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# Teen Workers' Exposures to Occupational Hazards and Use of Personal Protective Equipment

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**Background** *Prior research indicates that working adolescents seek care for the toxic effects of on-the-job chemical and environmental hazard exposures.*
**Methods** *This cross-sectional survey of a nationally representative sample of 866 adolescent workers in the retail and service sector examines their exposures, personal protective equipment (PPE) use, and training.*
**Results** *Two-thirds of respondents were exposed to continuous, very loud noise, 55% to thermal hazards and 54% to chemical hazards. Few teens reported using any PPE, though those who had been trained reported somewhat higher usage.*
**Conclusions** *Teens working in the retail and service sectors experience a variety of chemical, thermal, biologic and noise exposures. Efforts to eradicate such exposures need to be complemented by increased provision of PPE and appropriate training in their use by employers.* Am. J. Ind. Med. 51:735–740, 2008. *© 2008 Wiley-Liss, Inc.*

***KEY WORDS: adolescent; workers; occupational; protective equipment; noise; burn hazard; chemical hazard; training***

## INTRODUCTION

Limited information exists about chemical and other potentially toxic exposures adolescents experience at their workplaces [Landrigan and McCammon, 1997; Rubenstein and Bresnitz, 2001; Woolf et al., 2001; Woolf, 2002; Ide and Parker, 2005]. A national study by Woolf et al. [2001] found that 3–4% of all occupational toxic exposures between 1993 and 1997 were among youth 12–17 years of age [Woolf et al., 2001]. Other studies show that males are more likely to be exposed than females [Rubenstein and Bresnitz, 2001; Woolf et al., 2001] and that exposure increases with the age of the young worker [Woolf and Flynn, 2000; Woolf et al., 2001]. Much of this research uses poison control center data [Woolf et al., 2001; Brevard et al., 2003] and may underestimate the extent to which teens are exposed to potentially toxic hazards in their workplaces. These studies indicate that toxic effects come from exposure to cleaning compounds, paints, solvents and glues, caustics, alkaline corrosives, hydrocarbons, acids, and bleaches [Woolf and Flynn, 2000; Woolf et al., 2001]. Typical routes of exposure include inhalation, skin absorption and ocular splashes. Although immediate toxicity of these acute exposures may be limited, chronic exposure can have more harmful and long-term effects.

The literature on burn injuries to working adolescents indicates that in retail settings, burns are second only to cuts as a source of injuries requiring emergency care [Mardis and Pratt, 2003], with burns being more common among males [Hendricks and Layne, 1999]. Burns often are associated with adding, filtering, or removing hot grease, dropping objects into hot grease, slipping on the floor, cleaning the grill

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or fryer, and splashing hot grease during cooking or working near or with hot surfaces [Hayes-Lundy et al., 1991; National Research Council. Committee on the Health and Safety Implications of Child Labor, 1998].

Little is reported in the occupational health and safety literature about the use of personal protective equipment (PPE) by adolescents, and what does exist focuses mostly on agricultural settings [Knobloch and Broste, 1998; Curwin, 2002; Schenker et al., 2002; Reed et al., 2006] in which relatively few adolescents are employed [National Research Council. Committee on the Health and Safety Implications of Child Labor, 1998].

This article examines the self-reported exposures to chemical, biological and physical hazards in the workplace, the use of personal protective equipment, and training in PPE use among a national sample of adolescents working in the retail and service industries—the industries where more than three quarters of all U.S. adolescents are employed [National Research Council. Committee on the Health and Safety Implications of Child Labor, 1998].

## MATERIALS AND METHODS

### Data Source

This analysis relies on data from our cross-sectional telephone survey conducted in 2003 from a nationally representative sample of working teenagers in the United States. The survey design and methods are described in more detail in Runyan et al. [2007]. We interviewed teen workers after obtaining consent and interviewing one of the teen's parents during which time we established the age and sex of the working teen.

For this analysis, the study population included teens who held a paying job for at least 2 months within the 12 months prior to the interview (the referent job) and who were between the ages of 14 and 17 while working in this job. If respondents had more than one eligible job, the most recent job was used as the referent job. The sample for this analysis is restricted to respondents who worked in either the service or retail industry.

All procedures were reviewed and approved by the Office of Human Research Ethics' Institutional Review Board of the University of North Carolina at Chapel Hill School of Public Health.

### Measures

#### *Exposures*

Hazardous exposures in the referent job were classified into four categories: chemical, noise, biologic, and thermal. For each of the exposure items, respondents indicated their exposure as ''always,'' ''often,'' ''sometimes,'' ''rarely,'' or ''never.'' In this analysis, we dichotomized the responses to include those who were ever exposed to the specific hazards studied, whether they reported ''always,'' ''often,'' ''sometimes,'' or ''rarely''.

To assess *noise exposures*, we examined how often respondents reported ''working where there was continuous, very loud noise.'' We identified respondents' *thermal* exposures with the item ''How often have you worked with hot liquids, grease, or near hot surfaces that could burn you?'' Respondents were considered as having *chemical exposures* based on their responses to the following survey items: ''How often have you worked . . .'' (1) ''. . . when there were fumes, foul smelling odors, or thick smoke?'' (2) ''. . . where you were working with flammable or explosive substances, such as gasoline or petroleum products?'' (3) ''. . . with pesticides, herbicides, or weed killers?'' (4) ''. . . with solvents or paint thinners?'' and (5) ''. . . with sprayed paint?'' Respondents were identified as having *biologic exposures* based on their response to: ''How often have you been exposed to needles, blood products, or medical wastes?''

#### *Personal protective equipment*

We measured personal protective equipment use in the referent job based on responses to the following question: ''Have you ever used any type of protective clothing or equipment at (referent job)?'' Those who responded ''Yes'' were subsequently asked, ''What type of protective clothing or equipment have you used at (referent job)?'' Respondents could list up to eight types of protective equipment or clothing that they used. We classified their responses into five categories: burn protection, eye protection, face protection, hand protection, and hearing protection. *Burn protection* includes any of the following responses: ''oven mitt,'' ''mittens,'' ''safety mitts,'' ''burn arm sleeves,'' ''protective gloves for carrying grease,'' ''insulated gloves,'' ''cooking gloves,'' and ''safety gloves.'' *Eye protection* includes: ''goggles,'' ''safety glasses,'' ''sunglasses,'' ''eyeglasses,'' or ''protective eyewear.'' *Face protection* includes: ''dust mask,'' ''mask,'' ''gas mask,'' ''ventilation mask,'' ''face mask,'' or ''pocket mask.'' *Hand protection* includes: ''latex gloves,'' ''plastic gloves,'' ''medical gloves,'' ''rubber gloves,'' ''hazmat gloves,'' ''lead gloves,'' ''gloves,'' or ''safety gloves.'' *Hearing protection* includes: ''ear plugs,'' ''hearing protection,'' or ''ear muffs.''

#### *Trained to use personal protective equipment*

We asked respondents: ''Have you gotten any kind of safety training while working at (referent job)?'' Those who responded ''Yes'' were subsequently asked, ''Did your training at (referent job) include how to use protective equipment?'' If respondents answered ''Yes,'' they were

classified as having received training on how to use personal protective equipment. ''Respondents who answered ''No'' to the first question and respondents who answered ''Yes'' to the first question'' and ''No'' to the second question were classified as not having received training on how to use personal protective equipment.

## Statistical Analysis

Using SAS Version 9.1.0 (SAS Institute Inc., Cary, NC, 2003), we conducted descriptive analyses to examine the incidence of each type of exposure, PPE use among those exposed, and training received in how to use personal protective equipment, comparing responses by sex and age group. Because child labor laws differentiate restrictions by age groups (14–15 vs. 16–17), we report our data in these two age groups. We accounted for the sampling design and weighting of the data in all analyses and computed weighted percentages and 95% confidence intervals and unweighted frequencies [see Runyan et al., 2007 for a detailed explanation of the weighting strategy].

# RESULTS

## Study Population

Overall, 438 males and 428 females meeting our study criteria are included in the analysis. One hundred nine of the respondents reported on work while they were 14–15 years of age and 757 described work done while they were 16–17 years of age. Two-thirds of the respondents had a referent job in the retail industry and one-third in the service industry.

## Exposures

Overall, 67% of respondents reported having been exposed to continuous, very loud noise, 55% reported thermal exposures and 54% indicated they had worked with one or more of the chemical exposures we included (Table I). Only 8% reported biologic exposures, such as blood or medical waste. With the exception of thermal exposures for which a higher proportion of young females than young males reported exposure, a higher proportion of males and older workers reported each exposure type examined.

Figure 1 displays the proportions of teens reporting exposures to multiple different hazards. Among the 751 respondents reporting at least one type of exposure, higher proportions of females than males reported exposure to one or two hazards, while higher proportions of males reported having three, four and five or more types of exposures.

## Use of Personal Protective Equipment

Overall, as shown in Table II, modest proportions of respondents who reported hazardous exposures indicated that they used the types of PPE listed, as coded from an open-ended item in the survey. Although the numbers are small, males and older workers were proportionally more likely to

**TABLE I.** Weighted Percent (95% CI) of U.S. Youth Working in the Retail or Service Industry Reporting Selected Hazardous Exposures, by Sex and Age, 2003, n = 866

| | Weighted percent (95% confidence interval) | | | | |
|---|---|---|---|---|---|
| | Males | | Females | | |
| **Hazardous exposures** | **14–15 (n = 63)** | **16–17 (n = 375)** | **14–15 (n = 46)** | **16–17 (n = 382)** | **Total (n = 866)** |
| Noise exposures[a] | 64.1 (47.2, 81.1) | 73.1 (66.0, 80.2) | 57.8 (38.5, 77.0) | 63.0 (55.2, 70.9) | 67.0 (62.1, 71.9) |
| Thermal exposures[b] | 36.6 (19.7, 53.4) | 61.7 (54.0, 69.3) | 44.3 (25.8, 62.9) | 53.5 (45.0, 62.1) | 55.3 (49.8, 60.8) |
| Chemical exposures | | | | | |
| Any chemical exposure (any of the following) | 61.6 (44.5, 78.7) | 69.3 (60.8, 77.8) | 29.7 (12.8, 46.6) | 41.5 (32.9, 50.1) | 53.7 (48.1, 59.3) |
| Fumes, foul smelling odors, or thick smoke | 47.4 (26.7, 68.2) | 56.5 (47.9, 65.1) | 19.5 (5.5, 33.5) | 29.7 (22.0, 37.4) | 41.4 (35.8, 47.0) |
| Flammable or explosive substances, such as gasoline or petroleum products | 23.2 (8.6, 37.8) | 31.5 (23.4, 39.5) | 5.9 (0.0, 12.5) | 14.5 (7.1, 22.0) | 21.6 (16.7, 26.6) |
| Pesticides, herbicides, or weed killers | 10.0 (1.4, 18.5) | 14.1 (98.2, 20.1) | 6.6 (0.0, 17.3) | 9.8 (3.4, 16.1) | 11.4 (7.4, 15.3) |
| Solvents or paint thinners | 10.0 (0.6, 19.4) | 28.6 (20.0, 37.3) | 9.6 (0.0, 21.0) | 9.5 (4.2, 14.7) | 17.4 (12.8, 22.0) |
| Spray paint | 12.2 (0.0, 24.6) | 15.3 (7.8, 22.8) | 1.3 (0.0, 3.4) | 6.5 (1.7, 11.3) | 10.2 (6.3, 14.2) |
| Biologic exposures[c] | 2.4 (0.0, 6.6) | 9.1 (5.8, 12.5) | 2.0 (0.0, 4.9) | 9.2 (5.5, 12.9) | 8.3 (6.1, 10.6) |

Percentages are derived from weighted data, while reported frequencies are unweighted.
[a]Exposed to continuous, loud noise.
[b]Exposed to hot liquids, grease, or near hot surfaces that could burn.
[c]Exposed to needles, blood products or medical wastes.

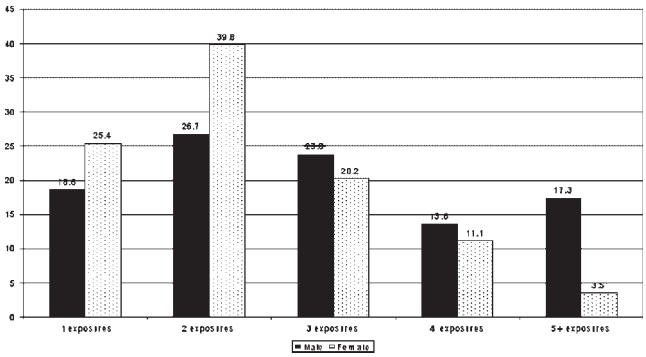


**FIGURE 1.** Weighted percent of U.S. youth working in the retail or service industry reporting multiple exposures among those who reported any exposure, by sex, n = 751.

report PPE use when exposed to most types of hazards. The only exception is the use of such protection for thermal exposures.

## Training to Use Personal Protective Equipment

Though not shown in the tables, analyses indicate that among those who received PPE training and reported a hazardous exposure, slightly more than a third reported using hand protection to reduce contact with biological agents (39%), with chemical agents (35%), and for burn protection (34%). Only 18% reported using eye protection, while 9% indicated they used face protection and less than 2% used hearing protection. In contrast, those who received no training reported even lower usage including hand protection for biologic and chemical agents (7% and 26%, respectively) and for burn protection (17%). The figures for untrained workers using eye, face and hearing protection were 10%, 1% and 2%, respectively.

# DISCUSSION

## Summary

High proportions of adolescents working in the retail or service industries reported being exposed to noise, thermal and chemical hazards though relatively few reported exposure to biologic hazards. Compared to females, males were more likely to report exposure to nearly each type of hazard. Older adolescents (ages 16–17) were more likely than younger ones (ages 14–15) to report each of the exposures considered in this study. Less than half of the teens reported that they received training in how to use personal protective equipment. Though slightly more who had been trained reported using such equipment compared to those who were not trained, the proportion reporting use of PPE is very small even among those who were trained, signaling a substantial deficit in safety procedures. Reflecting other studies of how work experiences differ for males and females, this analysis showed that males were exposed to a greater number of hazards, but they were more likely to use personal protective equipment.

**TABLE II.** Weighted Percent (95% CI) of U.S. Youth Working in the Retail or Service Industry Reporting Personal Protective Equipment Use Among Those Reporting the Selected Exposures , by Exposure Type, Sex and Age, 2003, n = 751

| | Weighted Percent (95% Confidence Interval) | | | | |
|---|---|---|---|---|---|
| | Sex | | Age | | |
| | Males | Females | 14–15 | 16–17 | Total |
| Hazardous exposures and PPE use | | | | | |
| Noise exposures | n = 298 | n = 255 | n = 66 | n = 487 | n = 553 |
| Hearing protection | 2.8 (1.2, 4.4) | 0.5 (0.0, 1.0) | 0.0 (0.0, 0.0) | 1.9 (0.9, 2.8) | 1.7 (0.8, 2.5) |
| Thermal exposures | n = 234 | n = 210 | n = 49 | n = 395 | n = 444 |
| Burn protection | 23.5 (14.3, 32.7) | 28.7 (17.9, 39.6) | 11.9 (2.9, 20.9) | 27.4 (19.7, 35.2) | 26.1 (18.9, 33.2) |
| Chemical exposures | n = 292 | n = 177 | n = 46 | n = 423 | n = 469 |
| Any protection (any of the following) | 42.2 (32.4, 52.0) | 23.0 (11.5, 34.6) | 14.1 (2.0, 26.2) | 37.1 (28.8, 45.3) | 34.7 (27.0, 42.3) |
| Eye protection | 18.1 (10.4, 25.9) | 8.2 (0.0, 18.3) | 6.9 (0.0, 16.6) | 15.1 (8.3, 21.8) | 14.2 (8.1, 20.4) |
| Face protection | 4.4 (2.1, 6.6) | 6.0 (0.0, 15.8) | 4.4 (0.0, 10.7) | 5.1 (0.5, 9.6) | 5.0 (0.9, 9.1) |
| Hand protection | 37.4 (27.5, 47.3) | 20.7 (9.4, 32.0) | 14.1 (2.0, 26.2) | 32.8 (24.5, 41.1) | 30.8 (23.2, 38.5) |
| Biologic exposures | n = 48 | n = 44 | n = 4 | n = 88 | n = 92 |
| Hand protection | 36.9 (21.0, 52.9) | 19.3 (3.0, 35.6) | 0.0 (0.0, 0.0) | 28.6 (16.8, 40.3) | 27.6 (16.2, 39.0) |

Percentages are derived from weighted data, while reported frequencies are unweighted.
Sample sizes vary for each PPE item and missing values are not included in denominators of weighted percentages.

## Limitations

The primary limitation of this study is that exposures and PPE use were self-reported. Therefore, the data are subject to recall bias and there is the possibility that respondents either over- or under-reported their exposures and/or their use of PPE. We could not verify the presence of any of the hazards reported or measure intensity of exposures. Likewise, our measurement of the frequency of exposure included a category of ''rarely'' that was endorsed by as few as three percent of respondents indicating exposure to biological hazards, but as many as 27% of those indicating exposures to loud noises or reporting exposures to fumes, foul smelling odors or smoke. We cannot be sure how much exposure ''rarely'' reflects, but are confident it is more than ''never.'' In addition, information about training to use personal protective equipment relies on the recollections of adolescent workers and may have underestimated actual training.

Survey items about PPE use were open-ended, necessitating the categorization of items post hoc based on original, verbatim responses, introducing the potential for misclassification. It is possible that young workers failed to identify equipment they actually used, either due to inaccurate recall or not understanding what equipment is considered ''protective clothing or equipment.'' Likewise, we had to make assumptions about the use of such equipment in the context of the exposures reported. For example, respondents who were exposed to chemicals may have worn plastic gloves for purposes other than to reduce direct contact with a chemical agent (e.g., to serve food). Our coding was such that we likely overestimated the use of personal protective equipment. However, given the scarcity of data on this topic in the literature, our findings provide some of the first evidence about PPE use among adolescents working in retail and service jobs.

Also, though our survey uses a national sample, the numbers for some types of exposures are small and confidence intervals are large.

## Implications and Conclusions

Though mortality associated with the types of hazards we examined are rare among young workers [Dunn and Runyan, 1993; Castillo et al., 1994; Woolf et al., 2001], documented morbidity is more common and may occur at higher rates than among adult workers [Belville et al., 1993; Layne et al., 1994; Brooks and Davis, 1996; Woolf and Flynn, 2000; Brevard et al., 2003; Calvert et al., 2003]. However, because investigations vary in their methods of calculating rates, comparison is difficult across studies and between adolescents and adults.

Though evidence indicates that use of personal protective equipment can reduce injury and illness risks, usage patterns of such equipment is poorly understood. The fact that PPE use is so limited among adolescents suggests the need for more attention to both the availability of personal protective equipment in the workplace and adequate employer supervision and training to ensure this equipment is used and used properly. These results indicate that PPE use among adolescents exposed to hazards is very limited. Though it appears that training in the use of personal protective equipment has the potential to increase usage, relying only on training is insufficient.

There is clearly a need for more in depth investigation of the varied hazardous exposures working teens experience in the retail and service industries as well as in other sectors of the U.S. economy. Such research should examine opportunities to reduce hazardous exposures through changes in how work environments are designed and how work practices are organized. And, where hazards cannot be eradicated, efforts should be made to study how best to increase the use of personal protective equipment and to reduce the potential for harm. This research can inform the development and evaluation of personal protective equipment itself as well as work practices including training and supervision, taking into account whether equipment is properly designed to accommodate the physical characteristics (i.e., size and shape) of young workers as well as factors that may influence the willingness of teenagers to use protective clothing or equipment. These efforts should include attention to the special issues of managing adolescents who lack experience with work overall and, more particularly, lack experience with specific hazards or safety procedures.

Clinicians should make a point to engage with teenage patients and their parents about the potential risks associated with employment in certain situations. This should include taking a careful history about work involvement and discussing potential hazards and protective strategies [Runyan, 2007]. Likewise, parents should be encouraged to guide their adolescents in asking about workplace safety and should, themselves, engage with their teens' employers to help ensure that regulations are obeyed and safety procedures are adequate.

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