Window renovation and exposure to lead—an observational study

Howard Mason¹, Frank Gallagher² and Dil Sen²

Introduction

Lead was a significant constituent of old household paints up to about the 1960s and 1970s. A number of regulations at this time, such as British Standard 4310 (1974) [1] and European Directive (77/728/EEC) [2], had reduced the lead paint hazard. The former regulation recommended that only paint with <10 000 ppm lead should be applied to surfaces which children may chew and the latter directive required all paint containing >5000 ppm lead to be appropriately labelled. In 1989 the European Directive (89/677/EEC) proposed a ban of the use of paints containing added lead carbonate or sulphide pigments except for art and specialized historic restoration purposes. Older, normal undercoat and topcoat paints used on exterior surfaces could contain added lead at variable concentrations, and samples from painted surfaces have been reported to be as high as 30 000–250 000 ppm in both the UK [3,4] and USA [5]. The Paint Research Association refers to some old paints containing up to 50% (500 000 ppm) lead by weight [6]. Household wood surfaces painted with such paints posed significant hazards, being implicated in childhood lead poisoning as late as the 1970s and 1980s [7,8]. In many cases the old lead-based paint had been covered with newer non-lead-containing paint, so the hazard remained and redecorative activities such as paint-stripping of wood would involve risk of lead exposure. Therefore the burning off or sanding off of paint from household fixtures/fittings such as windows and doors are both tasks which can generate significant exposure and are not recommended for removal of paints [9,10].

Related work activities such as removal of painted doors and stripping back to bare wood are often done by specialized contractors, and can also involve a risk of lead exposure. Such firms are usually small in size, and use a primary chemical dip such as dichloromethane, and finish off by sanding. Both activities can cause significant lead exposure. Increased activity in these firms reflects the high level of interest in maintaining and refurbishing old properties in the UK. A number of firms also carry out specialized repair and maintenance of original features in period houses, such as sash-windows. These are

Background

Renovation of windows in old houses has recently established itself as an industry. A recognizable occupational lead exposure exists, which has not been studied previously.

Aim

To compare lead exposure amongst window renovators with other groups of lead-exposed workers.

Methods

Using blood lead results measured at the Health and Safety Laboratory (HSL), Sheffield, comparisons were made between three cohorts: window renovation workers, all male workers monitored by HSL during the period 1999–2001 and 63 male subjects involved in chemical paint-stripping of wood.

Results

Both the window renovation and the wood-stripping cohorts show significantly higher blood lead distributions than the ‘all workers’ cohort \((P < 0.001)\). A similar pattern was also found for comparison of the prevalence of subjects above the UK suspension level of 60 \(\mu\)g/dl (2.89 \(\mu\)M) (window renovation, \(P < 0.001\); wood-stripping, \(P < 0.0001\)). Blood lead results at or above the suspension level in wood-strippers were significantly higher compared to window renovators \((P = 0.034)\).

Conclusion

Window renovation is shown to present a potential for significant lead exposure, and suspension from work under The Control of Lead at Work Regulations 2002. Two groups of risk factors predominate: the well-documented potential for release of lead from old paint, and the peripatetic nature of the work.

Key words

Law and legislation; lead; lead exposure.
expensive to replace and their retention adds value to the property. Their renovation involves removal of perished paint and veneers of wood from the frames and the repainting, re-varnishing or replacement with new wood. Some of these more specialized firms operate as independent operators under the licence or franchise of a central brand organization. Firms that are involved in such stripping of old paint are likely to have fallen within the scope of successive Control of Lead at Work (CLAW) regulations [11–13] due to exposure to lead from the removal of old paint. The aim of these regulations is to prevent exposure from occurring, or at least minimize it to the lowest level reasonably practicable. Workers who are ‘significantly exposed’ to lead by inhalation, ingestion or through the skin must be subject to statutory medical examinations by a Health and Safety Executive (HSE) medical inspector or appointed doctor in order to safeguard them from the risk of lead poisoning. ‘Significant exposure’ is taken to be a random blood lead equal or exceeding 35 μg/dl. This report describes the findings arising from this specialized renovation work, and draws comparison with other relevant lead-exposed groups.

Methods

The study was carried out using only blood lead (Pb) measurements from the Health and Safety Laboratory (HSL), Sheffield. This removed any potential analytical bias in comparison between groups. HSL undertakes routine blood lead analyses under CLAW for a wide number of firms, undertaking some 3000 blood lead analyses per annum. The long-term coefficient of variation of the blood lead method, as defined from internal quality control material, is 4.8% at 42 μg/dl (2.03 μM).

Blood lead results were compared cross-sectionally from workers in three cohorts of lead-exposed workers. The first cohort comprised the first measured blood lead results obtained during the period 1998–2000 for 97 male subjects employed by 13 UK centrally licensed independent operators who perform window renovation by veneer removal/replacement under a central franchiser’s brand name. These results were required of the central group by inspectors of UK HSE’s Employment Medical Advisory Service in response to their growing concern following the identification of significantly exposed workers at one branch. The second cohort consisted of the first blood lead results of all male workers monitored under the current CLAW 1998 regulations who had analyses performed by HSL during the period 1999–2001. This comprised 3364 subjects. The third cohort comprised the blood lead results obtained during the period 1999–2000 from a cross-sectional study of 63 male subjects employed amongst 32 premises in England and Scotland involved in chemical paint-stripping of wood, termed as ‘wood-strippers’ in this paper. These workers had blood samples taken for lead measurements as part of an investigation (STRIP99) by the Agriculture and Wood sector of the Field Operations Directorate of HSE targeting small firms undertaking paint removal from wood. One premise was removed from this field study data as it consisted of one of the window renovation franchisees.

All blood lead measurements carried out by HSL for workers of the window renovation franchisees were also compared longitudinally over the 6-year-period 1998–2003 inclusively.

Results

Table 1 shows the characteristics of the three cohorts. Both the window renovation and the wood-stripping cohorts show significantly higher blood lead distributions than the overall cohort of all workers monitored at

<table>
<thead>
<tr>
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<th>Wood-strippers</th>
<th>Window renovation workers</th>
<th>HSL (all)</th>
</tr>
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<tbody>
<tr>
<td>Sample size</td>
<td>63</td>
<td>97</td>
<td>3364</td>
</tr>
<tr>
<td>Minimum value (μg/dl)</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
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<td>25th percentile value (μg/dl)</td>
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<td>5</td>
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<td>75th percentile value (μg/dl)</td>
<td>53</td>
<td>43</td>
<td>29</td>
</tr>
<tr>
<td>Maximum value (μg/dl)</td>
<td>70</td>
<td>84</td>
<td>78</td>
</tr>
<tr>
<td>Number of subjects at or above suspension level</td>
<td>11</td>
<td>6</td>
<td>37</td>
</tr>
<tr>
<td>Percentage of subjects at suspension level</td>
<td>17.5%####</td>
<td>6.2%</td>
<td>1.1%##</td>
</tr>
</tbody>
</table>

**Denotes statistical significance (P < 0.001) in comparing medians of wood-strippers and window renovation workers with the HSL cohort using the non-parametric Kruskal-Wallis test.

#### and ## represent statistical significance P < 0.0001 and P < 0.001 respectively, comparing wood-strippers and window renovation workers against the HSL cohort using Fisher’s exact test.
HSL under CLAW 1998 during this time-frame. Analysis using a non-parametric Kruskal–Wallis comparison between the three cohorts suggested that the median blood lead level in both the window renovation and wood-stripping cohorts were significantly higher than the ‘all’ workers cohort ($P < 0.001$). Using comparison by Fisher’s exact test, window renovation ($P < 0.001$) and wood-stripping ($P < 0.0001$) cohorts had a significant prevalence of subjects above the suspension level of 60 μg/dl (2.89 μM), compared to the all workers cohort. The suspension level being the level at or above which, if sustained upon rechecking, the regulations require the worker to be removed from significant occupational lead exposure. There was also a higher prevalence of blood lead results at or above the suspension level in the wood-strippers compared to the window renovators (Fisher’s exact test, $P = 0.034$).

We further explored whether this analysis was biased by the distribution of blood lead samples that HSL analyses compared to blood lead levels in the overall UK population under health surveillance for lead exposure. Figure 1 shows the distribution by blood lead category for those blood lead samples from males measured at HSL data against that provided by HSE for the Great Britain population under health surveillance for lead 1999/2000 [14]. The distributions appear very similar, especially at the higher blood lead levels. The HSL data suggest a prevalence of individuals over the suspension level of 1.1% whereas the UK national data on 16 832 male lead workers suggest 1.3% at the suspension level or higher.

Variation of the cross-sectional blood lead results amongst the window renovation franchisees is shown in Figure 2. While there were significant differences in the number of blood lead results from each of the 13 members, there was no evidence that specific franchisees were better or worse than others in controlling lead exposure to their workforces.

The distribution of all blood lead measurements carried out by HSL for workers working within the window repair group over the 6-year period 1998–2003 is shown in Table 2. There is no significant trend over time in blood lead measurements or in the prevalence of results greater than the suspension level.

**Discussion**

Our study demonstrates that window renovation by veneer removal/replacement is a work activity with potential for significant lead exposure, and suspension from work under CLAW [12]. This risk to workers of exposure during the specialized repair and refurbishment of original and now highly desirable features in old, domestic properties has not previously been considered. Broadly, there are two main risk factors responsible for this situation. One factor is the well-documented potential for exposure in relation to processes which release lead from old lead-based paint. This involves inhalation of lead from sanding and general dust arising during removal of veneers, and some franchisees also report occasional burning off of paint, and the ingestion of lead containing dust. Secondly, the peripatetic nature of the work where much of this work is undertaken by small firms, often employing fewer than five people, who work off-site, often from their vans and in houses that are empty and undergoing complete renovation. Facilities for hand-washing, before eating, drinking or even smoking, showers or even changing facilities may not be readily available. This may compound the exposure problem. When working at occupied domestic premises, such workers normally try not to disturb their clients, which also deters them from using the available washing facilities. Thus, the general facilities available and the on-site supervision of workers may not be ideal.
The franchised nature of the business studied could represent a source of bias in these findings. However, if this is the case we suspect the workers we studied are likely to have better standards of health and safety performance than single-firm operations due to sharing of awareness, which went on during HSE’s investigation. However, the multiple, distinct management structures of franchised window renovation activity in the construction sector could also pose particular difficulties with an understanding of legal duties and therefore compliance with existing health and safety legislation.

The exclusive use of HSL results in our study removed any potential for analytical bias between groups. First blood lead results were used in the window renovation and ‘all blood lead’ cohorts in order to minimize bias due to improved control applied during the study period, and from repeat measurements which were more likely to be taken on workers with high blood leads. Single blood samples were only taken in the wood- strippers group.

The validity of HSL’s total blood lead analyses as a comparative population may be assessed by comparison with the overall Great Britain population under medical surveillance for lead exposure [14]. Figure 2 shows the distribution by blood lead category for those blood samples from males measured at HSL data against that provided by HSE for the Great Britain population under medical surveillance for lead during 1999/2000 [14]. The distributions are very similar, especially at higher blood lead levels, with HSL data suggesting a prevalence of individuals at or exceeding the suspension level of 1.1% whereas the Great Britain data on 16,832 males suggest a prevalence of 1.3%.

Assessment of variation of blood lead results within the window renovation group (Figure 1) shows that although only 6 workers show levels at or above the suspension levels, most franchises had results approaching the action level for adult males of 50 μg/dl. Statistical analysis did not suggest any significant difference in median blood levels between the various member companies.

This study demonstrates that the relatively new and growing practice of refurbishment of old windows is associated with a genuine risk of lead poisoning, as with any process which causes dust or fume to be generated from older paints containing added lead pigments. Solutions required to minimize the potential for harm to employees involved in this work activity includes the understanding of legal duties, sound management systems and work practices, good welfare facilities and the provision of information, instruction and training to all concerned.

Conflicts of interest

None declared.

References