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Rasmussen, Charlotte Diana Nørregaard; Lindberg, Naja Klærke; Ravn, Marie Højbjerg; Jørgensen, Marie Birk; Søgaard, Karen; Holtermann, Andreas

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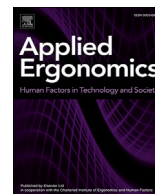
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Processes, barriers and facilitators to implementation of a participatory ergonomics program among eldercare workers



Charlotte Diana Nørregaard Rasmussen ^{a, b, *}, Naja Klærke Lindberg ^b,
Marie Højbjerg Ravn ^a, Marie Birk Jørgensen ^a, Karen Søgaard ^b, Andreas Holtermann ^{a, b}

^a National Research Centre for the Working Environment, Lersø Parkallé 105, 2100 Copenhagen Ø, Denmark

^b Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark, Campusvej 55, 5230 Odense M, Denmark

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ABSTRACT

This study aimed to investigate the processes of a participatory ergonomics program among 594 eldercare workers with emphasis on identified risk factors for low back pain and solutions, and reveal barriers and facilitators for implementation.

Sixty-nine per cent of the identified risk factors were physical ergonomic, 24% were organisational and 7% were psychosocial risk factors. Most solutions were organisational (55%), followed by physical (43%) and psychosocial solutions (2%). Internal factors (e.g. team or management) constituted 47% of the barriers and 75% of the facilitators. External factors (e.g. time, financial resources, collaboration with resident or relatives) constituted 53% of the barriers and 25% of the facilitators.

This study revealed the processes and implementation of a participatory ergonomics program among eldercare workers. The findings can be transferred to workers, workplaces, health and safety professionals, and researchers to improve future participatory ergonomics programs.

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1. Introduction

Eldercare workers have a high prevalence of low back pain (LBP) (Holtermann et al., 2013; Torgen et al., 1995). Prevention of LBP is often focused on ergonomics programs aiming to decrease the physical workload by reducing heavy lifting and awkward postures (Verbeek et al., 2012). A participatory ergonomics process is believed to encourage workers to be involved in managing their own work, consequently decreasing work-related risk factors (Wilson and Haines, 1997) and thereby improve health (Haines et al., 2002). Accordingly, the importance of involving the participants in planning and managing a significant amount of their own work activities has been emphasised for successful interventions (Driessen et al., 2010c; Pohjonen et al., 1998; Rivilis et al., 2008; Van Eerd et al., 2010; Westgaard, 2010).

A review on processes and implementation of participatory ergonomics found that participant responsibilities regarding risk

identification, solution development, and implementation of change is central to the participatory ergonomics process (Van Eerd et al., 2010). However, due to the participatory approach, we do not know much about what will be the actual content of a participatory ergonomic intervention, e.g. risk identification or solution development. This knowledge is important for gaining a better insight into the perceived risk factors for LBP among the workers, which may be different from the evidence-based risk factors, such as for instance physical loading of the back, e.g. heavy lifting, bending and twisting and sustained non-neutral postures (Hoogendoorn et al., 1999, 2000).

Many studies on participatory ergonomics do not clearly describe their implemented programs, or measure the extent to which programs were implemented as planned (Rivilis et al., 2008; Van Eerd et al., 2010). Moreover, only little is known about barriers and facilitators for the implementation of a participatory ergonomics program (Driessen et al., 2010a). Knowledge of factors promoting or hampering successful implementation is important in order to understand the process and thereby explain outcome of an intervention. This is fundamental for an optimized implementation of future participatory ergonomics programs (Wijk and Mathiassen,

* Corresponding author. National Research Centre for the Working Environment, Lersø Parkallé 105, 2100 Copenhagen Ø, Denmark.

E-mail address: cnr@nrcwe.dk (C.D.N. Rasmussen).

2011). Therefore information about processes, barriers and facilitators to implementation of participatory ergonomics programs is needed.

We conducted a multi-faceted workplace intervention consisting of participatory ergonomics, physical training and cognitive behavioural training (CBT) aiming at reducing LBP among 594 eldercare workers from four districts consisting of 54 working teams in a municipality in Denmark. We have earlier reported that this multi-faceted intervention was successful in reducing the primary outcome LBP (LBP days, intensity and bothersomeness) (Rasmussen et al., 2015). Secondary analyses on intermediate outcomes of the participatory ergonomics program revealed a significant reduction in lifting without assistive devices following the intervention (Rasmussen et al., 2016). These effects on the intermediate and proximal outcomes were mainly in accordance with our program logic (see Fig. 1) for the evaluation of the intervention. This paper enhances the interpretation of these results by focusing on the implementation of the participatory ergonomics program.

We designed a very flexible participatory ergonomics program to be able to meet the needs of the workers. We asked the participants to identify their perceived risk factors for LBP. Therefore we did not know which risk factors would be identified and which solutions would be suggested by the participants. Most interventions only measure the outcomes of the study and information about the processes and implementation is hidden in a “black box” (Saunders et al., 2005). The knowledge of what happens in this “black box” may however, be crucial not only to determine why the intervention worked or did not work, and to distinguish between implementation failure (interventions being poorly implemented) and theory failure (Jaegers et al., 2014; Kristensen, 2005; Oakley et al., 2006) but also for optimizing implementation of future participatory ergonomics interventions. Furthermore, studies that do not evaluate processes and implementation are subject to Type III error, concluding an intervention is ineffective when it was not implemented in full (Linnan and Steckler, 2002).

Therefore the aim of this study was to gain insight into the processes of a participatory ergonomics program with emphasis on identified risk factors for LBP and solutions, and revealing barriers and facilitators for implementation (the “black box” (Fig. 1)) of a participatory ergonomics program among working teams consisting of 594 eldercare workers.

2. Methods

This study is embedded in a pragmatic stepped wedge cluster randomized controlled trial (RCT), which has been described previously (Rasmussen et al., 2013). In short, 594 participants were randomized to receive the intervention in one of four successive time periods, three months apart. The study population mainly consisted of nurses' aides (89%), but the intervention was also offered to the service department (kitchen workers or janitors). The main effect outcomes were LBP days, intensity and bothersomeness (Rasmussen et al., 2015). Secondary effect outcomes were the intermediate outcomes physical capacity, work demands and maladaptive pain behaviours, and the distal outcomes (Brenner et al., 1995) work ability and sickness absence due to LBP (Rasmussen et al., 2016). The RCT has been approved by the Danish Data Protection Agency and the Ethics Committee for the regional capital of Denmark (journal number H-4-2012-115) and was conducted in accordance with the Helsinki declaration. The study has been registered as ISRCTN78113519 in the current controlled trials register and the study protocol has been published (Rasmussen et al., 2013).

The recruitment of the workplaces and the study population is described in detail in a previous paper (Rasmussen et al., 2014). Briefly, the second largest municipality in Denmark was contacted regarding participation. After the municipality gave formal confirmation of collaboration the details about the recruitment of workers were settled. In this municipality, the administration of eldercare was divided into 9 districts (under the department of health). At a meeting the study was presented for the managers of the 9 districts. Moreover they were given a short written description of the aim, content and activities of the project and possible benefits from participating in the study. Afterwards, they were given the opportunity to discuss the project with their employees and decide whether or not their district wanted to participate in the project. All workers in the participating districts were invited to a short information meeting of 30 min' duration providing information about the project. Prior to the information meeting, written information about the aim and activities was distributed to all workers in a short brochure. Eligible participants were to be employed more than 20 h a week and being 18–65 years of age. The exclusion criteria to the study were unwillingness to participate, long term sick-listed or not being permanently employed. Written

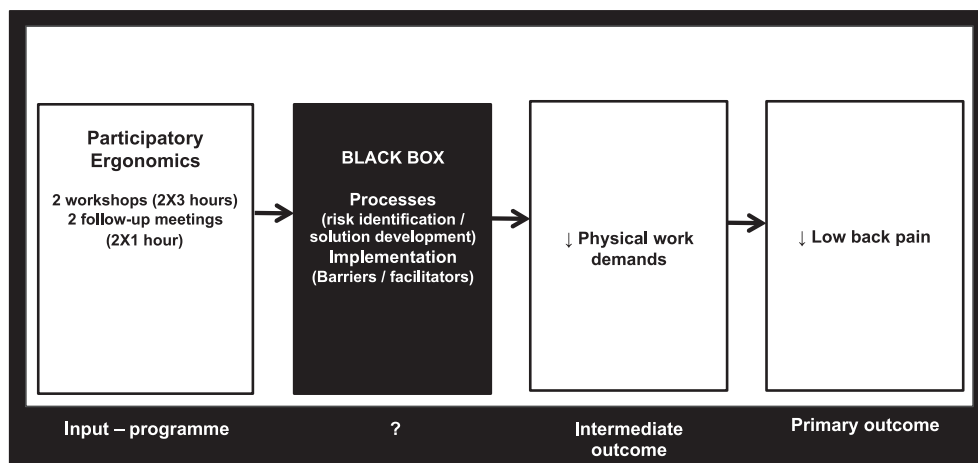


Fig. 1. The program logic of the participatory ergonomics program aiming at reducing low back pain. The processes and implementation of the participatory ergonomics leading to an effect on the intermediate (physical work demands) and the primary outcome (low back pain) constitute a “black box” – e.g. the identified risk factors and the suggested solutions by the workers and the barriers and facilitators for implementation. Revealing processes in the “black box” may explain the effect (or lack of effect) on the intermediate as well as the primary outcome.

informed consent was obtained from the participants before randomisation.

A balanced cluster randomization was applied with strata formed by each of the participating districts and clusters formed within each stratum based on working teams ($N = 54$). To promote comparability between the clusters they were balanced on number of participants in each cluster to minimize imbalance over several strata. Therefore, we randomized the clusters according to their size with the four largest clusters randomized first. Due to logistics related to the intervention delivery, small teams were merged to a cluster when located in geographical proximity. All grouped clusters ($N = 21$) belonging to a specific stratum were drawn from a deck of cards with each colour representing a step from one to four in the study. Researchers blinded to the identity of the strata and clusters carried out the randomization (Rasmussen et al., 2013).

The intervention lasted three months and consisted of integrated physical training (12 h), cognitive behavioural training (6 h) and participatory ergonomics (9 h). The activities were conducted simultaneously and integrated so for instance skills learned in the CBT programme were referred to or included in the physical training programme, and physical activity and physical demanding work tasks were themes of the CBT programme. The intervention was scheduled in the working time of the participants and delivered by trained local therapists (two occupational therapists and four physiotherapists) with a mean of 11 years of experience since professional qualification. The therapists that delivered the intervention all had previous experience with ergonomics due to previous job experience from the eldercare sector or from their formal education. The local therapists had six days of training from the research group where they were educated in delivering the entire intervention. Our training of the therapists was focused on the process of guiding the participants in how to identify risk factors, development of solutions and implementation of them. The therapists received training in the participatory ergonomics program for one day (7 h). One of the researchers gave a powerpoint presentation explaining the purpose and the content of each sessions of the intervention (start-up meeting, workshops and evaluation meetings). In addition, a protocol describing all intervention activities in detail was given to the therapists. The protocol included detailed information with agenda and specific tasks for each session. Throughout the study period, the therapists were offered support from the research group if needed. Only the participatory ergonomics will be described in detail in the following. For further information about the physical training and CBT, see the published study protocol (Rasmussen et al., 2013).

2.1. Participatory ergonomics

Inspiration from the framework by Haines and co-workers (Haines et al., 2002) as well as the blueprint by Wells and co-workers (Wells et al., 2003) was used in the development of the participatory ergonomics program. The participatory ergonomics was initiated by a one-hour start-up meeting. At this meeting, an ergonomic work group was formed for each intervention team, consisting of 5–7 workers and a trained therapist. The trained therapists were instructed to mainly guide the process of the participatory ergonomics, and leave it to the workers themselves to identify risks and solutions. Throughout the process the ergonomic work group was responsible for making all the decisions. The protocol-based process followed six steps: 1) identification of risk factors for LBP, 2) analysis of the identified risk factors, 3) solution building, 4) prototype implementation, 5) evaluate prototype and 6) adopt solution. In order to make the participatory ergonomics feasible for the workplace, it was decided that it should be conducted as two three-hour workshops followed by two one-hour

evaluation of the implementation. At the first three-hour workshop, the ergonomic work group identified risk factors for LBP. We asked the participants to focus broadly on their own perception of risk factors for LBP, and analyse these. They were also asked to prioritise three to four of the risk factors for continuous work. The main criteria for prioritising the risk factors were being a relevant work task (e.g. either that many workers perform this task or that it was performed on a regular basis) and that it should be perceived as a significant risk factor for LBP.

At the second three-hour workshop, the ergonomic work group found solutions for the three to four prioritised risk factors and outlined an action plan. The criteria for the solutions were that they should be efficient and feasible, meaning that they were likely to be implemented within the time period of three months and that they should aim at decreasing the risk for LBP and/or make the work tasks less strenuous. At two one-hour follow-up meetings, the ergonomic work group evaluated the implementation of the solutions and if needed possible adjustments were made. To disseminate the findings of the participatory ergonomics, the ergonomic work group was required to inform the supervisor as well as their co-workers about the process after each workshop and meeting. Moreover, posters with prioritised risk factors and the solutions were placed in the staff room.

2.2. Theory

A workplace intervention commonly used for prevention of LBP is ergonomics programs attempting to improve the fit between the worker and the work by decreasing the physical workload. Ergonomics programs most often focus on physical job features, such as tools or workstations, heavy lifting, awkward postures, and repetitive tasks (Verbeek et al., 2012). *Participatory ergonomics is defined as 'the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goal'* (Haines et al., 2002). The involvement of the workers in the process is essential, as it ensures that participants take responsibility regarding risk identification, solution development, and implementation of change (Van Eerd et al., 2010) which is important for the effectiveness (Durlak and DuPre, 2008; Nielsen et al., 2007). Moreover having sufficient resources available (in terms of money, time, materials etc.) is also important for a good implementation (Cole et al., 2009; Driessen et al., 2010a; Van Eerd et al., 2010). The participatory ergonomics process is believed to encourage workers to be involved in controlling their own work, consequently decreasing work-related risk factors (Wilson and Haines, 1997) and thereby improve health (Haines et al., 2002). In the study protocol, we provided an a priori program logic (Rasmussen et al., 2013), that describes the pathway from the intervention to the reduction of LBP. We anticipated that the workers would be able to identify risks and implement solutions that would have an intermediate effect by reducing physical work demands (physical exertion and occupational lifting) (Pohjonen et al., 1998) which in turn would contribute to the reduction of LBP (Fig. 1).

2.3. Data collection and analysis

Data were collected from each of the ergonomic work groups by obtaining their action plans, which they filled out at the second workshop. The action plans contained information about three to four prioritised risk factors for LBP as well as the solutions to them, and the appointed person responsible for the implementation and a deadline for implementation of the solutions.

At the final follow-up meeting, the ergonomic work groups

rated the implementation on a 0–10 scale, with 10 meaning a complete implementation within the allocated timeframe of three months and 0 as non-implementation. The values 0–2 were defined as “low or no implementation success” and values 8–10 were defined as “high implementation success”. Finally, on a separate evaluation sheet, the barriers and facilitators for implementation of the participatory ergonomics program were noted. Since the participatory ergonomics was conducted at team-level, all risk factors, solution and implementation scores were based on consensus from the ergonomic working group, so that each team delivered one action plan and evaluation sheet.

The authors categorised the information on prioritised risk factors and solutions from the action plans into categories that arose from visual inspection of the action plans. Within each of the categories, sub-categories that emerged when looking at the data from the action plans were formed. One of the authors (NKM) did the initial categorisation, and at a meeting among all the authors all prioritised risk factors and solutions, no matter the initial category, were discussed and re-categorised if the group reached consensus about this. During this process, the group also allowed new categories to arise. The same process was carried out with the barriers and facilitators for implementation.

3. Results

Of the 54 working teams, 42 intervention teams were formed. The reason for this was that smaller working teams were merged to one intervention team, and some teams already having a close collaboration chose to have the participatory ergonomics process together. In addition to this, two intervention teams could also choose to have the participatory ergonomic process together. Most of the planned sessions (99%) were conducted. This means that almost all the 42 teams completed the 9 h of intervention. However, most teams only had 2–4 participants in the ergonomic work group and not the expected 5–7 workers. This makes the intervention less time consuming than originally planned with respect to man-hours. From the 42 intervention teams, 35 action plans (83%) were collected. Of the 35 teams providing an action plan, 17 teams were working in nursing homes, 14 teams were working in homecare and 4 teams were working in the service department (kitchen workers or janitors).

3.1. Risk factors identification and prioritisation

The categorisation of prioritised risk factors resulted in three overall categories: 1) physical ergonomic category, e.g. classic biomechanical risk factors such as physical transfer of things or people, use of assisting devices, working postures, and restricted workspace in homes and care centres, 2) organisational category, e.g. lack of communication or bad communication between supervisors and employees or colleagues in-between on organisational issues such as coordination of work procedures and tasks, and organisational situations related to workspace (indoor or outdoor), such as lack or misplacement of equipment, and 3) psychosocial category, e.g. low prioritisation of staff wellbeing, or conflicts with the person that needs care (from here on named the resident) or relatives to the resident. Furthermore, a subdivision into whether the risk factor was associated with a care situation or not was made.

Each action plan consisted of 3–5 risk factors prioritised by the respective ergonomic workgroup, comprising 142 risk factors in total. In [Table 1](#), a description of all 142 prioritised risk factors is shown. Most of the prioritised risk factors (69%) were categorised to the physical ergonomic category, whereas 34 (24%) risk factors were categorised to the organisational category and 10 (7%) risk

factors were categorised to the psychosocial category. The highest prevalence of risk factors in the physical ergonomic category was related to working postures (36%). Of the 43 risk factors related to working postures in a care situation, the majority of the risk factors (37%) related to helping the resident put on compression stockings and getting them dressed, and 13 (30%) risk factors were related to difficulty in transferring a resident. For the ergonomic risk factors not involving a care situation, the majority related to heavy lifting (8%) and assistive devices (8%). The prioritised risk factors within the organisational category were mainly related to communication (10%) and organisation of work tasks (10%). Finally, the prioritised risk factors within the psychosocial category were few (7% in total) and evenly distributed among management, resident and relative-related.

3.2. Solutions to prioritised risk factors

The categorisation of the solutions by the researchers resulted in three overall categories: 1) physical ergonomic solutions, covering use of assistive devices, improving transfer of residents and working techniques, 2) organisational solutions, covering procedures, communication, and structure of meetings and changing of the workspace and 3) psychosocial solutions, covering communication with relatives and the resident ([Table 1](#)).

The 35 teams suggested a total of 149 solutions, meaning that a risk factor can have more than one solution, but no team had fewer solutions than risk factors. [Table 2](#) shows the risk factors and their respective solutions stratified on the three categories. Most of the solutions were categorised as organisational solutions (55%). The most frequently suggested solution was implementation of new procedures regarding organisation of the work with 34 in all (23%). Another frequent organisational solution was communication (15%). The physical ergonomic solutions corresponded to 43% with solutions that were related to acquisition or better use of assistive devices (16%), improvement of transfer and working techniques (15%), and training and knowledge (11%). Only 3 (2%) solutions were psychosocial (better communication with residents and relatives).

[Table 2](#) also shows how the different types of risk factors (physical ergonomic, organisational, and psychosocial risk factors) are solved with different solutions (physical, organisational or psychosocial solutions). Out of 71 physical ergonomic risk factors related to care situation, 44 (62%) had a physical ergonomic solution, and 27 (38%) had an organisational solution. For the 31 physical ergonomic risk factors not related to care situation, 16 (52%) had a physical ergonomic solution, 14 (45%) had an organisational solution and one risk factor had a psychosocial solution. For the 38 organisational risk factors, 3 (8%) had a physical ergonomic solution and 35 (92%) had an organisational solution. Finally, for the 9 psychosocial risk factors, 1 (11%) had a physical ergonomic solution, 6 (67%) had an organisational solution and two risk factors had a psychosocial solution (22%).

3.3. Implementation

A total of 112 (75%) action plans were rated on a scale from 0 to 10. A high implementation score (8–10) was found in 43 solutions (38%) and a low implementation score (0–2) was found in 37 solutions (33%). Of the 43 high implemented score solutions, 25 (58%) were organisational solutions, 16 (37%) were physical ergonomic solutions and 2 (5%) were psychosocial solutions. Of the 37 low implemented solutions, 23 (62%) were physical ergonomic solutions, 13 (35%) were organisational solutions and 1 (3%) was a psychosocial solution ([Fig. 2](#)).

Table 1

Categorisation and characterisation of risk factors and solutions. The risk factors are divided into three overall categories: physical ergonomic category (stratified on related to care situation or not related to care situation), organisational category and psychosocial category. A total of 142 risk factors were identified. The solutions are divided into physical ergonomic, organisational and psychosocial solutions. A total of 149 solutions were identified.

Risk factors				
Category of identified risk factors		Characterisation of identified risk factors		Total (N = 142) n (% of total)
Physical Ergonomics	Related to care situation	Working postures	Impaired body position/technique of the worker, and situations involving transfer of resident	43 (30%)
		Workspace	Inappropriate workspace in the resident's home	7 (5%)
		Assistive devices	Little or poor use of assistive devices, lack of equipment or lack of knowledge on how devices are used	13 (9%)
		Others	Care situations where other issues than the above apply	2 (1%)
		Working postures	Impaired body position/technique of the worker	8 (6%)
	Not related to care situation	Workspace	Inappropriate workspace in the resident's home	3 (2%)
		Assistive devices	Little or poor use of assistive devices, lack of assistive devices or lack of knowledge of how devices are used	11 (8%)
		Heavy lifting	Heavy lifting of materials, equipment etc.	11 (8%)
		Communication	Lack of communication or bad communication between colleagues, for instance about transfer techniques and/or procedures and distribution of work assignments	15 (10%)
		Organising work tasks	Organisation of work, such as sufficient time to solve work tasks, clarity of the tasks, prioritising tasks and allocating sufficient manpower to tasks	14 (10%)
Organisational	Workspace	Organisational situations related to workspace (indoor or outdoor), such as lack or misplacement of equipment that increases the risk for work-related injuries	5 (3%)	
		Management	Management issues, e.g. low prioritisation of staff wellbeing or psychological pressure on employees	3 (2%)
	Resident Relatives	Mentally demanding residents or violence from residents	4 (3%)	
		Challenging relatives	3 (2%)	
Psychosocial	Management	Management issues, e.g. low prioritisation of staff wellbeing or psychological pressure on employees	3 (2%)	
	Resident Relatives	Mentally demanding residents or violence from residents	4 (3%)	
Resident Relatives	Challenging relatives	3 (2%)		
Solutions				
Category of solutions		Characterisation of solutions		Total (N = 149) n (% of total)
Physical ergonomics	Assistive devices	Acquisition of and/or better use of assistive devices	24 (16%)	
		Improving transfer and working techniques	23 (15%)	
	Training and knowledge	Provision and/or use of existing information, training, education and knowledge	17 (11%)	
Organisational	Procedures	Develop or use the standard procedures at the workplace and/or improve coordination between colleagues, management or with resident/relatives	34 (23%)	
	Communication	Improve communication among colleagues, the supervisor and team, as well as among external companies/suppliers	23 (15%)	
	Structure of meetings	Changing the structure of team meetings in relation to the time and/or meeting agenda	6 (4%)	
	Tasks	Tasks should be solved or more tasks should be outsourced to specific people or carried out differently than in the past	11 (7%)	
	Workspace	Changing the workspace of the surroundings. That implies moving furniture or changing the location of an object	8 (5%)	
Psychosocial	Communication with relatives	Better communication with relatives	2 (1%)	
	Communication with resident	Better communication with resident	1 (1%)	

3.4. Barriers and facilitators

Barriers and facilitators were derived from the final ergonomic evaluation sheet, and a total of 88 barriers and 75 facilitators to implementation were identified. This implies that not all teams suggested barriers and/or facilitators to all of their suggested solutions. The categorisation of the barriers and facilitators for implementation resulted in two categories: internal or external factors. For the barriers 47% were internal factors and 53% were external factors. The internal barriers were related to the team (collaboration and communication) (28%) or management (18%). The external factors were related to time (delays, lack of time or holidays) (22%), insufficient financial resources (11%), problems with the resident (e.g. their attitude or health status and temper)

(7%), problems with relatives (e.g. relatives' attitude, collaboration and temper) (3%), and co-operation with other companies/suppliers (10%) (Table 3).

The facilitators were also divided into whether they were influenced by internal (73%) or external factors (27%). The internal facilitators were related to the team (e.g. team dynamics and communication) (32%), management (15%), a therapist (8%) or knowledge (19%). The external factors were related to time (3%), financial resources (4%), residents (3%), relatives (3%) and co-operation with other companies/suppliers (15%) (Table 3).

Fig. 3 shows how the barriers and facilitators for implementation are related to each of the three categories of solutions. The majority of the barriers (51%) were related to physical ergonomic solutions, whereas the majority of the facilitators (53%) were

Table 2
Solutions to the identified risk factors. The solutions are divided into physical ergonomic, organisational and psychosocial solutions. A total of 149 solutions were identified. For each risk factor the number and type of solutions is shown in absolute numbers.

Risk factors		Solutions (N = 149)									
		Physical ergonomics (n = 64)			Organisational (n = 82)				Psychosocial (n = 3)		
		Working postures	Improving transfer devices and working techniques	Training and knowledge	Procedures	Communication	Structure of meetings	Tasks	Workspace	Communication with relatives	Communication with resident
Physical Ergonomics (N = 102)	Related to care situation (n = 71)	6	14	10	9	3	–	3	1	–	–
	Workspaces	1	1	–	1	1	–	–	3	–	–
	Assistive devices	5	5	1	5	–	–	–	–	–	–
	Others	–	–	1	1	–	–	–	–	–	–
	Not related to care situation (n = 31)	1	1	1	1	3	–	–	1	–	–
	Workspaces	–	–	1	1	1	–	–	–	–	–
	Assistive devices	3	1	1	2	1	–	–	–	–	1
	Heavy lifting	6	1	1	1	1	–	–	3	–	–
	Communication	–	–	2	4	7	3	–	–	–	–
	Organising work tasks	–	–	–	6	2	1	–	5	–	–
Organisational (n = 38)	Workspaces	1	–	–	2	2	–	–	–	–	–
	Management	–	–	–	–	1	2	–	–	–	–
	Resident	1	–	–	–	1	–	–	–	–	–
	Relatives	–	–	–	1	–	–	–	–	–	2
	–	–	–	–	–	–	–	–	–	–	–
Psychosocial (n = 9)	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–

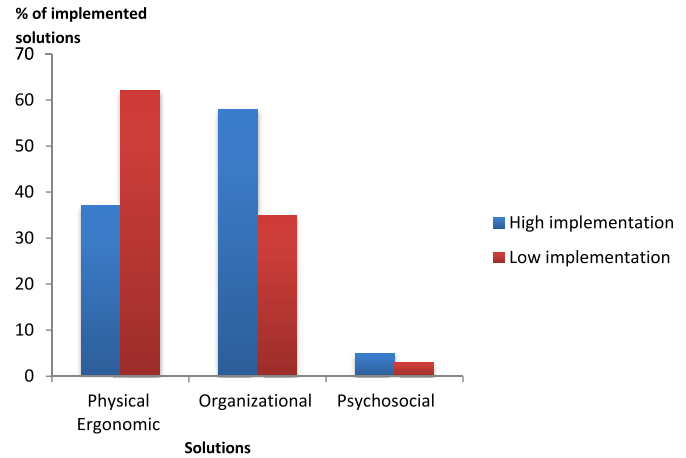


Fig. 2. The distribution of high implemented solutions (N = 43) and low implemented solutions (N = 37) in percentages for each of the categories of solutions (physical ergonomic, organisational or psychosocial).

related to organisational solutions.

4. Discussion

This study aimed to gain insight into “the black box” of a participatory ergonomics program aiming to reduce LBP among eldercare workers, i.e. the processes of a participatory ergonomics program with emphasis on risk factors, in the workers own perception and their suggested solutions, and barriers and facilitators for implementation. The primary findings were that most risk factors were categorised as physical ergonomic (69%), but most risk factors were solved with an organisational solution (55%). Less than half (38%) of the suggested solutions were noted as fully implemented and 33% were noted as low-implemented. Internal factors (e.g. team or management) constituted 47% of the barriers and 75% of the facilitators. External factors (e.g. time, financial resources, collaboration with resident or relatives) constituted 53% of the barriers and 25% of the facilitators.

Through categorisation of 142 risk factors, we got information about risk factors for LBP perceived by the eldercare workers themselves. A high prevalence of risk factors relating to the physical ergonomic category was found. This category contains classical biomechanical work-related risk factors for LBP (da Costa and Vieira, 2010), such as physical loading of the back, e.g. heavy lifting, bending and twisting and sustained non-neutral postures (Coenen et al., 2014; Hoogendoorn et al., 1999, 2000). However, the findings of this study also indicate that risk factors of organisational and psychosocial character to a very high degree are present among the eldercare workers. More specifically, a third of the risk factors are of organisational or psychosocial character. As an important consequence ergonomic interventions should not only focus on classic physical ergonomic risk factors alone.

From the 149 solutions we get important insight in the workers own perception of how to solve different risk factors in this setting. In a previous study by Driessen and co-workers (Driessen et al., 2010b) 63 solutions were categorised into three predetermined categories: 1) ergonomic measures, 2) organisational, and 3) co-worker and working group related. We used the data collected from our study to guide us in the categorisation of risk factors and solutions. However our categorisation (physical ergonomic, organisational, and psychosocial) turned out to be very similar to the one used in the study mentioned above (Driessen et al., 2010b). The many suggested solutions highlight the complexity of solutions

Table 3

Category and characterisation of the barriers and facilitators to implementation. The total number of barriers to implementation was 88 and the total number of facilitators to implementation was 73 and they were divided into internal or external factors. The internal factors were related to the team, management, a therapist or knowledge. The external factors were related to time, financial resources, resident, relatives and co-operation with company/supplier.

Category of barriers to implementation		Characterisation of barriers to implementation	Number of barriers (N = 88) n (% of total)
Internal factors	Team-related	Lack of focus on solving the problem in the group or it is not taken serious by all or there's lack of awareness of the problem and how to solve it	25 (28%)
	Management	Lack of support from the supervisor and/or management, lack of initiative and focus on solutions at team meetings, lack of guidance from therapists and others with respect to training in transfer techniques and use of assistive devices	16 (18%)
External factors	Time	Delays, lack of time and holidays	19 (22%)
	Resources (financial)	Limited budgets and budgets that require approval	10 (11%)
	Resident	The resident's attitude, health status and temper	6 (7%)
	Relatives	Relatives' attitude and collaboration	3 (3%)
	Co-operation with company/supplier	A company/a supplier's lack of delivery or materials that are missing or broken	9 (10%)
Category of facilitators to implementation		Characterisation of facilitators to implementation	Number of facilitators (N = 73) n (% of total)
Internal factors	Team-related	Team dynamics and communication	24 (32%)
	Management	Supervisor or management take the initiative to implement the solution	11 (15%)
	Therapist	Therapist takes the initiative to implement the solution	6 (8%)
	Knowledge	Information, knowledge and education promote the possibility of successful implementation. Increased focus and testing of new methods	14 (19%)
External factors	Time	More time allocated	2 (3%)
	Resources (financial)	Money allocated and/or approved budgets and low-budget solutions	3 (4%)
	Resident	Involved residents (e.g. more active/involved in care situations)	2 (3%)
	Relatives	Good collaboration with the resident's relatives	2 (3%)
	Co-operation with company/supplier	Good collaboration with a company or a supplier, quick delivery of newly ordered materials/equipment, materials/equipment is functioning	11 (15%)

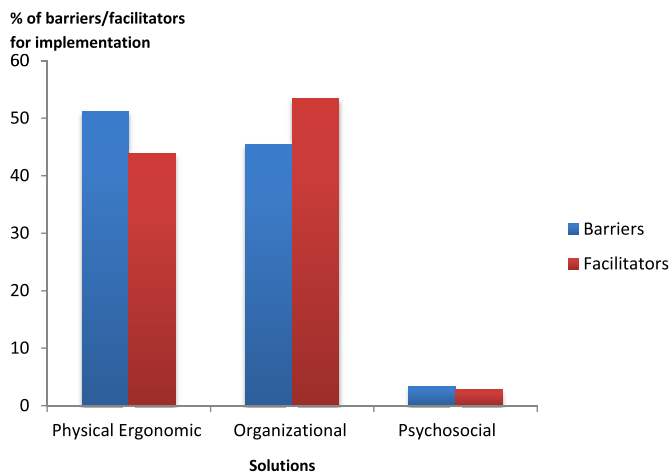


Fig. 3. The distribution of barriers and facilitators for implementation in percentages for each of the categories of solutions (physical ergonomic, organisational or psychosocial).

to risk factors for LBP. This needs to be acknowledged, and therefore interventions predominantly based on technique training or single factor interventions may not be sufficient.

We found that organisational solutions had a greater success rate (58%) of implementation compared to physical ergonomic solutions (37%). These findings match the findings by Driessen and co-workers who found that implementation of some physical ergonomic solutions were hampered because the physical ergonomic solution was too comprehensive to implement within the study duration of three months (Driessen et al., 2010b). Nonetheless this

and other studies still find that simple physical ergonomic changes such as introducing new tool/equipment were easier to implement (Driessen et al., 2010b; Linnan et al., 2001; Van Eerd et al., 2010). Physical ergonomic solutions may lead to less sustainable changes, as the individual will be more likely to go back and do things as it has always been done since these solutions primarily rely on a change in the individuals' behaviour (Lally et al., 2010; Whysall et al., 2006; Wijk and Mathiassen, 2011). Thus, if efforts are directed at solving risk factors on an organisational level by improving communication, guidelines and procedures, there will be a better chance of achieving sustainable changes.

Previous studies have reported on the barriers and facilitators experienced during implementation of a participatory ergonomics program (Cole et al., 2009; Driessen et al., 2010a; Van Eerd et al., 2010). The evaluation methods in these studies only vary slightly, and it is almost the same categories that are found and the same definitions used to explain these categories. Common factors for the mentioned studies and the results found in the present study are the importance of direct involvement of the workers, their level of influence in the process of implementation and the resources available (in terms of money, time, materials etc.). When looking at barriers connected to specific categories of solutions, we found that 51% of the barriers were connected to solutions in the physical ergonomic category. For facilitators, we found that 53% were connected with the organisational solutions. This too indicates that physical ergonomic solutions are not that straight forward and easy to implement, whereas the organisational solutions increases the likelihood for successful implementation.

We found approximately 38% of the solutions were implemented. Other studies on participatory ergonomics processes found that about half of the suggested solutions were implemented within the intervention time periods that varied from 2 weeks to 14 months (Anema et al., 2003; Loisel et al., 2001; Pehkonen et al.,

2009). Therefore consideration of time available to implement changes in participatory ergonomics processes is important. In the current study, we asked the participants to suggest solutions that should be efficient and feasible, meaning that they were likely to be implemented within the time period of three months (Rasmussen et al., 2013). However, a task may have been fulfilled, a new procedure implemented or better communication achieved after the follow up period of three months in our study.

A limitation of the present study is that not all of the teams identified barriers and facilitators for implementation, making it hard to draw conclusions applicable to all groups. Yet, we regard the existing data to provide sufficient information of what may hamper and facilitate implementation of ergonomic solutions. A huge strength of this study is the amount of detailed information on the actual processes and implementation of the participatory ergonomics program.

5. Conclusion

In this participatory ergonomics intervention aiming at reducing LBP among eldercare workers, most of the risk factors identified by the participants were categorised as physical ergonomic, but most suggested solutions were organisational. Less than half of the suggested solutions were noted as fully implemented. Most barriers to implementation concerned external factors (e.g. time, financial resources, collaboration with resident or relatives), whereas most facilitators were internal factors (e.g. team or management). The many suggested solutions highlight the complexity of risk factors for LBP. This needs to be acknowledged, and therefore interventions predominantly based on technique training or single factor interventions may not be sufficient. Therefore, future participatory ergonomics programs should not only focus on classic physical ergonomic risk factors alone and should probably be directed at solving risk factors on an organisational level and by improving communication and procedures within the team to be successfully implemented. Moreover, the findings from this study highlight the importance of actively involving the workers in determining their respective risk factors. The detailed description and evaluation of the processes and implementation of the participatory ergonomics program (the “black box”) can be transferred to workers, workplaces, health and safety professionals, and researchers to improve future participatory ergonomics programs among eldercare workers.

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