

Traumatic Injury Among Drywall Installers, 1992 to 1995

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This study examined the traumatic-injury characteristics associated with one of the high-risk occupations in the construction industry—drywall installers—through an analysis of the traumatic-injury data obtained from the Bureau of Labor Statistics. An additional objective was to demonstrate a feasible and economic approach to identify risk factors associated with a specific occupation by using an existing database. An analysis of nonfatal traumatic injuries with days away from work among wage-and-salary drywall installers was performed for 1992 through 1995 using the Occupational Injury and Illness Survey conducted by the Bureau of Labor Statistics. Results from this study indicate that drywall installers are at a high risk of overexertion and falls to a lower level. More than 40% of the injured drywall installers suffered sprains, strains, and/or tears. The most frequently injured body part was the trunk. More than one-third of the trunk injuries occurred while handling solid building materials, mainly drywall. In addition, the database analysis used in this study is valid in identifying overall risk factors for specific occupations. (J Occup Environ Med. 2000; 42:1101–1108)

Construction workers face enormous injury hazards because of the nature of their work. Construction tasks are highly dynamic and complex; they often require workers to handle massive materials, maintain awkward postures, and perform repetitive and forceful activities. In addition, construction workers may often have to perform jobs under adverse working conditions such as inclement weather, unstructured worksite layout, confined spaces, and varying elevations.¹ Furthermore, construction projects commonly involve multiple contractors and subcontractors and are often performed at a rapid pace to meet project deadlines.^{1,2} These conditions place construction workers at risk for occupational injuries.

In 1995, the construction industry had the highest days-away-from-work case-incidence rate at 4.1 per 100 full-time workers, compared with a rate of 3.7, 3.3, and 3.2 for the transportation, agriculture, and mining industries, respectively.³ In a study of workers' compensation data of 21 states, 7 of 30 occupations in the construction industry were identified as priority research targets for injury prevention.⁴ Drywall installers ranked fourth highest, after construction laborers, carpenters, and roofers.⁴ Their compensable injury rate (27.5 cases per 100 workers) was almost 3 times the average (9.5 cases per 100 workers) for all construction occupations combined.⁴ In Washington State, the composite incidence rate for drywall installation (1992 to 1994) was 23.6 per 100 full-time

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employees, which was the highest of all industries.⁵

In the construction industry, drywall installation often seems to mean drywall hanging, which is usually conducted by drywall installers or carpenters. Drywall finishing is often done by painters. To perform drywall installation, workers first must transport the bulky (4 feet wide, 8 to 16 feet long, and 3/8 to 1 inch thick) and heavy (54 to 224 pounds) drywall sheets from where they are stored to where they are to be hung. The drywall sheet is then cut to accommodate the size of the wall or ceiling and any electrical fixtures, openings, windows, or doors. The task of drywall hanging requires the use of electrical screw guns or hammers that are often held overhead or below the knee. Workers must grasp and hold the drywall sheet in place and then fasten the sheet onto the wood or metal studs using the screw gun or hammer. These activities are very physically demanding, thus exposing drywall installers to potential hazards.

A significant amount of research addresses the general injury characteristics associated with the construction industry for all occupations combined.⁶⁻¹¹ However, research on occupation-specific injuries, particularly drywall installation, is sparse. The construction industry is composed of many specialized groups. Because of the complexity and diversity of construction job tasks, research focused on one speciality usually cannot be generalizable to others. An understanding of the traumatic injury characteristics for high-risk occupations is essential in developing effective strategies for injury prevention. In addition, because of such practical limitations as the unorganized nature of construction tasks and work environment, quantitative assessment methods and instruments (eg, electromyography, motion analysis system, and force platform) often cannot be implemented practically and reliably. Therefore, this study was undertaken

to identify possible risk factors involved with one high-risk occupation in the construction industry,⁴ drywall installers, through the analyses of traumatic injury characteristics by using a large-scale existing injury database.

Methods

The drywall-installation-related traumatic-injury data were obtained from the Bureau of Labor Statistics (BLS) through a direct request. In 1992, BLS implemented a redesigned Occupational Injury and Illness Survey to target serious nonfatal occupational injuries and illnesses. This redesigned annual survey was conducted to estimate the number and frequency of occupational injuries and illnesses based on a sample composed of approximately 250,000 establishments.¹² This survey does not include self-employed workers, workers on farms with fewer than 11 employees, private household workers, and employees in federal, state, and local governments.¹² Because of the lack of an exact number of wage-and-salary drywall installers in the construction industry, the denominator was not available for calculating the traumatic incidence rates for this study.

Traumatic injury frequency data on drywall installers involving days away from work were derived from BLS for the period 1992 to 1995. The current study addresses only traumatic injury cases that resulted in at least 1 day away from work. Individual cases resulting in solely restricted work activity and cases requiring just medical treatment were not included. In addition, the current study focused on traumatic injuries associated with drywall installers (occupational code 573 based on the 1990 occupational classification structure developed by the Bureau of the Census) employed as wage-and-salary workers in the US construction industry. Drywall finishers were not included in the study inasmuch as they belong to a different occupational category (painters).

To investigate the traumatic injury characteristics of drywall installers, four aspects of injuries involving days-away-from-work were examined: (1) the principal physical characteristic of the injury (nature of the injury); (2) the part of the body directly linked to the nature of the injury (part of body affected); (3) the manner in which the incident occurred (type of event or exposure); and (4) the object, exposure, or motion that directly produced the injury (source of the injury).¹² In addition, two-way analyses were performed with the top leading nature of the traumatic injury by the source of the traumatic injury, the injured body part, and the type of incident (event). These analyses were done to identify the possible injury scenarios leading to high frequencies of injury. To determine the injury characteristics associated with specific body parts, the interactions of the injured body part by the event, as well as the injured body part by the source of injury, were also examined.

Although it is important to examine the frequencies of injury, the analysis of injury data would not be complete without the study of injury severity. Therefore, median days away from work were examined in terms of the four characteristics of injury. The number of workdays missed can vary widely from one type of traumatic injury to another because it tends to be a very skewed distribution. BLS chose the median days away from work as the severity measure because it is better in defining incidents resulting in relatively long absences from work.³ The interpretation of high medians should be done with caution, because they can be heavily influenced by long-duration cases.³

Results

Data from the BLS annual survey of occupational injuries and illness indicate that there were a total of 16,023 traumatic injuries for wage-and-salary drywall installers in the construction industry from 1992

TABLE 1

Median Days Away From Work for Drywall Installers, Construction Industry, and All Industries Combined, 1992 to 1995

	1992	1993	1994	1995
Drywall installers	8	10	8	9
Construction industry	7	7	7	7
All industries	6	6	5	5

TABLE 2

Percentage Distribution of Days-Away-From Work Cases of Drywall Installers, 1992 to 1995

	Total Cases	Percent of Total Cases Involving						
		1 Day	2 Days	3 to 5 Days	6 to 10 Days	11 to 20 Days	21 to 30 Days	31 Days or More
1992	4,680	10.9	12.4	17.9	15	11.2	5.2	27.5
1993	4,122	9.6	12.3	17.1	12.1	13.4	8.6	27
1994	4,156	10.7	13.4	15.4	15.7	13.4	5.6	25.9
1995	3,065	11	7.7	20.3	15.2	13	6.2	26.5

TABLE 3

Leading Nature of Traumatic Injuries Among Drywall Installers, 1992 to 1995

Nature (Code*)	Total No. of Injuries (n = 16,023)	Percent of Total Cases†	Median ‡ Days Away From Work
Traumatic injuries to muscle, tendons, ligaments, joints, etc (02)	7,179	44.8	7-10
Sprains, strains, tears (021)	7,032	43.9	7-10
Open wounds (03)	2,263	14.1	3-7
Cuts, lacerations (034)	1,674	10.4	3-7
Traumatic injuries to bones, nerves, spinal cord (01)	2,210	13.8	39-48
Fractures (012)	1,786	11.1	40-60
Surface wounds and bruises (04)	1,802	11.2	3-5
Bruises, contusions (043)	1,164	7.3	5
Multiple traumatic injuries and disorders (09)	1,826	11.4	10-20
Other	743	4.6	-

* Occupational injury and illness classification code, 1992 edition, by Bureau of Labor Statistics.

† Percentages may not add to 100 because of rounding.

‡ The column shows the range of the 1992, 1993, 1994, and 1995 median days away from work.

through 1995. The estimated number of traumatic injuries were 4680 (1992), 4122 (1993), 4156 (1994), and 3065 (1995), respectively. There were notable reductions in the total number of traumatic injury cases between 1992 and 1993 (558 cases) as well as between 1994 and 1995 (1090 cases). Table 1 presents the median days away from work for

drywall installers, the construction industry, and all industries combined. The median days away from work for drywall installers varied slightly over the 4 years, ranging from 8 days in 1992 and 1994 to 10 days in 1993. These numbers were above the construction median of 7 days and the median of 5 to 6 days for all industries combined. Half of

the drywall installers afflicted with days-away-from-work traumatic injuries missed 8 days or more. Table 2 shows the percent distribution of total cases. More than a sixth of the cases in 1995 and one-fifth of the cases in 1992, 1993, and 1994 had 1 or 2 days of lost work time, whereas at the extreme end of the distribution, more than a fourth of the cases involved at least 31 days of lost work time.

Nature of the Injury

Traumatic injuries to muscle, tendons, ligaments, and joints were the primary nature of injury, accounting for nearly 45% of the total injuries during the 4-year period (Table 3). About 98% of the traumatic injuries to muscle, tendon, ligaments, and joints were sprains, strains, or tears. Traumatic injuries to bones, nerves, and spinal cord resulted in a median of 39- to 48-day absences from work for the 4-year period, which was 4 to 6 times that of traumatic injuries to muscles, tendons, ligaments, and joints (Table 3). Fractures, cited in 1786 cases involving days away from work over the 4-year period, had a median of 60 days in 1994.

Body Parts Affected

Table 4 presents the distribution of body parts affected by the traumatic injury. The back (27.8%) was the most frequently injured body part among drywall installers. Nearly one-fourth of the total cases incurred an injury to the upper extremity, with injuries divided evenly among the fingers, hands, and arms. Injuries to shoulders, arms, or knees often resulted in 10 or more days away from work (Table 4).

Source of the Injury

The distribution of sources of traumatic injury is shown in Table 5. Three primary sources of injury constituted about 64% of the total injuries: floors, walkways, ground surfaces (28.3%); building materials—solid elements (22.7%); and persons—injured or ill worker

TABLE 4

Leading Body Parts Affected by Traumatic Injuries of Drywall Installers, 1992 to 1995

Body Parts Affected (Code*)	Total No. of Injuries (n = 16,023)	Percent of Total Cases [†]	Median [‡] Days Away From Work
Trunk (2)	6,180	38.6	7–12
Back, including spine, spinal cord (23)	4,454	27.8	7–11
Shoulder, including clavicle, scapula (21)	848	5.3	10–21
Upper extremities (3)	3,969	24.8	5–15
Fingers (34)	1,019	6.4	3–7
Hands, except fingers (33)	1,019	6.4	5–9
Arms (31)	998	6.2	15–25
Lower extremities (4)	3,189	19.9	8–16
Legs (41)	1,606	10	8–25
Knees (412)	1,229	7.7	14–25
Ankles (42)	725	4.5	5–13
Multiple body parts (8)	1,297	8.1	10–20
Head (0)	1,013	6.3	2
Other	375	2.3	–

* Occupational injury and illness classification code, 1992 edition, by Bureau of Labor Statistics.

[†] Percentages may not add to 100 because of rounding.

[‡] The column shows the range of the 1992, 1993, 1994, and 1995 median days away from work.

TABLE 5

Leading Sources of Traumatic Injuries for Drywall Installers, 1992 to 1995

Source (Code*)	Total No. of Injuries (n = 16,023)	Percent of Total Cases [†]	Median [‡] Days Away From Work
Floors, walkways, ground surfaces (62)	4,528	28.3	14–23
Floors (622)	2,721	17	15–27
Ground (623)	886	5.5	10–36
Building materials: solid elements (41)	3,641	22.7	6–11
Wallboard, drywall (4198)	2,414	15.1	6–11
Persons: injured or ill worker (56)	2,018	12.6	10–14
Bodily motion or position of injured, ill worker (562)	1,994	12.4	10–15
Containers: nonpressurized (11)	767	4.8	2–10
Hand tools: nonpowered (71)	618	3.9	3–7
Fasteners, connectors, ropes, ties (42)	629	3.9	3–4
Other	2,822	23.9	–

* Occupational injury and illness classification code, 1992 edition, by Bureau of Labor Statistics.

[†] Percentages may not add to 100 because of rounding.

[‡] The column shows the range of the 1992, 1993, 1994, and 1995 median days away from work.

(12.6%). More specifically, floors were the most common source of injury, which contributed to 17% of the total traumatic injuries. Wallboard, especially drywall (15.1%), was the primary building material associated with the injuries. Bodily motion or position of the injured or ill worker, which classifies stress or strains induced by a free movement

of the body, was responsible for about 12% of the total injuries. Floors, walkways, and ground surfaces, which were the leading source of injury, resulted in a median of 14 to 23 days away from work, whereas injuries involved with building material (solid elements) resulted in a median of 6 to 11 days away from work (Table 5).

Event or Exposure

Table 6 includes the distribution of leading events or exposure. More than 95% of the total cases fell within three broad categories—bodily reaction and exertion (37.2%), falls (32%), and contact with object (26.6%). Overexertion while lifting accounted for about 16% of the total injuries. Bodily reactions (11.9%), mostly while bending, climbing, crawling, reaching, or twisting, were also common events associated with injury. The most common falls to a lower level occurred in 21% of total cases, with approximately one-third (7.3%) of those involving falls from scaffolds. Among the leading events and exposures, falls resulted in the longest absences from work, with medians of 14 to 21 days (Table 6). Falls to a lower level (medians, 14 to 31 days) were often more severe than falls on the same level (medians, 10 to 20 days).

Interaction Analysis

Two-way analyses with the top leading nature of injury by the event were performed to determine the incident that led to the high frequencies of injury to muscles, tendons, ligaments, and joints. It was found that about 44% of traumatic injuries to muscles, tendons, ligaments, and joints involved overexertion and about 21% of the injuries resulted from bodily reaction (Fig. 1). Nearly 45% of traumatic injuries to bones, nerves, and spinal cord occurred when the workers fell to a lower level, and 16.5% occurred when they fell on the same level (Fig. 2). More than 80% of the traumatic injuries to muscles, tendons, ligaments, and joints affected workers' trunks (60.6%) and lower extremities (21.6%) (Fig. 3). Because more than one-third (38.6%) of the injuries affected drywall installers' trunks, the interactions of the event and the source of injury were examined. This was done to determine what type of incident and source were associated

TABLE 6
Leading Events of Traumatic Injuries for Drywall Installers, 1992 to 1995

Event (Code*)	Total No. of Injuries (n = 16,023)	Percent of Total Cases†	Median ‡ Days Away From Work
Bodily reaction and exertion (2)	5,955	37.2	7-10
Overexertion (22)	3,707	23.1	5-9
Overexertion in lifting (221)	2,524	15.8	5-8
Overexertion in hold, carrying, turning, or wielding objects (222)	626	3.9	3-24
Bodily reaction (21)	1,902	11.9	8-13
Bending, climbing, crawling, reaching, twisting (211)	881	5.5	6-14
Falls (1)	5,120	32	14-21
Fall to lower level (11)	3,391	21.2	14-31
From scaffold (116)	1,169	7.3	13-34
From ladder (113)	768	4.8	10-23
Fall on same level (13)	1,902	11.9	10-20
Contact with object (0)	4,262	26.6	2-9
Struck by object (02)	1,928	12	3-10
Struck against object (01)	1,583	9.9	3-7
Other	686	4.3	-

* Occupational injury and illness classification code, 1992 edition, by Bureau of Labor Statistics.

† Percentages may not add to 100 because of rounding.

‡ The column shows the range of the 1992, 1993, 1994, and 1995 median days away from work.

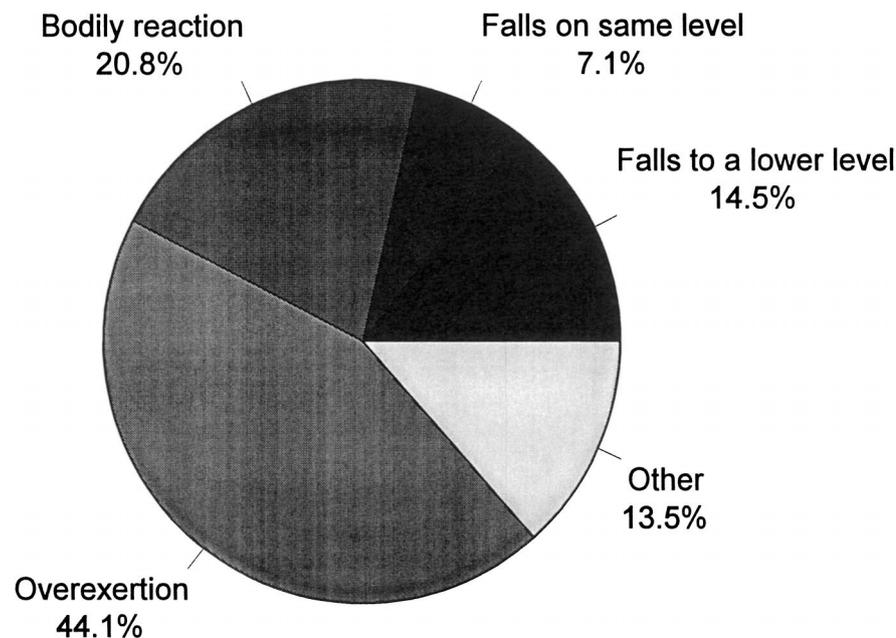


Fig. 1. Percentage distribution of traumatic injuries to muscles, tendons, ligaments, or joints by type of incident, 1992 to 1995.

with the high frequency of trunk injuries among drywall installers. It was found that more than one-third of trunk injuries (34.6%) were related to solid building material (eg, wallboard, drywall) handling (Fig. 4) and that 35.5% of injured trunks

resulted from overexertion in lifting (Fig. 5).

Discussion

This study examined traumatic-injury characteristics to identify potential risk factors associated with

drywall installers by using a large-scale existing database. The results provide an overview of the characteristics of the traumatic injuries that occur in drywall installation. This study also demonstrates an approach to identify the risk factors for specific occupations without using an instrument-based measurement system at the worksite or in the laboratory.

Drywall installers appeared to be at high risks for overexertion, falls to a lower level, and being struck by an object. The most common nature of injury was sprains, strains, or tears. The most frequently injured body part was the trunk. Common sources of injury were from floors and wallboards. These results reveal that the leading nature of injury, body parts affected, and type of incident for drywall installers were similar to those of construction workers⁷ but that the sources of injury were different. Thus, intervention strategies should be implemented on an occupation-specific and task-specific basis. The leading sources of injury for construction workers were metal items, work surface, and manual hand tools,⁷ whereas the injuries of drywall installers were most often associated with floors, wallboard, and bodily motion. Therefore, in addition to preventing injuries associated with floors, such as slips and falls, effective intervention strategies for drywall installers should focus on tasks that are likely to cause sprain and strains during free body movement. Examples are hanging drywall sheets onto the lower half of the wall or ceiling, which involves excessive bending or reaching.

Overexertion accounted for more than 23% of total traumatic injury cases of drywall installers. This high frequency is supported by a recent study of musculoskeletal disorders in union carpenters, in which drywall and ceiling workers were found to have the highest prevalence of work-related musculoskeletal disorders (ranging from 20% to 24%).¹ In the current study, it was found that more

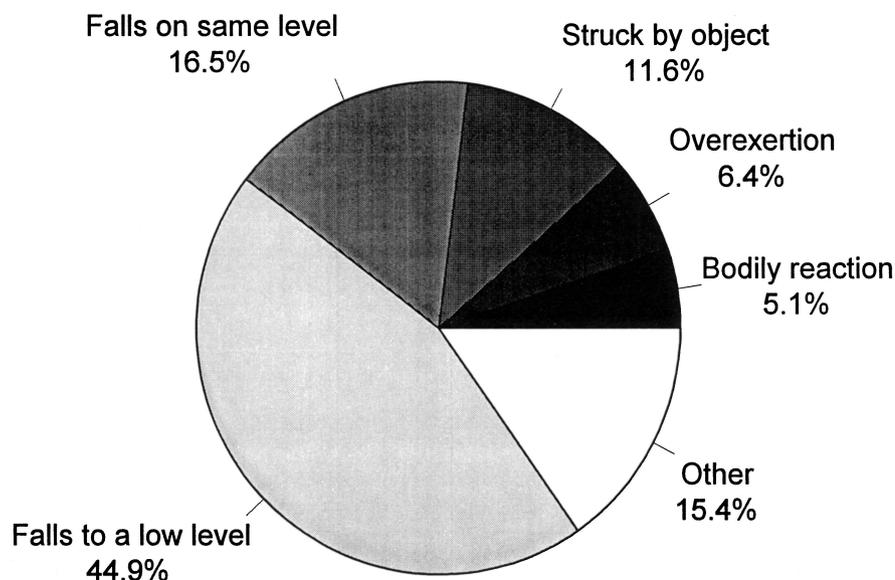


Fig. 2. Percentage distribution of traumatic injuries to bones, nerves, or spinal cord by type of incident, 1992 to 1995.

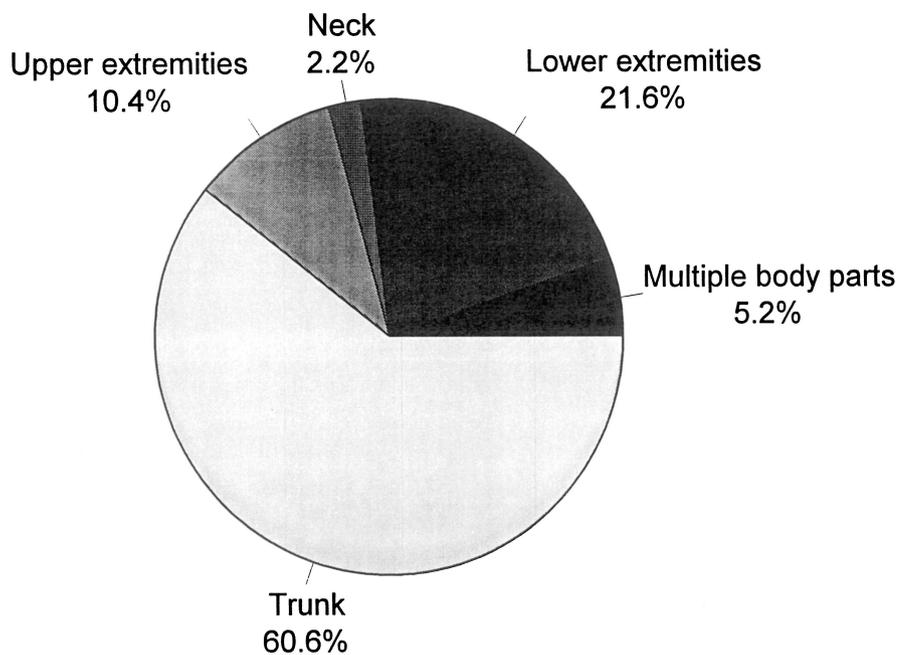


Fig. 3. Percentage distribution of traumatic injuries to muscles, tendons, ligaments, or joints by body parts affected, 1992 to 1995.

unload the assistive devices. Moreover, the drywall hanging process involves numerous lifting activities. Installing drywall to the upper half of the wall or ceiling requires lifting sheets above the shoulder or overhead in place until they are fastened, which imposes considerable stress on workers.¹⁴

Falls were the second highest cause of injury among drywall installers, especially falls to a lower level. Falls have been a long-existing problem in the construction industry. Previous studies have documented that falls are the most common cause of occupational fatality among construction workers.^{6,7} Falls are also one of the most common causes of nonfatal injury in the construction industry.⁷ Drywall installers, like most construction workers, often must perform tasks at elevations. To install drywall sheets to the ceiling or upper half of the wall, workers first must lift drywall to the elevated surface and then constantly extend their upper extremities and upper trunks to handle the drywall sheets until they are fastened. These activities place excessive demands on workers' postural stability because they are likely to cause the body's center of mass to reach closer to the outer edges of the base of support and, thereby, increase the probability of falling. In addition, workers may not be able to use their body movement strategy efficiently and accurately in response to any possible momentary loss of balance while they are handling bulky and heavy materials. Moreover, drywall installation to a ceiling or the upper half of the wall is often done in confined and elevated spaces, such as on the rung of a ladder or a plank on a scaffold. These standing surfaces make it difficult for workers to change stance effectively to increase their base of support. All of these risk factors for falling—repetitive extension of upper extremities and trunks, heavy and bulky material handling, and restricted standing surface—are also

overexertion cases occurred during lifting (16%) than during holding, carrying, turning, or wielding tasks (4%). This might be attributable to the wide use of carts, dollies, and drywall carriers when transporting drywall sheets. These assistive devices, designed specifically for transporting drywall sheets, are available

and easy to use at construction sites.¹⁴ Thus, the duration and frequency of carrying heavy drywall sheets can be noticeably decreased, which should reduce a considerable amount of the stress imposed on the body during the performance of this task. However, drywall installers still must lift the drywall sheets to load or

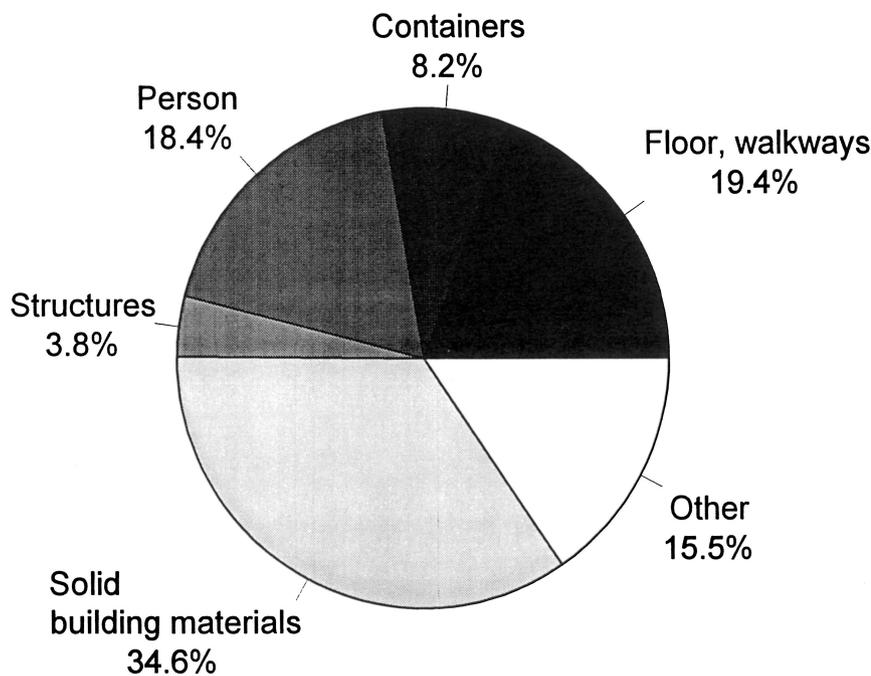


Fig. 4. Percentage distribution of trunk injuries by source of injury, 1992 to 1995.

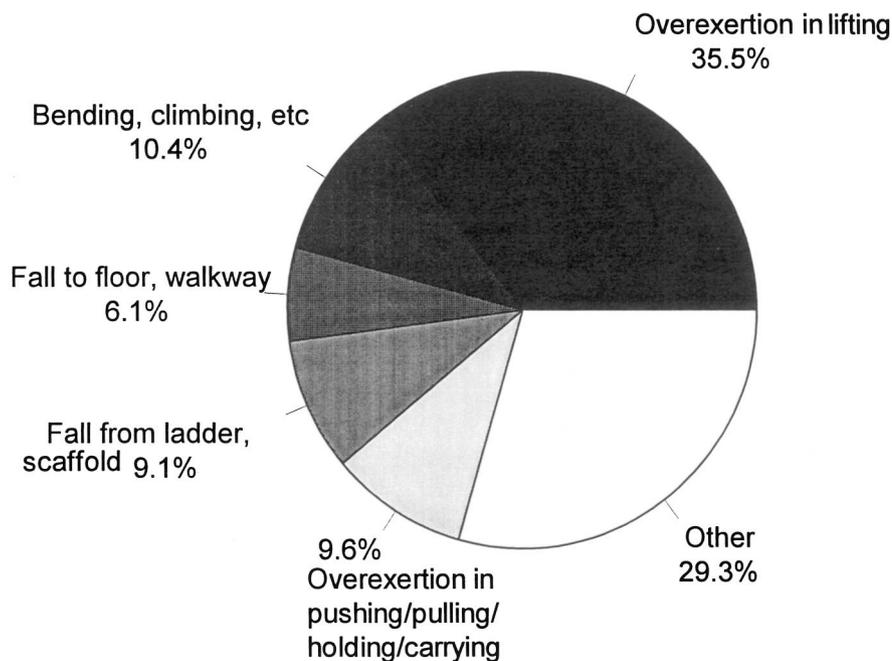


Fig. 5. Percentage distribution of trunk injuries by type of incident, 1992 to 1995.

the general male population has sufficient trunk strength to perform the task.¹⁴ These findings reaffirm that the handling of bulky and heavy drywall sheets places inordinate stresses on workers, particularly during drywall lifting. In the current study, the back was found to be the most vulnerable area of all trunk segments and accounted for about 28% of total traumatic injuries. This is not surprising inasmuch as the handling of heavy and bulky material is the main characteristic of the drywall specialty. This finding is also consistent with the results from our previous survey of drywall installers in which the lower back, upper back, and neck were identified by the workers as the body parts that are subject to the most physical stress for the installation of lower wall, upper wall, and ceiling, respectively.¹⁵ However, in a survey of 522 carpenters, Lemasters et al found that work-related musculoskeletal disorders of the upper extremity (shoulders, hands, or wrists) rather than the back were most prevalent among drywall and ceiling workers.¹ It was hypothesized that a survivor effect may exist, because workers with developed back problems may shift to jobs that do not require extensive bending and lifting.¹

A variety of ergonomic assessment methods and instruments are available for identifying risk factors. However, in the construction industry, there are many practical limitations in accurately and reliably identifying risk factors associated with a specific occupation (eg, drywall installers). This study provides an approach to identify the risk factors associated with drywall installers without (1) the necessity of establishing and validating an instrument-based measurement system (eg, electromyography, motion analysis system, and force platform) at the worksite or in the laboratory; and (2) the subjective bias that is frequently found in workers' interviews (eg, questionnaires).

known risk factors for overexertion injuries.

The most frequently injured body part during drywall installation was the trunk (39%), followed by the upper extremities (25%). Trunk injuries of drywall installers were most likely to be associated with the han-

dling of solid building materials (32%), especially drywall. This finding is consistent with a previous study of the biomechanical stresses of drywall lifting.¹⁴ It was found that lifting drywall sheets produced considerable stresses on the workers' torsos—only a limited percentage of

In sum, this descriptive study provided insight into the traumatic injuries of drywall installers and allowed us to discern specific risk factors associated with the injuries. Results from this study suggest that injury-prevention efforts for drywall installers should be directed toward tasks performed on elevated and restricted working areas along with tasks that require drywall lifting. Future laboratory studies are needed to identify proper handling methods and assistive devices that reduce the risk factors for overexertion and falls during drywall installation.

Acknowledgments

The authors thank Mr William L. Weber of the Bureau of Labor Statistics for providing the injury data. Special thanks also go to Mr Dave E. Fosbroke, Mr John Myers, and Ms Suzanne Marsh of the Division of Safety Research, National Institute for Occupational Safety and Health for helping to obtain the injury data and for providing recommendations throughout the project.

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Definitions

Clock: A mechanical device to wake up people who have no children.
 Conscience: The inner voice warning one that someone may be looking.
 Cynic: Someone who smells the flowers and looks for the casket.
 Experience: What one gets when one does not get what one wants.
 Federal Law: Ten thousand books explaining the Ten Commandments.
 Happiness: Wanting what one gets.
 Marriage: Getting used to a lot of things one least expected.

—From Landers A. *Philadelphia Inquirer*, June 7, 2000, p D2.