Job-specific workers’ health surveillance for construction workers
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Response rate of bricklayers and supervisors on an internet or a paper-and-pencil questionnaire.

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Abstract

It is unclear whether or not internet surveys yield response rates comparable to paper-and-pencil surveys for specific occupational groups, such as construction workers. The objective of this study was to examine the differences in response rates between a paper-and-pencil-questionnaire and an internet questionnaire for two construction-related occupations: bricklayers and supervisors. In total 600 participants were randomly assigned to the internet questionnaire survey or to the conventional paper-and-pencil questionnaire survey. Undeliverable postal was excluded from the response rate. A total of 237/590 subjects responded, leading to a response rate of 40% across both arms of the study. Total response rate in the paper-and-pencil questionnaire group (45%, 131/293) was significantly higher (Chi-Square = 4.99, p = 0.025) than in the internet questionnaire arm (36%, 106/297). Among bricklayers, the response rate on the paper-and-pencil questionnaire (44%, 64/147) was significantly higher (Chi-Square=7.36, p = 0.007) than on the internet questionnaire (28%, 42/148). For construction supervisors response rates were not different for both arms of the study, 46% (67/146) on the paper-and-pencil questionnaire and 43% (64/149) on the internet questionnaire. Overall, a paper-and-pencil questionnaire is more effective in terms of response rate than an internet questionnaire in a random sample of two construction professions.

Relevance to industry: Questionnaire surveys play an important role in gathering information on interventions aimed at reducing occupational risks and health effects for construction workers. The most effective survey mode should be explored before a large scale survey is carried out.
Introduction

Traditionally, written questionnaire surveys play an important role in occupational health care research. Potentially, electronic health care surveys using the internet could reduce time and costs and could enhance response rates. However, a lack of access to an internet-connected computer might negatively influence the response rate of internet surveys. In the Netherlands, this problem has been rapidly resolved: in October 2009 93% of all Dutch residents had access to the internet.

Therefore, it is obvious that in modern, efficient occupational health care the use of information and communications technology (ICT) should be considered. But whether or not an internet survey is the right method for examining employee populations is unclear. On the one hand, a meta-analysis has shown that internet surveys in general yield a lower response rate, but employees are actually found to be more willing to respond to internet surveys. On the other hand, socio-demographic factors that relate to respondents’ internet resources such as computer skills and age, can affect respondents’ willingness to do an internet survey. Intuitively it makes sense to assume that there might be differences in response rate among various occupations in which those factors may play a role.

In order to explore this assumption in more detail, we examined a branch which has often been the focus of occupational health care and intervention research: the construction industry. Surveys of construction workers have traditionally relied on paper-and-pencil questionnaires and thus far – as far as the authors know - no attempts have been made to compare internet and paper-and-pencil questionnaires for construction workers. It could be argued that several barriers might affect the response rate on an internet questionnaire. For example, most construction workers have had a professional training, but no higher education. Their familiarity with computers and internet usage is likely to be lower than for the general population. Nevertheless, the typical “construction worker” does not exist because of the wide variety of occupations with different levels of education. Physically demanding occupations, such as bricklaying are widely represented, but more manager-like and higher educated occupations, such as construction supervisor, also exist. This diversity in workers within the construction industry should be taken into account when evaluating the most effective way of administering occupational health questionnaires in this field.

The present study therefore examines differences in response rates concerning a paper-and-pencil-questionnaire and an internet questionnaire for two construction occupations: bricklayers and supervisors. As age is a known factor affecting response rate, we also examined differences in age of the respondents of the two different survey methods. We hypothesized that there would be no differences in response rate, between both questionnaire modalities or between both occupations.
The present study is part of a larger research effort in which the main objective is to survey physical, environmental and psychosocial factors among 3000 construction workers and possibly related health effects. Based on this information, preventive measures can be selected that are most likely to tackle job-specific risk factors and health effects. When evaluating the effectiveness of these preventive measures, offered to the workers in a workers’ health surveillance, questionnaire surveys will be used in order to monitor the workers.

**Methods**

**Design**

We performed a parallel group randomized experiment in a Dutch population of bricklayers and construction supervisors. In October 2009, we randomly selected 600 construction workers, 300 bricklayers and 300 construction supervisors, from a Dutch registry comprised of all employed Dutch construction workers. Home addresses were taken from the registry. Half of the participants (150 bricklayers and 150 construction supervisors) were randomized to the internet questionnaire survey, and half to the standard paper-and-pencil questionnaire survey. Participants were blinded to the randomized nature of the study. No further criteria of randomization were imposed. The study was powered to 80% to detect a 10% difference in response rates (35-45%) at an alpha level of 0.05 among both occupations. The survey was performed from November to December 2009.

**Paper-and-pencil**

All participants in the paper-and-pencil group received a sealed envelope at their home address containing the following items: a postal card with the invitation to participate in the questionnaire survey, a 24-page coded questionnaire and a stamped, self-addressed envelope. The questionnaire contained an introductory page with more extensive information concerning the study. The questionnaire contained questions on personal and job characteristics, such as occupation during the last year and age, work ability, recovery from workdays, fatigue during work, safety issues, psychosocial work characteristics and psychosocial well-being. On the last page, we asked the paper-and-pencil-group whether or not they would have liked to fill in the questionnaire by using a computer and the internet (“Would you have liked to fill in this questionnaire by using a computer and the internet?”). This question could be answered with a “yes” or a “no”. Completing the questionnaire took approximately 15 minutes. Participants were asked to fully complete and return the questionnaire within two weeks. All participants received a lottery ticket. One reminder containing a postal card was sent to all participants after one week.
Internet
All participants in the internet questionnaire group received a sealed envelope at their home address containing a postal card with an invitation to participate in the questionnaire survey, the web-address of the link to the questionnaire, a login name (one letter and 3 digits) and password (two digits and one letter). The content for both questionnaires was identical, but in the last section of the internet questionnaire participants were asked whether or not they would have liked to fill in the questionnaire by using paper-and-pencil (“Would you have liked to fill in this questionnaire by using paper-and-pencil?”). Furthermore, we asked the internet group for experienced drawbacks of the internet questionnaire. Questions were presented screen-by-screen. Completing the questionnaire took approximately 15 minutes. Participants were asked to fully complete the questionnaire within two weeks. All participants received a lottery ticket and one postal card reminder containing each potential participant’s login name and password after one week.

A website was created from which the participants could easily access the questionnaire. The internet survey application was purchased from a commercial company. This company provided the tailored online questionnaire application and the hosting. Identity of respondents was ascertained through login and password.

Statistical Methods
The primary analysis was concerned with comparing response rates between both types of questionnaires using Chi-Squared tests. Secondary, we tested i) for differences in age between responders on the questionnaire modalities using a Mann-Whitney U test and ii) for differences in age across all four groups using a Kruskall-Wallis test. Furthermore, we compared respondents’ opinions on the internet questionnaire between both occupations. Undeliverable postal was excluded from the response rate. Statistical significance was set to an alpha level of 0.05.

Results
In Figure 1, the inclusion and exclusion of participants is shown. From the 600 postal items that were initially sent, 10 were returned as undeliverable. Participants who had not worked as either a bricklayer or construction supervisor during the last year, were excluded. In Table 1, the respondents’ characteristics are shown. All respondents were male.

Paper-and-pencil surveys versus internet surveys
After three weeks 40% (237/590) of the potential respondents completed the questionnaire. The total response rate was 45% (131/293) in the paper-and-pencil questionnaire arm and
36% (106/295) in the internet questionnaire arm. The difference in response rates between both arms was statistically significant (Chi-Square = 4.99, p = 0.025). There was no difference in age of the respondents between both questionnaire modalities (p = 0.441).

Table 1: Respondents’ characteristics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bricklayers Paper-and-pencil</th>
<th>Bricklayers Internet</th>
<th>Construction supervisors Paper-and-pencil</th>
<th>Construction supervisors Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=64</td>
<td>n=42</td>
<td>n=67</td>
<td>n=64</td>
</tr>
<tr>
<td>Age (years)</td>
<td>median: 48</td>
<td>46</td>
<td>48</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>range: 19-62</td>
<td>17-60</td>
<td>25-63</td>
<td>28-63</td>
</tr>
<tr>
<td>Years employed in construction industry</td>
<td>median: 31</td>
<td>29</td>
<td>31</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>range: 3-44</td>
<td>2-45</td>
<td>3-47</td>
<td>3-47</td>
</tr>
<tr>
<td>Years employed in current occupation</td>
<td>median: 21</td>
<td>7</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>range: 2-44</td>
<td>1-39</td>
<td>2-35</td>
<td>1-43</td>
</tr>
</tbody>
</table>

**Bricklayers versus construction supervisors**

A total of 36% (106/295) of the bricklayers responded to the survey. Of the bricklayers in the paper-and-pencil arm, 44% (64/147) responded compared to 28% (42/148) in the internet arm. The response rate among bricklayers in the paper-and-pencil arm was statistically significantly higher than the response rate in the internet arm (Chi-Square = 7.36, p = 0.007). A total of 44.4% (131/295) of the construction supervisors responded, with 46% (67/146) completing the paper-and-pencil survey and 43% (64/149) completing the internet survey. No difference was found between both survey modalities among the construction supervisors.
supervisors (p=0.611). In the internet arm, a statistically significantly greater number of construction supervisors responded as compared to bricklayers (Chi-Square = 6.87, p = 0.009). There was no difference in age of the respondents across the four groups (p = 0.114).

**Opinions on the internet questionnaire**

In the paper-and-pencil surveys 70% (82/117) of the respondents stated that they did not like to complete the questionnaire through the internet. For the internet arm, 97% (91/94) preferred the internet questionnaire as compared to 3% (3/94) who did not like to fill in a paper-and-pencil version, all of them bricklayers. The internet respondents named the following advantages for using the internet: user-friendly (68%, 64/94), speed (57%, 54/94) and no need to return the questionnaire by mail (48%, 45/94). Other points of appreciation included the fact that internet-based surveys use modern technology (41%, 39/94) and are a paper-saving method (38%, 36/94). Four respondents (4%) did not report any advantages.

When asked about drawbacks experienced during completion of the internet questionnaire, 8 respondents (9%) named the login procedure and use of a password, 15% (14/94) mentioned the high frequency of mouse clicking and 2 respondents (2%) did not find the internet questionnaire pleasant to read from screen. Other experienced drawbacks included the following: no possibility to add text when one feels the need to do so, no indication of the number of questions remaining in the survey and difficulties with accessing the questionnaire. A total of 70% (66/94) of the respondents did not report any drawbacks to the internet version.

**Discussion**

This study found a higher response rate when using a paper-and-pencil questionnaire as compared to an internet questionnaire in a randomly selected sample of construction workers consisting of bricklayers and construction supervisors. In fact, the number of bricklayer responses for the paper-and-pencil questionnaire was higher than the number of bricklayer responses for the internet version. For construction supervisors, response rates for the two survey modalities were not statistically different. Cook et al.\textsuperscript{14} conducted a meta-analysis of response rates in internet based surveys and they found a mean response rate of 34.6% (SD 15.7). Our overall response rate of 36% on the internet questionnaire is comparable. The result for the bricklayers is consistent with the findings in reviews conducted on this topic.\textsuperscript{12,15} Shih and Fan (2008) reported an 11% lower response rate for internet surveys compared to paper-and-pencil surveys based on a meta-analysis. When the paper-and-pencil respondents in the present study were asked whether they would have liked to complete the questionnaire by using a computer and internet, only 27% (35/131) reacted positively. However, in the internet arm of this study almost all respondents (97%, 91/94)
preferred the internet questionnaire over a standard paper-and-pencil survey. This trend is also seen in the study of Kongsved et al.\textsuperscript{16} It must be noticed that the paper-and-pencil group had to decide on something they might not have ever seen before. Therefore, the choice of the paper-and-pencil group cannot be regarded as a ‘preference’. In this perspective it could be argued that the response rate might be increased by giving the respondents a choice of response mode, but Fricker and Schonlau\textsuperscript{12} indicated that allowing respondents to choose between survey modes does not lead to a higher response rate.

Educational level might have played a role in the difference in response rates between the questionnaire modalities. In general, non-responders tend to be lower educated, regardless of the survey modality.\textsuperscript{17,18} We did not question the educational level, but the present-day construction supervisors tend to have Higher Vocational Education. In the present study, however, no difference was found in response rate between bricklayers and the supervisors on the traditional paper-and-pencil questionnaire. The difference in response rate between both occupations, and thereby indirectly in computer skills, was limited to the internet questionnaire.

A lack of user friendliness due to the presentation of the internet questionnaire and the log-in procedure could be a disadvantage for the internet questionnaire.\textsuperscript{8} Furthermore, both the paper-and-pencil group and the internet group were initially requested by postal card to participate. According to the meta-analyses of Manfreda et al.\textsuperscript{6} this way of inviting respondents might have led to a 15% lower response rate on the internet questionnaire. Subsequently, age is frequently mentioned as a factor affecting participation in internet surveys.\textsuperscript{8} Even after controlling for internet access and computer skills, age still affects respondents’ willingness to participate in an internet survey.\textsuperscript{8} However, in the present study there was no difference in age among the respondents on both questionnaire modalities, nor was there a difference in age across all four groups. The median of the age of the whole population from which the random sample was drawn, was 49 (range 19-65) years for the supervisors and 46 (range 17-64) years for the bricklayers. The age of the respondents in the present study was not different from the age of the population as a whole.

An interesting issue is that in the supervisor group only two non-supervisors filled in the paper-and-pencil survey while ten did so in the internet survey. In the internet survey, we asked the respondents’ occupation (Are you currently working as a bricklayer/supervisor? yes/no) in the first screen. When a respondent clicked ‘no’, a screen was displayed with a notification that the respondent was mistakenly invited for the survey and that they did not have to fill in the questionnaire. Access to the internet questionnaire was denied for those respondents. We printed the same message on the first page of the paper-and-pencil questionnaire. However, many supervisors wrote down a more comprehensive description of their occupation and filled in the paper-and-pencil questionnaire. For example: assistant
supervisor, chief supervisor, supervisor demolition works, supervisor paintworks, etc. Probably, comparable supervisors in the internet group answered ‘no’ when asked whether or not they were currently working as a supervisor and consequently did not have the possibility to fill in the questionnaire.

A plausible explanation for the difference in response might be that more supervisors have internet access or computer experience than bricklayers, despite the current level of internet access in Dutch households. Furthermore, supervisors were possibly able to fill in the questionnaire at their work, an opportunity likely not to be available to the bricklayers. We acknowledge this coverage-problem, but we are also aware of the fact that there will be always a fraction of the population with little or no coverage for any mode. For example, illiterate persons might appear in surveys among lower educated populations. They are not likely to respond to a traditional paper-and-pencil questionnaire either. In future research these and other barriers for bricklayers and similar construction workers could be explored.

Besides response rate, other key characteristics of surveys such as timeliness, data quality and cost could be considered when evaluating the effectiveness of a questionnaire survey. In the present study we did not examine the actual length of survey response time. For most research purposes this is perhaps less of an issue than is data quality. Some authors suggest that the honesty of responses, particularly for questions of a sensitive nature, might be different for both survey modalities. In the study of Radon et al. 5% of the respondents were concerned with data security and mentioned this as the reason for not using an online questionnaire. We can not rule out this possibility in explaining the difference between both modalities. Next to this, potential measurement differences between the survey modes may exist, but the present study was not designed to verify such differences.

Furthermore, the completeness of responses might be different between both survey modalities. Items or scales of the paper-and-pencil questionnaire could be skipped or forgotten, while this was impossible for the internet questionnaire. This particular limitation of internet questionnaires, a lack of user-friendliness, might also lead to incomplete questionnaires. Based on the number of questionnaires not fully completed (14 in the paper-and-pencil arm compared to 12 in the internet arm), this possibility does not seem to bias our results. Closely related to this is the fact that the missing data between both modalities might be different. Next to the factors influencing data quality caused by the behaviour of the respondents, is that data quality is also affected by the data transcription into an electronic format. Measurement error is likely to be minimal when using an electronic mode of obtaining data.

By choosing a random sample of bricklayers and construction supervisors for both arms, the sampling error in the present study is for both survey modalities comparable. We did not
execute a non-response follow-up and consequently we can not make assumptions on the non-response bias. The authors suggest this as a valuable next step in research concerning survey modalities among construction workers.

Conclusion

Overall, a paper-and-pencil questionnaire is more effective in terms of response rate than an internet questionnaire in a random sample of two construction professions. The main study in which the present study is embedded, will be designed accordingly. The type of construction profession of the respondents, however, seems to modify the response rate between the two survey methods.
References


