



Trends in tractor related fatalities among adults working on farms in Victoria, Australia, 1985–2010

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ABSTRACT

Tractors are associated with more fatalities than any other piece of machinery in agriculture, with tractor rollovers being a frequent mechanism. This study examines tractor fatalities between 1985 and 2010 in Victoria, Australia, and examines the impact of the 1998 legislation mandating the retrofitting of rollover protection structures (ROPS). The data source was the Victorian WorkCover Authority to whom unintentional work placed deaths are reportable. During the study period, 121 tractor fatalities occurred, of which 55 were rollovers. Poisson regression modelling indicated a significant decline in rollover fatalities during this period of approximately 7% per annum (incidence rate ratio [IRR] = 0.93, 95% CI 0.90–0.97), however there was no simple relationship between the introduction of the legislation and the fatality decrease. It is proposed that the impact of previous voluntary retrofitting initiatives, coupled with the existing requirement for ROPS on new tractors, may have increased ROPS fitment to a critical point prior to the final requirement for retrofitting, diluting the effect over a number of years so that it could not be detected using the statistical techniques that have been applied. An increased trend in run over fatalities was also found (IRR = 1.04, 95% CI 1.00–1.09) suggesting the need for research into interventions for this type of fatality, such as safe tractor access platforms.

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1. Introduction

Agriculture is one of the most hazardous industries in the U.S. (Sanderson et al., 2006) and Canada (Pickett et al., 1999), where tractor overturns (rollovers) produce the greatest number of agricultural machinery related fatalities (Brison and Pickett, 2003; Sanderson et al., 2006). Similarly, in Australia, tractors have been identified as being associated with more fatal injuries than any other piece of agricultural equipment (Franklin et al., 2000). The Australian state of Victoria is the second most populated state in the country (Australian Bureau of Statistics (ABS), 2006a) and has a strong agricultural sector, being Australia's largest food and fibre exporting state (Department of Primary Industries, Victoria). A study of farm work related fatalities in Victoria, for the period of 1985–1996, showed that, in line with national trends, tractor incidents were the most common type of agricultural fatality (72%) in that state, and that tractor rollovers accounted for 61% of all fatal tractor incidents (Day, 1999). Run overs and entrapment in or between moving parts accounted for 12% and 11% of tractor fatalities respectively.

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Since that study, a number of measures have been employed in Victoria to reduce tractor roll over deaths specifically. In view of the demonstrated effectiveness of roll over protective structures (ROPS) in fatality prevention (Springfeldt, 1993), the state authorities sought to encourage the installation of ROPS by conducting a series of rebate programs (1987 [556 rebates], 1990 [1436 rebates], 1994 [1116 rebates], 1997/98 [12,129 rebates]) to offset installation costs prior to mandating installation. These endeavours to address the tractor roll over problem were conducted within the context of other initiatives to address farm safety more generally. Legislation requiring ROPS to be installed on new tractors manufactured or imported from 1981 came into effect in 1985 and was supported by information, awareness and education programs (Day and Rechnitzer, 1999).

The 1997/98 rebate program, which offered \$150AUD to farmers for each tractor retrofitted, coincided with the implementation of legislation mandating the retrofitting of ROPS to existing tractors (Occupational Health and Safety Regulations, 1988, Victoria). It achieved high participation rates and was effective in reducing the number of unprotected tractors from approximately 24% (17,240 operational tractors) in 1996 to 7% (5291) (Day and Rechnitzer, 2004). However, it is not known whether this reduction in the number of unprotected tractors in Victoria, has translated into a sustained reduction in roll over related fatalities. Further, trends in other types of tractor related fatalities

have not been examined for the post legislative implementation period.

Therefore, the main aims of this study were to (1) determine whether measures related to the increased use of roll over protective structures on tractors have resulted in a reduction in tractor roll over fatalities in Victoria, and (2) determine the patterns and trends of all fatal tractor related incidents in Victoria from 1985 to 2010.

2. Methods

This study used a retrospective, population cohort design examining tractor related fatalities between 1985 and 2010 in Victoria, Australia. The primary outcome measure was the rate of tractor fatalities, classified according to type.

Fatality data for agricultural workers (excluding forestry and fishing) aged 15 years and older for the period January 1985–December 2010 was provided by the Victorian Workcover Authority, the statutory health, safety and workers' compensation authority in Victoria. This authority operates under the name of Worksafe. Unintentional workplace deaths in Victoria are notifiable to Worksafe under the Occupational Health and Safety Act, 1985 (Vic), and successor arrangements under the Occupational Health and Safety Act, 2004 (Vic) ("The Act"). Under Part 5 of The Act, an employer or self-employed person must notify Worksafe if a death occurs on their premises, or a place under their control. Deaths determined to be strictly of natural causes, by suicide, or traffic accidents (unless due to work related causes) are not included in this definition. Worksafe-notified fatalities for the agricultural industry have previously been shown to be complete for persons over 15 years of age, but incomplete for children under this age, when compared with coronial data (Day, 1999).

Cases for this study were selected from the Worksafe database, with supplementary coding undertaken by researchers. Tractor related fatalities were identified and coded according to type. A tractor incident was defined as one in which a tractor and/or attachment was the agent of fatal injury, or where the tractor and/or attachment was a major factor in the cause of a fatal injury event. Front-end loaders were assumed to be attached to a tractor and were therefore included in the analysis. Supplementary coding based on the textual descriptions of incidents was undertaken to classify tractor fatalities into roll over, run over by tractor or attachment, entrapment by tractor or attachment, and other causes. The coding scheme is described elsewhere (Day, 1999). The textual descriptions for cases from 1995 to 2010 were also used to gain an understanding of the context of the fatality.

In the absence of an estimate of hours worked on tractors, total working hours estimates prepared by the ABS (2006b) were used as a measure of exposure to risk for the agricultural worker population involved in the study. As this figure was not constant (average weekly working hours ranged between an average 45.1 h per week in 1986 to a minimum of an average of 38.8 h per week in 2004) the annual estimate of working hours was incorporated as the offset term in regression modelling.

Fatality frequencies were converted to rates per 1,000,000 working hours of adult persons employed in agricultural industries in Victoria using, as the denominator, labour force estimates prepared by the ABS (2006b). These estimates include persons 15 years and over, who are employed in agriculture as an employer, employee, self-employed or contributing family member (including unpaid work), as well as estimates of the hours worked. The annual employed population was calculated as the average of the four quarterly estimates, and working hours were based on summing the quarterly part-time and full-time working hour estimates.

Table 1

Frequency of farm work-related fatalities, Victoria, Australia, 1985–2010.

Year	All farm	All tractor	Roll over	Run over	Other tractor fatality type
1985	5	3	2	0	1
1986	10	10	5	1	4
1987	8	7	7	0	0
1988	7	7	5	1	1
1989	4	4	2	2	0
1990	8	7	4	1	2
1991	5	3	2	1	0
1992	9	6	5	0	1
1993	7	6	3	0	3
1994	14	9	5	1	3
1995	12	6	2	4	0
1996	9	4	1	0	3
1997	11	4	1	1	2
1998	9	4	0	3	1
1999	14	5	1	3	1
2000	11	6	1	3	2
2001	12	6	3	3	0
2002	9	1	0	0	1
2003	7	5	0	3	2
2004	13	8	2	2	4
2005	1	0	0	0	0
2006	7	3	1	1	1
2007	8	6	1	2	3
2008	8	3	0	1	2
2009	13	5	1	3	1
2010	11	3	1	2	0
Total	232	131	55	38	38

Three-year moving average fatality rates were generated by dividing the average frequency for each three-year interval by the employed workforce average of each interval. Three-year moving average rates were used for the descriptive analysis, since considerable year-to-year variation was present in the annual frequencies. Trends in annual agricultural fatalities (all-cause farm fatalities, all tractor fatalities, tractor rollover fatalities, tractor non rollover fatalities, and non tractor fatalities) were analysed using Poisson regression techniques.

The regression analysis tested whether there was significant change in fatality rates over the study period, and explored which of three models provided the best fit for the data: (1) a linear decrease in fatalities over time; (2) a change in the rate of change in fatalities pre-, and post- implementation ("Dichotomous model"), and (3) a categorical five year block (e.g. 1986–1990, etc.) model. In addition, an interaction effect for the dichotomous model was tested.

3. Results

3.1. Tractor fatality trends

There was a total of 131 tractor related fatalities in Victoria between 1985 and 2010, of which 55 were due to tractor rollover (Table 1). Three-year moving average rates for all-cause farm fatalities and tractor related fatalities (rollover and all non rollover) for the period between 1986 and 2010 and are shown in Fig. 1. A downward trend for deaths due to tractor rollover can be seen particularly between 1985 and 1997.

There was no consistent observable trend associated with the rebate programs, with decreases notable for only two of these (1987 and 1991). Most of the reduction had occurred prior to mandatory requirement for ROPS retrofit and the final round of rebates in 1997/98, by which time the fatality rate had fallen to an average of 0.28 rollover fatalities per 1,000,000 person working hours. Although there was a temporary increase in fatality rate in the early 2000s, related to 3 fatalities that occurred in 2001, there was no further reduction following introduction of the ROPS retrofit legislation.

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