Job-specific workers’ health surveillance for construction workers
Boschman, J.S.

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Chapter 11.

General Discussion
The objectives of this thesis are to provide an evidence base for a job-specific WHS for bricklayers and construction supervisors and to evaluate a job-specific WHS for bricklayers and construction supervisors compared to the generic WHS currently employed. The following research questions were formulated:

1. What are the occupational demands and health effects for bricklayers and construction supervisors?
2. What is the content of the job-specific WHS for bricklayers and construction supervisors?
3. Does a job-specific WHS for construction workers lead more workers to undertake preventive actions than the generic WHS that is currently employed?

In this chapter, the main findings are described, followed by an interpretation of the results of studies in this thesis and a discussion of the research context. Finally, recommendations for future research and practice in occupational health care are presented.

Main findings

1. Occupational demands and health effects

Occupational demands for bricklayers include high physical demands; environmental demands, such as dust and quartz exposure, vibration, UV-radiation and noise (Chapter 2); and psychosocial demands, such as a lack of job control, learning opportunities and negative future perspectives (Chapter 4). High work speed and quantity were associated with symptoms of depression (Chapter 4). A considerable proportion (22%) of Dutch bricklayers was positively screened for common mental disorders (Chapter 4, 5) and these workers were found to have a high likelihood of low current work ability and low work ability one year later (Chapter 5). Furthermore, two-thirds of the bricklayers reported long-lasting or regular musculoskeletal complaints, mainly back, knee and shoulder/upper arm problems. The majority of complaints were perceived to be work-related, and half of the workers indicated that they experienced many problems during work because of the complaints (Chapter 6). In addition to the increased risk of musculoskeletal disorders, bricklayers were found to be at an increased risk of developing lung cancer and getting injured (Chapter 2).

Occupational demands for construction supervisors include walking and standing, UV-radiation, high mental demands, high workload/time pressure, and several adverse social organisational circumstances (Chapter 2, 4). In a Dutch sample of supervisors, one-third of the workers were positively screened for common mental disorders (Chapter 4, 5). As with the bricklayers, high work speed and quantity were associated with symptoms of depression (Chapter 4). Further, among construction supervisors, low participation in decision making and low social support of the direct supervisor was associated with symptoms of depression (Chapter 4). Moreover, construction supervisors who reported common mental disorders were shown to have a high likelihood of low current work ability and low work ability one
year later (Chapter 5). Regarding musculoskeletal health, more than half of the supervisors reported musculoskeletal complaints, particularly back, shoulder/upper arm, neck and knee problems. Half of this population reported many problems during work due to their complaints (Chapter 6).

2. The job-specific WHS: modules, instruments, and protocols

The job-specific WHS was designed to detect adverse work-related health effects, reduced work ability and/or reduced work functioning. The job-specific WHS for both occupations consisted of modules assessing both physical and psychological requirements. In the WHS for both occupations, the following domains were represented: musculoskeletal system, safety (vision, perception of sound, psychological vigilance and working at heights), hazardous substances (affecting the skin and lungs), health in relation to work (cardiometabolic health) and work ability. The selected measurement instruments chosen, were based on their appropriateness to measure the workers’ ability and health requirements given the specific occupation. The instruments included a questionnaire, biometrical tests, and physical performance tests that measured physical functional abilities (Chapter 8). Furthermore, in the job-specific WHS, the occupational physicians (OPs) were provided with guidance for (job-specific) preventive actions (Chapter 7).

3. Job-specific WHS versus generic WHS

The process of starting a job-specific WHS in occupational health care for construction workers was evaluated; the programme implementation rate was nearly 60% and was therefore regarded as acceptable. Low reach, limited protocol adherence and modest engagement of the workers with the preventive recommendations were the most prominent aspects that influenced programme implementation outcomes. The increase in the workers’ knowledge about their health status and work ability was substantial, and the workers’ satisfaction with the intervention was good. The perceived effect of the advised preventive actions on health status was sufficient (Chapter 9).

The job-specific WHS resulted in 80% of the construction workers undertaking preventive actions, a statistically significant increase of 13% compared to the workers who attended the currently employed generic WHS. The OPs carrying out the job-specific WHS recommended 25% more workers preventive actions (44% more job-specific written recommendations) compared to the OPs carrying out the usual WHS. The hypothesis that a job-specific WHS would ultimately facilitate workers in undertaking preventive actions, was confirmed. Moreover, the job-specific WHS was better at providing the workers with knowledge on their health and work ability. However, the workers perceived less effects of their actions on their health status than did the control group with the generic WHS (Chapter 10).
Figure 1. Scheme of job-specific workers’ health surveillance: more workers are provided with preventive recommendations by the OP and more workers are facilitated in undertaking preventive actions.

**Interpretation of findings**

Previous studies regarding WHS for construction workers did not address how the content of the WHS was determined and how it relates to workers’ health and/or work functioning. In the UK\textsuperscript{1} and German\textsuperscript{2} studies for example, the workers were offered several tests, for example urinalysis, but no rationale for the selected tests and instruments was provided. In the present thesis the provision of an evidence-base for the content of the job-specific WHS had a prominent role. Based on the studies presented in this thesis, different physical, psychosocial and safety demands need to be considered in WHS for different types of construction occupations, as the demands vary in type, duration, frequency and intensity among the occupations. The generic WHS for construction workers described by Hartmann et al.\textsuperscript{2} resulted mainly in recommendations regarding wearing hearing protection and improving cardiometabolic health, and even visits to the dentist were advised. No recommendations aimed at musculoskeletal health or mental well-being were addressed. Health checks for construction workers without addressing work-related health issues or work functioning seem therefore of limited value in improving workers’ health and functioning.
The instruments of the job-specific WHS were selected based on their usefulness for assessing health issues and (physical) work ability (i.e., questions and physical performance tests). Previously reported surveillance strategies among construction workers were aimed at medical anamnesis\(^1\) and functional medical diagnostics.\(^4\) Based on the findings in the present thesis, this medical-oriented approach should be revised and supplemented with the assessment of physical abilities and possible limitations in performing occupational tasks, as this approach reveals where potentially relevant actions should be aimed at.

Moreover, the physical performance tests under guidance of an ergonomist as part of the job-specific WHS, allowed for an integration of expertise from both the ergonomist and OP. The request of OPs for this enrichment regarding the current WHS for construction workers has previously been documented by Duvekot and De Zwart\(^5\) and the usefulness has now been confirmed within the scope of job-specific WHS. In addition, the workers were satisfied with the physical performance test under guidance of an ergonomist, a finding that matches with similar approaches to provide construction workers with practical advice about work-related issues by means of an occupational health professional.\(^6\)

The process evaluation indicated that total programme implementation was acceptable and, based on the positive outcomes found in the controlled trial, it was sufficient for it’s intended purpose. However, the performance on, a priori determined, key elements of the process was limited (for example the correct processing of the questionnaire data by the medical assistant and OP and the correct determination of the signs to intervene at by the OP). This finding indicates that some process elements did not influence the outcome to the extent that was expected, and that it remains difficult to simply attribute success or failure of a programme to the process of implementation. As outlined by Durlak and DuPre\(^7\) the relative influence of different factors and process elements, or possible interactions that occurred, may have contributed to the success, but were not captured in the process evaluation.

**Research context**

**Study population**

The studies in the present thesis involved Dutch construction workers (with the exception of the systematic review). In all studies, the mean age (approximately fifty years old) of the participants was relatively high. Regarding the surveys, the most likely explanation is that currently, the sector’s work force is rapidly ageing.\(^8\) Therefore, when interpreting the results of the surveys, it should be noted that the higher age of the participants might have resulted in a high prevalence of adverse health effects, as older age is associated with the presence of more adverse health issues\(^9\) and reduced physical functioning.\(^10,11\) Moreover, the associations between demands and health complaints may vary among different age
groups. However, the population reflected the actual age distribution in the industry, and the findings are therefore likely to reflect current work and health issues in the industry. Regarding the interpretation of the age distribution among the participants in the job-specific and generic WHS, it should be mentioned that workers aged 40 years or older are invited every two years for their health surveillance compared to once in every four years when they are younger. A skewed age distribution is therefore to be expected among the participants in a WHS.

Another reflection on the population of interest in this thesis is that a physically demanding and a mentally demanding occupation were chosen as examples, and the content of the WHS was optimised for those workers working solely in these occupations (i.e., as a bricklayer or construction supervisor). Nevertheless, in practice, bricklayers often combine their work as bricklayer with tasks more associated with a carpenter, tiler or jointer. Likewise, supervisors who work at smaller building projects often have a broader range of tasks and are much more likely to perform physically demanding tasks than the more managerial supervisors working on large building projects. Although our approach allowed an optimal fit between the content of the job-specific WHS and the occupation of interest, it also affects generalisability.

When designing job-specific WHS programmes to be used in practice and optimised for the individual construction worker, the aforementioned additional occupational demands should be considered and taken into account when necessary.

Furthermore, it was found that a substantial dilution occurred between OPs recommendations and workers’ actions. Behaviour is the result of a person’s intentions and abilities and, more specifically, the decisions and actions which people make about their health are affected by their health literacy. People with a low health literacy have a lower level of engagement in health promoting behaviours. Low level of education and higher age are known factors related to low health literacy and might have affected the degree to which the construction workers in our sample had the capacity to process and understand the health information and services needed to make appropriate health decisions. Although in both the control and intervention group a high number of workers undertook preventive actions, there is room for improvement in facilitating the workers’ engagement with undertaking preventive actions, possibly by improving their health literacy.

The development of job-specific WHS

We developed a job-specific WHS based on a stepwise approach. The first steps included gathering knowledge on occupational demands and health effects and thereby providing an evidence base for the job-specific WHS. Several study designs were used for this purpose, depending on the aim and research questions. Aggregated evidence from a systematic literature review (Chapter 2) is acknowledged as being of high methodological quality. However, in a sector with changes in use of materials, equipment or project organisation,
up-to-date knowledge of occupational demands, health effects, work ability and associated work factors remains essential for developing an adequate health surveillance system. For example, bricklayers have adopted tools for mechanical transport of materials and improved their working height by new types of scaffolding.\textsuperscript{23,24} Due to psychosocial work factors and changes in the economic climate, both occupations have to deal with changes in their working environment.\textsuperscript{25} The observational studies provided up-to-date information for Dutch bricklayers and supervisors to inform the development of the job-specific WHS. However, other research methodologies might have been of added value in gathering comprehensive knowledge on occupational demands, such as hierarchical task analysis\textsuperscript{26,27}, or qualitative methods such as focus group interviews with workers and experts.\textsuperscript{28}

The strategy to develop the job-specific WHS included the participation and opinions of the people affected by the issues under study (e.g., workers/clients, health professionals).\textsuperscript{29} A pilot study was performed, and a training session for OPs and ergonomists involved in the study was organised. By doing so, physicians’ and workers’ perspectives on health surveillance and potentially effective preventive actions were incorporated: this approach proved to be useful in the present study, which has also previously been shown in other studies.\textsuperscript{24,30,31}

**Evaluation of job-specific WHS**

Health service activities are regarded as complex\textsuperscript{32} and accordingly, the job-specific WHS can be regarded as a complex intervention. It required i) a high number of interacting components in both the intervention and the control group; ii) a high number of complex actions by the OPs and workers; iii) a high degree of flexibility and tailoring to the needs of the individual worker\textsuperscript{33} and iv) several practical constraints for implementing the job-specific WHS. Previously, researchers were encouraged to evaluate a complex intervention by means of a randomised controlled trial (RCT), as this design is regarded the best design for evaluating the effectiveness of an intervention.\textsuperscript{34} Over the years, performing a trial by using another study design before conducting a large scale and expensive RCT, is stimulated to evaluate feasible and potentially effective interventions.\textsuperscript{32} Therefore, within the scope of current Dutch occupational health care, a controlled trial was designed that allowed for a comparison of the job-specific WHS and the generic WHS as implemented in practice. This trial provided an accurate estimate of the added effect that would occur when the job-specific WHS would be put into routine use.

Based on the prevalence of adverse health effects and associated problems in work functioning (Chapter 1, 4, 5, 6), a high proportion of workers is likely to benefit from preventive actions. However, the type of preventive actions and the expected gain in health status or work functioning are likely to vary largely greatly between workers. Furthermore, the health benefits may be revealed many years after the actual intervention. In addition,
these benefits may be difficult to study in smaller samples due to a lower prevalence and may require multiple actions (for example, the decreased risk of getting lung disease after stopping smoking and making better use of personal protection of lungs and airways). Moreover, as the job-specific WHS was also aimed at detecting signs of impaired work functioning and solving these issues, the effect might not only be measurable in terms of occupational health. Because a change in behaviour is the prerequisite for a change in health or work functioning, assessing reported actions might be the most central outcome measure when evaluating multimodal interventions, such as the job-specific WHS discussed in the present thesis.

Starting the job-specific WHS, led to higher direct extra costs, including over € 300 for the bricklayers and over € 60 for the supervisors. The implications of this added costs depends on the extent to which the preventive actions of the workers result in financial savings in terms of reduced absenteeism costs, medical costs or productivity loss at work. As indicated by Meijster et al., it is important to assess costs and benefits from different perspectives (of employers, society and employees). The return-on-investment of the job-specific WHS was not assessed, but Meijster et al. demonstrated how a substantial return-on-investment can be achieved by promoting the health of the work force and Oude Hengel et al demonstrated how a return-on-investment can be achieved with an intervention that did not show significant improvements in health or work ability of the workers.

Implications for research

The present thesis aimed to provide an evidence base for a job-specific WHS for bricklayers and construction supervisors and to evaluate the job-specific WHS by comparing it to the generic WHS currently employed. The following paragraphs discuss which knowledge gaps were identified and which future directions in research could be taken.

More insight into potentially effective interventions

The focus for potentially (theoretically) effective interventions was assessed in the context of the occupational demands and health effects of the occupations in question. The next step should be to evaluate the actual usefulness and effectiveness on health and work functioning of the selected interventions for the specific occupations. In doing so, the evidence-base for the job-specific WHS will be broadened and reinforced at the level of the interventions.

More insight into the separate elements of job-specific WHS

In the present thesis, a job-specific WHS was designed to be as optimal as possible and included a job-specific questionnaire, job-specific physical performance tests and job-
specific guidance for the OP. Now that is confirmed that the job-specific approach is of added value for the outcome of WHS, it is useful to gain more insight into the elements of the WHS. The instruments in the job-specific WHS were chosen based on their appropriateness to measure the individual workers’ health and work ability, but examples of the added value of the instruments on physical work ability were only provided through multiple case studies. A more rigorous study design could clarify this issue and allow for a judgement of the necessity and gain from the instruments included in job-specific WHS to be made.

The gain that can be expected from the preventive actions the workers undertake depends largely on the quality of those preventive actions. In the future, it would be valuable to assess the use of (evidence-based) practice guidelines by OPs\textsuperscript{37} and the quality of the consecutive preventive actions the workers undertake. The first step is to verify whether the guidelines are used to counsel the workers. Next, the effects on the behaviour of the workers and relevant outcome measures should be assessed, as using a guideline alone does not mean it would be better than the OPs’ counselling as usual.\textsuperscript{38}

**More insight into effects of health surveillance**

The current system for collecting data gathered by the WHS for Dutch construction workers allows for a long-term follow-up of a population of workers employed in the construction industry. It would be interesting to evaluate the longitudinal effects of health surveillance throughout the career of construction workers. Only then it can be verified to what extent the goals of WHS have been realised, i.e., (i) prevention of the onset, recurrence and/or worsening of work-related diseases; (ii) promotion of individuals’ health in relation to work; and (iii) promotion of individual’s work functioning and deployment of the individual.\textsuperscript{39} As demonstrated by Oude Hengel and colleagues\textsuperscript{36}, older construction workers are impaired by poor health and in their ability and willingness to continue working. An effective future health surveillance throughout the working lives of employees should address these health issues in an early stage and thereby improve the sustainable employability of construction workers.

One aspect of the job-specific WHS that was not addressed in the present thesis, concerns the costs that are associated with comprehensive occupational health care facilities. As researchers should also provide information for decision makers\textsuperscript{33}, a proper assessment of costs and benefits should be included in further research concerning the optimisation of job-specific WHS. In the future, implementation of a feasible job-specific WHS and a cost-benefit evaluation would provide insight into the return-on-investment.
Recommendations for practice: improving occupational health care for construction workers

During the course of the present thesis, the financial climate changed substantially. Particularly, the construction industry was struck by an economic recession, which affects the opportunities for modifying and optimising occupational health care for the individual workers when financial means are limited. However, improvements and innovation should be elaborated and implemented within the boundaries of what is possible. In the following paragraphs, future directions for practice are discussed in the context of the findings of the present thesis.

Consider a job-specific approach

An important general recommendation for practice is that a job-specific approach is of added value in optimising health surveillance for construction workers. A job-specific WHS can facilitate prevention because the workers are screened with job-specific instruments and are provided with knowledge regarding their health and work ability that is specific to their occupation: and ultimately, a high percentage of workers is successfully motivated to undertake action. Thereby, a general approach to WHS, often referred to as ‘health checks’\textsuperscript{40}, appears to be of lesser value compared to the job-specific approach of WHS.

The OPs were assisted in recommending job-specific preventive actions by structured guidance on several health topics for each occupation. Although it is likely that this protocol contributed to the positive outcome, using it was time consuming (Chapter 9). It is recommended to further facilitate the OPs\textsuperscript{41} and optimise the implementation of a structured protocol for assessing workers’ health and work functioning and providing guidance on preventive actions. For example, an electronic professional support system that suggests potentially effective interventions, for specific occupations and health complaints could be developed. Next, it is important to revise this guidance according to the most recent evidence and available guidelines\textsuperscript{17} and keep the OPs’ knowledge updated by providing training and education on job-specific health issues.

An innovative element of the job-specific WHS was the evaluation of individual physical work ability by means of job-specific physical performance testing. This type of testing has previously been used in WHS for other high demand occupations.\textsuperscript{42} Although the tests led to an increase in the costs of the WHS, the close cooperation of the ergonomist and OP in determining potentially effective interventions is likely to be advantageous for the individual worker. Based on the experiences of ergonomists and OPs who participated in the present study, it seems fruitful to explore the added value of this type of performance testing among other relevant occupations. An evidence-based modular approach, such as
the one developed for the pre-employment examinations for Dutch construction workers\textsuperscript{28}, may be an approach worth considering to increase feasibility and provide an improved WHS for workers in other construction occupations.

**Explore strategies to involve more workers in WHS**

The process evaluation showed that it was difficult to involve the workers in the innovative job-specific WHS. Several barriers relating to the circumstances under which the study was conducted might have played a role in this finding, such as the economic recession. However, in the future, strategies should be explored to provide more workers with occupational health care facilities. For example, workers could be offered an internet-based surveillance programme followed by a consultation with the OP if signs of adverse health effects or reduced work functioning were detected.\textsuperscript{43} From our results, it appeared that a digital approach might be a fruitful strategy for the supervisors (Chapter 3). Thus, the job-specific WHS could be extended by tailoring the mode by which the health surveillance and interventions are offered to the occupation of interest.
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