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Working Safer or Just Working Longer? The Impact of an Aging Workforce on Occupational Injury and Illness Costs

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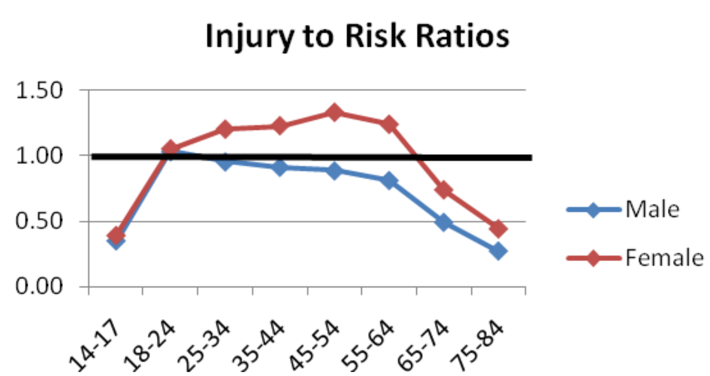
Project funded under a grant from the
Commission on Health and Safety and Workers' Compensation

Executive Summary

There has been concern about the impact of an aging workforce on occupational safety and health (National Academy of Sciences, 2004; Society for Occupational and Environmental Health, 2009). This interest is partially driven by the impact of the cohort of baby-boomers and in part by concerns that injuries to older workers might drive occupational costs that would increase disability costs for workers and workers' compensation costs for employers. This study for the Commission on Health and Safety and Workers' Compensation (CHSWC) examines how older workers' injury frequency and costs differ from younger workers' and how this will affect the workers' compensation system.

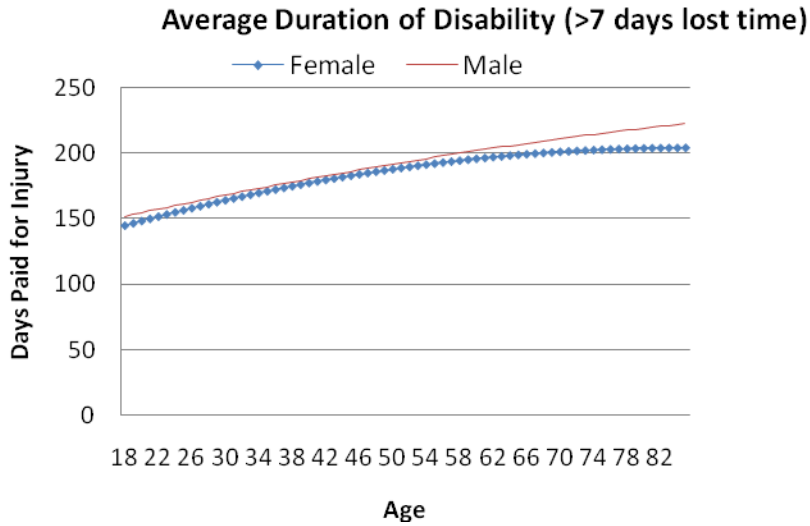
We first examine the common contention that injury risk declines with age as workers become more experienced. We find that after controlling for the types of jobs and the hours worked, injury risk through the age of 64 only declines for men, while the risk for women stays constant or increases gradually with age.



In a surprising and related finding, we identify that the risk of occupational injury is 20%

to 50% higher for women in the same job working the same hours as men. This difference becomes more severe with age: injury risk is similar for the 18-24 year age group but 50% higher for the 55-64 age group.

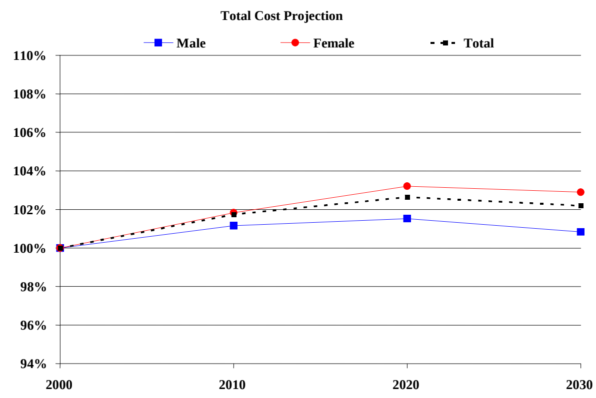
Consistent with prior research, the duration of disability increases steadily with age. Contrary to most previous research, we find that after controlling for the type of medical diagnosis, women have slightly shorter durations of disability than men.



The fraction of older workers in the workforce is driven by a number of factors. Most important, the cohort of baby-boomers is large and entering the older cohorts (55+ years). In addition Social Security retirement age is increasing, a greater fraction of women are in the workforce and, workers are delaying retirement for financial reasons. The following table summarizes the fraction of the workforce 55 and over in for 2000, 2010, 2020 and 2030.

	Fraction of the Labor Force 55+			
	2000	2010	2020	2030
Men	6.8%	9.4%	11.7%	11.6%
Women	5.0%	7.3%	10.0%	10.4%
Total	11.8%	16.7%	22.7%	23.0%

Interestingly, despite the large increases in the fraction of workers 55+, the impact of the aging workforce on expected workers' compensation costs is modest. Frequency and duration effects partially offset each other and older workers still represent a minority of all workers. The aging workforce will increase workers' compensation costs only about 2% as of 2030 above the cost if the distribution of workers by age had remained the same as 2000.



The small changes in the age driven changes in expected workers' compensation costs may mask some real concerns for employers and workers. The most immediate concern is the impact of an aging workforce on Medicare's efforts to recover medical treatment costs from the workers' compensation system. Workers' compensation Medicare set-asides (WCMSAs) for older workers eligible or nearly eligible for Medicare have increased from $180 million (2004) to $950 million (2008) or from 1% to 4% of total workers' compensation paid medical. Both the total amount and the percentage of workers' compensation medical costs have continued to rise and should exceed 8-10% of medical costs by 2020.

In addition, we find evidence in this study that under reporting of occupational conditions, a concern across workers of all ages, is substantially more severe among older workers eligible for Medicare. This additional under reporting for older workers means, despite progress made by made on recoveries through WCMSAs, Medicare will be subsidizing approximately 5%-7% of workers' compensation medical costs in 2020 due to the under reporting of occupational conditions for workers over the age of 64.

Suggestions for future research

This study points up important areas for future research.

- Most important is the issue of higher injury rates for women in the same occupations. Research should focus on the types of injuries and illnesses experienced by women and men in the same occupations. This might highlight the types and consequently the sources of the greater risk for women.
- Second, because the elevated risk for women gets worse with age, additional attention in the research should focus on older women.
- Third, the under reporting of occupational conditions by older workers appears to be especially high. Researchers should work with Medicare to build integrated data that could examine this issue and the impact on Medicare.
- Fourth, if under reporting of occupational conditions increases dramatically when workers are over 64, resulting in Medicare subsidies to workers compensation, the same could be true for the California State Disability Insurance (SDI) which covers non-occupational disabilities, including those to older workers. CHSWC has researched the overlap between workers' compensation and SDI in a past study and found substantial problems. This would expand upon that previous research.
- Finally, CHSWC could host a small conference or series of roundtable discussions to

examine efficient solutions to the overlap between workers' compensation and Medicare. There is evidence that Medicare has been subsidizing workers' compensation. Part of this subsidy has been reduced though greater attention to WCMSAs. However, WCMSAs and some solutions for the under reporting issue are likely very expensive ways to resolve the Medicare subsidy. CHSWC could lead the effort to identify more efficient solutions to this serious issue. It is likely that more efficient solutions could eliminate the subsidy of workers' compensation by Medicare and actually reduce employer cost.

Acknowledgements:
We would like to thank the Commission on Health and Safety and Workers' Compensation for their financial support for this project and Christine Baker and the CHSWC staff for assistance in obtaining data for this study. Martha Jones, Research Manager for the Division of Workers' Compensation assembled the data from the WCIS, without which much of the analysis would not be possible. Our appreciation also goes to Jon Stiles, Research Director, UC Data Archive and Technical Assistance (UC DATA) for assistance on assembling CPS and BLS data and for helpful comments on the analysis.

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1.0 Introduction

Do older workers get injured more or less often than younger workers? How are the costs of occupational injuries affected by age? And what do the answers to these questions mean for future cost trends? These are important questions for employers, workers, government budgets and benefit programs. The importance is magnified because the workforce is aging (Toossi, 2007), Social Security retirement age is increasing (P.L. 98-21. H.R 1900), and many older workers are choosing to stay in the labor force for economic reasons (AARP 2003; MetLife Mature Market Institute 2005; Merrill Lynch 2006; Society for Occupational and Environmental Health, 2009).

The research in this area is limited and often anecdotal. Oft repeated "wisdom" says older workers get injured less often because they are safer and more experienced. However, when injured, it takes longer to recover, costs more in disability payments and medical treatment, is more likely to cause permanent disability, and results in greater economic loss to the worker. But, how true are these claims? And if true, is the reason age related or driven by other factors?

For instance, even if we find that older workers are less likely to experience injury, as many claim, are the workers actually safer due to experience that comes with age, or are lower injury rates simply the consequence of more experienced/older workers sorting into safer jobs, such as supervisory positions?

Similarly, if older workers experience longer average time off work when disabled, is age the reason? Or do older workers experience the kinds of injuries that are associated with longer disability duration simply due to the types of occupations in which they work. For instance, if concentrated in sedentary jobs, older workers may be more likely to suffer back injuries, which take longer to heal, than the lacerations and contusions associated with traditional high-risk occupations. Alternatively, older workers may be more likely to experience cumulative injuries that are associated with longer disability, because of greater lifetime exposure to the underlying cause.

If age drives injury frequency and/or disability duration, then an aging workforce will lead to increasing occupational medical and disability costs. On the other hand, if older workers' occupational conditions are simply a product of the types of work they perform, then a higher proportion of older workers will not lead to changes in medical treatment, insurance and government benefit costs. Rather older workers will simply be replacing younger workers who would face the same injury risk. In either case, understanding how an older workforce interacts with occupational safety is important for focusing future investments in primary and secondary prevention of occupational disability.

2.0 Literature Review

Occupations of Older Workers

There is evidence that older workers are underrepresented in occupations that involve physical labor. Kaufman and Spilerman (1982) find that in addition to entry-level occupations, younger workers are overrepresented in heavy labor occupations. They also find that professional occupations are characterized by a higher concentration of older workers. Supervisory occupations and middle level management jobs were associated with middle-aged workers. The authors note that some occupations with higher occupational risk, such as policemen and fire fighters, also have retirement policies that may keep the average age lower.

Hirsch et. al. (2000) find that occupations with the oldest workers tend to be those that require few physical demands, have flexible hours and schedules, and have low skill/training requirements. The authors note that for women there are more occupations that are bimodal distributions, employing both young and old workers, such as sales occupations, cashiers, and private household childcare.

Injury Rates Among Older Workers

There has been inconsistent and sometimes conflicting evidence across research studies about whether occupational injury rates decrease with age. Salminen (2004) conducted a comprehensive review of 63 studies from 18 countries on this topic. The review found that the majority of nonfatal injury studies showed that older workers did have a lower injury rate than younger workers (56 percent of the studies reviewed found this to be true). A review of 22 studies by Laflamme & Menckel (1995) supported the finding that accident frequency tends to decrease as age increases. Reviews by Layne & Landen (1997) and Rhodes (1983) reached similar conclusions.

Layne & Landen discuss some possible reasons behind why older workers experience fewer occupational injuries. They point to a "healthy worker survivor effect" (older workers that remain in the labor force tend to be healthier and less prone to injury), progressive job selection/seniority (older workers have the option of moving into less risky positions), and work experience (older workers are more experienced and therefore less likely to make mistakes that can lead to injury).

While it seems that the majority of studies find a decreasing likelihood of occupational injury with age, there have been a significant minority of studies that reached a different conclusion. Seventeen percent of the studies reviewed by Salminen found that the injury rate increases with age and 27 percent showed no difference between age groups. Peek-Asa et. al. (2004) found that after controlling for lifting intensity and length of employment, workers over age 55 had similar injury rates to workers younger than 55. Chau et. al. (2009) found that risk of injury associated with jobs with high physical job demands was twice as high for workers over age 45 than for younger workers.

There are also some differences in the effect of age on injury by gender. Gluck and Oleinick (1998) studied five age groups of workers (16-24, 25-34, 35-44, 45-54, and 55-64). They found that claim rates peaked for men in the 25-34 year age range and then declined to the 55-64 year age range. For men, the effect of the claim rate by age was greatest in manual labor occupations. For women, claim rates reached their highest point in the 25-44 year range before declining, and patterns were similar across occupations. The more extensive review by Salminen (2004) also found differences by gender. Seventy percent of reviewed studies found that older men have a lower injury rate than younger men but only 44 percent showed that older women have lower injury rates than younger women. By contrast, 30 percent of studies found the opposite - that older women had a higher injury rate.

Severity of Injury Among Older Workers
Both Salminen (2004) and Layne and Landen (1997) found evidence that while older workers are less likely to be injured than younger workers, they experience more severe injuries. Salminen's review of studies found that the fatality rate of older workers is higher than younger workers (likely due to their decreased ability to resist impact). Layne and Landen found that among workers that are injured enough to go to the emergency department, older workers (age 65+) are more likely than younger workers (age 55-64) to be hospitalized (6.8% vs. 4.0%). Boufous and Williamson (2009) found that drivers aged 65 years and older were nearly twice as likely to be permanently injured or die as a result of a work related crash compared to a younger age group (15-24 years old). Peek-Asa et al. (2004) found that workers over age 45 had a higher average number of lost workdays per injury.

3.0 Data & Methodology

3.1 Projecting Trends in Labor Force Participation by Age and Gender through 2030

The first goal of this study is to estimate the impact of age on the frequency and cost of occupational injuries and illnesses. The second goal is to use those results to predict the impact of the workforce’s changing age demographics on future occupational incidence rates and costs. Our data and focus are on California, but the results have implications more broadly for other states and the nation.

As a first step, we project the age and gender distribution of the California labor force for 2010 through 2030. We created projections of the age and gender composition for the California labor force in several steps. First, using data available from the Integrated Public Use Microdata Series (IPUMS) CPS samples we estimated current participation rates for California by age and gender.[1] Subsequent year CA-LFPRs were calculated by adjusting the 2009 baseline by changes in the national labor force participation rate by gender and age projected by BLS for each year through 2030. The calculations were made separately by age group and gender. An alternative approach would have been to rely on BLS national estimates, but at baseline, the CA-LFPRs differed substantially from national rates.

We then applied the CA-LFPR to California population projections available from the U.S. Census Bureau to estimate the distribution of the labor force by age and gender from 2010 through 2030. The key portion of the labor force distribution, those age 55 and older, are presented in Figure 1.

Figure 1 is the projected share of the particular age-gender group out of all labor force participants combined (men and women together). For example, out of all labor force participants in the year 2030, 3.7% are expected to be women aged 55-59 and 4.0% are expected to be men aged of 55-59.

The figure highlights how large the changes will be for each age cohort over 55 during the first thirty years of this century particularly for the oldest-age cohorts of workers.

[1] The IPUMS is a product of the University of Minnesota, Minnesota Population Center. . The data are available from 1969 through 2009 See: http://cps.ipums.org/cps/

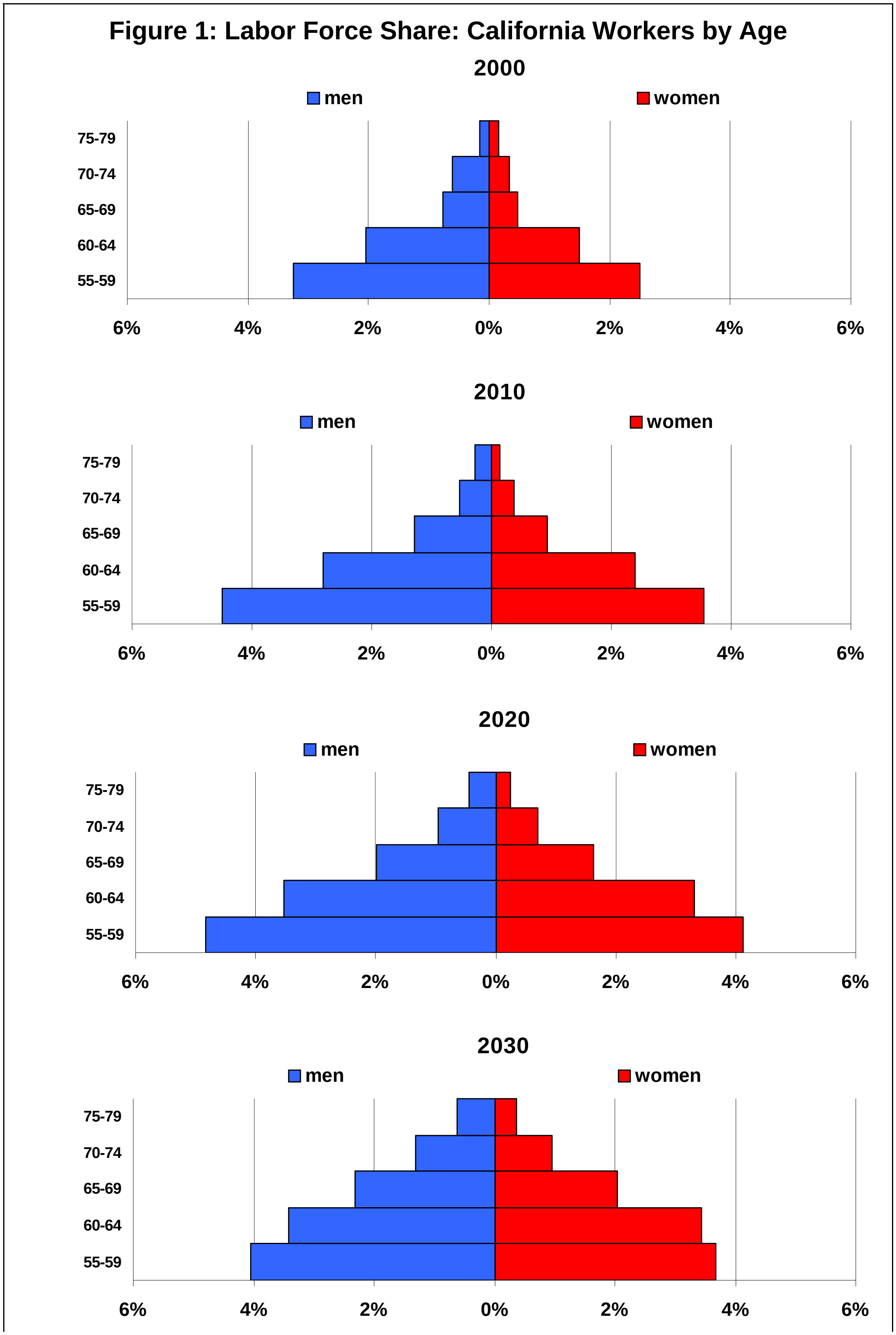
Figure 1: Labor Force Share: California Workers by Age
2000
men
women
75-79
70-74
65-69
60-64
55-59
6%
4%
2%
0%
2%
4%
6%
2010
men
women
75-79
70-74
65-69
60-64
55-59
6%
4%
2%
0%
2%
4%
6%
2020
men
women
75-79
70-74
65-69
60-64
55-59
6%
4%
2%
0%
2%
4%
6%
2030
men
women
75-79
70-74
65-69
60-64
55-59
6%
4%
2%
0%
2%
4%
6%

Table 1: Percentage in age/sex group out of total working adults

	2000	2010	2020	2030
Men				
15-19	2.5%	2.0%	1.4%	1.5%
20-24	5.8%	6.0%	4.9%	5.0%
25-29	7.0%	6.7%	7.1%	6.3%
30-34	7.5%	6.3%	7.3%	6.4%
35-39	7.7%	6.1%	6.4%	6.9%
40-44	7.1%	6.3%	5.5%	6.5%
45-49	6.1%	6.1%	5.0%	5.3%
50-54	5.0%	5.9%	5.3%	4.7%
55-59	3.2%	4.5%	4.8%	4.0%
60-64	2.0%	2.8%	3.5%	3.4%
65-69	0.8%	1.3%	2.0%	2.3%
70-74	0.6%	0.5%	1.0%	1.3%
75-79	0.2%	0.3%	0.4%	0.6%
Total Men	55.6%	54.8%	54.6%	54.4%
Women				
15-19	2.5%	2.0%	1.5%	1.5%
20-24	4.9%	5.5%	4.5%	4.6%
25-29	5.4%	5.5%	5.7%	5.0%
30-34	5.6%	4.8%	5.5%	4.9%
35-39	5.9%	4.7%	4.8%	5.1%
40-44	6.0%	5.1%	4.4%	5.1%
45-49	5.1%	5.4%	4.4%	4.7%
50-54	4.0%	4.9%	4.6%	4.2%
55-59	2.5%	3.5%	4.1%	3.7%
60-64	1.5%	2.4%	3.3%	3.4%
65-69	0.5%	0.9%	1.6%	2.0%
70-74	0.3%	0.4%	0.7%	0.9%
75-79	0.2%	0.1%	0.3%	0.4%
Total Women	44.4%	45.2%	45.4%	45.6%

3.2 Injury rates by age:
The next step in the study involved estimating the impact of age on the relative likelihood of injury. For this we merged data from several sources including the Current Population Survey (CPS), workers' compensation premium rates from the California Department of Insurance (CDI) and California injury and illness data from the Workers' Compensation Information System (WCIS) maintained by the California Division of Workers' Compensation.

The CPS data are from the 2003-2008 "Earners Study" sub-sample. CPS households are interviewed for a total of 8 months; however information on earnings is only collected at the 4th and 8th interview (known as the "outgoing rotations"). CPS data are rich in demographic detail, including age, gender, work status (including self-employment indicator) and if working, 3-digit Bureau of Census codes for both industry and occupation.

A key challenge in this type of analysis is creating values that discriminate accurately and precisely the occupational injury risk faced by different workers. Industry data at disaggregate levels are compiled by the Bureau of Labor Statistics using the Survey of Occupational Injuries and Illnesses. However, there is a very broad range of risk across different occupations within any industry. Occupation specific injury and illness rates are collected by BLS, but at a very aggregate level. Other studies have relied on industry-only data, occupation-only data, or data by industry and occupation, but only for a very limited and specific occupation within an industry (Zwerling et al., 1996; Kelsh & Sahl, 1996).

Our solution is to identify the relative risk of injury across workers by linking workers' compensation premium rate data to the individual-worker level. Workers' compensation insurance has a unique coding system, called class codes, that classifies jobs according to similar risk levels.[2] Frequently the groupings cross industry and occupation categories when the risks are considered similar. Clerical and professional occupations are grouped independent of industry, for example. On the other hand, similar jobs will be coded differently across industries if the risks differ. For example, a nurse will be treated differently if he works in a hospital vs. a doctor's office. The level of discrimination in workers' compensation codes is quite fine, with about 500 different classifications and rates that differ by a factor of 100 or more between the highest and lowest risk classes.

We use 3-digit Bureau of Census Industry and Occupation codes to define an industry-occupation pair for each worker in the CPS. For a previous study (Neuhauser and Donovan, 2008), UC Berkeley developed a cross-walk between each of the approximately 10,000 industry-occupation pairs in the CPS and the related class codes used by workers' compensation insurance. This allows us to link the risk value for a class code to each worker in CPS.

The risk value we use is the relative workers' compensation premium rate calculated for the specific class code. The base premium rate for each class is published by California's Department of Insurance. We chose the mid-point year (2005) in our CPS sample for the workers' compensation premium rates used to calculate a single risk value for each class code. We do this because the level of premium rates can change a great deal, year-to-year in response to law, regulation, and insurance market variables. The relative rates between classes change much more slowly. And, for this work we are only interested in the relative risk between classes.

Workers' compensation premium rates are published as (premium)/($100 of payroll). Our interest is calculating a relative value per standard unit of worker exposure to risk. To standardize payroll into exposure units using the CPS, we calculate the average hourly wage among all workers in each workers' compensation class code. Then we divide through by $100

[2] For detailed description of the classes used by California see the "California Workers' Compensation Uniform Statistical Reporting Plan" available from the Workers' Compensation Rating Bureau of California. [URL here]

to calculate the average hours of exposure represented by $100 of payroll. Finally, we divide through the premium rate by the number of hours represented by $100 of payroll.[3] This gives us an average risk/hour for each worker in our California-CPS sample. This is the calculation:

*$premium/$100*$100/$hour = Risk.*

Using these relative risk values for each industry-occupation pair in the CPS and the number of hours worked in the past week reported by CPS respondents, we calculate a risk value for each worker in our CPS sample. Finally, we can create an expected distribution of injuries for any cell in a table that divides respondents by one or more characteristics. In this case we create the expected injury distribution for California by age and gender.

Next we obtained data on the actual occupational injury and illness distribution in California based on all cases reported to the California Division of Workers' Compensation (DWC) Workers' Compensation Information System (WCIS). The data were prepared and tabulated for us by Martha Jones, the Research Manager for DWC. All insurers, self-insured employers, and state agencies are required to report all claims to the WCIS.

3.3 Duration of disability by age

The next area of investigation involves whether older workers, conditional on being injured, have higher or lower costs associated with that injury than younger injured workers. Our preference would be to use total cost (indemnity + medical) for this comparison. However the data on total cost with accurate and complete reporting of costs as well as demographic and other control variables are not available for California at the present time. Instead, we us disability duration as a proxy for total cost and take advantage of the State Disability Insurance (SDI) Single Client File (SCF) for this research. SDI data are from the non-occupational disability insurance program in California. The SDI program's coverage of the California workforce is nearly identical to workers' compensation insurance, but compensates non-occupational disabling conditions. While our preference would be to use the California Division of Workers' Compensation's Workers' Compensation Information System (WCIS) data for measuring the duration of disability, the WCIS disability duration data are known to be incompletely reported by a number of claim administrators. We have not been able to confirm a representative subset of reporting units with complete data to use in this type of study.[4]

There is another advantage to using SDI data. SDI cases always include an ICD-9 medical diagnosis for claims. This is crucial for controlling for the types of injuries and illnesses experienced by each group under study. We expect that the distribution of conditions will differ across age and/or age-gender groups. These differences may be driven by the nature of the occupations dominating an age-gender group. Consequently, it is important that we control for

[3] The reader will note that issues related to generally higher wages for older workers in the same job do not enter into this specification, avoiding problems of using payroll as a denominator.\

[4] WCIS data on incidence of injuries and illness (based on First Reports of Injury) are considered quite complete and accurate. However, there has been little work done to evaluate the completeness of reporting of the duration of disability which is based on Subsequent Reports of Injury. This study would add substantial value to the WCIS by examining these data more closely and evaluating their completeness and representativeness.

the nature of the medical condition in these analyses. WCIS data includes coding on the nature of the injury, the cause of the injury and the body part injured, but this categorization is not as precise as the coding of medical diagnosis. WCIS has been collecting medical transaction data that includes diagnosis, but these data are still incomplete and, when reported, frequently use ICD-9 codes like 959 (Injury, other and unspecified), which are inadequate for this work and rarely used to code SDI cases.

Choosing the correct estimation approach for the impact of age on duration is complicated. We start with a regression approach. We control for the nature of the medical conditions and estimate the impact of age on the duration of disability (number of days paid), separately for men and women.

However, this might not be the easiest specification to apply in our analysis where our age measure is categorical rather than continuous. It may also be suboptimal to allow distribution of disabilities by age to vary in the same way that non-occupational disabilities vary. We also calculate an alternative by weighting each age-gender category to a common distribution of disabling conditions and calculate average durations within each category.

Once we have the average (weighted) duration, we calculate the duration ratio, which is the average duration for the particular age/sex group divided by the average duration overall (men and women across all ages). [5]

4.0 Results

Figure 2 describes the average risk profile of workers by age and gender. In this figure we show the average risk for workers after considering both the specific occupational risk and the hours of exposure. These data show that average risk for men is fairly constant between 18 and 44 and declines steeply after age 44. For women, job risk remains more constant through age 54 and declines more slowly thereafter than for men. Because men make up a larger fraction of the

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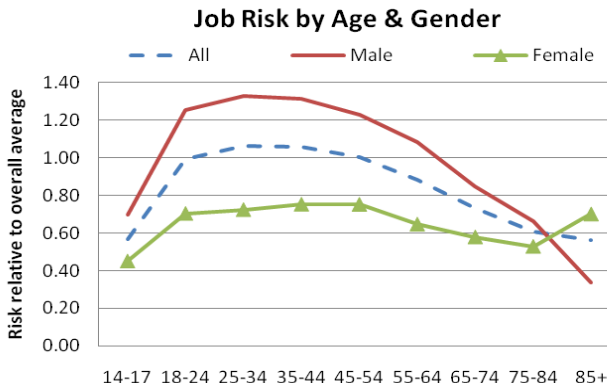
$$\text{Average Duration}^{age} = \sum_{i=1}^{n}\left[\text{Average Duration}_j^{age} * \frac{\text{Number of Claims}_j}{\sum_{j=1}^{n}\text{Number of Claims}_j}\right]$$

Here, the subscript “j” refers to a specific ICD-9, 3-digit diagnosis.

$$\text{Weight} = \left(\frac{\%\ \text{ICD9 for all}}{\%\ \text{ICD9 in age, sex group}}\right)$$

workforce at all ages, the combined trend more closely mirrors the trend for men. Older workers are typically in less risky occupations and work, on average fewer hours per week. Both of these reduce their risk of occupational injury and illness.

Figure 2



These data allow us to answer the question of whether older workers are safer, given their exposure to risk. In the past, this has been impossible to measure because researchers did not have an sufficiently accurate and precise measure of the risk of occupations that could be linked to data, like CPS, that contain data on the hours and employment by age and gender. We linked the data on expected incidence rates to data on actual incidence rates. The expected distribution is based on the average risk in a job and the exposure (hours worked). The actual distribution is derived from the California Workers' Compensation Information System (WCIS) maintained by the California Division of Workers' Compensation.

Table 2 gives the expected distribution of injuries by age derived from CPS and the crosswalk of class risk to industry and occupation. The second column under each gender is the actual distribution of injuries as identified for 2003-2008 from reports to the California Division of Workers' Compensation. The third column under each gender is the ratio of actual injuries to expected injuries.

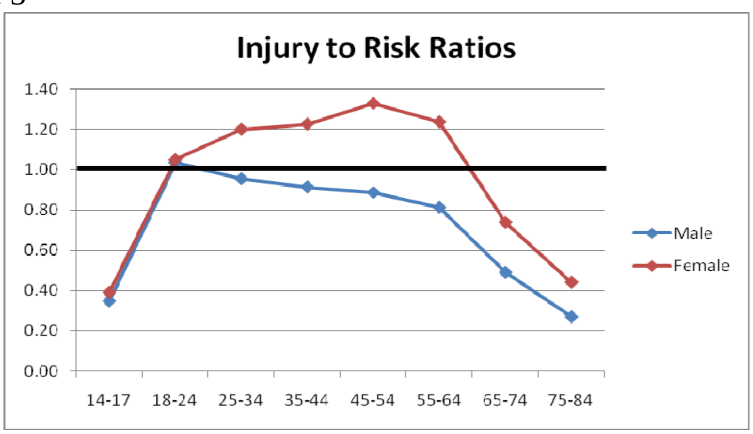
Table 2: Occupational Injury and Illness Distribution by Gender & Age Expected and Actual

	Male			Female		
Age	Expected	Actual	Ratio (A/E)	Expected	Actual	Ratio (A/E)
14-17	0.84%	0.29%	0.345	0.63%	0.25%	0.397
18-24	9.32%	9.63%	1.033	4.68%	4.92%	1.051
25-34	16.90%	16.13%	0.954	7.29%	8.75%	1.200
35-44	17.15%	15.67%	0.914	8.26%	10.13%	1.226
45-54	13.88%	12.30%	0.886	7.67%	10.18%	1.327
55-64	6.75%	5.48%	0.812	3.90%	4.82%	1.236
65-74	1.44%	0.70%	0.486	0.80%	0.59%	0.738
75-84	0.33%	0.09%	0.273	0.17%	0.08%	0.471

Expected calculated by authors; Actual tabulated by California Division of Workers' Compensation

The third column results in Table 2 are graphed in Figure 3. This figure shows how actual injury rates diverge from expected injury rates for different age and gender groups. A ratio of 1.0 indicates that workers have actual injury rate equal to the expected injury rate. That is, they are no more or less safe than we expect based on the nature of their occupations and the number of hours they work. A number of conclusions jump out from this analysis.[6]

Figure 3



The injury risk results for men and women differ in surprising ways. For men, the customary thinking is confirmed. After controlling for occupational risk and exposure, injury rates decline

6 The similarity of the relative rates for men and women and the closeness to 1.0 should not be mistaken for the authors setting the rates to 100% for the 18-24 age groups. This is merely the nature of the data.

for men in all age groups after 18-24. This is consistent with earlier studies, even though we control for the risk of injury in a more precise manner, not available to previous researchers.

On the other hand, the actual rate of injury for women, after controlling for occupational risk is constant or even increasing for all age groups from 18-24 through 55-64. That is, women between 25 and 64 experience more frequent injuries than predicted by the risk of their occupations and this relative risk may actually be increasing with age (age being often thought of as a proxy for experience).

In addition and quite striking, women's injury rates are uniformly higher than injury rates for men after controlling for occupational risk. This is a surprising new finding and may explain much of the inconsistency in findings of earlier research. When viewing all workers, the impact of age will depend heavily on the fraction of the sample that is female. Also, between the 1960s and 1990s, the portion of the labor force that was female increased substantially and the fraction of women in higher risk industries, like construction and manufacturing also increased. This combination probably contributed to substantial attenuation of the downward trend in occupational injury rates over these decades, a trend that has apparently accelerated in the late 1990s and early 2000s as the gender distribution has stabilized.

This finding is especially interesting given that, if there is a bias in the risk assignment, one would expect the assignment to over estimate female risk. Consider first, even within class codes there is some variation in occupational risk. For example, wholesale and retail groceries are classified together, but wholesale operations are much more risky. And, it is likely that if anything, females are more concentrated in the less risky end of the class code distribution. Even within the same job, people sometimes argue that men take the more physical tasks. Each of these argues for over-estimation of female risk and an offsetting under estimation for men.

Our results on the duration of disability by age are consistent with older workers having higher claim costs, conditional on claiming an occupational injury of illness. After controlling for the diagnosis (3-digit ICD-9 code), age is a stong predicter of longer duration for both men and women. This is consistent with higher costs for older workers. The regression coefficients for the key independent variables are given in the table below. For easier interpretation we graph the results of the regression in figure 4.

Table 3: Regression Coefficients—Disability duration

	B	SE	Sig.
(Constant)	108.863	4.488	.000
Age	2.236	.205	.000
Age Sq	-0.013	.002	.000
Age*Male	-0.622	.280	.026
Male	15.420	5.847	.008
Age Sq * Male	.008	.003	.017
R^2	.350		

Note: 120 diagnostic codes entered as dummy variables are not shown

Figure 4

The regression results offer a surprising conclusion. Most prior literature has found women to have longer durations of disability than men. Our research finds the opposite. Controlling for diagnosis, women have slightly shorter durations of disability than men. The impact of age on duration is most similar between men and women in the mid-range of working age and the differences most pronounced at the extremes.

These results highlight how durations compare for men and women in the same age group with the same distribution of disabling conditions. That is, we are comparing 50 year old men with carpal tunnel syndrome to 50 year old women with the same condition and finding the durations are very similar, but maybe slightly shorter for women. This is different from answering the question of whether age drives a different distribution of conditions for men versus women. More work should be done to understand how age determines the type of conditions and whether that differs by gender.

A different way of laying out these data is by the average duration of disability for each age-gender group relative to the average for all workers. These data are presented in table 4 below and used to compute the overall estimates of the impact of an aging workforce.

Table 4

Age	**Average Weighted Duration**	**N**	**Duration Ratio**
Female			
15-19	80.70	504	.6686
20-24	89.15	3,574	.7386
25-29	102.99	5,585	.8534
30-34	111.82	7,685	.9265
35-39	115.30	9,821	.9553
40-44	123.66	11,128	1.0246
45-49	124.99	10,597	1.0356
50-54	127.15	9,065	1.0535
55-59	132.99	6,213	1.1019
60-64	137.47	3,473	1.1391
65-69	134.09	1,138	1.1110
70-74	150.39	516	1.2461
75-79	194.71	188	1.6133
Total Female	120.16	69,486	.9956
Male			
15-19	79.05	841	.6549
20-24	96.55	5,850	.8000
25-29	105.67	6,951	.8756
30-34	110.09	8,465	.9122
35-39	117.86	9,339	.9766
40-44	122.44	9,467	1.0145
45-49	126.14	8,486	1.0452
50-54	136.10	6,855	1.1277
55-59	144.77	5,174	1.1995
60-64	153.31	3,130	1.2703
65-69	139.38	953	1.1549
70-74	158.41	414	1.3126
75-79	148.86	167	1.2334
Total Male	121.24	66,092	1.0046
Overall Total	120.69	135,578	1.0000

Using the California labor force participation rate projections from 2010-2030 by age and gender and share projected for the California population by age-gender groups from 2010 out to 2030 we created for this study, we projected the impact of an aging workforce on the incidence of occupational injuries, the duration of occupational injuries, and the total cost of occupational injuries (assuming disability duration is an adequate proxy for cost).

Figure 5

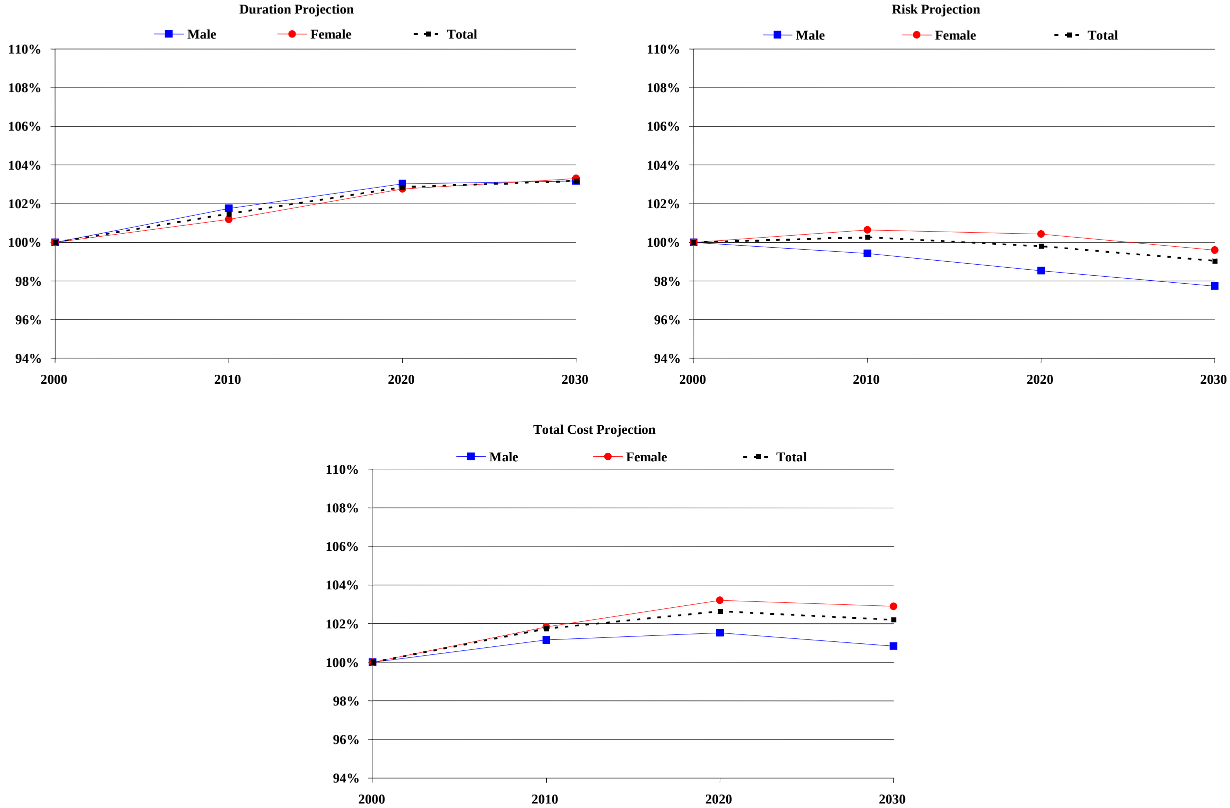


Table 5: Total Cost Projections Impact of Aging (% Baseline, year 2000)

	2000	2010	2020	2030
Female	100.0%	101.8%	103.2%	102.9%
Male	100.0%	101.1%	101.5%	100.8%
Total	100.0%	101.7%	102.6%	102.2%

5.0 Discussion

There has been a large amount of concern about the impact of workforce aging (National Academy of Sciences, 2004; Society for Occupational and Environmental Health, 2009). This interest is partially driven by the impact of the cohort of baby-boomers and in part by related concerns about Social Security and Medicare which have gotten a lot of press related to looming bankruptcies of the respective trust funds.

We observe in this study that the impacts of age on the frequency of injury and the duration of disability are substantial. And the fraction of the workforce 55 and older is expected to increase by more than 120% by 2030. However the overall impact of an aging workforce on frequency, duration and, especially, total cost is expected to be modest.

The reasons for this disconnect are several. First, frequency and duration effects are partially off-setting. Frequency will decline and duration will increase as a consequence of the aging of the workforce. Since these offset each other, total cost is even less impacted.

Second, while the fraction of the workforce over 55 will more than double, it will still represent a minority of workers, 11.8% in 2000, 23.0%, in 2030. Demographic changes tend to be very gradual. The largest cohorts of workers are in the 18-54 age groups. California has, on average, a younger population than most other states. Immigrants tend to be young and California has the largest fractions of immigrants of any state. Many immigrant groups have high birth rates relative to native born Americans. Consequently, California is less affected than other states because it has a lower fraction of its population in the oldest age groups.

Finally, concerns over Social Security, Medicare, and other areas like long-term care insurance are much more affected by the growth of the older population because virtually all of the beneficiaries are in this group.

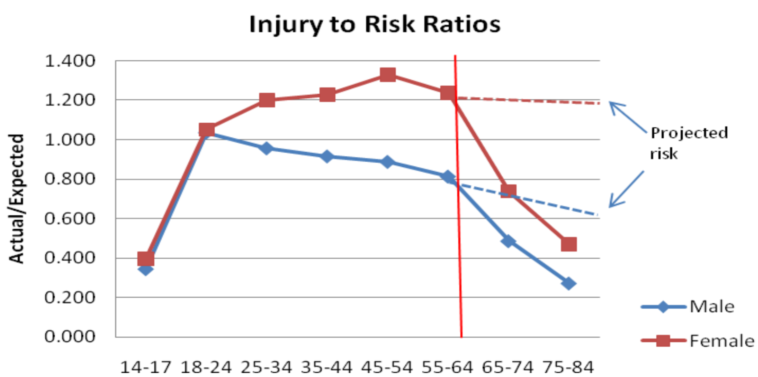
Medicare recovery from workers' compensation
However, this sanguinity about the impact of the aging workforce on workers' compensation should be tempered. This analysis has focused on the workers' compensation system and aging assuming nothing else changes beyond the population distribution. This ignores two major external effects that could change the landscape. First, Medicare has been demanding and getting much larger awards as part of the workers' compensation Medicare Set-aside (WCMSA) process. This issue was summarized in a note to CHSWC and other stakeholders as a result of a Freedom of Information Act request to CMS by one of the authors.[7] That work found that

[7] "Brief on Medicare Set-Asides" Frank Neuhauser, September 2010. Available from author.

between 2004 and 2008 the dollar amount Medicare required be set-aside, generally for older injured workers eligible or near eligibility for Medicare, had increased by 525% or by nearly $800 million/year. These costs represent previously unrealized costs for workers' compensation insurers and self-insured employers. It is likely that these costs continued to expand after 2008. This rapid increase in WCMSA amounts may change substantially the occupational injury costs currently recognized by employers and insurers for older workers.

Second, a compelling case could be made for Medicare recovery of previously avoided costs for under-reporting of occupational conditions for older workers eligible for Medicare at the time of injury. When an older worker's occupational condition is not reported as occupational then a WCMSA is not even a factor. If a substantial fraction of occupational conditions are under-reported for Medicare-eligible workers, the medical costs for these injuries and illnesses will be directly subsidized by Medicare. This issue is separate from any generalized under-reporting for workers of all ages.[8] We will highlight the issue by reproducing Figure 3 with some additional notation.

Figure 3(a)



In Figure 3a we roughly project the trend in injury risk for both men and women using the data from Figure 3. What we observe is that there is a significant break in the rate of reported injuries relative to expectations and this break occurs exactly at the point of eligibility for Medicare. The timing is exactly the same for both men and women, who prior to that age have otherwise different trends. Also, the underlying trend in absolute job risk for men and women do not change across the 55-64 and 65-74 & 75+ age ranges (see figure 2). This is reasonably strong evidence that whatever the reporting level for occupational injuries is for persons under 65, under reporting increases substantially after workers reach 65. As a rough estimate, a worker over the age of 64 is 40% to 60% less likely to report an occupational injury than a similar worker 55-64 in the same job working the same number of hours.

Since virtually all workers become eligible for Medicare at 65, it is likely that the alternate source of medical insurance (Medicare) is at least partially driving the increased under reporting.

8 There is a large and growing literature on the under-reporting of occupational conditions across all age groups. See for example, Lakdawalla, et al., 2007; Leigh et al., 2004; and Boden & Ozonoff, 2008)

And, it is almost certain that the medical treatment for these occupational conditions is being transferred from workers' compensation to Medicare.

Mitigating the impact of under reporting on total costs, older workers make up a minority of workers, work fewer hours and work in occupations with lower risk of injuries. Consequently, the approximately 50% under reporting only represents about 1.5% of all occupational injuries currently reported.

On the other hand, medical treatment cost for older workers' conditions is likely higher, driving the transferred cost closer to 2-3% of occupational medical treatment. And, the more than doubling of the fraction of older workers could mean Medicare will be subsidizing 5%-7% of occupational medical treatment simply as a result of the additional under reporting characteristic of older workers.

Gender and injury

This study highlights a new and important issue. We find that women face a substantially greater risk of occupational injury relative to men when working in the same job. Between the ages of 25 and 64, women have injury rates 20% to 40% higher than men in the same job, working the same number of hours.

This higher risk for women has been missed because women are less likely to be injured overall. Women, despite representing about half the workforce, represent only about 40% of occupational injuries and illnesses. However the overall lower injury rates for women can be attributed to concentration in less risky occupations. Once you control for occupational risk, women are much more likely to become injured than men.

Over time, women can be expected to be more evenly distributed among occupations, such as construction and manufacturing, which have substantially higher risk. The higher injury rates for women, when in these jobs, should be a major focus of future research. Experience may be a factor. Male labor force participation is more concentrated at lower ages, meaning, at any age, men are likely to be more experienced. However the constancy of female injury risk over the period 25-64 suggests this is likely to explain only a minority of higher risk for women.

Another explanation could be that higher-risk occupations, traditionally dominated by men, are characterized by workplaces, machinery and safety equipment that is designed for men and poorly adapted for the increasing number of female workers.

Future research

This study points out important areas for future research. Most important is the issue of higher injury rates for women in the same occupations. Research should focus on the types of injuries and illnesses experienced by women and men in the same occupations. This might highlight the types and consequently the source of the greater risk for women.

Second, because the elevated risk for women gets worse with age, additional attention in the research should focus on older women.

Third, the under reporting of occupational conditions by older workers appears to be especially high. Researchers should work with Medicare to build integrated data that could examine this issue and the impact on Medicare.

Fourth, if under reporting of occupational conditions increases dramatically when workers are over 64, resulting in Medicare subsidies to workers' compensation, the same could be true for the California State Disability Insurance (SDI) which covers non-occupational disabilities, including those to older workers. CHSWC has researched the overlap between workers' compensation and SDI in a past study and found substantial problems. This would expand upon that previous research.

Finally, the Commission on Health and Safety and Workers' Compensation could host a small conference or series of roundtable discussions to examine efficient solutions to the overlap between workers' compensation and Medicare. There is evidence that Medicare has been subsidizing workers' compensation. Part of this subsidy has been reduced though greater attention to WCMSAs. However, WCMSAs and some solutions for the under reporting issue are likely very expensive solutions to the Medicare subsidy. CHSWC could lead the effort to identify more efficient solutions to this serious issue. It is likely that more efficient solutions could eliminate the subsidy of workers' compensation by Medicare and actually reduce employer cost.

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Appendices

Labor Market Projections using Duration and Risk ratios

Male and Female Labor Force Projections, weighted for Duration:

$$\%\text{ of LF by Age \& Sex} = \left(\frac{(\#\text{ California LF by Age \& Sex})}{(\text{Total LF within Sex})}\right) * (\text{Duration Ratio by Age \& Sex})$$

Male Labor Force Percentage weighted by Duration Ratio

Age Group	2000	2010	2020	2030
15-19	2.9%	2.4%	1.7%	1.8%
20-24	8.4%	8.8%	7.2%	7.4%
25-29	11.1%	10.8%	11.3%	10.2%
30-34	12.3%	10.6%	12.1%	10.7%
35-39	13.5%	10.8%	11.4%	12.5%
40-44	13.0%	11.6%	10.2%	12.1%
45-49	11.5%	11.6%	9.6%	10.2%
50-54	10.1%	12.1%	10.9%	9.7%
55-59	7.0%	9.8%	10.6%	8.9%
60-64	4.7%	6.5%	8.2%	8.0%
65-69	1.6%	2.7%	4.2%	4.9%
70-74	1.4%	1.3%	2.3%	3.2%
75-79	0.3%	0.6%	1.0%	1.4%
Total	**97.9%**	**99.6%**	**100.9%**	**101.0%**
% Baseline (2000)	**100.0%**	**101.7%**	**103.0%**	**103.2%**

Female Labor Force Percentage weighted by Duration Ratio

Age Group	2000	2010	2020	2030
15-19	3.8%	2.9%	2.2%	2.2%
20-24	8.2%	8.9%	7.3%	7.5%
25-29	10.3%	10.4%	10.7%	9.4%
30-34	11.6%	9.9%	11.3%	9.9%
35-39	12.7%	9.9%	10.2%	10.8%
40-44	13.9%	11.5%	9.8%	11.4%
45-49	11.9%	12.3%	10.1%	10.7%
50-54	9.5%	11.5%	10.7%	9.7%
55-59	6.2%	8.6%	10.0%	8.9%
60-64	3.8%	6.0%	8.3%	8.6%
65-69	1.2%	2.3%	4.0%	5.0%
70-74	0.9%	1.0%	1.9%	2.6%
75-79	0.6%	0.5%	0.9%	1.3%
Total	**94.7%**	**95.8%**	**97.3%**	**97.8%**

% Baseline (2000)	100.0%	101.2%	102.8%	103.3%

Total Labor Force Projections, weighted for Duration:

$$\%\text{ of LF by Age \& Sex} = \left(\frac{(\#\text{ California LF by Age \& Sex})}{(\text{Total LF})}\right) * (\text{Duration Ratio by Age \& Sex})$$

Total Labor Force Percentage weighted by Duration Ratio

Age Group	2000	2010	2020	2030
15-19	3.3%	2.6%	1.9%	2.0%
20-24	8.3%	8.8%	7.2%	7.5%
25-29	10.7%	10.6%	11.1%	9.8%
30-34	12.0%	10.3%	11.8%	10.3%
35-39	13.2%	10.4%	10.9%	11.7%
40-44	13.4%	11.5%	10.0%	11.8%
45-49	11.7%	11.9%	9.8%	10.4%
50-54	9.8%	11.8%	10.8%	9.7%
55-59	6.6%	9.3%	10.3%	8.9%
60-64	4.3%	6.3%	8.3%	8.3%
65-69	1.4%	2.5%	4.1%	4.9%
70-74	1.2%	1.2%	2.1%	2.9%
75-79	0.4%	0.6%	1.0%	1.3%
Total	**96.5%**	**97.9%**	**99.2%**	**99.6%**
% Baseline (2000)	**100.0%**	**101.5%**	**102.8%**	**103.2%**

Male and Female Labor Force Projections, weighted for Risk:

$$\%\text{ of LF by Age \& Sex} = \left(\frac{(\#\text{ California LF by Age \& Sex})}{(\text{Total LF within Sex})}\right) * (\text{Risk Ratio by Age \& Sex})$$

Male Labor Force Percentage weighted by Risk Ratio

Age Group	2000	2010	2020	2030
15-19	1.5%	1.3%	0.9%	0.9%
20-24	10.8%	11.3%	9.3%	9.6%
25-29	12.0%	11.7%	12.3%	11.0%
30-34	12.8%	11.0%	12.6%	11.2%
35-39	12.6%	10.1%	10.7%	11.6%
40-44	11.7%	10.4%	9.2%	10.9%
45-49	9.8%	9.9%	8.2%	8.7%
50-54	8.0%	9.5%	8.6%	7.7%
55-59	4.7%	6.6%	7.2%	6.0%
60-64	3.0%	4.2%	5.2%	5.1%
65-69	0.7%	1.1%	1.8%	2.1%
70-74	0.5%	0.5%	0.9%	1.2%
75-79	0.1%	0.1%	0.2%	0.3%
Total	**88%**	**88%**	**87%**	**86%**
% Baseline (2000)	**100.0%**	**99.4%**	**98.5%**	**97.7%**

Female Labor Force Percentage weighted by Risk Ratio

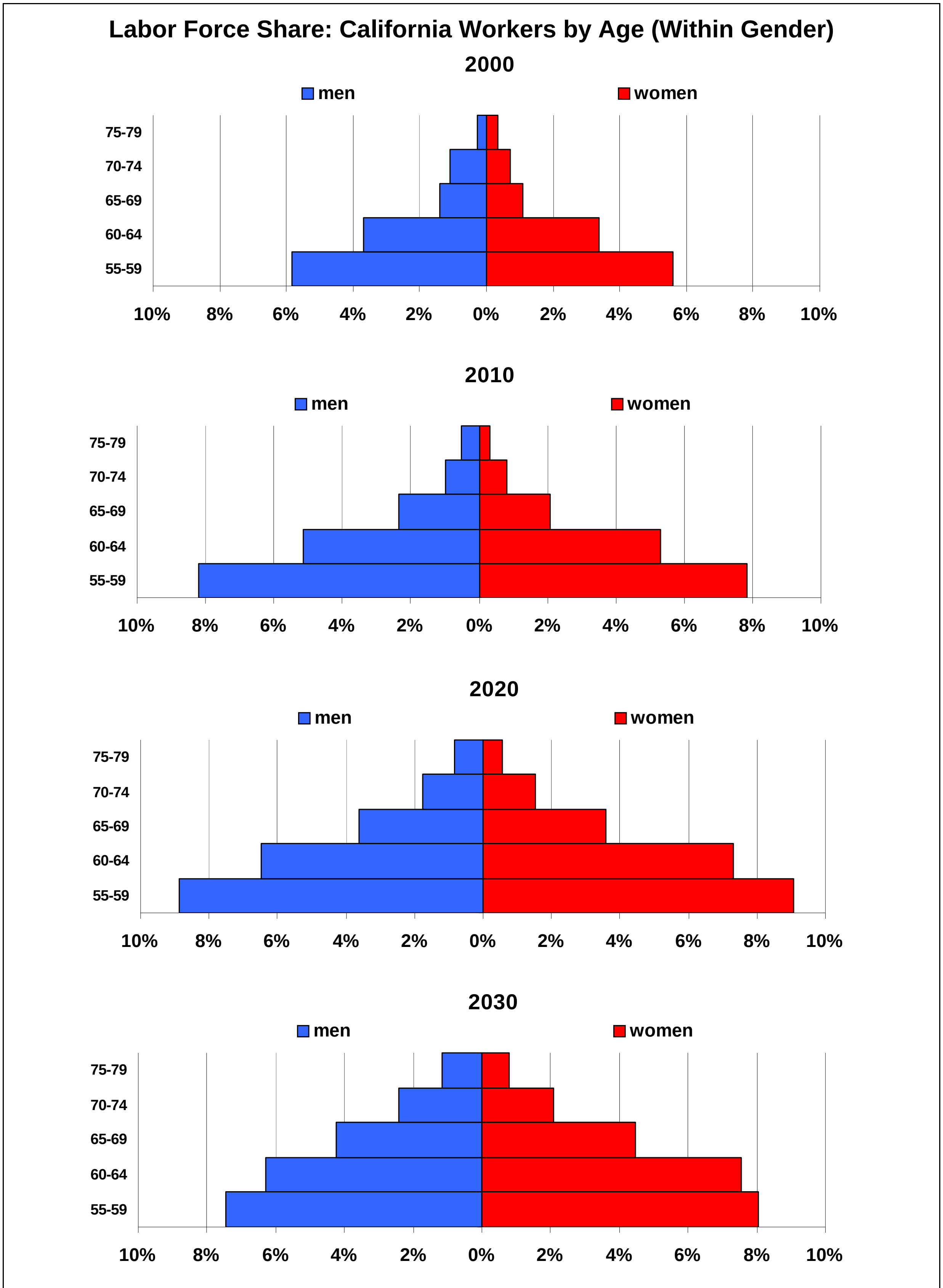
Age Group	2000	2010	2020	2030
15-19	2.2%	1.7%	1.3%	1.3%
20-24	11.7%	12.7%	10.4%	10.7%
25-29	14.5%	14.6%	15.1%	13.2%
30-34	15.0%	12.8%	14.6%	12.8%
35-39	16.4%	12.7%	13.1%	13.9%
40-44	16.7%	13.8%	11.8%	13.7%
45-49	15.3%	15.8%	12.9%	13.7%
50-54	12.0%	14.6%	13.5%	12.3%
55-59	7.0%	9.7%	11.3%	10.0%
60-64	4.2%	6.6%	9.0%	9.3%
65-69	0.8%	1.5%	2.6%	3.3%
70-74	0.5%	0.6%	1.1%	1.5%
75-79	0.2%	0.1%	0.2%	0.3%
Total	**116.5%**	**117.2%**	**117.0%**	**116.0%**
% Baseline (2000)	**100.0%**	**100.6%**	**100.4%**	**99.6%**

Total Labor Force Projections, weighted for Risk:

$$\%\text{ of LF by Age \& Sex} = \left(\frac{(\#\text{ California LF by Age \& Sex})}{(\text{Total LF})}\right) * (\text{Risk Ratio by Age \& Sex})$$

Total Labor Force Percentage weighted by Risk Ratio

Age Group	2000	2010	2020	2030
15-19	1.8%	1.5%	1.1%	1.1%
20-24	11.2%	11.9%	9.8%	10.1%
25-29	13.1%	13.0%	13.6%	12.0%
30-34	13.8%	11.8%	13.5%	11.9%
35-39	14.3%	11.3%	11.8%	12.6%
40-44	13.9%	11.9%	10.4%	12.2%
45-49	12.3%	12.6%	10.3%	11.0%
50-54	9.8%	11.8%	10.8%	9.8%
55-59	5.7%	8.0%	9.0%	7.8%
60-64	3.5%	5.3%	7.0%	7.0%
65-69	0.7%	1.3%	2.2%	2.6%
70-74	0.5%	0.5%	1.0%	1.3%
75-79	0.1%	0.1%	0.2%	0.3%
Total	**100.8%**	**101.1%**	**100.6%**	**99.8%**
% Baseline (2000)	**100.0%**	**100.3%**	**99.8%**	**99.0%**


Labor Force Share: California Workers by Age (Within Gender)
2000
men
women
75-79
70-74
65-69
60-64
55-59
10%
8%
6%
4%
2%
0%
2%
4%
6%
8%
10%
2010
men
women
75-79
70-74
65-69
60-64
55-59
10%
8%
6%
4%
2%
0%
2%
4%
6%
8%
10%
2020
men
women
75-79
70-74
65-69
60-64
55-59
10%
8%
6%
4%
2%
0%
2%
4%
6%
8%
10%
2030
men
women
75-79
70-74
65-69
60-64
55-59
10%
8%
6%
4%
2%
0%
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