the need to make alterations or adjustments to ill-fitting PPE, the lack of adequate training or proper use of PPE in their job tasks, and ill-fitting PPE has hampered their work in some way. The male-dominated culture of the construction industry has been identified as the top key reason for their lack of access to properly fitting PPE. These thus call for the industry stakeholders to address women’s PPE concerns, and one key step would be to promote awareness of women’s PPE needs within the construction industry.

1. Introduction
There is much anecdotal evidence of women’s difficulties in accessing properly fitting personal protective clothing and equipment (PPE) in the construction industry, and this subject matter has also managed to attract more attention from researchers in recent years (e.g., [1-3]). Previous studies indicate that women still have difficulties in accessing properly fitting PPE. Although women remain under-represented in the construction industry [4-5], the safety-oriented design and production of PPE are critically important for the protection of all workers regardless of their gender. Improperly fitting PPE could lead to serious injuries or death, and productivity losses at the workplace. It could also be detrimental to employer-employee relationship [2-3, 6]. Del Castillo [7] urged that PPE needs to be individually adapted, and that it must meet the specific needs and characteristics of each end-user including man, woman, young worker as well as people with disabilities. While some previous studies had focussed on women difficulties in accessing properly fitting PPE, authors have indeed acknowledged the need of similar studies on smaller and larger individuals, male or female, and pregnant women due to the increased workforce diversity in the industry [2, 8]. The focus of this study is, however, on women in construction. Their concerns, experiences and needs of PPE, and how these have transformed their work are important to raise awareness within the industry [7-8]. This study aims to provide an overview of women’s accessibility to properly fitting PPE in the Australian construction industry. Specifically, it explores the difficulties experienced by women in construction in getting properly fitting PPE. The research findings have implications to employers in addressing the PPE issues...
faced by women workforces, in particular, in reviewing their PPE purchasing decisions. The findings also seek to promote awareness within the construction industry on women’s PPE needs.

2. Literature review

According to Onyebeke et al. [2], there have been very few studies addressing PPE needs of women, and that the respective studies are outdated in their review of literature. In the present study, the researchers had faced the similar difficulty in locating the respective scholarly work. However, it is noted that there is much anecdotal evidence based on short reports by different parties of interest. This can be partly be explained by the fact that the industry stakeholders are not mindful of the PPE issues confronting female workforces [8]. Thus, unavoidably, this literature review has included the anecdotal evidence discovered in the literature search process. The identified reasons of the lack of access to properly fitting PPE for women can be broadly classified according to the industry stakeholders. For employers, it has been reported that there is a lack of awareness within their organization on women’s PPE needs. ‘One size fits all’ has been reported as a common strategy adopted by employers in purchasing their PPE [2]. Women workforces are expected to use the smaller sizes of PPE designed for men, to make adjustments to their PPE, and/or to purchase their own PPE [2, 8]. These could lead to additional risks and less optimal use of PPE. Improperly fitting PPE presents safety hazards to any worker. The construction tradeswomen in Curtis et al.’s [3] study were concerned about their health of safety for different reasons including inadequate safety equipment. The respondents in Onyebeke et al. [2], on the other hand, claimed that their employers were indifferent about their employees’ safety. Indeed, Zuckerman et al. [8] pointed out that many individuals in charge of purchasing PPE were unlikely to consider purchasing PPE designed for women.

Turning to PPE manufacturers, they are urged to design and manufacture PPE based on recent women’s anthropometric data [2, 9-10]. Unfortunately, the authors claim that this data is not readily available to manufacturers. In Flynn et al.’s [11] study that focussed on PPE manufacturers, they found that it can be difficult for workers to find alternative-sized PPE (i.e., for a larger range of body shapes and sizes) because the manufacturers rarely promoted or labelled these products as alternative-sized. Also, they found that the models used to display PPE were overwhelmingly white males of average sizes. This could partly explain that while PPE for women is available on the market, it is not easily found or widely ordered [10]. This seemingly suggests that the lack of awareness among women themselves on the availability of PPE for women could contribute to their limited access to properly fitting PPE [6]. Authors have highlighted that female employees’ feedback is imperative in meeting their PPE needs. Trades Union Congress [12] encourages female employees to report issues with PPE to their supervisor and to the union, and they should not just accept it when their employers say there is no suitable PPE available for women.

Above all, at the industry level, some very recent studies found that the male-dominated industry culture contributed to women’s limited access to adequately fitting PPE (e.g., [2-3, 8]). These studies claim that one of the key steps to solving this problem would be to promote awareness of women’s PPE needs within the construction industry. Other than employers, manufacturers and female employees themselves, authors suggested that regulatory agencies, unions, labour representatives, distributors, and training organizations all have roles to play as well (e.g., [8, 12]). The identified roles include to recognize the issue and promote better distribution, purchasing and supply of PPE for women. It is also important to educate workforces on the importance of using PPE that fits properly, and to provide training on how to determine that it does fit properly and correctly. Authors have also recommended additional anthropometric research could be helpful in addressing the PPE issues in the industry [2, 8]. While there is much anecdotal evidence of women’s difficulties in accessing properly fitting PPE along with authors’ recommendations in addressing this issue, this study aims to address the research gap on this subject area through a large-scale online survey involving women in construction. Their voices and experiences could provide an insight relating to women’s PPE concerns and needs that have hitherto remained unheard.
3. Research method
This study adopted a survey research design that permits timely data collection from a large population. Data was collected via an online questionnaire survey in the last quarter of 2018. For the development of the questionnaire, measurement items related to PPE were adopted from previous studies on PPE for women. The respondents were asked to indicate their perception based on a five-point Likert scale (for e.g., 1 = very dissatisfied and 5 = very satisfied). The online survey link was distributed via emails and social media by professional bodies and women’s networks in the Australian construction industry. The targeted respondents are women workforces (i.e., professional women, tradeswomen and women labourers) in the construction industry who are at least 18 years old and are using PPE in their job tasks. Unfortunately, it was not possible to keep track of number of surveys sent because of the use of social media and the researchers had no access to email address book of the supporting organizations. For the data analysis, with the large sample size (see Section 4), parametric statistical tests were used to test the mean values of the examined variables based on a test value = 3 (i.e., the mid-point or neutral score on a five-point Likert scale) in identifying statistically significant variables and/or relationships.

4. Results
The research findings were based on 636 sets of usable survey responses. The 636 respondents were comprised of professional women (92.5%), tradeswomen (6.0%) and women labourers (1.5%) working across different states and territories in Australia. The majority (71.5%) of them are experienced women workforces aged between 26 and 45 years old. Most (74.5%) of the respondents are Australian and around 75% of them hold an undergraduate or postgraduate degree. A total of 93.6% of the respondents were employees in public or private sectors. In terms of average weekly working hours, above half (55%) of the respondents worked between 41 and 60 hours, and close to 60% of the respondents reported that their income was the primary source of support for their families. The frequency of usage of PPE among the respondents was captured by the average number of days they had to work on a construction job site. Figure 1 shows the corresponding frequency distribution of the respondents with close to one-third worked full-time on site. Similarly, there is close to one-third of the respondents in the ‘others’ group. The majority of PPE users in the ‘others’ group indicated that they had to work on site on a fortnightly, monthly or ad-hoc basis. Nonetheless, at least 70% of the respondents are frequent PPE users who worked on construction sites on a weekly basis. Thus, their responses are reliable to provide an insight into the subject matter.

![Figure 1. The respondents’ frequency of usage of PPE](image)

The respondents were asked to indicate: (1) the types of PPE they used in performing their job tasks, and (2) the level of difficulties in accessing the respective properly fitting PPE. The most common type of PPE used by the respondents are safety boots, safety helmets, safety glasses/googles and waterproof and high visibility clothing (jackets or vests). Figure 2 shows the respondents’ experience in terms of level of difficulties in accessing properly fitting PPE for their job tasks. It should be noted that the percentage of users on the y-axis was calculated based on the actual number of users (but not $N = 636$)
for the respective PPE. The evidence is suggestive that properly fitting ‘trouser’ is the most difficult PPE item to obtain for the respective users with 80% of them (total number of users = 475) rated the level of difficulties as moderately difficult to difficult. The next PPE item which has been considered difficult to access is ‘protective clothing/ overalls/ outwear’ with around two-thirds of the respective users (total number of users = 480) had responded with varying level of difficulties. Also, around 50% of the respective users of safety boots and waterproof and high visibility clothing had faced difficulties in accessing these PPE items that are properly fit. Nonetheless, the results seems to suggest that it is rather easy for the respective users to access all other PPE items that are properly fit (for e.g., safety helmets, safety glasses and ear defenders).

![Figure 2. Level of difficulties in accessing properly fitting PPE](image)

When the respondents were asked whether they need to make alterations or adjustments to PPE provided by their employer or from their own purchase, close to one-third (32%) of them answered ‘yes’. Consistent with findings from the respective users of individual PPE, the trousers are the most commonly cited PPE that need alterations or adjustments. These include trimming the bottoms and adjustments to the waist of trousers for a better fit. The next common PPE required alterations or adjustments are protective clothing/ overalls/ outwear that were considered “too big” by the respective respondents.

Table 1 shows the respondents’ perceptions on the lack of access to properly fitting PPE. The three top-ranked reasons are: (i) the male-dominated culture of the construction industry (mean = 4.34); (ii) the limited supply of women-specific PPE in the market (mean = 4.08); and (iii) the lack of availability of PPE designed specifically for women from the manufacturers and employers are unaware of the fit problems experienced by female employees (mean = 4.00). A one-sample t-test shows that the mean scores of all listed reasons are statistically significantly above 3 (i.e., the neutral level, p < 0.05). This provides strong evidence that the respondents are generally agreeable to each of the listed reasons.
Table 1. Reasons for the lack of access to properly fitting PPE.

| Reasons                                                                 | Mean Rank | Strongly disagree (1) | Disagree (2) | Neither agree nor disagree (3) | Agree (4) | Strongly agree (5) |
|-------------------------------------------------------------------------|-----------|-----------------------|--------------|--------------------------------|-----------|--------------------|
| • There is a lack of availability of PPE designed specifically for women from the manufacturers | 4.00      | 3                     | 2.99         | 7.23                           | 9.43      | 47.80              | 32.55 |
| • There is limited supply of women-specific PPE in the market (e.g., difficult to find them in PPE stores) | 4.08      | 2                     | 3.46         | 6.60                           | 8.18      | 41.51              | 40.25 |
| • Employers' lack of knowledge about the existence of PPE designed specifically for women | 3.75      | 6                     | 4.09         | 8.96                           | 20.60     | 40.41              | 25.94 |
| • Employers are unaware of the fit problems experienced by female employees | 4.00      | 3                     | 2.83         | 7.23                           | 12.89     | 41.19              | 35.85 |
| • Female employees themselves are lack of knowledge about the existence of PPE designed specifically for women | 3.68      | 7                     | 4.09         | 12.58                          | 16.35     | 44.97              | 22.01 |
| • Employers have the "one size fits all" mindset, thus choose not to purchase PPE designed specifically for women | 3.83      | 5                     | 5.66         | 10.22                          | 15.09     | 33.49              | 35.53 |
| • The culture of the construction industry is very male-dominated        | 4.34      | 1                     | 1.42         | 3.77                           | 7.86      | 33.65              | 53.30 |
| • PPE designed specifically for women is more expensive than those for men | 3.45      | 8                     | 2.99         | 7.55                           | 50.16     | 19.81              | 19.50 |

In examining the adequacy of PPE training and impact of ill-fitting PPE on their work productivity, the respondents were first asked to rate the information, instruction and/or training they received for proper use of PPE (including its storage and maintenance) in their job tasks (see Figure 3). The results show that about one-fifth (21.5%) of the respondents did not receive information, instruction and/or training for proper use of their PPE. For the remaining respondents who had access to information, instruction and/or training, only 33.8% of them considered the information and training as ‘adequate’ and ‘very adequate’. Also, 14% of the respondents rated the information and instruction and/or training as ‘inadequate’ and ‘very inadequate’. Overall, it is notable that respondents perceived the level of information, instruction and/or training received for proper use of PPE is statistically significantly inadequate (i.e., below the fair level, mean = 2.60 < 3 out of scale of 5, \( p < 0.05 \)). Turning into work productivity, Figure 4 shows that about one-third (35%) of them reported that ill-fitting PPE has not hampered their work productivity. While others responded that ill-fitting PPE has hampered their work in some way, close to 4% responded the impact as significant (i.e., ‘considerably’ and ‘a great deal’).
5. Discussion

The results are, indeed, consistent with anecdotal evidence that justified the need of this research study. The overall picture emerges from this study is that access to properly fitting PPE is a major issue for women workforces in the Australian construction industry. The problems they are facing include: the need to make alterations or adjustments to ill-fitting PPE, the lack of adequate training or proper use of PPE in their job tasks, and ill-fitting PPE has hampered their work in some way. The findings are, indeed, consistent with other studies reporting lack of access to properly fitting PPE among female workforces in the construction industry in different countries (e.g., [2, 6, 8, 13]). These thus call for training organizations and employers to review their organisational health and safety protocols and training curriculums. For example, construction apprenticeship training programs should promote awareness on the importance of accessing properly fitting PPE and formalize the associated training curricula. For PPE manufacturers, it would be helpful if they could address the concerns of the lack of availability and distribution network of PPE designed specifically for women, especially those commonly used PPE. Employers, on the other hand, could consider revisiting their PPE purchasing decisions by first investigating the fit problems experienced by their female employees. Many respondents perceived that employers’ unawareness of the fit problems experienced by women workforces is one of the top reasons for their lack of access to properly fitting PPE. Onyebeke et al. [2] suggested that the use of regular in-house survey in construction firms could address this issue. Indeed, Wagner et al. [1] found that women workforces’ satisfaction with PPE are positively correlated with their overall job satisfaction. If employers supported the purchase and availability of properly fitting PPE for women workforces, this would contribute to more positive working experiences that led to more satisfied employees, and perhaps higher job retention among women in construction.

6. Conclusions

This is the first large-scale study, to the authors’ knowledge, on empirical investigation of PPE for women in the Australian construction industry. It is encouraging to have such a large group of women workforces in construction who were willing to share their experiences on PPE. The results further support evidence in the literature indicating that access to properly fitting PPE is a major issue for women workforces in the construction industry. While this study provides an insight into women’s accessibility to properly fitting PPE in the Australian construction industry, the findings must be taken within the study limitations. Most respondents are professional women in the Australian construction industry, and the sample sizes for tradeswomen and women labourers are extremely small. Therefore, sample bias cannot be excluded when interpreting the findings. It is important to gather perceptions from
these two groups of women workforces on PPE in future study to provide a comprehensive view on this subject matter in facilitating the development of action plans by the respective industry stakeholders.

7. References

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