

# An Accident-Risk Assessment Study of Temporary Piece Rated Workers

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**Abstract:** An occupational injury surveillance study (record study of five years duration) was conducted involving the workers of a fertilizer producing industry in eastern India to assess whether the risk of occupational accidents in temporary piece rated workers was higher in comparison to the permanent time rated workers. At the same time, to collect the personal details of the workers who have worked in the industry in the study period, an interview was also conducted. Mean age of temporary piece rated workers and permanent time rated workers were  $(35.9 \pm 12.5)$  and  $(35.3 \pm 11.4)$  respectively. Distribution of other variables like nature of work, level of education, experience, habits were also very similar between the two worker groups. Accident incidence rate, accident frequency rate and accident severity rate were found to be significantly higher in temporary piece rated workers. This difference was more prominent in case of time-loss accidents than in no time-loss accidents. Relative risk has varied from 2.3 to 18.0 in case of time-loss accidents. In case of no time-loss accidents, it has varied from 1.1 to 2.6. When relative risk is considered after taking both types of accidents together, it has ranged from 1.2 to 3.5. This study concluded that the temporary piece rated workers are more vulnerable to occupational accidents.

**Key words:** Occupational accidents, Temporary piece rated workers, Permanent time rated workers, Accident incidence rate, Accident frequency rate, Accident severity rate

## Introduction

In many countries occupational accidents represent a major problem in public health. Severe consequences also do occur as after-effect<sup>1</sup>. Social and economic loss takes place<sup>2,3</sup>. Every year almost one thousand workers die and one fourth of a million are injured in industries in India in organized sectors only. Thousands of others are crippled due to accidents in unorganized sectors. Number of insured persons in the pay-roll of permanent disablement benefit has gone up to 113,500 with addition of about 15,000 fresh cases of

disablement due to employment injury during 1997–1998<sup>4</sup>.

A variety of factors have been found to be responsible for occupational accidents, either directly or indirectly. Work conditions<sup>5</sup>, age<sup>6–9</sup>, educational status, safety training<sup>10</sup>, experience<sup>11</sup>, smoking<sup>12, 13</sup>, alcohol<sup>14–17</sup>, psychosocial factors<sup>18</sup>, shift of work<sup>19</sup> and weather<sup>20</sup> have all been designated as responsible factors. Some authors have also shown that the type of worker (temporary or permanent)<sup>21</sup> and speed of work<sup>22</sup> are also important factors in the causation of occupational accidents. Some epidemiological investigations<sup>21,23</sup> have shown that the temporary workers are more vulnerable to occupational accidents than permanent workers. But, they have been only a few. Some investigators

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have already mentioned the need of more research in relation to occupational accidents in temporary workers<sup>23)</sup>.

In India, workers according to their status of employment are of three types permanent, temporary piece rated (usually employed through contractor) and temporary time rated. On the retirement of a permanent worker, a temporary time rated worker can get a chance to shift to permanency. But the temporary piece rated workers do not get this chance under usual circumstances. In permanent workers, there is a chance of shifting into safer jobs after repeated accidents. But, temporary workers do not enjoy such benefit. Temporary piece rated workers are not only temporary (do not get job always in the year) but also piece rated (wages depend upon amount of work done). On the contrary permanent time rated workers work always in the year and they get fixed amount of wages after working for fixed period of time. Temporary time rated workers also do not get job always in the year but they get fixed amount of wages after working for fixed period of time. The aim of this study has been to assess whether the risk of occupational accidents in temporary piece rated workers is higher in comparison to the permanent time rated workers.

## Materials and Methods

This present study was an occupational injury surveillance study (record study of five years duration) involving the workers of a fertilizer-producing factory in eastern India conducted during the period January–March 2001. At the same time, to collect the personal details of the workers, an interview was also conducted with the workers who have worked in the factory in the study period of five years (January 1996–December 2000). Thus, data in relation to age, sex, job, level of education, experience, habits of smoking and alcohol etc. were collected. A total of 307 permanent time rated and 419 temporary piece rated workers were interviewed. Nine permanent time rated and 29 temporary piece rated workers, who have worked during the study period could not be interviewed due to non-availability. So, data in relation to personal characteristics could not be obtained from them. But, accident related data was collected in relation to all 316 permanent time rated and 448 temporary piece rated workers.  $\chi^2$  test was applied to the data regarding the personal characteristics of the workers in order to examine the comparability between temporary piece rated workers and permanent time rated workers.

Accident registers, pay rolls, productivity registers were examined for the study period of five years to collect data in relation to number of accidents, number of employees,

amount of lost man-days and amount of working man-hours. To calculate average number of workers exposed in each year, number of workers employed in each month was taken into account. Accident incidence rate, accident frequency rate and accident severity rates were calculated as per the guidelines of ILO<sup>24)</sup>. All the rates were calculated for all the five years, for both kinds of workers and for all types of accidents (time-loss accident, no time-loss accident, total accidents). Ninety-five percent confidence intervals were calculated<sup>25)</sup> for each calculation of accident incidence rate, frequency rate and severity rate for comparison between the two kinds of workers. Incidence rate was calculated as number of accidents per thousand exposed workers. Frequency rate was calculated as number of accidents per million working man-hours and severity rate was calculated as number of lost man-days per thousand working man-hours.

Relative risk was calculated by dividing accident incidence rate, accident frequency rate or accident severity rate of temporary piece rated workers by that of permanent time rated workers. Ninety-five percent confidence intervals of relative risk were also calculated<sup>26)</sup>.

In this factory, whenever an accident takes place the concerned worker or his colleagues report to the supervisor who in turn sends the worker to the occupational health center along with a filled up proforma containing basic information regarding the accident. At occupational health center, treatment is given and further reporting is done to factories inspectorate as well as to the social security scheme. If the concerned worker has to remain away from the job on one day or more due to accident (time loss accident), it is to be reported to the factories inspectorate and social security scheme office so that on the basis of this report the workers get compensation towards loss of wages from social security scheme. But, when the worker returns to the job in less than a day (no time loss accident), the accident is not to be reported to factories inspectorate and social security scheme and in such cases there is no compensation available to the worker. Only medical treatment is given from occupational health center. All the relevant details of all the reportable and non-reportable accidents are maintained at occupational health center. In such circumstances, time loss accidents are 100% reported because the workers do it for their own interest to achieve compensation towards wages loss. But, some percentage of no time loss accidents may be neglected and thereby may not be reported to occupational health center specially in case of temporary piece rated workers (to save time loss during the period of work) where the amount of wages is directly related to amount of work done. This may be a limitation of this study. Another limitation may be that

**Table 1. Distribution of Characteristics of Workers**

Personal Characteristics	Category	PTR Workers (%) (n=307)	TPR Workers (%) (n=419)	Significance
Age (years)	< 25	76 (24.7)	121 (28.9)	NS
	25–35	93 (30.3)	101 (24.1)	
	35–45	65 (21.2)	72 (17.2)	
	45–55	55 (17.9)	90 (21.5)	
	≥ 55	18 (5.9)	35 (8.3)	
	Mean ± S.D	35.3 ± 11.4	35.9 ± 12.5	NS
Educational Status	Illiterate	53 (17.3)	80 (19.1)	NS
	Primary (Class I–IV)	101 (32.9)	107 (25.5)	
	Secondary (Class V–X)	121 (39.4)	199 (47.5)	
	Higher Secondary (Class XI–XII)	26 (8.5)	29 (6.9)	
	College	6 (1.9)	4 (0.9)	
Smoking habit	Smokers	209 (68.1)	293 (69.9)	NS
	Non-smokers	98 (31.9)	126 (30.1)	
Alcohol habit	Alcoholic	106 (34.5)	151 (36.0)	NS
	Non-alcoholic	201 (65.5)	268 (64.0)	
Tobacco-chewing habit	Tobacco-chewers	192 (62.5)	239 (57.0)	NS
	Non Tobacco -chewers	115 (37.4)	180 (42.9)	
Experience (years)	< 5	57 (18.6)	89 (21.2)	NS
	5–10	81 (26.4)	117 (27.9)	
	≥ 10	169 (55.0)	213 (50.8)	
Nature of work	Production	123 (40.1)	171 (40.8)	NS
	Maintenance	89 (29.0)	119 (28.4)	
	Packing, loading, unloading	95 (30.9)	129 (30.8)	

TPR: Temporary Piece Rated, PTR: Permanent Time Rated.

the worker cohort is not properly followed up throughout the entire study period. If it could have been done, more detailed analysis could have been made in relation to the contributing factors like nature of jobs, educational status, age group of workers etc. resulting in more concrete findings regarding the cause of accident occurrence.

## Results

Table 1 shows the characteristics of the two worker groups. Mean ages were 35.3 yr for permanent time rated workers and 35.9 yr for temporary piece rated workers. Seventeen point three percent of permanent time rated workers were illiterate while 10.4% were higher secondary or above level educated. The percentages were 19.1 and 7.8, respectively, in case of temporary piece rated workers. Eighty-one point four percent of permanent time rated workers and 78.7% of temporary piece rated workers had experience of five years or more in the same factory. Majority of both kinds of workers were involved in production division. All the employees of

this factory were males. No female worker was employed in this factory.

Table 2 describes the distribution of accident incidence rate over the period of five years in the two types of workers. In case of the temporary piece rated workers, rate of time loss accidents varies from 323 to 793. In case of permanent time rated workers, the same rate varies from 31 to 143. Distribution of accident incidence rate for no time-loss accidents has shown less difference between two types of workers. In the temporary piece rated workers, the rate has varied from 1,239 to 1,565. In the permanent time rated workers, the rate varies from 536 to 1,240. When both types of accidents are considered in conjunction, the rate remained to be much higher in the temporary piece rated workers. In the year 1998, accident incidence rate has been relatively low in case of permanent time rated workers. No definite cause could be found out to justify this finding.

The distribution of calculated relative risk (accident incidence rate in temporary piece rated workers / accident incidence rate in permanent time rated workers) over the

**Table 2. Distribution of Accident Incidence / Frequency / Severity Rate and Relative Risk According to Type of Accident**

		Year				
		1996	1997	1998	1999	2000
<b>Incidence rate</b>						
Time loss accident	TPR Worker	793 (688–898)	353 (286–421)	553 (469–636)	323 (262–384)	455 (388–522)
	PTR Worker	143 (99–186)	81 (49–114)	31 (11–50)	138 (94–181)	98 (61–135)
	Relative risk	5.5 (4.0–7.7)	4.3 (2.8–6.8)	18.0 (9.2–35.2)	2.3 (1.6–3.4)	4.6 (3.1–7.0)
No time loss accident	TPR Worker	1565 (1418–1713)	1404 (1269–1539)	1408 (1274–1541)	1245 (1124–1365)	1239 (1128–1350)
	PTR Worker	1240 (1111–1369)	820 (717–924)	536 (452–620)	1134 (1010–1258)	1073 (950–1195)
	Relative risk	1.3 (1.1–1.4)	1.7 (1.5–2.0)	2.6 (2.2–3.1)	1.1 (0.9–1.3)	1.1 (1.0–1.3)
Total accident	TPR Worker	2359 (2177–2540)	1757 (1607–1908)	1960 (1803–2118)	1568 (1433–1703)	1694 (1565–1823)
	PTR Worker	1383 (1247–1519)	902 (793–1010)	566 (480–653)	1272 (1140–1403)	1171 (1043–1298)
	Relative risk	1.7 (1.5–1.9)	1.9 (1.7–2.3)	3.5 (2.9–4.1)	1.2 (1.1–1.4)	1.4 (1.3–1.6)
<b>Frequency rate</b>						
Time loss accident	TPR Worker	498 (432–563)	190 (153–226)	294 (250–339)	183 (148–218)	272 (232–312)
	PTR Worker	61 (43–80)	34 (20–47)	13 (4–22)	58 (40–76)	41 (26–57)
	Relative risk	8.1 (5.8–11.3)	5.6 (3.6–8.7)	22.4 (11.4–43.8)	3.2 (2.2–4.6)	6.6 (4.4–9.9)
No time loss accident	TPR Worker	982 (889–1074)	754 (682–826)	750 (679–821)	706 (638–774)	741 (675–808)
	PTR Worker	533 (478–588)	341 (298–384)	229 (193–265)	475 (423–527)	450 (399–502)
	Relative risk	1.8 (1.6–2.1)	2.2 (1.9–2.6)	3.3 (2.7–3.9)	1.5 (1.3–1.7)	1.6 (1.4–1.9)
Total accident	TPR Worker	1480 (1366–1593)	944 (863–1025)	1045 (961–1129)	889 (813–966)	1014 (936–1091)
	PTR Worker	594 (536–653)	375 (330–420)	242 (206–279)	533 (478–588)	492 (438–545)
	Relative risk	2.5 (2.2–2.8)	2.5 (2.2–2.9)	4.3 (3.6–5.1)	1.7 (1.5–1.9)	2.1 (1.8–2.3)
<b>Severity rate</b>						
	TPR Worker	8.5 (8.2–8.8)	3 (2.9–3.2)	5 (4.8–5.1)	4.4 (4.2–4.5)	6.3 (6.1–6.5)
	PTR Worker	0.8 (0.7–0.9)	0.33 (0.3–0.4)	0.26 (0.22–0.30)	0.9 (0.8–1.0)	1.3 (1.2–1.4)
	Relative risk	10.7 (9.8–11.7)	9.1 (7.9–10.4)	18.8 (16.2–21.9)	4.8 (4.4–5.3)	4.7 (4.4–5.1)

TPR: Temporary Piece Rated, PTR: Permanent Time Rated, ( ): indicates 95% Confidence Interval.

period of five years shows that the relative risk varies from 2.3 to 18.0 in case of time-loss accidents. In case of no time-loss accidents, it has varied from 1.1 to 2.6. After taking both types of accidents together, it has ranged from 1.2 to 3.5.

The same trend is also observed in case of distribution of accident frequency rates. The accident frequency rate is significantly higher in case of the temporary piece rated workers than in case of the permanent time rated workers. The difference of rate between the two worker groups is much higher in case of time-loss accidents than in case of no time-loss accidents. Frequency rate of total accidents varies from 889 to 1,480 for temporary piece rated workers and from 242 to 594 for permanent time rated workers. The same rate for time loss accidents varies from 183 to 498 for temporary piece rated workers and from 13 to 61 for permanent time rated workers. In case of no time loss accidents the rate varies from 706 to 982 for temporary piece rated workers and from 229 to 533 for permanent time rated workers.

The distribution of relative risk calculated on the basis of accident frequency rate (accident frequency rate in temporary piece rated workers / accident frequency rate in permanent time rated workers) shows that the relative risk varies from 3.2 to 22.4 in case of time-loss accidents. In case of no time-loss accidents, it has varied from 1.5 to 3.3. After taking both types of accidents together, it has ranged from 1.7 to 4.3.

Severity rate is a measure of assessment of harmful effects of occupational accidents on the industry as it takes loss of man-days into account. The severity rates are from 3.0 to 8.5 for the temporary piece rated workers and from 0.26 to 1.3 for the permanent time rated workers. The relative risk calculated on the basis of severity rate varies from 4.7 to 18.8.

From the data of Table 2, it is evident that there is statistically significant difference between temporary piece rated workers and permanent time rated workers in relation to accident incidence rate, accident frequency rate and accident severity rate.

## Discussion

The two types of workers had similar trend in age distribution, habits of smoking and alcohol, educational status, experience and job. The factory had no established safety training system. Only way for gaining knowledge of safety was on the job experience. In this respect, the permanent time rated workers may have been in a better position than the temporary piece rated workers although they have the same experience pattern of working in the same factory. This is because of the fact that the temporary piece rated workers do not get chance to work always in the year like the permanent time rated workers. Accordingly, effective experience may be less in the temporary piece rated workers.

Accident incidence rates have been significantly higher in the temporary piece rated workers for all types of accidents (time-loss, no time-loss and total). This observation reflects higher risk of occupational accident in the temporary piece rated workers. So far as distribution of accident frequency rate is concerned, it also reflects significantly higher accident risk in the temporary piece rated workers. From the point of view of industry, the temporary piece rated workers are responsible for relatively more man-day loss than the permanent time rated workers. Calculation of relative risk and 95% confidence interval has shown that the temporary piece rated workers have statistically significant higher risk of accidents.

This finding of higher accident risk of the temporary piece rated workers is similar to the experience of some already published reports<sup>21, 23</sup> which have dealt with accidents of temporary workers. The cause of this increased risk can be attributed to some factors. Effective experience and thereby safety knowledge may be relatively less in the temporary piece rated workers. The relatively increased accident risk of the temporary piece rated workers may also be due to the fact that these workers are not only temporary but also piece rated. Whenever they work, their amount of wages is in direct relationship with the amount of work done by them. So, by compulsion, they work hurriedly. This increased speed of their work may have contributed to their increased accident risk<sup>22, 27</sup>. One interesting finding of this study is that the values of relative risk are higher in case of time-loss accidents than in case of no time-loss accidents in relation to both incidence rate and frequency rate. This finding is difficult to be explained by the usual factors of accident occurrence. But, it can well be explained with a statement adopted from an ILO publication<sup>28</sup>, which says; "Insecurity of employment is almost certainly a cause of accidents. When

workers fear dismissal, they may well be in an emotionally unbalanced state, which will make them more liable to have accidents. In countries with social security legislation, which guarantees payment of at least a part of wages in cases of absence from work caused by an accident, but not in case of ordinary unemployment, accidents are even caused willfully to provide an income during an impending period of unemployment. However, such cases are not within the scope of ordinary accident prevention work." In Indian context also, social security scheme being in operation, the temporary piece rated workers may have used accident as a tool for income in periods of unemployment or in periods of less income.

Though willful accident is a probability, before making a comment on occurrence of such accidents, we should consider that due to the irregular nature of their employment, temporary workers may not be as well trained as permanent ones as their effective job experience is relatively less. Moreover, it may so happen that relatively more accident-prone jobs are given to temporary workers. Usually, the temporary piece rated workers do neither become permanent nor they get a chance to shift to safer jobs even after repeated accidents in the same job. These factors may also have contributed to the higher accident incidence rate in case of temporary piece rated workers. In this context, the limitations of this study are also important. If the worker cohort could have been properly followed up throughout the entire period of study, contributing factors like nature of jobs, educational status, age group of workers etc. may have been taken sufficient care of in analyzing the cause of accident which might also have explained the increased accident incidence in temporary workers.

However, more extensive studies, taking more confounding factors into account, will be useful to confirm the higher risk of temporary piece rated workers in the occurrence of occupational accidents. Possibility of commitment of willful accidents in such workers should also be comprehensively explored in further studies.

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