



The health effects of the exposure to vibration due to trains: a longitudinal study

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ABSTRACT

Of the 4927 participants in a survey into the health effects of vibration from trains held in 2013, 1349 participated in a repeated measurement in 2019. Participants were 16 years and older, and were living in the Netherlands within 300 meters from a railroad track. 40% of these residents experienced highly annoyance from vibrations and 30% experienced highly sleep disturbance from vibrations caused by trains in general. Only for passenger trains an increase was observed in the percentage highly annoyed and highly sleep disturbed, while the figures for cargo trains are stable over time.

INTRODUCTION

The health effects of vibrations due to trains have been rarely studied among residents. In order to gain more insight in the type and size of these effects and in whom these do occur, in 2013 a survey was held by RIVM among 4,927 people of 16 year and older living within 300 meters from a railroad track in the Netherlands. Information was gathered by means of a questionnaire about annoyance, sleep disturbance, self-reported health, and their determinants. 16.000 participants were recruited by a postal invitation. Their addresses were selected on the basis of distance to the railroad track, building year of the dwelling, and soil type. Situational factors were also accounted for such as train intensities and situational and contextual factors such as the number and types of trains, and speed. Based on the results, it was estimated that on average 20% of the people in the Netherlands of 16 years and older living within 300 meters from the railroad track experienced highly annoyance from vibrations

caused by trains. By far the largest part of annoyance is reported in relation to vibrations due to cargo trains: about 22,7% of the people in the Netherlands of 16 year and older living within 300 meters from the railroad track was highly annoyed by vibrations due to cargo trains; only 3% was highly annoyed due to vibrations from passenger trains. For highly sleep disturbance, similar observations were done: based on the survey, it was estimated that on average 16.3% of the people in the Netherlands of 16 years and older living within 300 meters from the railroad track was highly sleep disturbed by vibrations due to cargo trains; about 3,6% was highly sleep disturbed due to vibrations from passenger trains[1,2].

In 2019 the Dutch Ministry of Infrastructure and Water management asked RIVM to carry out a repeated measurement among people who participated in the study "Living Along the Railroad" in 2013, who had indicated that they could be re-approached. This is a prerequisite in view of current privacy regulations. One of the main aims of this repeated measurement was to monitor railway related annoyance and sleep disturbance as well as self-reported health.

This paper focusses on annoyance and sleep disturbance as main outcomes of exposure to vibrations from cargo and passengers trains.

Aim

This paper addresses the following main questions:

1. What is the estimated extent of the percentage highly annoyed and highly sleep disturbed due to vibrations from trains in the group of people that has been investigated in 2013 and 2019?

This implies that we do not strive for a representative sample and a generalization (in terms of weighing) of the total population. In this repeated measure we compare participants with themselves in order to monitor trends in context, exposures and effects .

2. Has the percentage highly annoyed and highly sleep disturbed due to vibrations from trains changed in the period between 2013 and 2019?

METHOD

Of the 4927 people who participated in 2013, 3421 indicated that they would be willing to participate in a follow up study. In the fall of 2019, they were invited to fill in an online questionnaire or a written questionnaire at request. Two reminders were sent.

Questionnaire, measurement of annoyance and sleep disturbance

The questionnaire used in the study of 2019 was a shorter version of the one used in 2013 [1-3].

Annoyance was measured by the ISO standard 11-point scale [4]. (ISO, 2003) asking "*to what extent people were annoyed, bothered or disturbed in the past 12 months by vibration from rail traffic noise while at home*". Participants with score 8, 9 or 10 were considered to be highly annoyed.

Sleep disturbance was measured with a question based on the ISO standard question, asking “to what extent the sleep was disturbed by vibration from rail traffic in the past 12 months while at home”. The question was asked for trains in general and for passenger, cargo trains and maintenance and other railroad related activities separately. Answers could be given on an 11 point scale (0-10) ranging from not at all to very much. Here participants with score 8, 9 or 10 were considered to be highly sleep disturbed.

RESULTS

Participants

In total, 1349 participants (40%) of the 3421 people who were invited completed the questionnaire in 2019.

Table 1: study population characteristics

Study population characteristic	Participants in 2013 (N=4.927)	Invited in 2019 (N=3.421)	Participants in 2019 (N=1.349)
	%	%	%
Age (yrs)			
16-44	33	34	22
45-64	44	45	55
65 and older	23	21	23
Sex			
Men	53	55	58
Women	47	45	42
Educational level*			
Low	3	2	1
Medium I	21	19	18
Medium II	30	31	31
High	46	48	50
Home owner	69	72	81

Table 1 presents some characteristics of the participants measured in 2013, for the selected participants who were invited for the repeated measurement and the participants in 2019. This shows that the participants in 2019 did not differ significantly from those in 2013 on crucial factors. The mean age of the participants is respectively 51, 52 and 55 years. The percentage highly educated is relatively high for all groups respectively 46, 48, 50%. Also, home ownership is relatively high and increasing from 67 to 81% among the participants.

The percentage highly annoyed due to vibrations from trains

Figure 1 compares the percentage highly annoyed due to vibration of cargo and passenger trains in 2013 and 2019. Results show that the percentage of participants who were highly annoyed due to vibration of cargo trains was 43% in both years (2013 vs 2019). An increase in the percentage highly annoyed from 8% to 20% due to vibrations of passenger trains is observed.

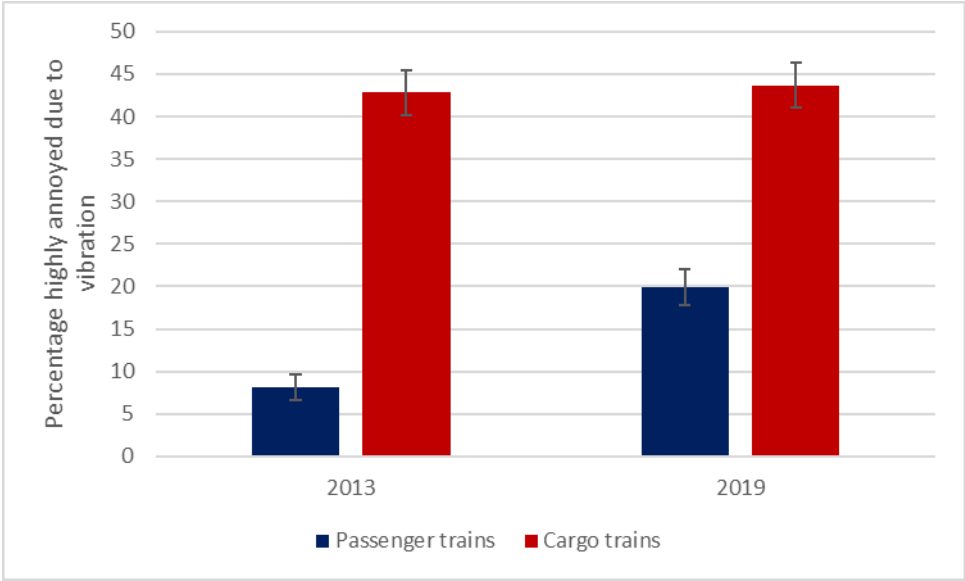


Figure 1: Percentage highly annoyed form cargo trains and passenger trains between 2013 and 2019.

The percentage highly sleep disturbed due to vibrations from trains

Figure 2 shows the percentage highly sleep disturbed due to vibrations from cargo and passenger trains separately. The same pattern can be observed as in figure 1. The percentage highly sleep disturbed due to cargo trains was 30% in 2013 and 32% in 2019. For passenger trains the percentage highly sleep disturbed increased from 6,4% in 2013 to 11,4% in 2019.

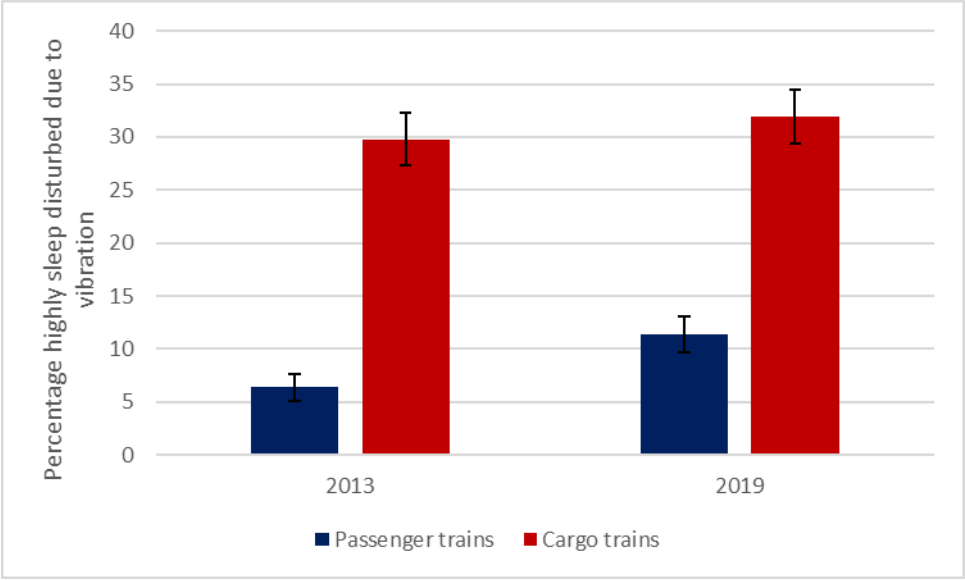


Figure 2: Percentage highly sleep disturbed from cargo trains and passenger trains between 2013 and 2019.

CONCLUSIONS

By conducting the repeated measurement, participants were compared with themselves in the context of monitoring.

The repeated measurement of 1349 participants examined how reactions to train vibrations, in terms of annoyance and sleep disturbance have developed in the past six years (2013-2019). Although cargo trains cause the highest percentages of highly annoyed and highly sleep disturbed, the percentages are stable over time. For passenger trains, however, there has been an increase from 8% to 20% for the highly annoyed and from almost 6% to 11% for the highly sleep disturbed.

FUTURE ANALYSIS

Possible explanations for the changes in the experience of highly annoyance and sleep disturbance due to vibration of passenger trains are still being explored. Factors other than exposure are also taken into account. These will be shown at the conference.

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