

Piece rates and their effects on health and safety

A literature study made by
Bo Johansson, Kjell Rask and Magnus Stenberg

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Sundström-Frisk (1990)

Studies over **statistical correlations** between piece rate wages and work injuries. The studies quantify risk ratios for piece rate workers.

Studies of **indirect correlations** between piece rate and negative effects, e.g. that piece rates cause stress, which in turn gives an increased risk for unintentional mistakes, which in turn cause an increased risk for accidents which leads to more accidents.

Studies of piece rate **workers opinions and experiences of relations** between piece rates and different negative effects, e.g. injuries. Data is collected with surveys and interviews.

State of the art 1990

Research is fragmented and deals mainly with accidents.

*The conclusion from the literature survey is that **piece rate wages increase the risk for work injuries under certain circumstances**: for certain types of piece wages, for certain types of risk exposure and for certain types of work tasks performed by individuals that respond to the piece rate wage as a instrument of control.*

*The mechanisms that explain the relation between piece rate wages and an increased risk for injuries is as follows: **during piece rate work there usually is a positive correlation between increased risk taking and increased earning, then the stress level becomes increased with an increased tendency for mistakes and the conditions for an effective preventive risk management are worsened.***

Literature survey

- Informaworld
- SAGE Journals online
- Academic Search Elite
- SCIRUS
- Scopus
- Oxford Journals
- CSA
- Arblinc
- WEB of science
- Google Scholar
- Labordoc (ILO)
- Pubmed
- Ergonomic abstracts

Literature survey

- piecework OR piece work OR piece rate OR piece wage
- accident OR injury OR absence OR disease OR health OR unhealth OR musculoskeletal OR sick leave.

Selected articles, finally included articles and their publication time

Published	Nr of selected articles	Nr of finally included articles
1989 and previous	24	12
1990-1999	24	7
2000-2008	37	12
Total	85	31

Table 2. Articles included in the literature survey and studied effects

Studied effects	- 1989	1990 - 1999	2000 - October 2008
Risk behavior, security and accidents	Sundström-Frisk (1984) Pettersson et al. (1983) Wrench and Lee (1982) Mason (1977)	Blank et al. (1998) Sundström-Frisk (1990)	Wright and Quinlan (2008) Patterson (2007) Gravseth et al. (2006) Weyman et al. (2003)
Physical work load, exhaustion, injuries			Toupin et al. (2007) Lilley et al. (2002)
Health, musculoskeletal injuries, pains, and occupational injuries		Mayhew and Quinlan (1999) Bejerot and Theorell (1992) Brisson et al. (1992)	Lacey et al. (2007) Wang et al. (2007) McCurdy et al. (2003) Roquelaure et al. (2001)
Severe disability and premature ageing	Brisson et al. (1989) Vézina et al. (1989) Vézina et al. (1987)		
Early retirement			Schubert and Sobala (2005)
Mental health and complaints	Vinet a et al. (1986) House (1980)	Shirom et al. (1999) Nadeau (1990)	
Medicine use	Vinet et al. (1989)		
Physiological effects	Timio et al. (1979) Levi (1972)		
Effects of precarious employment			Quinlan et al. (2001)

Risk behavior, security and accidents

In a comprehensive literature study (70 references) Wright and Quinlan (2008) have investigated correlations between driver payment methods, remuneration and safety outcomes in the road freight industry. Their literature study shows that there is solid survey proof that links payment levels and payment systems to crashes, speeding, driving in fatigued condition and use of drugs.

Physical work load, exhaustion, injuries

Toupin et al. (2007) has measured productivity and physical workload among 38 Canadian brush cutters who were on piece rate pay. Results show that the studied piece rate system may lead the cutters to work in a way that may compromise their health and safety. The actual physical work load was in average twice as high as the recommended maximum value.

Health, musculoskeletal injuries and pains, occupational injuries

Wang et al. (2007) has investigated the correlations between work organization and the risk for musculoskeletal disorders among 314 female sewing machine operators in garment industry in Los Angeles, USA. Results show that operators on piece rate wages more often report pains. The risk for pains was more than doubled compared with operators on time based wages according to the following OddsRatio (OR). Neck, shoulders OR = 2.25, 95 % CI = 1.1-4.8. Back and hips OR = 2.54, 95 % CI = 1.3-5.2. Upper limbs OR = 2.94, 95 % CI = 1.1–8.0. Lower limbs OR = 2.69, 95 % CI = 1.0-7.4.

Severe disability and premature ageing

Vézina et al. (1989) studied premature ageing among a group of 800 Canadian female ex-sewing machine operators with more than 30 active years in their profession. The results showed that the risk of severe disability due to arthritic and osteoarticular disorders was 9 times higher among operators on piece work than among their colleagues on a time based pay. The number of years in piecework was related to the prevalence of severe disability

Early retirement

Szubert and Sobala (2005) have studied determinants of early retirement among 637 blue collar workers in Poland. A number of significant risk factors for early retirement were identified and quantified. Work in piecework system turned out to be strongest determinant with a risk factor (OR = 7.00, 95% CI = 2.01-24.37). The second strongest work related determinant was heavy lifting at work (OR = 2.24, 95% CI = 1.20-4.17).

Mental health and complaints

Shirom et al. (1999) studied emotional stress among 2 747 factory workers in Israel.

Workers on an individual performance-contingent pay system experienced higher levels of depression and somatic complaints compared to their fellow workers that were paid according to working hours.

Medicine use

Vinet et al. (1989) tested two hypotheses regarding piecework, repetitive work and medicine use in the Canadian clothing industry. Their hypotheses were that (1) piecework compared to time paid work would enhance medicine use and that (2) repetitive work also would enhance medicine use. The hypotheses were tested on 800 female sewing machine operators and the test showed that pieceworkers resulted an enhanced risk for using stomach medicine (OR = 2.57, 95% CI = 1.19-3.96). Repetitive work also clearly enhanced this risk (OR = 2.43, 95% CI = 1.26-3.60).

Physiological effects

Timio et al. (1979) present a study where 30 confectionary workers alternated between piece rate work and work with a fixed daily wage and where 30 metal workers alternated between paced assembly line work and work off the line. Free adrenaline and noradrenaline was measured during work. Work under time stress resulted in an increase with 450 percent for urinary free adrenaline and with 230 percent for noradrenaline.

Effects of precarious employment

Quinlan et al. (2001) has performed a literature study about the various effects of precarious employment. A total of 93 published articles, monographs or book chapters were reviewed. Precarious employment was associated with deterioration in occupational health and safety in 76 of these studies. The study shows that a significant part of temporary workers are on piece rate or similar wage systems.

Table 3. Studies of 200 persons or more and type of population

Author/authors (year)	Studied population (nr of persons)	Type of population
House (1980)	2 856	Tire, rubber, plastics and chemical workers
Shirom et al. (1999)	2 747	Various factory workers
Wrench and Lee (1982)	1 706	Textile and metal workers
Bejerot and Theorell (1992)	1 496	Dentists, dental nurses
Mason (1977)	1 430	Timber loggers
Lacey et al. (2007)	1 193	Various blue collar workers
McCurdy et al.(2003)	837	Agricultural workers
Brisson et al. (1992)	800	Textile workers
Vézina et al. (1989)	800	Textile workers
Vézina et al. (1987)	800	Textile workers
Vinet et al. (1989)	800	Textile workers
Vinet et al. (1986)	800	Textile workers
Weyman et al. (2003)	787	Coal miners
Szubert and Sobala (2005)	637	Various blue collar workers
Roquelaure et al. (2001)	537	Agricultural workers
Brisson et al. (1989)	533	Textile workers
Sundström-Frisk (1984)	422	Timber loggers
Lilley et al. (2002)	367	Timber loggers
Wang et al. (2007)	314	Textile workers
Nadeau (1990)	267	Textile workers
Mayhew and Quinlan (1999)	200	Textile workers

Table 4. Type of reported studies (in chronological order)

Type of study	Comparative studies	Case studies	Before/after studies	Literature studies
Retrospective	Lacey et al. (2007) Szubert and Sobala (2005) Roquelaure et al.(2001) Mayhew and Quinlan (1999) Shirom et al. (1999) Bejerot and Theorell (1992) Brisson et al. (1992) Nadeau et al. (1990) Brisson et al. (1989) Vézina et al. (1989) Vinet et al. (1989) Vézina et al. (1987) Vinet et al. (1986) Mason (1977)	Patterson (2007) Gravseth et al. (2006) Weyman et al. (2003) House (1980)	Blank et al. (1998) Sundström-Frisk (1984) Pettersson et al. (1983)	Wright and Quinlan (2008) Quinlan et al. (2001) Sundström-Frisk (1990)
Prospective	Wang et al. (2007) McCurdy et al. (2003) Lilley et al. (2002) Wrench and Lee (1982) Timio et al. (1979) Levi (1972)	Toupin et al. (2007)		

Conclusions

- Even though research still is sparse and fragmented much of the accumulated knowledge about the effects of piece rate work tell us that piece rates often have a negative effect on health and safety. **The fact that 27 of the 31 studied articles found negative effects of piece rates on different aspects of health and safety does not prove causality but they together give very strong support for the hypothesis that that piece rates in most situations have negative effects on health and safety.**
- In order to achieve better knowledge about the effects of piece rates in branches where piece rates are regarded problematic we conclude that further research is needed and that such research has to be designed to meet specific questions that are to be answered.

Fortsatt forskning?

- En retrospektiv studie i bygg- och anläggningsbranschen
- Syfte: Att ta fram ett faktabaserat underlag till parterna så att de kan utforma ett gemensamt handlingsprogram för ett hälsofrämjande byggarbete
- Enkätstudie med urval från AFA Försäkringars skaderegister
- Ca 5 000 skadade från den senaste tioårsperioden tillfrågas
- Ca 4 000 oskadade som referensgrupp
- Frågor inom tre områden: löneform, korta byggtider, arbetsledning
- Multivariat dataanalys
- 20-30 djupintervjuer kompletterar
- Finansiering från SBUF och AFA Försäkring
- Doktorandprojekt