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Hernia: Is It a Work-Related Condition?

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Background *Development of hernias among active workers is a major occupational problem, however, the work-relatedness of hernias has not been well investigated. It is a difficult question for occupational and primary care physicians who must often address whether a worker with an inguinal hernia should be restricted from work requiring lifting of heavy objects.*

Methods *To evaluate the possible work-relatedness of inguinal hernias, a cross-sectional study was performed. The goal of the study was to determine hernia incidence according to occupation with the Annual Survey of Occupational Injuries and Illnesses from the Bureau of Labor Statistics in 1994. Hernia incidence rates (per 10,000 workers) for industry and occupation categories were calculated with the estimates of the number of hernias in males and the employed male workers from the Current Population Survey. Rate ratios (RR) of hernia incidence rates were calculated.*

Results *In 1994, an estimated 30, 791 work-related hernias in males were reported by US private establishments. The occupation groups with the highest RR were laborers and handlers (RR, 2.47; 95% confidence interval (CI), 2.14–2.80), machine operators (RR, 2.13; 95% CI, 1.81–2.44), and mechanics and repairers (RR, 1.72; 95% CI, 1.43–2.00).*

Conclusions *Rate ratios for hernias vary considerably within industries and occupations, with the highest ratios found in industries and occupations involving manual labor. This provides support for the hypothesis that the hernias are work-related, especially in work involving strenuous, heavy manual labor.* Am. J. Ind. Med. 36:638–644, 1999. *Published 1999 Wiley-Liss, Inc.*†

KEY WORDS: hernia; industry; occupation; strenous manual work

INTRODUCTION

Hernias are abdominal defects of the anterior/inferior abdominal cavity. Most abdominal hernias are classified into three types: inguinal, femoral, and ventral hernia. The hernia frequency in the total U.S. population may be placed at about 5% of all adult males and 1% of all adult females. Inguinal hernias are the most common: they make up 80% of all hernias and usually occur in males [Zimmerman and Anson, 1967; El Qaderi et al., 1992].

Hernias generally reflect simple structural failures, and they have been reported to be precipitated by obesity, chronic obstructive lung diseases, advancing age, smoking and heavy lifting [Eubank, 1997]. Indirect inguinal hernias, which are the most common, are considered to be developmental anomalies of the processus vaginalis. Occupational factors could also be involved. It is generally believed that occupations requiring heavy lifting and severe straining are more frequently associated with the development of hernia [Zimmerman and Anson, 1967], however, the empirical data supporting this view are scarce. A common problem faced by occupational and primary care physicians

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is deciding whether a hernia could be caused by occupational factors such as lifting and whether a worker with an inguinal hernia should be restricted from work that requires lifting of heavy objects.

Hernias, although it is neither a fatal nor permanently disabling condition, are a frequent cause of lost work time. In the 1993 Bureau of Labor Statistics (BLS) Annual Survey of Occupational Injuries and Illnesses, hernias were associated with median work day losses of 26 days with an estimated 32,124 cases reported [U.S. Department of Labor, 1996]. The 12 month incidence rate was 4.1 cases per 10,000 workers.

A few studies have looked at the relation between hernia and working conditions such as heavy lifting, which causes increasing intra-abdominal pressure. Davis [1959] found that intra-abdominal pressure was increased in the stooping position rather than in the erect posture and depended on the speed of ''lift''. Palumbo et al. [1963] theorized that a shift in the visceral weight from the center of the abdomen to the groin could cause the rupture. Edgar [1979] recommended that people with inguinal or hiatus hernias should avoid occupations which entail a lot of lifting unless the pathology can be treated surgically.

However, Ljungdahl [1973] asserted that there is no significant relationship between the type of work and the appearance of hernia. Fisher [1981, 1982] opined unequivocally that ''there is nothing in the medical literature to support the contention that a patient with an inguinal hernia is incapable of lifting heavy objects''. Wantz [1997] also argued that strenuous physical activity by itself does not cause primary or recurrent inguinal herniation.

Despite the abundance of strong opinions, to our knowledge, there are no appropriate scientific studies addressing the role of physical work in the etiology of inguinal hernias. If assertions denying an association between work and hernia were universally accepted, hernias would not be reported as work-related. However, hernias are reported as work-related either because of a true association between hernia and lifting or because this is held as a wide-spread belief.

This study was conducted to determine the difference in the rate of hernias reported as work-related among industries and occupations, and to add evidence in the discussion of the relationship of working conditions to the development (or precipitation) of hernia.

MATERIALS AND METHODS

The Annual BLS Survey of Occupational Injuries and Illnesses collects data on injuries, illnesses, and hours worked from a random sample of 250,000 private industry establishments representing most of the private industry. The injury and illness data are obtained from Occupational Safety and Health Administration's (OSHA) 200 logs and supplementary records that establishments maintain throughout the reference year [U.S. Department of Labor, 1994]. The survey excludes self-employed people, farms with fewer than 11 employees, private households, and Federal, State, and local government agencies. Data for mines and railroads are provided to the BLS by the Department of Labor's Mine Safety and Health Administration and the Department of Transportation's Federal Railroad Administration and are reported with the Annual Survey results.

Augmenting the Annual Survey, descriptive information is collected on a sample of those cases that result in being at least one day away from work. This includes personal characteristics such as industry, occupation, race, gender, age, and length of employment. The injury or illness is characterized by information on the nature of injury or illness, the part of body affected, the event or exposure that produced the injury or illness, and the source (the object, substance, bodily motion, or exposure) that directly produced the injury or illness. The severity of the case is indicated by the number of days away from work.

Industry is coded using the 1987 Standard Industrial Classification Manual [Office of Management and Budget, 1987] and occupation using the 1980 Bureau of the Census classification system [U.S. Bureau of the Census, 1982]. The nature of the injury or illness, the part of body affected, the source of injury or illness, and the event or exposure are coded according to the OSH Case Characteristics Classification System developed by BLS [U.S. Department of Labor, 1996]. This system provides coding at four levels, from 1-digit to 4-digit, although not all categories can be expanded to the 4-digit level. The BLS nature of injury or illness classification structure is divided into seven divisions. Hernia is classified as one of the digestive system diseases and disorders (code 153) and subdivided into unspecified hernia, inguinal hernia, hiatal hernia, ventral hernia and hernia, not elsewhere classified.

Computations of hernia estimates in this report were carried out by BLS personnel by using special computer software designed for the analysis of this survey. Estimates of the number of hernia cases in 1994 were calculated for broad industry (1 and 2-digit SIC code) and broad and detailed occupation categories for gender, age, and days away from work for hernia (code 153), inguinal hernia (code 153.1), and inguinal and unspecified hernia (code $153.0 + 153.1$). The 95% confidence interval for the estimates was calculated by using the percent relative standard error provided by the Bureau of Labor Statistics.

The annual average number of employed male workers in private industry from the 1994 Current Population Survey was used as a denominator to calculate crude (i.e., no adjustment for other variables, such as age) twelve-month incidence rates. The incidence rate of hernia was calculated from hernia cases in an industry or occupation divided by

the population of an industry or occupation multiplied by 10,000 to estimate the number of cases per 10,000 workers.

The rate ratio (RR) was calculated to compare the risk of work-related hernia with the hernia incidence rate of each industry divided by the hernia incidence rate of the total. The rate ratio for each occupation was calculated by dividing the hernia incidence rate of each occupation by the hernia incidence rate of total. Estimate of the 95% confidence interval was calculated with the linear part of Taylor's series for ratio of the two rates [Britton et al., 1966] as follow.

$$\text{Estimated SE}(R_1/R_2) = \sqrt{1/R_2(\text{SE}(R_1))^2 + R_1/R_2(\text{SE}(R_2))^2}$$

R_1 = Hernia incidence rate of each occupation

R_2 = Hernia incidence rate of the total

$\text{SE}(R_{1\text{ or }2})$ = (%RSE/100) × (cases estimates/population × 10,000)

%RSE, case estimates are from BLS.

Population is from the Current Population Survey.

RESULTS

In 1994 there were an estimated 33,078 cases of occupationally related hernia or 4.1 cases per 10,000 (male and female) workers. The largest age group affected was 40–49 years old (29.7% of the 31,340 cases with known age). The next group was 30–39 years old (25.1%) (Fig. 1). Overall 86% (28,477 cases) were attributed to overexertion at work; among them, 70% (19,532 cases) were reported to be caused by lifting. The largest number of days away from work (DAFW) cases due to hernia was the category "31 days or more" and the median DAFW case was 25 days (Fig. 2). Males comprised 93.1% (30,791 cases) of all cases. Hernia (code 153) was subdivided into inguinal hernia (153.1) with 44.7% (14,776 cases), unspecified hernia (code 153.0) with 42.8% (14,162 cases), hiatal hernia with 0.7% (233 cases), ventral hernia with 3.2% (1,064 cases), and other hernia with 8.6% (2,844 cases).

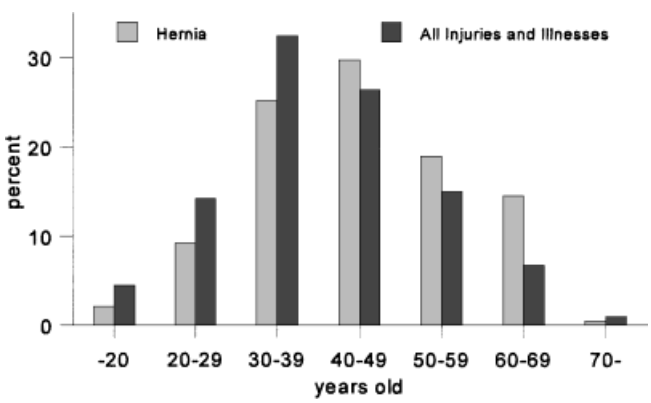

FIGURE 1. Age distribution of hernia and all cases, BLS 1994.

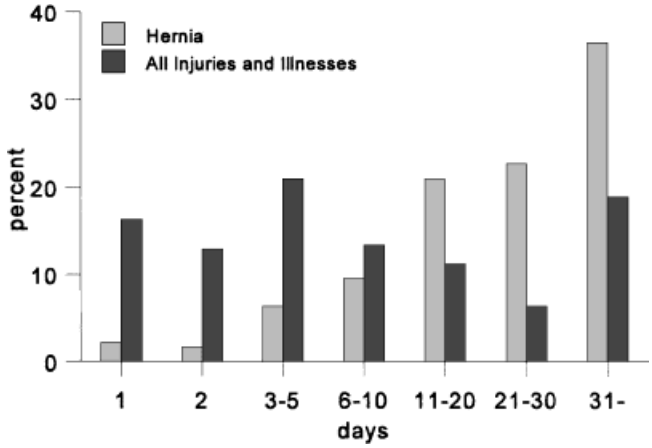

FIGURE 2. Days away from work of hernia and all cases, BLS 1994.

The overall annual incidence rate (IR) of hernia in males was 6.01 per 10,000 workers. Comparing the IR by industry, the wholesale trade industry showed the highest rate (IR = 10.7), followed by manufacturing (IR = 8.9) and the construction industries (IR = 8.4) (Table I). In the wholesale industry, the rate ratio of nondurable goods wholesale trade was higher than durable goods. Within manufacturing, food products showed the highest rate (RR = 4.46), followed by fabricated metal products (RR = 2.59), lumber and wood products (RR = 2.43), furniture and fixtures (RR = 2.42), and stone, clay, glass, and concrete products (RR = 2.16). Building material, hardware, and garden supply (RR = 1.51), trucks and warehousing (RR = 1.32), and air transportation (RR = 1.24) reported high RRs among retail trade and transportation, respectively.

Results for broad occupation groups are summarized in Table II. Handlers and laborers showed the highest rate ratio (RR = 2.47), followed by machine operators (RR = 2.13), fabicators, assemblers, and handworking occupations (RR = 2.03), mechanics and repairers (RR = 1.72), transportation and material movers (RR = 1.44) and construction trade occupations (RR = 1.27). In laborers, non-construction laborers had the highest rate ratio (RR = 4.52). In mechanics and repairers, there was no difference among the detailed specific occupations. In transportation and movers, driver-sales workers showed the highest rate ratio (RR = 4.73). In the machine operating occupation, woodworking machine operators had the highest rate ratio (RR = 4.28), followed by machine operators, assorted materials (RR = 2.37), fabricators and assemblers (RR = 2.37), and metal and plastic working machine operators (RR = 2.23). The hernia rate ratio of 1.27 in the broad construction trade occupation was not relatively high, however, structural metal workers showed the high rate ratio (RR = 4.42), followed by plumbers and pipe fitters (RR = 2.70) and brickmasons and stonemasons (RR = 1.86).

TABLE I. Incidence Rate (IR) of Hernia by Industry in Males, BLS, 1994

Industry	SIC code	Male workers[a]	Hernia cases	I.R.[b]	R.R.[c]
Agriculture	1–9	1,370,000	516	3.8	0.63
Mining	10–14	549,000	271	4.9	0.82
Construction	15–17	4,908,000	4,129	8.4	1.40
Manufacturing	20–39	13,337,000	11,810	8.9	1.47
Transportation	40–49	4,745,000	2,391	5.0	0.84
Wholesale trade	50–51	3,074,000	3,294	10.7	1.78
Retail trade	52–59	9,379,000	4,681	5.0	0.83
Finance and insurance	60–66	2,819,000	620	2.2	0.37
Service	70–87	11,047,000	3,080	2.8	0.46
Total		51,246,000	30,791	6.0	1.00

[a]The Current Population Survey, 1994.
[b]Per 10,000 workers.
[c]Incidence rate ratio compared to the incidence rate of the total.

TABLE II. Incidence Rate of Hernia by Occupation in Males, BLS, 1994

Occupation	BOC code	Male workers[a]	Hernia cases	I.R.[b]	R.R.[c] (95% CI)[d]
Handlers, equipment cleaners, helpers, and laborers	863–889	3,785,000	5,661	15.0	2.47(2.14–2.80)
Machine operators and tenders	703–779	2,966,000	3,824	12.9	2.13(1.81–2.44)
Fabricators, assemblers and handworking occupations	783–795	1,290,000	1585	12.3	2.03(1.69–2.37)
Mechanics and repairers	503–549	3,486,000	3,623	10.4	1.72(1.43–2.00)
Transportation and material moving equipment occupations	803–859	3,900,000	3,410	8.7	1.44(1.18–1.71)
Production inspectors, testers, samplers and weighers	796–799	340,000	271	8.0	1.32(0.95–1.69)
Extractive occupations	613–617	138,000	106	7.7	1.27(0.83–1.71)
Construction trade	553–599	3,557,000	2,735	7.7	1.27(1.02–1.52)
Precision product occupations	633–699	2,692,000	1,716	6.4	1.05(0.81–1.30)
Administrative support	303–389	2,816,000	1,533	5.4	0.90(0.67–1.12)
Service except private household and protective services	433–469	4,141,000	2,201	5.3	0.88(0.66–1.09)
Agricultural occupations	475–498	1,464,000	689	4.7	0.78(0.54–1.02)
Technicians and related support occupations	203–235	1,478,000	516	3.5	0.58(0.36–0.79)
Protective services	413–427	575,000	160	2.8	0.46(0.22–0.70)
Sales occupations	243–285	6,385,000	1,584	2.5	0.41(0.26–0.56)
Professional specialty occupations	043–199	5,225,000	617	1.2	0.20(0.07–0.32)
Executive, administrative, and specialty occupations	007–037	6,984,000	570	0.8	0.13(0.03–0.24)
Total		51,246,000	30,791	6.0	1.00(0.82–1.18)

[a]The Current Population Survey, 1994.
[b]Incidence rate ratio compared to the incidence rate of the total.
[c]Per 10,000 workers.
[d]Estimated 95% confidence interval.

To ensure stable estimates, we looked at incidence rates of major occupations, which were defined as occupations constituting more than 0.5% (more than 256,000 workers) of the total male working population. Table III presents the top 10 high risk occupations for hernia among 40 major occupations. Non-construction laborers ranked first (RR = 4.52), followed by miscellaneous machine operators (RR = 2.84), construction plumbers and pipefitters (RR = 2.70), construction laborers (RR = 2.34) and freight, stock and handlers (RR = 2.17).

DISCUSSION

Several causes of inguinal hernia have been suggested: (1) the ''saccular'' embryological theory [Russel, 1921–22], (2) a theory of a pathological change in the tissues [Keith,

TABLE III. The Top 10 High Risk Occupations Among 40 Major Occupations, BLS, 1994

Occupation	BOC code	Male workers[a]	Hernia cases	I.R.[b]	R.R.[c] (95% CI)[d]
Laborers, nonconstruction	889	919,000	2,495	27.2	4.52(4.04–5.00)
Miscellaneous machine operators	777	745,000	1,271	17.1	2.84(2.42–3.26)
Plumbers and pipefitters	585	388,000	630	16.2	2.70(2.19–3.21)
Construction laborers	869	650,000	915	14.1	2.34(1.94–2.74)
Freight, stock, material handlers	883	607,000	818	13.5	2.24(1.85–2.64)
Welders and cutters	783	517,000	674	13.0	2.17(1.77–2.57)
Assemblers	785	685,000	843	12.3	2.05(1.67–2.43)
Shipping and receiving clerks	364	404,000	495	12.3	2.04(1.63–2.45)
Truck drivers	804	2,328,000	2,451	10.5	1.75(1.45–2.05)
Janitors and cleaners	453	921,000	901	9.8	1.63(1.29–1.96)

[a]The Current Population Survey, 1994.
[b]Per 10,000 workers.
[c]Incidence rate ratio compared to the incidence rate of the total.
[d]Estimated 95% confidence interval.

1924] and (3) the smoking theory [Wagh et al., 1974]. An autopsy study demonstrated that 20% of adults have a patent processus vaginalis, thus predisposing them to indirect inguinal herniation [Hughson, 1925]. However, the lifelong prevalence rate of hernia is around 3–4% [Zimmerman and Anson, 1967]. Thus, a person with a patent processus vaginalis may not develop an inguinal hernia unless triggering factors such as the physical stress from intra-abdominal pressure, smoking, aging or decreased collagen content are present. In addition to structural defects, smoking is a recognized cause of hernias too. Cannon and Read [1981] reported that subjects who smoke had higher circulating serum elastolytic activity than controls, which may cause the muscles to weaken and could precipitate the development of hernia.

Increase in intra-abdominal pressure is also believed to cause inguinal hernia [Zimmerman and Anson, 1967]. The abdomen forms the compression system of the cantilever during lifting: raised intra-abdominal pressure produces an air cushion supporting the spine. Davis [1959] found that compared to the erect posture, intra-abdominal pressure was increased in the stooping position and depended on the speed of lift. Inguinal hernias can be produced or complicated by much heavy lifting even if this is done correctly from the orthopaedic aspect. Similarly, symptoms from a hiatus hernia can be made worse [Edgar, 1979]. For these reasons, there has been a long-standing belief that factors such as strenuous heavy lifting, which could increase intra-abdominal pressure, are among the causes of hernia development.

Mamtani and Cimino [1992] reported that sanitation workers who lift heavy loads with a concomitant increase in intra-abdominal pressure showed increased incidence of hernia (odds ratio = 1.79) compared to a control group. Flich et al. [1992] reported in their case–control study that high effort work increased the risk of inguinal hernia, while tobacco smoking was not different between cases and controls. Carbonell et al. [1993] also reported in their case–control study that inguinal hernias are associated with the exertion of a considerable amount of physical effort, and were more common younger, poorly educated manual workers.

Many authorities do not agree that occupation is a factor in the development or aggravation of hernia. Devlin [1988] states: 'There is no evidence that strong muscular or athletic exertion causes inguinal hernia in the absence of fascial and/or muscular abnormality,.... manual work or strain is never, or very rarely, the sole cause of inguinal hernia.' Wantz [1997] observed: 'Strenuous physical activity by itself does not cause primary or recurrent inguinal herniation. This conjecture has persisted for more than a century and is simply not true. Hernias of all types occur equally in those who are sedentary and in those who lift weights or do heavy manual labor.'

However, Wantz did not deny that inguinal hernia could be caused or aggravated by increase in intra-abdominal pressure from the vigorous physical activity which is common in some occupations. Though many authorities believe that hernias occur equally in workers no matter what they are doing, data are insufficient to support or refute this assertion. Recently, Smith et al. [1996] reported that their study has confirmed that there is seldom any subjective association between a muscle strain and the onset of a groin hernia. His results showed that in 7% of patients the hernia was subjectively attributable to a single muscular strain, although he studied only those who were not engaged in workers' compensation claims.

Our study assesses the differences in the incidence of inguinal hernia by industry and occupation. According to the BLS survey, the overall annual incidence rate of hernia

in males was 6.0 cases per 10,000 workers. Hernia ranked the 10th among occupational injuries or illnesses. Most cases were reported to be attributable to overexertion, especially lifting. The age distribution of hernias is skewed towards the slightly older than all reported occupational injury and illness cases taken together, but most cases were 30–50 years old. The high incidence rates in the wholesale trade, manufacturing and construction industries which generally require more manual work, were compatible with a prior hypothesis that hernias could be developed or aggravated by strenuous manual work. Hernia incidence rates were especially high in some industries, such as fabricated metal products, lumber and wood products, furniture and fixtures, and stone, clay, glass and concrete products among manufacturing industries, the building material, hardware and garden supply industry among retail trade industries, and trucks, and warehousing and air transportation industry among transportation industries. The occupations of laborers and handlers, machine operators, mechanics and repairers, transportation and material movers, and construction trades showed the highest incidence rates. In such construction trade occupations where workers in groups possibly work with heavy materials, construction framemetal or sheetmetal workers, plumbers and pipefitters, and brickmasons and stonemasons occupations showed high hernia incidence rates.

Most of top ten high risk occupations belong to the broad occupational groups which have high incidence rates. Traffic, shipping and receiving clerks, and janitors and cleaners were exceptions, being in administrative support and service occupations, respectively, occupation groups which generally have low hernia incidence rates. However, those occupations may also involve highly strenuous manual work. Seven occupations with high risk of hernia were listed among the top 15 high risk occupations of back pain, also associated with strenous manual work [Guo et al., 1995].

We are assuming that if increased abdominal pressure can contribute to developing inguinal hernias, hernias might be caused or precipitated by continuous heavy manual efforts as well as a single strenuous manual activity. If an individual's hernia is developed by work-related, increased abdominal pressure, the hernia might be prevented even though there was a pre-existing structural defect and we can say that it is a work-related condition. If hernias are not related to working conditions, as Wantz's [1997] opinion is, the question arises if they should be reported as work-related and compensated as work-related.

This study has certain limitations. The reported hernia cases could be biased by industry or occupation because the BLS survey asks employers to report only work-related cases. An employer's judgement of work-relatedness could be influenced by various factors, including beliefs about the etiology of hernias. For example, some employers may be more likely to attribute a hernia to work when it occurs in a manual laborer. Another limitation is that a denominator is not available from the BLS survey. However, the Current Population Survey is a good estimate of the number of workers in each industry or occupation. Therefore, it should not affect the general trend of incidence rates.

This study illustrates a substantial amount of work on work-related hernias reported from occupations likely to involve strenuous activities, especially lifting. While it is consistent with the hypothesis that hernia could be work-related and that factors in the workplace, such as heavy lifting, could contribute to the development of hernia, we are unable to draw any conclusion about etiology from these data. Given that there is a relative paucity of consistent and sound research (and substantial differences in opinion), further exploration of occupational factors causing or aggravating hernias should be conducted.

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