

Hazards of the job

World at work: Refuse collectors

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A discussion of risks of the job and measures to protect the workers

Refuse is collected all around the world. The following collecting methods are mentioned in the literature:¹ bags (plastic and paper), bins (110–150 l), drums (110–210 l), two-wheeled containers (80–360 l), and four-wheeled containers (300–1800 l). Over all, the job of a refuse collector can be characterised by frequent lifting, carrying, pushing, and/or pulling of heavy objects. In the Netherlands, most production systems to collect domestic refuse make use of a closed refuse truck with an automatic lifting device to empty two-wheeled containers (fig 1) or four-wheeled containers (fig 2).^{2,3} Only in a few parts of the Netherlands, especially in city areas where households have no space to place a container, are bags collected.⁴ In general, the wheeled containers are collected by a team of a truck driver and one or two refuse collectors. Table 1 presents the time spent on the different tasks and activities.² An average work day of a refuse collector lasts about 8 hours (range 6–12). A refuse collector of two-wheeled containers collects about 11 000 kg of refuse per day, and a refuse collector of four-wheeled containers about 14 000 kg. This is about 500 (22 kg of refuse per container) two-wheeled containers and 130 (110 kg of refuse per container) four-wheeled containers each day. In general, a refuse collector pushes and pulls one two-wheeled container at a time. Pulling of the two-wheeled container is often done with one hand behind the back. A four-wheeled container is in general transferred by two persons.²

The work is mainly performed by male employees, although there are also some female employees in the Netherlands. The aerobic power of a refuse collector does not differ from workers without physically demanding tasks.⁵ Refuse collectors seem to have larger muscle strength compared to workers without physically demanding tasks. This may be due to a training effect or due to "a healthy worker selection effect".⁵

HAZARDS OF THE JOB AND IN THE WORKPLACE

Occupational accidents

Refuse collectors are at a high risk for fatal and non-fatal occupational

accidents. In 1998 the United States Bureau of Labor Statistics reported that US refuse collectors experienced 48.8 fatalities per 100 000 workers in 1996, and that refuse collecting was the seventh riskiest occupation in the USA.⁶ An analysis over the period 1992–97 yielded an occupational fatality rate of 46 per 100 000 refuse collectors. This rate is about 10 times higher than the overall fatality rate in the USA.⁷ For instance, in 1998 the US Bureau of Labour Statistics showed that 42 refuse collectors were killed on the job in 1998.⁷ Transportation incidents accounted for about 70% of these deaths. The second most important cause of death (19%) was "contact with object/equipment". In Denmark, no fatal accidents were reported in the period 1989–92.¹ No other data on fatal accidents were found. For non-fatal accidents, the incidence rate of occupational accidents was at least 95 per 1000 employees per year among Danish refuse collectors and 17 per 1000 in the total workforce according to the Danish Registry of Occupational Accidents and Diseases.¹ A more detailed study at a single Danish company in 1993 showed that of the 667 employees, 114 experienced an injury: an incidence rate of occupational accidents of 170 per 1000 employees per year.⁸ Another Danish study reported 178 accidents among 210 refuse collectors in 1992: an incidence rate of occupational accidents of 847 per 1000 employees per year.¹ For the USA, Dorevitch and Marder⁷ reported the number of compensation claims for the municipal refuse collectors in Cincinnati in the period 1965–67 and of two private companies in San Francisco in 1982: 284 and 467, respectively. Unfortunately, no data are presented of the population at risk. In Brazil, a study performed in a medium sized town of about 500 000 inhabitants reported 103 occupational accidents among 81 refuse collectors over a period of 12 months: an incidence rate of more than 1200 per 1000 employees per year.⁹ Another Brazilian study reported an incidence rate of occupational accidents of about 700 per 1000 refuse collectors per year.¹

The type of injuries and the causes seem to vary by country, based on

studies from Brazil,^{9,10} Denmark,⁸ Taiwan,¹¹ and the USA.^{6,7} For instance, the percentage of fractures among the medical diagnoses of the occupational accidents seems to be higher in Brazil (5%) and the USA (5–7%) than in Denmark (1%). No data were available in the Taiwanese study. Also, the percentage of cutting injuries among the causes of the occupational accidents seems to be much higher in Brazil (29–31%), Taiwan ("37% of the refuse collectors had a injury caused by a sharp object in the last 12 months"), and the USA (11–31%) than in Denmark (4%). In general, the body parts most often injured were the back, arms, and legs. In the different studies, the injury types mentioned in more than 10% of the cases were strains/sprains, contusion, cutting injury, tenosynovitis, laceration, twisting, and soft part injury. The causes mentioned in more than 10% of the cases were "fall or slip injury", "struck or injured by goods, vehicles or objects", "cutting or perforating objects", and "overloading of the body". One study showed a decrease in the number of injuries with increasing seniority.⁸ In a Canadian study, about the same result was found.¹²

Musculoskeletal complaints

Studies on health complaints among refuse collectors in Brazil,^{9,10} Denmark,^{1,8,13} Taiwan,¹¹ the Netherlands,^{14,15} and the USA^{6,7} reported an increased risk for musculoskeletal complaints. The body region most affected is the low back. Other frequent affected areas are the shoulder, knee, and neck, depending on the method of collection. The high biomechanical workload in refuse collecting is seen as an important risk factor for these musculoskeletal complaints. The following risk factors are present.

Lifting

A study on the biomechanical workload while lifting an empty four-wheeled container from the street to the sidewalk showed that peak compression forces on the low back exceeded the NIOSH limit of 3400 N by far.¹⁶ The same kind of results were found for lifting of bags, bins, and drums.^{16,17}

Pushing and pulling

Studies on the biomechanical workload during pushing and pulling of two-wheeled and four-wheeled containers reported relatively low compression forces on the low back, varying between about 400 N and 2800 N.^{16–19} Only in the case that a four-wheeled container with a total weight of 385 kg was pulled¹⁶ and a two-wheeled container with a total weight of 74 kg was pulled and



Figure 1 Collecting of two-wheeled containers.

pushed,¹⁹ was the NIOSH criterion of 3400 N exceeded. Two studies also quantified the shoulder load while collecting two-wheeled containers.^{17, 19} Although no comparable limit exists for shoulder load as for low back load, both studies rated the shoulder load as relatively low during pushing and pulling. Despite the low intensity of the low back and shoulder load, work practise guidelines regarding push and pull forces are exceeded.¹⁹ Moreover, pushing and pulling of containers is performed day after day, year after year. Besides, pushing and pulling is seen as a risk factor for shoulder complaints rather than for low back complaints.²⁰

Whole body vibration

Whole body vibration is seen as an important risk factor for back complaints.²¹ Not only the truck driver, but also the refuse collectors are exposed to whole body vibration while sitting in the refuse truck or standing on the riding steps at the back of the truck. Unfortunately, no specific study was found that actually quantified the exposure for driving a refuse truck. The exposure might be higher than in a normal truck due to, for instance, the mechanical system that empties the wheeled container, the mechanical compression of the collected refuse in the cargo space, and the fact that city streets are often less smooth than asphalt roads.

Fatigue complaints

Several studies from different countries reported that the energetic workload



Figure 2 Collecting of a four-wheeled container.

limit of 30% $\dot{V}O_{2max}$ for an eight hour working day is exceeded for collecting two-wheeled containers and for collecting bags and bins.^{1-4, 22, 23} In general, the energetic workload is higher during the collecting of bags and bins than during the collecting of two-wheeled and four-wheeled containers. In the Netherlands, the energetic workload limit is not exceeded for collecting four-wheeled containers.² Despite these results, no studies were found on fatigue complaints on a long term basis.

Respiratory complaints

Refuse collectors have an increased risk of respiratory and influenza like symptoms.^{1, 24, 25} Refuse collectors are exposed to microbial agents, irrespective of the refuse they collect. Despite the low levels of exposure, a respiratory inflammatory

response is measurable.²⁶ Exposure to fungal spores, β (1→3)-glucans, and endotoxin probably results in the respiratory inflammatory response.²⁷ The implications of chronic inflammation in the nose and subsequent nasal symptoms are not yet known but need to be established.^{26, 27}

Gastrointestinal complaints

A high frequency of gastrointestinal problems has been reported for refuse collectors,^{1, 25} especially in the summer.²⁸ The wet biological fractions of refuse—that is, garden waste, and the degradable fraction of household refuse, are responsible. An exposure-response relation was found among refuse collectors between nausea and endotoxin exposure, and between diarrhoea and exposure to both endotoxins and viable fungi.²⁹

Table 1 Mean (SD) of the duration of the most important tasks and activities for refuse collectors of two-wheeled and four-wheeled containers in the Netherlands²

	Two-wheeled containers		Four-wheeled containers	
	Mean	SD	Mean	SD
Tasks (minutes)				
Collecting	287	57	342	30
Driving	78	27	100	9
Dumping	11	9	13	9
Pausing	99	29	62	9
Activities (minutes)				
Standing	70	28	65	8
Walking	68	22	61	8
Sitting	158	136	256	30
Handling of bags	1	1	6	1
Pushing full container	27	9	6	2
Pushing empty container	6	5	3	2
Pulling full container	27	12	12	2
Pulling empty container	20	8	8	3

Table 2 The Dutch guideline for refuse collectors of two-wheeled containers, subdivided in three age categories

Age of the refuse collector	Maximum amount of refuse (kg)	Maximum number of two-wheeled containers	Maximum number of hours collecting
<30 years	11300	514	5.5
30–39 years	8300	377	4.0
>39 years	5200	236	2.5

The maximum amount of refuse, the maximum number of two-wheeled containers, and the maximum number of hours collecting, may not be exceeded during an eight hour working day.³⁰

Hearing complaints

The noise limit of 80 dB(A) for an eight hour working day was exceeded while collecting refuse in the Netherlands.¹⁴ The average noise level (SD) for collecting two-wheeled containers, four-wheeled containers, and bags was 94.7 dB(A) (2.9), 96.4 dB(A) (1.5), and 92.4 dB(A) (5.3), respectively. In the same study, about 85% of the refuse collectors of two-wheeled containers, 50% of the refuse collectors of four-wheeled containers, and 65% of the refuse collectors of bags complain about the high noise level. No study has been found that quantified the hearing loss among refuse collectors.

MEASURES TO PROTECT THE WORKER

Measures to increase safety

There are numerous safety measures, for instance:^{7–9}

- Reduction in working speed
- Training and instruction of refuse collectors
- Protective clothing (including retro reflective striping) and shoes
- Properly positioned riding steps, that are slip resistant, strong enough, and large enough, and properly

placed grab handles should be present

- Camera on the back of the refuse truck to maintain visual contact between the driver and the collectors
- Automatic speed reduction to 30 km.hour⁻¹ while a refuse collector is standing on the riding step at the back of the truck
- An audible warning when the truck is operating in reverse
- Regulations and administrative control.

Measures to reduce the risk of musculoskeletal and/or fatigue complaints

The following measures to reduce the physical workload among refuse collectors have been evaluated and seem to be effective:

- Job specific guideline for refuse collectors regarding maximum production limits (table 2)³⁰
- Job rotation between collecting bags, sweeping streets, and driving a sweeping machine³¹
- Job rotation between collecting two-wheeled containers and driving a refuse truck¹⁵

- Replacement of bags and bins with wheeled containers^{16, 17}
- Increasing the number of two-wheeled containers at a refuse collecting point from 2 to 16 or 32³²
- Removing kerbs or obstacles at places where wheeled containers are collected¹⁹
- Surfaces of flagstones instead of paving stones or grass at places where wheeled containers are collected¹⁸
- A two-wheeled container with a centre of mass closer to the wheel axis, larger wheels and higher handles compared to a standard two-wheeled container^{19, 33}
- Transferring a four-wheeled container by two persons instead of one¹⁶
- At least a 10 minute rest break per hour while collecting four-wheeled containers.³⁴

An intervention that reduces both peak and cumulative load is probably most effective to prevent the onset of complaints.

Measures to reduce the risk of respiratory and gastrointestinal complaints

- Prevention of exposure can be achieved by using refuse trucks with a high loading for two-wheeled and four-wheeled containers. When the scoop is situated on the top (about 4 metres above the ground), the “cloud” of organic dust is well away from the breathing zone of the refuse collectors and their personal exposure to microorganisms is low. Reducing the exposure by means of job rotation between collecting and driving is not seen as an adequate measure.

Measures to reduce the risk of hearing complaints

- In the Netherlands, employees are obliged to wear personal protective hearing devices above noise levels of 85 dB(A). By using custom moulded hearing protectors with an adequate attenuation filter, so called otoplastics, communication is still possible and other relevant sounds, for instance of traffic, can still be heard.

New collection methods

In recent years, two promising new collecting methods have been introduced, namely an underground storage system (fig 3) and an automated collection system of two-wheeled containers (fig 4). The underground storage system is a sort of dustbin on the street with a large depot underground. Citizens carry their own refuse to the underground



Figure 3 An example of an underground storage system.



Figure 4 An example of a refuse truck with an automatic side collection system.

storage system. The large depots are emptied with the use of a crane on a refuse truck. In the automated collection system of two-wheeled containers, a mechanical arm on the refuse truck picks up a two-wheeled container, empties it, and puts it back on the street. In some cases, a refuse collector walks beside the refuse truck to position the two-wheeled containers in the right way. In general, these new production systems can be considered huge improvements with respect to physical, respiratory, and auditory work demands. However, these new ways of collecting also bring new health risks. Frequent joy-stick use to position the mechanical arm and the crane may increase the risk of work related upper extremity disorders. The increase in the time driving may increase the risk of back complaints due to whole body vibration. Moreover, a solitary function

as a driver/operator may lead to complaints due to an increased psychosocial workload.

Periodic health surveillance

Despite the initiatives to further improve the working conditions, it is unlikely that all health risks can be eliminated. Specific occupational demands remain present in the job of refuse collector.³⁵ Therefore, specific periodic health surveillance (PHS) for refuse collectors has been developed in the Netherlands. The aim of the PHS is on the one hand to detect early signs of work related disease and on the other hand to monitor the work ability of the refuse collector on a regular basis. The PHS consists of: (1) a questionnaire concerning work ability, work demands, occupational hazards, and related health complaints such as musculoskeletal and respiratory disorders; (2) general health tests such as tests for measuring the pulmonary function, blood pressure, hearing, and seeing; and (3) specific tests to measure the physical workload

Main messages

- Refuse collectors are at risk for fatal and non-fatal occupational accidents.
- Refuse collectors have an increased risk for musculoskeletal and hearing disorders due to the high physical workload and the high noise levels.
- Refuse collectors have an increased risk of respiratory and gastrointestinal complaints due to exposure to microbial agents in the organic dust. The long term effects are still unknown.

Policy implications

- To reduce the risk of occupational accidents and work related diseases, several effective and feasible measures are available.
- A job specific periodic health surveillance for refuse collectors should be obligatory to detect early signs of work related disease and to monitor the work ability of the refuse collector.

during the working day on the basis of the heart rate and to establish the maximum voluntary lift and pull strength.³⁵ The PHS should be performed at entrance and at least every four years for refuse collectors of 18 years and older, and at least every two years for refuse collectors of 52 years and older. This is in agreement with PHS regulations in the Dutch building industry.

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