Aging Workers & Ergonomics

A Fresh Perspective

By Robert R. Fox, George E. Brogmus and Wayne S. Maynard

The graying of the workforce in the U.S. and in other developed countries is a well-recognized fact. People are living longer and electing to stay in the workforce beyond the typical retirement age. In 2010, persons age 55 and older made up nearly 20% of the entire U.S. workforce. In the European Union, nearly one-quarter of the workforce is age 50 or older (Vendra & Valenduc, 2012). In the U.S., more than 13% of those age 65 and older are still working in some capacity. The U.S. General Accounting Office (2001) estimates that by the year 2015 the proportion of workers over age 55 will have nearly doubled since 1990.

Some of this increase is due to the baby boomer population reaching retirement age. In addition, in the U.S., older workers are postponing retirement due to changes in the Social Security retirement age, the need for increased income to pay medical and other expenses, the desire to maintain certain health insurance benefits and a decrease in retirement savings and/or pension amounts. Workers also may postpone retirement because they are in good health and enjoy the social benefits and intellectual challenges of work (AARP, 2005).

This article explores aspects and implications of the aging workforce, including an examination of some physical changes associated with aging and how meaningful they may be for work performance. Recent data on age and injury rates and costs are discussed and particular areas of concern are highlighted. The role of ergonomics in safeguarding older workers is addressed as are other global demographics that may be of concern to future safety and ergonomics practitioners.

IN BRIEF

- **The number and proportion of older workers is increasing. Objectively assessing the magnitude of this increase and the implications to occupational safety is crucial to effective responses by ergonomists and OSH professionals.**
- **Most age-related performance declines are not work- or injury-relevant.**
- **Injuries to workers age 65 and older have favorable rates and costs compared to most other age ranges.**
- **Relevant concerns for workers age 65 and older include same-level falls and fatal vehicle crashes.**

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The litany of changes associated with aging have raised questions about or fostered negative perceptions about the capabilities of older workers.

What Constitutes an Aging Worker?

Sobriquets such as *old, aging* or *young* defy easy definition and are often contextual or relative. Kroemer (2006) provides a characterization by age as follows: a middle-aged person becomes an older person at age 40 or 45; elderly at about age 65; old at age 75; and very old if older than age 85. He notes that no definite boundaries exist that determine when a young person turns middle age or eventually turns elderly or old.

Age categories are often defined relative to various changes associated with the aging process. Depending on the capacities or capabilities affected, the impact of aging on some aspects of work performance may start as early as the late 30s. Many researchers, particularly in studies of manual work, identify age effects on work activities as starting at about age 45 to 50 in some persons. The U.N. and World Health Organization do not have an official criterion for being of "old" age, but the groups tend to use age 60 or older when referring to the older population, but that criterion can change depending on the country and issues of interest (**www.who.int/healthinfo/survey/ageingdefnolder/en**). AARP allows membership for persons 50 years or older, while the Age Discrimination in Employment Act applies to age discrimination to anyone age 40 or older (**www.eeoc.gov/facts/age.html**).

Aging: Physical, Cognitive & Health-Related Changes

Following is a brief review of the various physical, cognitive and perceptual changes commonly associated with aging (adopted from Åstrand & Rodhal, 1986; Fisk, Rogers, Charness, et al., 2009; Kroemer, 2006; Shepard, 1974; Snook, 1993; Wegman & McGee, 2004):

•**Strength.** Strength can be categorized and defined in many ways. Furthermore, different kinds of strength depend on the measurement method and equipment used (e.g., static, dynamic, isoinertial, isokinetic). Much of the strength data used in ergonomics for task design are based on static strength measurement protocols during which a subject exerts a volitional maximum effort against an anchored load cell for generally 1 to 3 seconds. Many sources report static strength as peaking in the early to mid 20s/early 30s, then decreasing slowly into the 40s, with a more rapid change after the 50s. About 25% of strength is lost over the adult lifespan. This is at best a simplification as significant variations exist across individuals. Exercise, habitual activity and genetic endowment all play a role in how much or how little strength changes with age.

•**Physical changes to the spine.** Signs include shrinkage of the intervertebral disks, reduction in the range of spinal motion, narrowing of the facet joints, and a reduced ability to bear loads and absorb shock. An inch of height may be lost from age 20 to age 60.

•**Aerobic capacity.** This characteristic shows a mean decrease with age of about 25% over the adult life span. Various links in the cardiovascular system weaken with age: maximum heart rate decreases; heart stroke volume and lung volume reduce; and tolerance to external heat loads decreases. Some of these changes may not necessarily be strictly age related. Again, habitual activity, exercise and genetic endowment may all play a part.

•**Flexibility, dexterity, range of motion.** Joint flexibility and range of motion show decreases with age. The neck and the trunk show the most decrease. While these findings are largely from cross-sectional population studies, changes in active workers due to the effects of age lack documentation.

•**Perceptual/visual.** The lens of the eye becomes more opaque, and people become more vulnerable to glare and need more light for adequate visual conditions. Also, onset of presbyopia occurs with age and is commonly seen after age 40. These changes are perhaps the most common and the least variable of all changes generally associated with aging.

•**Cognitive/information processing.** As people age, reaction time slows (up to 50%) for many types of tests. Information processing, including short- and long-term memory, is not as efficient as in younger persons. Older people may require up to 50% more training time to learn new skills, although some studies argue that for work-related knowledge the opposite is true. The relevance of some of these findings to work-related tasks has not been clearly shown.

•**Self-reported health condition.** According to the 2013 National Health Interview Survey (CDC, 2014), only 44.2% of persons age 65 and older report excellent or very good health, compared to 64.5% for adults age 18 to 64.

•**Chronic health conditions.** CDC (Ward & Schiller, 2013) reports that more than 60% of persons age 65 and older have at least two of 10 leading chronic medical conditions (hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, hepatitis, weak or failing kidneys, chronic obstructive pulmonary disease or asthma). This compares to fewer than 35% of persons age 45 to 64 with two or more chronic conditions and fewer than 10% of those age 18 to 44. These chronic health conditions are often accompanied by medications that can affect mobility, balance, cognitive performance and safety.

Age & Work Performance: Putting Age-Related Changes in Perspective

The litany of changes, both physical and cognitive, associated with aging have raised questions about or fostered negative perceptions about the capabilities of older workers, particularly those in industrial jobs. Other negative perceptions that exist among employers about older workers are based in part on a superficial understanding of the biological changes associated with aging. These include:

•Older workers have more health problems that inhibit their work.

•Hiring older workers means increased hiring costs due to training and benefits (e.g., healthcare insurance).

•Older workers have reduced physical stamina and less ability to learn new skills, thereby reducing their productivity.

While measurable physical changes occur with age, the relationship between these changes and the ability to perform physical and mental work is neither simple nor direct.

Age & Physical Work Capacity

Looking specifically at manual materials handling research, the apparent decline in physical capabilities between ages 50 and 60 does not appear to lead to reduced manual lifting capabilities. Mital, Nicholson and Ayoub (1997) note that while individuals' physical capabilities decline with age, the decline is not observed in the manual lifting capability. Ayoub and Mital (1989) reviewed several studies that indicated that between ages 18 and 61, age had no effect on the manual lifting capacity of workers. Mital, et al. (1997), speculate that older workers compensate for the physical declines through improved skills and neuromuscular coordination. These studies are cross-sectional studies on age groups and did not follow individuals longitudinally to track changes or declines over time. However, the implications are that working populations seem to represent a group that performs similarly regardless of age.

Age & Learning

Research has shown that loss of cognitive function is negligible in persons younger than age 70 (Fisk, et al., 2009). Verbal communication and tacit knowledge (experiential) remain stable or actually improve with age, and older workers are more motivated to exceed expectations than younger workers (AARP, 2005).

Age & Productivity

In many jobs, experience, quality and learned efficiencies make older workers more productive than younger workers. Older workers are less likely to miss work due to noninjury reasons than younger workers (e.g., family obligations). Also, older workers develop compensatory strategies (time-acquired skills) that make them as effective as or, often, more effective than younger workers for many kinds of tasks. Sometimes, a trade-off results in higher quality work at lower speed from older workers.

It is also known that context experience compensates for auditory processing decrements. In other words, older workers can compensate for poorer hearing by having a larger database of words and phrases, and the experience to discern the more likely content. When it comes to actual job performance, every aspect improves as people age (AARP, 2005). For older workers, it is often true that professionalism, loyalty, written communication skills, analytical skills and business knowledge are higher than in younger workers (AARP, 2005). The combination of greater accuracy, creativity, dependability and better spot judgment by older workers can increase, not decrease, productivity.

Age & Worker Health: Comorbidities & Workers' Compensation Claims/Costs

Individual worker health can contribute to workplace injury and workers' compensation claims cost as evidenced in these three recent studies. A National Council on Compensation Insurance (NCCI) research brief (Laws & Colon, 2012) reports that workers' compensation claimants with a corresponding comorbidity diagnosis (including obesity) are typically older than the average claimant. A comorbidity diagnosis was defined as medical transactions incurred and recorded through the workers' compensation system with a recorded ICD9 code indicating a specified comorbidity. Claims with comorbidity diagnoses had about twice the medical costs of comparable claims without comorbidity diagnoses. Older claimants with comorbidity diagnoses tended to have higher medical costs than comparable claims for younger claimants (Laws & Colon, 2012). Another NCCI study (Laws & Schmid, 2011) reports that the obese diagnoses were 5 times more expensive than their nonobese counterparts.

Longitudinal data studies demonstrating a strong association between obesity and occupational injury over time are rare. However, a Liberty Mutual study (Lin, Verma & Courtney, 2013) provides compelling evidence that obesity plays a role, not only as a comorbidity making post-injury outcomes more complex, but also as a contributor to injury risk in the first place.

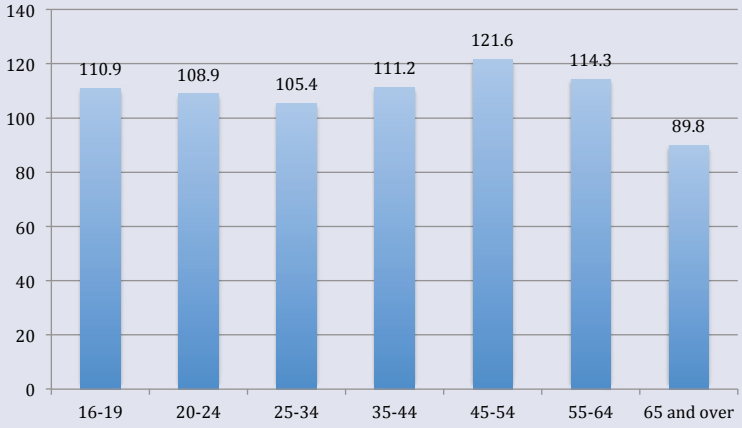
Age & Injury Rates

Interesting relationships between age, injury rates and injury costs are seen in two different sources of injury data: workers' compensation claims data published by NCCI and OSHA incident and severity data published by Bureau of Labor Statistics (BLS). BLS does not collect injury cost data but NCCI does so from 43 states, not including California, North Dakota, Ohio, Texas, Washington, West Virginia and Wyoming.

Figure 1 shows the 2012 rate of injuries with days away from work by age range (BLS, 2014a). Workers age 65 and older have a much lower rate of inju-

Figure 1

Rate of Injuries & Illnesses With Days Away From Work by Age Range

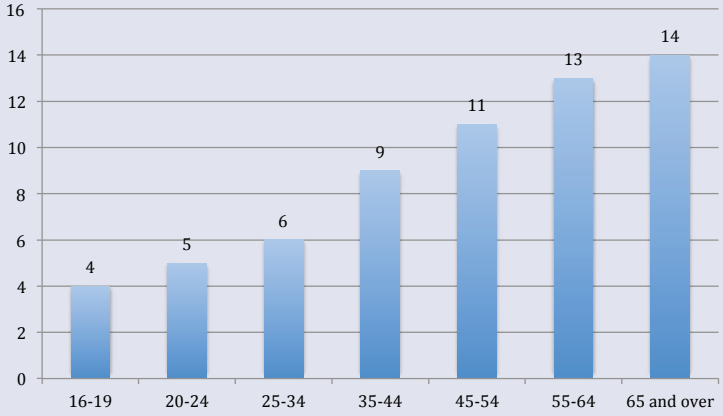


Note. *2012 injury and illness cases with days away from work per 10,000 full time employees. Data from Bureau of Labor Statistics "Profiles" generated from http://data.bls.gov/gqt/InitialPage on Dec. 10, 2014, based on updated, corrected 2012 data issued Nov. 14, 2014.*

Workers age 65 and older have a much lower rate of injuries with days away from work than the rest of the workforce. However, the length of disability for older workers tends to be longer and they experience a much higher fatality rate than younger workers.

Figure 2

Number of Median Days Away From Work by Age Range



Note. *2012 median days away from work, private industry and government. Data from Bureau of Labor Statistics "Multi-Screen" data search for nonfatal cases involving days away from work: Selected characteristics (2011 forward), generated from www.bls.gov/iif/#data on Dec. 10, 2014, based on updated, corrected 2012 data issued Nov. 14, 2014.*

Older workers have the highest median number of days away from work by age range. One would think this would result in higher workers' compensation indemnity (replacement wages) losses, but it does not.

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Figure 2 shows the 2012 median number of days away from work by age range (BLS, 2014b). Older workers have the highest median number of days away from work by age range. One would think this would result in higher workers' compensation indemnity (replacement wages) losses, but it does not. According to NCCI, indemnity severity increases steadily with age through age group 45 to 49 (Figure 3). It then stays relatively flat through age group 60 to 64, after which it declines (by roughly 20%) for age 65 and older. The primary reason the indemnity payments are low for workers age 65 and older, despite the longer median days away from work, is because indemnity payments are based on average weekly wage, which reaches a maximum when a worker reaches his/her early 50s, then declines gradually through age group 60 to 64. It then plummets, by some 30%, for workers age 65 and older (Wolf, 2010).

Figure 4 shows the average medical costs for NCCI data for the years 2000 to 2006 by age. The 65 and older cohort has the highest average medical costs, which is in line with the known higher severity (median days away from work) to older workers. However, the net total average cost of claims to workers age 65 and older is still lower than all the age ranges over 44 years old. This is despite the older worker claims that include costs for fatal injuries, which are the highest rate of all age ranges for workers age 65 and older. Figure 5 (p. 38) shows the 2013 rate of fatalities by age range (preliminary data). The majority of these fatalities are due to transportation-related events and falls.

Some studies have reported higher costs for older workers. One study showed that the cost per lost-time workers' compensation claim for workers age 45 to 64 was more than twice that of workers age 20 to 34; the most notable differences in diagnoses involved injuries to the rotator cuff and knees as well as lumbosacral neuritis or lower back nerve pain (Restrepo & Shuford, 2011).

This led to speculation that for any specific diagnosis, older workers are more likely to sustain higher-cost permanent injuries than younger workers. However, a 2012 follow-up study found this to not be the case (Restrepo & Shuford, 2012). While older workers are more likely to have more costly diagnoses than younger workers, the cost of those diagnoses are similar.

In another study, review of published epidemiological literature on the causes and types of injuries and their related costs for the construction industry with respect to age showed that workers age 50 and older had a lower frequency of workplace injuries than younger workers although the older workers had higher injury costs (Schwatka, Butler & Rosecrance, 2012).

One aspect influencing the complexity of the severity (median days away from work) and cost of injuries to workers age 65 and older may be due to the cause category of injuries. Workers age 65 and older experience a much higher proportion of same-level falls than other age ranges (Figure 6, p. 39), and these injuries may take longer to heal and cost more, on average, than musculoskeletal disorders (mostly back pain) that drive the costs in most of the other age ranges. Up to about age 60, manual materials handling accounts for the majority of injury costs; after age 60 this shifts to same-level falls. This was previously reported by Brogmus and Maynard (2008) and Wolf (2010).

For older workers, fall injuries are more serious and result in greater disability (Restrepo, Sobel & Shuford, 2006). Some researchers have questioned the higher median disability (Figure 2) based on speculation that some data for the oldest workers may be inflated due to a larger portion of older workers retiring from work during their disability. Wolf's (2010) data make it clear, however, that lower wages for workers age 65 and older account for the much lower indemnity costs.

The definition of what constitutes an older worker will largely determine the conclusion on average costs. Growing evidence suggests that an aging workforce has a far less negative effect on workers' compensation claim costs than might have been thought (Restrepo & Shuford, 2012).

Another issue is that the oldest workers (age 65 and older) not only have a lower rate of injuries than all other age ranges and a lower average cost than many age ranges, but they are also a relatively small proportion of the overall workforce (about 5% in 2012). The end result is that workers' compensation losses due to workers age 65 and older make up less than 4% of the total workers' compensation losses, even considering the monetary cost of work-related fatalities.

Recent studies (e.g., Wolf, 2010) show higher medical claim costs for the 65 and older age group, although, due to the lower indemnity costs and the small portion of the workforce made up by this co-

hort, some (e.g., Spiers, 2013) say that the suggestion that an aging workforce is a driving factor in increased employee injury costs is overstated.

That said, overall concerns for the aging workforce should be heightened, not lessened, if for no other reason than the noted high fatality rate and higher median days away from work. These facts are clear for the oldest workers (age 65 and older):

1) Falls/slips/trips are by far the greatest cause of injury.

2) They have a lower rate of injury with days away from work than any other age range.

3) They have a longer median days of disability than younger workers.

4) Their injuries cost less, on average, than all workers age 45 to 64.

5) Their fatality rate is much higher than all other age ranges.

6) Their overall costs to industry are less than 4% of all incurred workers' compensation costs.

Putting It All in Perspective

Several points regarding the nature of the physical and cognitive changes and the research that has established them are important:

1) Many of the declining physical capacities cited are typically based on studies of maximum capacities and not the submaximal level at which nearly all industrial physical work is performed. While these studies have important implications, submaximal work in real-world industrial environments may involve many additional factors that will affect a person's working capacity.

2) Similarly, many laboratory-based tests on visual and perceptual abilities are narrowly focused and do not necessarily reflect work performance in more complex and variable tasks. Many are suggestive in their results and not absolute statements across all conditions.

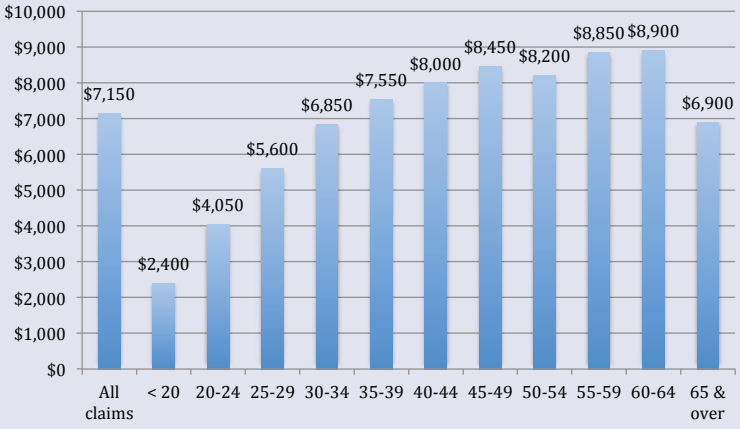
3) There is wide variation in the population with respect to the effects of aging and physical capabilities. In most cases, factors such as exercise and regular or habitual activity can slow or moderate some of the decline in physical capacities. Declines in physical strength may be more closely related to disuse than to chronological age. An experienced industrial working population may well show a pattern of conditioning as a result of many years of physical work. As a result, the strength and working capacities of that population may be maintained as they age. Other factors can mitigate aging effects as well.

- **Healthy worker effect.** Workers who continue in physically intensive tasks generally have the physical capability to do so as they age. Those who do not have the physical capability (at any age) have left the harder jobs.
- **Work smarter not harder.** Some researchers (e.g., Mital, et al., 1997) suggest that older workers tend to work smarter in that they use their skills and conduct their work in ways that serve to safeguard their physical capacities.
- **Seniority.** Harder jobs that are less desirable are often assigned to lower seniority/younger workers.

Interestingly, results of extensive surveys of perceptions of working conditions in the European Union suggest that the quality of employment for

Figure 3

Average Indemnity Paid per Claim

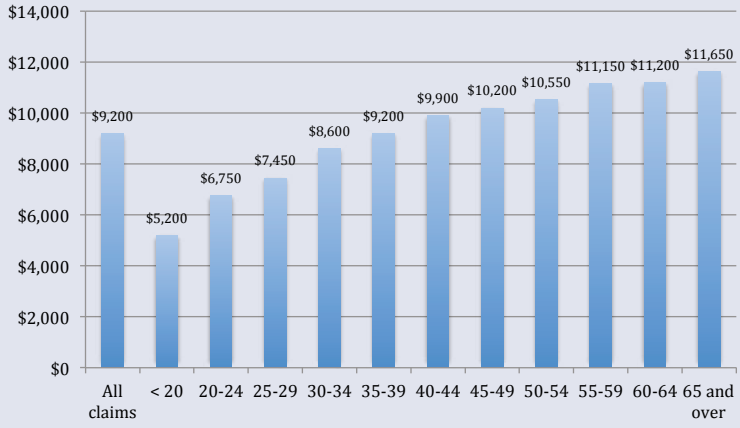


Note. *Average indemnity paid per claim by age range, 2000-2006, not adjusted for inflation. Data from "Claims Characteristics of Workers Aged 65 and Older" (NCCI Research Brief) (p. 16), by M.H. Wolf, January 2010, Boca Raton, FL: NCCI Holdings Inc. Data were estimated graphically using www.sketchandcalc.com.*

Indemnity severity (Figure 3) increases steadily with age through age group 45 to 49, then stays relatively flat through age group 60 to 64, after which it declines for age 65 and older. The 65 and older cohort has the highest average medical costs. However, the net total average cost of claims to workers age 65 and older is still lower than all the age ranges over 44 years old (Figure 4).

Figure 4

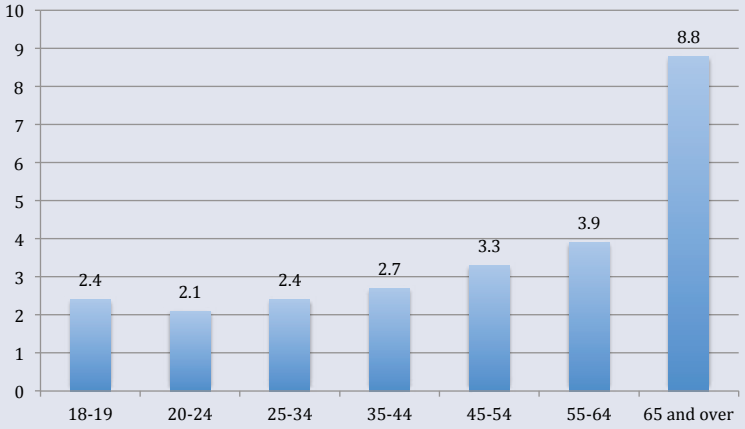
Average Medical Paid per Claim



Note. *Average medical paid per claim by age range, 2000-2006, not adjusted for inflation. Data from "Claims Characteristics of Workers Aged 65 and Older" (NCCI Research Brief) (p. 21), by M.H. Wolf, January 2010, Boca Raton, FL: NCCI Holdings Inc. Data were estimated graphically using www.sketchandcalc.com.*

Figure 5

Fatality Rate by Age Range



Note. *2013 fatalities per 100,000 equivalent full time workers, private industry and government. Data from "Fatal Occupational Injuries, Total Hours Worked and Rates of Fatal Occupational Injuries by Selected Worker Characteristics, Occupations and Industries, Civilian Workers, 2013 (preliminary data), by Bureau of Labor Statistics, 2014. Retrieved from www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2013hb.pdf.*

The majority of the fatalities in 2013 were due to transportation-related events and falls.

the over-50 age group was no worse and may be better than the under-30 age group (Vendra & Valenduc, 2012).

Areas of Concern for Older Workers

While older workers' capabilities are comparable (and in some cases, superior) to younger workers, some areas are of concern. As noted, same-level falls account for a significantly higher proportion of workers' compensation costs among older workers as compared to younger workers. As such, they should be a primary focus of aging-worker safety. One reason same-level falls drive older worker injury costs is the natural migration (and attrition) from strenuous jobs to less strenuous jobs as one ages.

Other reasons that same-level falls are a greater problem for older workers may include several age-related physical as well as cognitive factors including:

- perception of slipperiness;
- visual detection of hazards may be inferior in older workers;
- slower dark adaptation;
- increased glare sensitivity;
- decreased color sensitivity;
- reaction time decrements;
- decreased balance control.

These same factors may influence the high fatality rate of workers age 65 and older, namely those due to falls and driving-related crashes. With falls and vehicle crashes, workers age 65 and older have a higher likelihood of fatality compared to younger age ranges.

The Role of Ergonomics

Ergonomics is fundamentally the design of jobs to fit workers—all workers. Most guidelines already consider the older worker, including guidelines for manual materials handling, repetitive motion and control/display selection. Organizations concerned with the safety of older workers should continue to evaluate their losses and focus prevention efforts on those exposures that produce the highest number, cost and rate of injuries.

Regarding physical work, such as manual materials handling, some authors caution against assigning older workers to physically demanding tasks. For example, Mital, et al. (1997), out of concern for the age-related decline in the spine's load-bearing capacity, caution that older workers, particularly those older than age 50, should not be assigned to "physically demanding jobs." Given the persistent findings that manual handling capability of older workers remains largely comparable with younger workers, what constitutes a physically demanding job may be unclear.

However, if manual handling and other physical jobs are designed to be within the capability of most of the workforce and if hazards are addressed, then those jobs present an elevated injury risk to be effectively engineered out. In addition to workplace and task design, training workers, supervisors and engineers to identify and correct injury hazards in the workplace is paramount. The net effect is that the entire workforce, both older and younger workers, is better protected.

Because same-level falls are a leading cause of loss among all workers, especially older workers, organizations should strengthen efforts to prevent falls. Reducing slips, trips and falls (STFs) is an achievable goal for any organization. Company leaders should recognize that with an aging workforce, controlling slip and fall risks is increasingly important. Fundamentals of reducing slips and falls should include:

1) Maintain slip-resistant flooring in top condition.
2) Eliminate tripping hazards.
3) Control contaminants.
4) Implement effective spill and routine cleaning methods.
5) Mandate slip-resistant footwear.
6) Ensure proper stairway design.
7) Use appropriate mats.

Sufficient lighting inside and outside the facility is also important as lighting is critical for comfortable reading and visually detecting hazards. Guidelines for visual presentation of information include increasing level of illumination to greater than 100 cd/m^2 light reflected from reading surfaces (such as white paper) and reducing direct and reflected glare by positioning light sources as far away as practical from the operator's line of sight (Fisk, et al., 2009). IES (1993) guidelines for lighting state, "What might be bright enough for a healthy 30-year-old is not close to being adequate for an aged individual with impaired vision."

U.S. Access Board research (Jenness & Singer, 2006) indicates that the safety yellow color is so salient that it is highly visible even to those with very low vision. Contrast sensitivity (including contrasts in color) decline, on average, with age (Czaja &

Guion, 1990). This is important to remember when selecting colors for detectable warnings of items such as height transitions typical of curbs, steps and stairways including landings.

Evaluate Training Methods

All workers can benefit from an examination of training methods. It may be possible to allot more time for training/retraining and for practicing learned skills in an error-tolerant environment. This process equips the workforce to adapt better to changing work situations. Self-paced instruction (e.g. computer-based training) is preferred over lecture, as is self-paced training preferred over machine-paced on-the-job training because it allows a worker to start slower or slow down if needed. Recorded training presentations are preferred over demonstrations because recordings can be reviewed as many times as needed. Written instructions are always more effective than lectures since trainees can review them as needed (AARP, 2005).

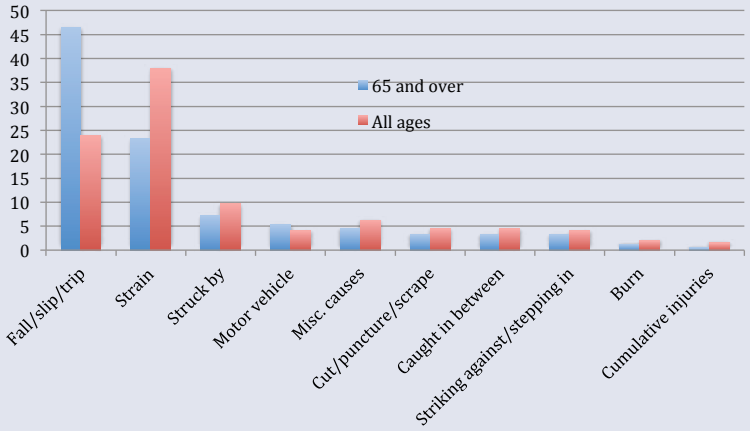
Workforce Demographics & Secular Change

The OSH profession must also consider broader age and demographics concerns. Workforce demographics and how they change in various ways over time is a concern. These can include changes to the ethnic and gender composition as well as changes to the worker population itself, including cultural outlook, physical fitness and work capacity. All of these factors should be of long-term interest to ergonomists, both nationally and globally.

Recent research has raised some interesting questions about generational changes and work capacities. Several psychophysical studies conducted since 2008 by Liberty Mutual Insurance and others on lifting, lowering, carrying, pushing and pulling have found a significant decrease in maximum acceptable weights of lift (MAW) compared to the 1991 Liberty Mutual guideline. In one study by Ciriello, Dempsey, Maikala, et al. (2008), the MAW for male lifting, lowering and carrying averaged only 69% of the 1991 values. Similar decreases were found for females, although interestingly, the female maximum acceptable forces for pushing and pulling increased as a percentage of the male values (Ciriello, Maikala, Dempsey, et al., 2011).

Singh, Park and Levy (2009) speculate on the reasons for the decline, noting that the subject selection criteria may have been less stringent or that the findings may represent a reduced psychophysical set point for such tasks, although the small number of studies conducted to date all confirm the decline. The authors also noted that the current studies lacked maximum voluntary contraction strength data and body composition data to allow comparisons with the earlier studies. While the studies noted that the anthropometric measurements of the recent, 1991 and pre-1991 studies were similar, they noted that body weight was significantly higher. While firm conclusions cannot be drawn from these few studies given limited sample sizes, recruitment and selection criteria, they suggest demographic trends that merit additional study.

Figure 6
Share of Claims by Cause



Note. *Percent of claims by cause, 2000-2006, not adjusted for inflation. Data from "Claims Characteristics of Workers Aged 65 and Older" (NCCI Research Brief) (p. 3), by M.H. Wolf, January 2010, Boca Raton, FL: NCCI Holdings Inc. Data were estimated graphically using www.sketchandcalc.com.*

A study on the age-related difference of extremity joint torque (EJT) of healthy Japanese adults age 20 to 79 found that young Japanese women (age 20 to 29) had significantly lower EJT for a variety of upper and lower extremity joints than older Japanese women including those 60 to 69 years of age (Hisamoto, Higuchi & Miura, 2005). The authors attribute the phenomena to the lack of physical activity in younger women and speculate that the younger female generation will lack the reserves of strength possessed by today's elderly once they, in turn, become elderly.

A German study on cross-section anthropometric surveys of more than 59,000 male and female children age 3 to 18 found significant changes in skeletal robustness for several skeletal features (elbow breadth and pelvic breadth) related to everyday physical activity since 1980 (Scheffler & Hermanussen, 2014). The researchers conclude that a reduction in physical activity and the amount of walking were responsible for the changes.

While tempting to speculate that an increasingly sedentary lifestyle is responsible wholly or in part for the decline in physical work capabilities, comprehensive hard data are lacking. One secular trend that is a cause for public health concern, and that shows a relationship to physical activity and fitness, is the increase in body weight. This is not just a problem in the U.S. and developed countries, but also an increasingly global issue. From 1980 to 2008, worldwide obesity rates almost doubled according to World Health Organization. In 2008, more than 1.4 billion adults age 20 and older were overweight, with 200 million men and nearly 300 million women classified as obese. As such, more of the world's population is now classified as overweight and obese than undernourished (Kenny, 2012).

The causes are complex, but they are linked to rising agricultural productivity, increases in in-

Workers age 65 and older experience a much higher proportion of same-level falls than other age ranges. These injuries may take longer to heal and cost more, on average, than musculoskeletal disorders that drive the costs in most of the other age ranges.

Concerns for the aging workforce should be heightened, if for no other reason than the high fatality rate and higher median days away from work.

come, availability of processed foods and the shift of labor from agricultural to more sedentary service occupations. While comprehensive data on the relationship between obesity and work capacity is generally lacking, some studies (e.g., Singh, et al., 2009) show little or no effect on maximum acceptable manual handling workloads of obese workers compared to nonobese workers. While obesity may or may not be a factor in workload capability, it shows a clear relationship to several chronic health concerns such as Type 2 diabetes, cardiovascular disease and some forms of cancer. As such it remains a major health cost concern for individuals, employers, healthcare providers and national health authorities.

Success Is Achievable

Interventions to address an aging workforce can span everything from hiring practices to retirement plans, and often involve multiple simultaneous interventions. When multiple interventions are implemented, it is difficult to discern what aspect was most impactful. Consequently, documentation of intervention successes aimed specifically at aging worker concerns is scarce in the peer-reviewed literature (Crawford, Graveling, Cowie, et al., 2010). Fortunately, interventions aimed at all workers will also benefit older workers, and many ergonomic interventions (Westgaard & Winkel, 1997) and case studies (Goggins, Spielholz & Nothstein, 2008) document reductions in injury metrics on the order of 20% to 100%.

Even more specific to the older workers are interventions to reduce same-level slips and falls. In the best published example of a comprehensive falls control program (Bell, Collins, Wolf, et al., 2008), researchers found that during the intervention period at three hospitals, older workers increased in prevalence and that "older workers (both males and females) suffered higher rates of STF injuries than younger workers." The intervention included:

- analysis of injury records to identify common causes of STFs;
- on-site hazard assessments;
- changes to housekeeping procedures /products;
- introduction of STF preventive products and procedures;
- general awareness campaigns;
- programs for external ice and snow removal;
- flooring changes;
- mandatory slip-resistant footwear for certain employee subgroups.

Due to these controls, STF-related workers' compensation claims dropped 58%. Due to the high rates from older workers and the growing proportion of older workers at these hospitals, Bell, et al. (2008), conclude, "Having an aggressive STF prevention program in place may be particularly useful in containing STF injury claim rates as worker populations increase in age."

Conclusion

OSH professionals and practicing ergonomists must be aware of the capabilities and limitations of the workforce(s) with which s/he must work. Age can be a factor but not necessarily in the stereotypical ways many people think. Employers, practicing ergonomists and OSH professionals should take-away several key points:

1) Identify and change any unfounded negative perspectives about older workers. These are unproductive and can shift the focus from responsible risk-reduction to blaming and fostering self-fulfilling expectations of longer disability. See older workers for what they are—stewards of accumulated wisdom and skill, a group that generates the lowest rates of serious injuries, and mentors who set the example of life-long productivity.

2) Do data analysis homework. Analyze workforce demographics and losses and compare them to national or local geographic data. An older worker problem is unlikely compared to the secular trends, but such analysis can reveal productive intervention directions. Focus on risks that drive loss and are age-independent.

3) Engage workers in wellness programs that target obesity and encourage healthy behaviors. Such programs can produce an additional protective safety benefit and contribute to positive workplace safety results.

4) Develop sound ergonomics and safety practices, as these benefit all workers regardless of age.

5) Train workers, supervisors and engineers to recognize, communicate and eliminate occupational injury hazards. Proper job training and retraining will help to maintain worker productivity and engagement.

6) Allow workers to share input into work design and organization.

7) Strengthen efforts to reduce falls, including the elimination of slipping/tripping hazards, proper stairway design, and use of proper mats and footwear.

8) Because of the high transportation-related fatality rate of older workers, examine and strengthen crash-reduction policies to ensure that all workers who may drive on company time, including drivers age 65 and older, are not at higher crash risk due to capability or past driving record.

9) Provide proper lighting in all work areas and install signage that meets guidelines for size, contrast and color use.

10) When workers are injured, keep in personal contact and aggressively pursue their return to work as soon as possible. **PS**

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