Effect of job rotation on work demands, workload, recovery, musculoskeletal health and sickness absence: the Dutch Experience

Paul Kuijer¹,² & Monique Frings-Dresen¹

¹ Coronel Institute for Occupational and Environmental Health, AmCOGG, Academic Medical Centre/University of Amsterdam, The Netherlands
² EXPres, expertise centre for rehabilitation, ergonomics and sports, Faculty of Human Movement Sciences, Vrije Universiteit Amsterdam, The Netherlands
Thank you & Merci beaucoup !
Effectiveness of interventions to reduce workload in Dutch refuse collectors

- Association for Waste and Cleansing Management (NVRD)
- Association of Dutch Waste Management Companies (VNA)
- Dutch Health Research & Development Council/Medical Sciences (ZonMw)
My presentation

1. Short term effects:
   - Work demands, work load and recovery

2. Long term effects
   - Musculoskeletal complaints & sick leave

3. Three take home messages
Refuse collectors *all around the world* are at a high risk for the development of musculoskeletal complaints

(Verbeek 1991; Poulsen et al. 1995; Robazzi et al. 1997; Pimenta Velloso et al. 1997; Dorevitch & Marder 2001; Yang et al. 2001)
Is job rotation an effective ‘cure’?

Job rotation is often advocated to reduce the physical workload and the risk of musculoskeletal complaints but there seems to be little evidence...
Rotating between journalist & crime fighter

Yes, it is the Man of Steel, whose awesome super-powers have rung around the world! But he is also someone else...

I'd better hurry into my street clothes if I'm to keep my date with Lois!
Aim

Effect of job rotation between driving a refuse truck and collecting two-wheeled containers on:
• work demands
• workload,
• recovery,
• musculoskeletal complaints &
• sick leave due to musculoskeletal complaints
Collecting of two-wheeled containers in The Netherlands
Work demands, Workload & Recovery

Kuijer et al., Human Factors, 2004
Methods

Intervention study at three companies
• a team of three workers participated (n=9)
• four weeks:
  – only truck driving (one week),
  – only refuse collecting (two weeks)
  – rotating between driving and collecting (1:2) (one week)
Methods

Intervention study
• task analyses (real time observation)
• physical workload
  – heart-rate and %VO_{2max}
  – urinary excretion of noradrenaline (workday)
  – perceived exertion and fatigue
• mental workload
  – urinary excretion of adrenaline and cortisol (workday)
• recovery
  – urinary excretion of (nor)adrenaline (after work)
Work demands

The diagram shows the amount and number of work demands grouped by task type:
- Driving (d)
- Collecting (c)
- Rotating (r)

The bars indicate the amount in units of 10 (kg/num). The number of demands is also mentioned.
Physical workload

- HR workday
- %VO2max workday
- HR collecting
- %VO2max collecting

- Driving (d)
- Collecting (c)
- Rotating (r)

- d < c, r
- c > r > d
In conclusion: Job rotation is an effective measure to...

- reduce the physical work demands & workload, as compared to refuse collecting only
- reduce the mental work demands & workload as compared to truck driving only
- no effect was found on recovery

- However, job rotation resulted in an increase of the physical work demands workload compared to truck driving only...
Musculoskeletal complaints & Sick leave

Kuijjer et al., submitted / proceedings
Methods

Questionnaire survey:

- two measurements: $t_0$ and $t_1$ (12 months in between)

- three groups
  - non rotating refuse collectors at $t_0$ and $t_1$ (NR-NR) (reference group)
  - rotating refuse collectors at $t_0$ and $t_1$ (R-R)
  - non rotating refuse collectors at $t_0$ and rotating at $t_1$ (NR-R)

- visited 23 companies and asked 280 employees to participate
Methods

• Analysis
  • non-response at $t_1$
  • musculoskeletal complaints: prevalence rate ratio’s (PR)
  • (sick leave due) musculoskeletal complaints: prevalence ratio’s (PR)

• adjustment for possible confounding such as age, number of working hours per week or complaints at $t_0$
Methods

- independent variables
  - personal characteristics such as age & number of working years
  - job demands such as hours collecting and driving per day, working hours per week
- dependent variables
  - musculoskeletal complaints (yes/no; last 12 months) (Kuorinka e.a. 1987)
  - sick leave due to musculoskeletal complaints (yes/no; last 12 months) (Burdorf e.a. 1996)
Results

Response (all approached companies participated)

• $t_0$: 243 (87%)
• $t_1$: 66%
  • 63 from group R-R
    (rotating refuse collectors at $t_0$ and $t_1$)
  • 21 from group NR-R
    (non rotating refuse collectors at $t_0$ and rotating at $t_1$)
  • 46 from reference group NR-NR
    (non rotating refuse collectors at $t_0$ and $t_1$)
## Results: complaints and sick leave

<table>
<thead>
<tr>
<th></th>
<th>Group NR-NR (n=46)</th>
<th>Group NR-R (n=21)</th>
<th>Group R-R (n=63)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR</td>
<td></td>
<td>PR 95%CI</td>
<td>PR 95%CI</td>
</tr>
<tr>
<td><strong>Adjusted PRs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back</td>
<td>1.0</td>
<td>2.5 1.0 - 6.1</td>
<td>2.3 1.1 - 4.9</td>
</tr>
<tr>
<td>Neck</td>
<td>1.0</td>
<td>4.6 0.5 - 44.6</td>
<td>7.5 0.9 - 57.5</td>
</tr>
<tr>
<td>Shoulder</td>
<td>1.0</td>
<td>0.9 0.3 - 2.8</td>
<td>0.7 0.3 - 1.9</td>
</tr>
<tr>
<td>Hand/Wrist</td>
<td>1.0</td>
<td>1.1 0.3 - 4.5</td>
<td>0.4 0.1 - 1.8</td>
</tr>
<tr>
<td>Knee</td>
<td>1.0</td>
<td>1.1 0.3 - 4.4</td>
<td>1.7 0.6 - 4.8</td>
</tr>
<tr>
<td>Sick leave</td>
<td>1.0</td>
<td>1.1 0.4 - 2.6</td>
<td>1.1 0.5 - 2.3</td>
</tr>
</tbody>
</table>
How do we explain this?
Can job rotation increase the risk of low back complaints?

‘Yes’ reasons:

• peak versus cumulative mechanical load
  (Norman et al. 1998, Frazer et al. 2003)

• risk factors for back complaints
  • whole body vibration during driving
    (Burdorf & Sorock, 1997, Hoogendoorn et al., 1999, Bovenzi & Hulshof, 1999)
  • static body postures during driving
    (Burdorf & Sorock, 1997)
  • pushing & pulling no risk factor for back complaints
    (Hoozemans et al., 2002)
Can job rotation increase the risk of low back complaints?

‘No’ reasons:

• healthy worker selection effect in (non-rotating) reference group
  • Schibye et al., 2001
  • Lund et al., 2001
• unhealthy workers selecting effect in rotating group
• more complaints & no difference in sick leave
In conclusion: Job rotation …

• was associated with an increased risk of low back complaints
• had no effect on sick leave due to musculoskeletal complaints
What would you advise the Dutch refuse collecting companies?
Take home messages ‘job rotation’:

1. Reduce mechanical peak load before introducing job rotation

2. A large reduction in physical work demands does not imply the same linear reduction in workload or risk of musculoskeletal complaints

3. Rotate between tasks or activities that involve different types of workload or stress different body regions
Thank you for your attention!