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Years of Potential Life Lost Due to Occupational Fatal Injury in the United States

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ABSTRACT

Fatal injury surveillance data coupled with life expectancy data may be used to assess the impact of occupational fatal injuries on years of potential life lost (YPLL).

We compare three definitions of YPLL and trends over time in YPLL. Two definitions determine YPLL as expected life lost to fixed life expectancies of 65 or 85 years. The third definition uses actuarial adjustments of life expectancy given survival to a given age stratified by gender and race. Fatalities from the National Traumatic Occupational Fatality (NTOF) database are used to illustrate the three definitions of YPLL.

The three YPLL measures were similar in magnitude and direction of the trend in YPLL over 1980–1992. Proper interpretation of these trends can only be made in conjunction with other measures (*e.g.*, rates). Almost all YPLL trends are declining, implying that over time fatal injuries are shifting to older workers. The exception is the increasing trend in YPLL for the retail trade industry, injury rates have also been increasing over time for this industry. Mining and construction have the highest YPLL among all industries. This analysis suggests efforts to prevent the occupational fatalities of younger workers should focus on the retail trade, mining, and construction industries.

Key Words: multiple regression, linear interpolation, actuarial adjustments

INTRODUCTION

William Haenszel (1950) suggested that chronic diseases associated with old age received a tremendous focus as perhaps the "most important public

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health problem of the day." However, he quickly noted that "there is plenty of room for effecting savings of potential years of life at younger ages, particularly from deaths due to accidents." It is with this observation in mind that we reflect on the analysis of years of potential life lost (YPLL).

The basic information for many occupational safety studies comes from injury surveillance data. The number of injuries and the corresponding number of workers employed are recorded for several levels of one or more predictor variables such as industry or occupation. Most studies of injuries are based on rates or counts of injury occurrence (see, *e.g.*, Stout *et al.*, 1996; Bailer *et al.*, 1998) or a measure trying to quantify the impact from each injury. While rates are an important outcome, they ignore an important aspect of occupational fatal injuries. Younger workers are often the victims of fatal injuries, resulting in greater YPLL than for most other causes of death (*e.g.*, cancer).

In this paper we present results from analyses using three different definitions of YPLL to determine which industries and occupations may need attention because of high YPLL or changes over time in YPLL. This paper also attempts to evaluate the impact of using different definitions of YPLL on the analyses. The first two definitions use fixed life expectancies of 65 and 85 years to determine YPLL. For these two definitions, the age at death for each person is subtracted from the fixed life expectancy to get YPLL. If the person dies at an age older than 65, the YPLL for the definition using the fixed life length of 65 years is set to zero years. Similarly, if the person dies past age 85, a YPLL of zero years is used for the definition using a life expectancy of 85 years. Fixed life expectancies of 65 and 85 years have been used by the U.S. Centers for Disease Control and Prevention (1997) for their computations of YPLL. A fixed life length for YPLL calculations has appeal in that a loss of life at a particular age is viewed as having equal impact regardless of any other characteristics of an individual. This fails to take into account the clear pattern of differences in expected life length between women and men and across different racial/ethnic groups. The third YPLL definition uses actuarial adjustments on life expectancy to determine YPLL to address this concern. Adjustments for age at death, gender, and race from Hahn and Eberhardt (1995) are used. We apply these three definitions to explore the average YPLL across different worker and workplace characteristics and trends over the years 1980 to 1992 in YPLL due to occupational fatal injuries.

METHODS

Data

The occupational fatal injury data considered in this analysis comes from the National Institute for Occupational Safety and Health's (NIOSH) National Traumatic Occupational Fatal (NTOF) injury data set. The NTOF database is a death certificate-based registry of occupational fatal injuries in the U.S. containing information about each fatality on age, gender, race, industry, and occupation within industry. A more detailed description of these variables and their codes can be found in NIOSH (1993).

Years of Potential Life Lost Calculations

The calculation of YPLL using a fixed life expectancy is straightforward and is computed as the life expectancy minus the age at death. We will compare fixed life expectancies of 65 and 85 years. Constructing YPLL from fixed time points like age 65 is useful because it can be used for comparisons with other countries that have different life expectancies or where actuarially adjusted life expectancy is not available. Age 85 is useful to see how using a longer fixed life expectancy affects YPLL or trends in YPLL over time. For example, suppose a worker dies at age 27 and their life expectancy is 65 years. Their YPLL would be 65 – 27 = 38 years. As an aside, using a fixed life expectancy of 65 years might be better described as years of working life lost. Similarly, if their life expectancy is 85 years then their YPLL would be 85 – 27 = 58 years. The age at death is greater than 65 years for some workers and others die at an age greater than 85 years: for these workers the YPLL is set to zero when they die at an age greater than the life expectancy being used. For example, if a worker dies at the age of 72 due to an occupational fatality and life expectancy is assumed to be 65 years then their YPLL would be zero years; however if we assume a life expectancy of 85 that same person would have a YPLL of 85 – 72 = 13 years. For workers who die after age 85, their YPLL is zero years for both fixed life expectancies.

YPLL can be calculated using actuarial adjustments for survival until time of death, gender, and race. We calculate the YPLL based upon the life expectancy data given in the "*Adjusted for undercount and misclassification*" section of Table 2 in Hahn and Eberhardt (1995) which is reproduced, in part, in Table 1. This table indicates that women have higher predicted years of life remaining than men across almost all races and attained ages. Table 1 also shows that Asians generally live longer than blacks, Native Americans, and whites. The prediction of YPLL for an individual dying at an age in between

Table 1. Predicted years of life remaining for different gender/racial groups.[a]

Age (years)	Black		Native American		Asian/Pacific Islander		White	
	Male	Female	Male	Female	Male	Female	Male	Female
1	65.5	73.5	71.3	78.7	81.5	85.3	72.5	78.9
25	43.1	50.1	49.4	55.7	58.7	62.0	49.5	55.5
45	26.7	31.9	32.5	37.2	39.7	42.5	31.2	36.3
65	13.7	17.7	17.2	20.8	22.6	24.5	15.4	19.1
≥85	6.4	7.5	6.8	8.3	11.4	10.0	6.0	6.9

[a] Extracted from Table 2 in Hahn and Eberhardt (1995).

Table 2. Mean age at death and mean YPLL due to occupational fatalities using different definitions of YPLL for different predictor variables.

Factor	Level	Age at death	$YPLL_{65}$[a]	$YPLL_{85}$[a]	$YPLL_{AA}$[a]
Year	1980	40.44	25.05	44.57	35.97
	1981	40.16	25.31	44.85	36.28
	1982	40.70	24.80	44.31	35.83
	1983	40.92	24.57	44.09	35.62
	1984	40.62	24.87	44.39	35.93
	1985	40.90	24.56	44.10	35.62
	1986	41.07	24.46	43.94	35.49
	1987	41.77	23.78	43.23	34.84
	1988	41.61	23.95	43.40	35.05
	1989	41.93	23.57	43.08	34.70
	1990	41.91	23.64	43.10	34.83
	1991	42.33	23.18	42.67	34.45
	1992	42.65	22.91	42.35	34.22
Gender	Male	41.36	24.16	43.65	34.96
	Female	39.48	25.97	45.53	41.74
Race	White	41.35	24.19	43.65	35.63
	Black	40.77	24.53	44.23	31.40
	Native American	37.44	27.82	47.60	38.51
	Asian	40.27	24.97	44.73	44.88
Industry	Ag. for. and fishing	47.81	19.04	37.22	30.38

	Asian	40.27	24.97	44.73	44.88
Industry	Ag, for, and fishing	47.81	19.04	37.22	30.38
	Mining	36.24	28.92	48.76	39.48
	Construction	39.03	26.21	45.98	36.86
	Manufacturing	41.21	24.14	43.80	35.02
	Trans and pub utilities	40.26	24.92	44.74	35.76
	Wholesale trade	40.26	25.12	44.74	36.11
	Retail trade	41.97	23.62	43.03	35.81
	Fin, ins and real estate	45.01	20.68	40.00	33.03
	Services	41.62	23.89	43.38	35.48
	Public Admin	39.58	25.65	45.43	36.43
Occupation	Exec, admin, and manag	45.44	20.12	39.56	32.18
	Prof specialty	43.00	22.51	42.00	34.55
	Tech and related support	37.69	27.40	47.31	38.44
	Sales	44.60	21.15	40.41	33.63
	Admin support incl clerical	41.09	24.46	43.91	37.04
	Service	39.80	25.56	45.20	36.63
	Farm, for, and fishing	47.48	19.28	37.56	30.49
	Prec prod, craft and repair	39.73	25.55	45.27	36.40
	Mach op/assem/inspect	39.69	25.61	45.32	36.42
	Transp/material moving	40.22	24.94	44.79	35.75
	Handlers/helpers/laborers	35.78	29.42	49.22	39.36

[a] YPLL65, YPLL85, and YPLLAA use life expectancies of 65 years, 85 years, and actuarially adjusted, respectively.

category endpoints in Table 1 is determined by linear interpolation. The predicted YPLL for an individual dying at age x (<85 years), which is in an interval bracketed by age categories in Table 1, say (t_{p-1}, t_p), is

$$YPLL = YPLL_{p-1} + (x - t_{p-1})\left(\frac{YPLL_p - YPLL_{p-1}}{t_p - t_{p-1}}\right)$$

While the predicted YPLL for an individual dying at age x (≥85 years) is calculated as

$$YPLL = YPLL_{85} + (x - 85)\left(\frac{YPLL_{85} - YPLL_{65}}{85 - 65}\right)$$

As an example, suppose an Asian female worker dies at age 50. Using the data from Table 1, her calculated YPLL is

$$42.5 + (50 - 45)\left(\frac{24.5 - 42.5}{65 - 45}\right) = 42.5 + 5\left(\frac{-18}{20}\right) = 42.5 - 4.5 = 38.0$$

Statistical Analyses

Multiple regression models (Neter, Wasserman, and Kutner, 1990) are used to examine the relationship between YPLL and calendar year and worker/workplace characteristics. Gender and race worker characteristics, and occupation and industry workplace characteristics were considered in the analysis. As an example, the multiple regression model in which all predictor variables enter the model additively can be written as:

$$\begin{aligned} YPLL_i = {} & \beta_0 + \beta_1\, year_i + \beta_2 year_i + \beta_2 I(female_i) \\ & + \beta_3 I(black_i) + \beta_4 I(Native\ American_i) + \beta_5 I(Asian_i) \\ & + \sum_j \alpha_j I(industry_i = j) + \sum_k \phi_k I(occupation_i = k) + \varepsilon_i \end{aligned} \qquad \text{(Model 1)}$$

where "i" is the index associated with a particular individuals fatal injury; "j" is the index for the different industries; "k" is the index for the different occupations; the β's, α's, and ϕ's are regression coefficients associated with the various predictor variables; and ε_i is assumed to be an independent normally distributed quantity. The predictor variable year is continuous and enters the model as one variable. We chose to model the year of death as a continuous predictor because decreases in mean YPLL over the years 1980 to 1992 are essentially constant from year to year regardless of the definition of YPLL used (see Table 2). For example, if $\beta_1 < 0$, this implies that predicted mean YPLL is decreasing with calendar time suggesting that fatal injuries tend to be shifting towards older workers. The categorical predictor variables (race, gender, industry, and occupation) enter the model as a series of indicator variables. In particular, if the categorical predictor variable has *n* levels, then that predictor requires *n–1* indicator variables in the model (see Neter, Wasserman, and Kutner 1990). For example, the indicator variable $I(female_i) = 1$ if the i^{th} worker is female and $I(female_i) = 0$ if the i^{th} worker is male. The reference groups for gender, race, industry, and occupation are male, white, agriculture-forestry-fishing, and executive-administration-manager respectfully. We will also look at trends in YPLL over the years 1980 to 1992 for each level of gender, race, industry, and occupation using the three different definitions of YPLL discussed in the Introduction and Methods sections.

RESULTS

The YPLL methods and statistical models described in the Methods section are illustrated with data from the NTOF database. A total of 67,218 traumatic occupational fatalities were used in this analysis. Traumatic occupational fatalities occurring after age 65 total 4529 with 128 of those occurring after age 85.

Table 2 illustrates the mean age at death and the mean YPLL for each definition at different levels of calendar year, gender, race, industry, and occupation. There is a very slight decrease in mean YPLL over time for each of the three definitions. The mean YPLL for females is higher than males, regardless of how YPLL is defined. While either fixed life length YPLL definition suggests women experience approximately 1.8 years less life than men due to fatal injuries, the actuarially adjusted YPLL suggests a more dramatic effect of almost 7 fewer years. This difference between definitions illustrates how discrepancies can occur between actuarially adjusting the life expectancy for survival to some age, gender, and race versus using a fixed life expectancy. The pattern for the actuarially adjusted mean YPLL within race is similar to the life expectancies seen in Table 1. The mean YPLL for Asians is largest, the mean YPLL for Native Americans is second largest, the mean YPLL for whites is second smallest, and the mean YPLL for blacks is the smallest. In the fixed life expectancy definitions of YPLL, the highest YPLL is among Native Americans which indicates Native Americans are dying from occupational accidents at relatively younger ages than blacks, whites, and Asians. The mean YPLL is highest for the mining industry and second highest for the construction industry. The mean YPLL for the construction industry is about three years less than that of mining. Implicit in such a statement is that relatively younger workers tend to be dying in mining as compared to construction. The lowest YPLL among the remaining industries were for agriculture / forestry / fishing and financial / insurance / real estate. The highest mean YPLL among all occupations occurs in handlers/helpers/laborers and technical/related support regardless of the YPLL definition used.

Table 3 shows the parameter estimates and p-values for the trend in YPLL between 1980 and 1992 for different levels of factors with no adjustments for the other factors. In essence, a trend in YPLL indicates some change in the pattern in the age characteristics of workers dying in occupational fatal injuries. A decreasing trend suggests a shift in the average age at death towards older workers while an increasing trend suggests a shift toward younger workers dying in occupational accidents over the years 1980 to 1992. For example, the model

$$YPLL_i = \beta_0 + \beta_1 year_i + \varepsilon_i \qquad \text{(Model 2)}$$

is fit separately to males and females in order to assess differences in trends between men and women. Table 3 summarizes the parameter estimates of β_1 along with their p-values for different definitions of YPLL. Model 2 was also fit separately to each category of race, industry, and occupation to evaluate the trend differences in YPLL for different levels of those predictors. The mean YPLL for both men and women declined significantly regardless of YPLL definition with males decreasing slightly faster than females. In other words, deaths among males are shifting towards older workers faster than fatalities among women dying in occupational fatal injuries. The mean YPLL for whites and blacks have significantly decreasing trends with the trend for whites decreasing at twice the rate of blacks. There are significant declines in the trend of mean YPLL between 1980 and 1992 for mining, construction, manufacturing, transportation/public utilities, wholesale trade, services, and public administration industries. However, the trend in mean YPLL for the retail trade industry has increased significantly. A corresponding increase in the trend in rates of occupational fatalities was also seen for retail trade (Bailer *et al.*, 1998). Thus, not only are fatalities in retail trade occurring in relatively younger workers, the overall rate of such events occurring is increasing. This may be due to an influx of a large number of inexperienced young workers in the retail trade industry. Significant decreasing trends in mean YPLL are seen for the occupations of professional specialty, technical/related support, precision production/craft/repair, machine operator/assembler/inspection, transportation/material moving, and handlers/helpers/laborers with the highest reduction appearing in technical/related support. The definition of YPLL has a negligible effect on the direction (positive or negative) or magnitude (absolute value) of trends in YPLL.

Table 4 shows parameter estimates and p-values for the trend in YPLL between 1980 and 1992 for different levels of factors with adjustments for all other factors. A model similar to Model 2 was used with the modification that all other factors were also included in the model. For example, a model with an intercept, calendar year, race, industry, and occupation was fit separately to males and females. Similar models were fit separately to the different levels of

Table 3. Trend estimates (p-value) from 1980 to 1992 with no adjustments for other factors using different definitions of YPLL.

Factor	Level	$Trend_{65}$[a]	$Trend_{85}$[a]	$Trend_{AA}$[a]
Gender	Male	–0.19 (.0001)	–0.20 (.0001)	–0.17 (.0001)
	Female	–0.12 (.0432)	–0.11 (.0824)	–0.11 (.0451)
Race	White	–0.20 (.0001)	–0.21 (.0001)	–0.18 (.0001)
	Black	–0.10 (.0149)	–0.11 (.0108)	–0.08 (.0163)
	Native American	–0.02 (.9290)	0.03 (.8770)	–0.00 (.9967)
	Asian	–0.04 (.6432)	–0.04 (.7224)	–0.05 (.6027)
Industry	Ag, for, and fishing	–0.08 (.0869)	–0.09 (.0986)	–0.07 (.1108)
	Mining	–0.60 (.0001)	–0.61 (.0001)	–0.55 (.0001)
	Construction	–0.16 (.0001)	–0.17 (.0001)	–0.15 (.0001)
	Manufacturing	–0.19 (.0001)	–0.20 (.0001)	–0.16 (.0001)
	Trans and pub utilities	–0.27 (.0001)	–0.28 (.0001)	–0.25 (.0001)
	Wholesale trade	–0.35 (.0001)	–0.37 (.0001)	–0.35 (.0001)
	Retail trade	0.16 (.0009)	0.18 (.0007)	0.17 (.0001)
	Fin, ins and real estate	–0.20 (.0817)	–0.20 (.1203)	–0.17 (.1082)
	Services	–0.09 (.0366)	–0.08 (.0683)	–0.08 (.0423)
	Public Admin	–0.28 (.0001)	–0.29 (.0001)	–0.23 (.0001)

Table 3. Trend estimates (p-value) from 1980 to 1992 with no adjustments for other factors using different definitions of YPLL. (continued)

Factor	Level	$Trend_{65}$[a]	$Trend_{85}$[a]	$Trend_{AA}$[a]
Occupation	Exec, admin, and manag	–0.06 (.2501)	–0.06 (.2559)	–0.03 (.5457)
	Prof specialty	–0.23 (.0005)	–0.24 (.0007)	–0.19 (.0019)
	Tech and related support	–0.35 (.0001)	–0.36 (.0001)	–0.32 (.0001)
	Sales	–0.03 (.6442)	–0.03 (.5976)	0.01 (.8787)
	Admin support incl clerical	–0.06 (.5468)	–0.05 (.6460)	–0.06 (.5275)
	Service	–0.09 (.0713)	–0.10 (.0690)	–0.07 (.1073)
	Farm, for, and fishing	–0.01 (.8172)	–0.00 (.9695)	–0.01 (.8802)
	Prec prod, craft and repair	–0.20 (.0001)	–0.21 (.0001)	–0.19 (.0001)
	Mach op/assem/inspect	–0.22 (.0008)	–0.22 (.0009)	–0.20 (.0007)
	Transp/material moving	–0.26 (.0001)	–0.27 (.0001)	–0.25 (.0001)
	Handlers/helpers/laborers	–0.24 (.0001)	–0.24 (.0001)	–0.19 (.0001)

[a] $Trend_{65}$, $Trend_{85}$, and $Trend_{AA}$ use life expectancies of 65 years, 85 years, and actuarially adjusted, respectively.

Table 4. Trend estimates (p-value) from 1980 to 1992 with adjustments for all other factors using different definitions of YPLL.

Factor	Level	$Trend_{65}$[a]	$Trend_{85}$[a]	$Trend_{AA}$[a]
Gender	Male	–0.17 (.0001)	–0.17 (.0001)	–0.15 (.0001)
	Female	–0.11 (.0657)	–0.10 (.1259)	–0.10 (.0685)
Race	White	–0.18 (.0001)	–0.18 (.0001)	–0.16 (.0001)
	Black	–0.10 (.0174)	–0.11 (.0121)	–0.09 (.0068)
	Native American	–0.06 (.7479)	–0.01 (.9683)	–0.01 (.9503)
	Asian	–0.02 (.8148)	–0.01 (.9019)	–0.03 (.7470)
Industry	Ag, for, and fishing	–0.04 (.4078)	–0.04 (.4570)	–0.04 (.3481)
	Mining	–0.58 (.0001)	–0.59 (.0001)	–0.52 (.0001)
	Construction	–0.16 (.0001)	–0.17 (.0001)	–0.15 (.0001)
	Manufacturing	–0.19 (.0001)	–0.20 (.0001)	–0.17 (.0001)
	Trans and pub utilities	–0.26 (.0001)	–0.27 (.0001)	–0.24 (.0001)
	Wholesale trade	–0.32 (.0001)	–0.34 (.0001)	–0.29 (.0001)
	Retail trade	0.16 (.0006)	0.17 (.0006)	0.14 (.0008)
	Fin, ins and real estate	–0.20 (.0764)	–0.19 (.1226)	–0.18 (.0788)
	Services	–0.10 (.0191)	–0.09 (.0392)	–0.09 (.0160)
	Public Admin	–0.29 (.0001)	–0.29 (.0001)	–0.26 (.0001)

Table 4. Trend estimates (p-value) from 1980 to 1992 with adjustments for all other factors using different definitions of YPLL. (continued)

Factor	Level	$Trend_{65}$[a]	$Trend_{85}$[a]	$Trend_{AA}$[a]
Occupation	Exec, admin, and manag	–0.08 (.0953)	–0.09 (.1042)	–0.08 (.0869)
	Prof specialty	–0.24 (.0003)	–0.25 (.0005)	–0.21 (.0003)
	Tech and related support	–0.35 (.0001)	–0.36 (.0001)	–0.32 (.0001)
	Sales	–0.04 (.4331)	–0.05 (.3793)	–0.04 (.3708)
	Admin support incl clerical	–0.07 (.5184)	–0.06 (.6079)	–0.06 (.5667)
	Service	–0.09 (.0883)	–0.09 (.0901)	–0.08 (.0617)
	Farm, for, and fishing	–0.03 (.5093)	–0.03 (.5961)	–0.03 (.4741)
	Prec prod, craft and repair	–0.17 (.0001)	–0.17 (.0001)	–0.15 (.0001)
	Mach op/assem/inspect	–0.19 (.0037)	–0.19 (.0042)	–0.17 (.0025)
	Transp/material moving	–0.25 (.0001)	–0.26 (.0001)	–0.23 (.0001)
	Handlers/helpers/laborers	–0.27 (.0001)	–0.27 (.0001)	–0.24 (.0001)

[a] $Trend_{65}$, $Trend_{85}$, and $Trend_{AA}$ use life expectancies of 65 years, 85 years, and actuarially adjusted respectively.

race, industry, and occupation. The results are similar to what was seen in Table 3 when no adjustments for other factors were made. The trend in YPLL from 1980 to 1992 for males and females has been decreasing with the YPLL for males decreasing slightly faster. The trend is significant for males in all definitions but is borderline significant for females depending on which YPLL definition is used. All races show a decreasing trend in mean YPLL with whites decreasing almost twice as fast as blacks. However, the trends in YPLL for Native Americans and Asians are not significant for any definition of YPLL suggesting that the age of workers dying in these groups has been stable over the years 1980 to 1992. The trends in YPLL for the mining, construction, manufacturing, transportation / public utilities, wholesale trade, services, and public administration industries are significantly declining regardless of definition. Trends in mean YPLL for the agriculture / forestry / fishing and finance / insurance / real estate industries are decreasing, but the trends are not significant.

DISCUSSION

YPLL is a useful measure of the impact of traumatic occupational fatalities. It measures mortality with large values suggesting the death of younger workers. Many other endpoints such as healthy life-years (Hyder AA, Rotllant G, and Morrow RH 1998), disability adjusted life-years (Murray CJL 1994), or simple mortality rates can also provide a measure of the magnitude of each fatal injury. We recognize that YPLL may lack information that occurs in other measures that try to measure the impact of traumatic occupational fatalities. These alternative measures may be better than YPLL at assessing some characteristics of unintentional fatal injuries at work. One advantage of using YPLL, especially the fixed life expectancy definition, is ease of computation. A disadvantage of YPLL is that it lacks information on both the size of the workforce and the rate of fatal injury within each unique category of possible predictors such as gender, race, industry, and occupation. An ideal measure would integrate the size of the workforce, the rate of fatal injury, and some measure indicating the impact of each fatality.

The NTOF database from NIOSH is an ideal data source because we are interested in modeling individual occupational fatalities. Another potential source of data is the Census of Fatal Occupational Injuries (CFOI), a Federal-State cooperative program sponsored by the Bureau of Labor Statistics (1997). The CFOI contains more deaths each year than the NTOF database because it draws data from several sources, however, it wasn't implemented in all 50 states and the District of Columbia until 1992. If we had data from the CFOI for the years 1980 to 1992, the additional deaths probably wouldn't affect the results too much since we are essentially modeling the mean YPLL and the trend of those means. The CFOI data, starting in 1992, could be used to validate the trends in YPLL from 1980 to 1992 seen with the NTOF data.

That trends in the YPLL due to occupational fatal injuries are generally decreasing begs a few questions about the interpretation of these findings. Are the mean values of YPLL decreasing because the age of the worker population is simply increasing or is this due to a true shift in the distribution of age at the time of death? Even if these trends do represent a true shift in the age distribution of the deaths, should a shift in mortality from younger to older workers be viewed as a success when our goal is clearly to protect all workers? Proper interpretation of these trends can only be made in conjunction with other measures of injuries such as trends in the fatality rates. The fact that both YPLL and fatality rates are declining for almost all of these industries and occupations (Bailer *et al.*, 1998) does suggest that current programs are having an effect on reducing the impact of fatal injuries in the workplace. The fact that trends in both YPLL and fatality rates are increasing in the retail trade industry raises concerns that further attention needs to be focused on reducing fatal injuries in this industry sector.

The highest mean YPLL occurs in the mining and construction industries but these industries also show significant decreases in YPLL over time. Mining has the largest decline in YPLL over time of all industries. These two industries also have the highest fatal injury rates, which are declining over time (Bailer *et al.*, 1998). Although improvements have been made in reducing mean YPLL and fatal injury rates, efforts should continue to be focused toward mining and construction industry workers to prevent the occupational fatalities of these workers. The mean YPLL in retail trade industry is similar to other industries but significantly increases over time. This may be the result of the large number of young workers in retail trade. The increasing trend in rates of occupational deaths for retail trade (Bailer *et al.*, 1998) supports an argument that efforts should be centered on the retail trade industry to determine why occupational fatalities are shifting toward younger workers at increasing incidence rates.

The three different definitions of YPLL had little effect on the analysis of trends in the mean YPLL over the years 1980 to 1992. In contrast, the alternate definitions yield different means and we believe that the actuarially adjusted definition of YPLL is the preferred construction for looking at the average YPLL or the total YPLL. While using an actuarially adjusted YPLL may lessen the harm to groups with lower life expectancies, the use of a fixed life expectancy reduces the harm to groups with higher life expectancies. First, the actuarially adjusted YPLL, say $YPLL_{AA}$, utilizes all of the observed fatalities. The YPLL employing age lost to a fixed age, say $YPLL_F$, assigns all deaths in workers who are older than the fixed calculation age a YPLL of zero. This suggests that some loss of information or some potential bias might be introduced when using the $YPLL_F$ in contrast to the $YPLL_{AA}$. Secondly, the choice of the fixed age for $YPLL_F$ calculation is arbitrary. Finally, the actuarially adjusted YPLL is based upon current expectations of years of life remaining. There is a precedent for such calculations — obviously, stratified lifetable calculations are used by insurance companies in setting life and health insurance rates. Even though women generally live longer than men, we are not suggesting that an occupational fatality occurring to a 35-year-old woman is somehow more tragic than an occupational fatality to a 35-year-old man. Any loss of life is tragic. We are suggesting that the definition of YPLL to reflect current population lifetables does validly reflect the magnitude of life lost in a manner that is less arbitrary than evaluating loss of life to a fixed age. As an aside, the $YPLL_{AA}$ can be updated to reflect changes in the population lifetable when such information is available. Thus, by using appropriate actuarial adjustments, we believe that we are more accurately reflecting the true potential years of life lost.

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