



OPEN ACCESS

Original research

Effects of the Labour Inspectorate Authority's regulatory tools on psychosocial and biomechanical work factors in Norwegian home care services: a cluster randomised controlled trial

Bjørnar Finnanger Garshol ¹, Stein Knardahl,² Jan Shahid Emberland,¹ Øivind Skare,³ Håkon A Johannessen¹

¹Department of Work Psychology and Physiology, National Institute of Occupational Health, Oslo, Norway

²Research Director, National Institute of Occupational Health, Oslo, Norway

³Department of Occupational Medicine and Epidemiology, National Institute of Occupational Health, Oslo, Norway

Correspondence to

Dr Bjørnar Finnanger Garshol, Department of Work Psychology and Physiology, National Institute of Occupational Health, Oslo 0304, Norway; bjga@stami.no

Received 13 May 2022

Accepted 6 September 2022

Published Online First

27 September 2022

ABSTRACT

Objectives This study aimed to determine the effects of the Labour Inspectorate Authority's (LIA's) regulatory tools on psychosocial and biomechanical work factors in the Norwegian municipal home care services.

Methods A cluster-randomised controlled trial conducted in the home care services with employee questionnaire data on work factors at baseline, and 6 and 12 months after the interventions. In total, 96 eligible municipalities were randomly assigned to either the control group or one of two interventions: (1) labour inspection visits, based on the LIA's standard inspections; and (2) guidance-through-workshops, where the participating services highlighted issues and trained labour inspectors provided guidance based on existing labour laws and regulations.

Results No favourable intervention effect was observed for the inspection intervention. No effects were observed for most of the variables in the guidance intervention, although an effect was observed for the following psychosocial factors: decision control, control over work intensity and empowering leadership. However, after adjusting for multiple testing, none of the observed effects were statistically significant.

Conclusion Labour inspections did not affect psychosocial and biomechanical work factors in the home care services. A favourable effect of the guidance intervention on psychosocial work factors was observed. However, this was not evident after adjusting for multiple testing. Further research is needed to elaborate on how labour inspections and other regulatory tools can impact psychosocial and biomechanical work factors.

Trial registration number NCT03855163.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Labour inspections increase compliance with existing regulations and decrease workplace injuries. However, little is known about the effects of inspection and other regulatory measures' effect on psychosocial and biomechanical work factors.

WHAT THIS STUDY ADDS

⇒ Labour inspections showed no effect on psychosocial and biomechanical work factors, while guidance workshops showed an initial favourable effect on psychosocial factors, with an increase in decision control, control over work intensity and empowering leadership. However, these effects were not significant after adjusting for multiple testing.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results suggest a need for designing inspection protocols and guidance-through-workshop sessions that more carefully emphasise psychosocial and biomechanical work exposures. Additionally, while one-time guidance sessions may be adequate, further studies should examine whether a more longitudinal approach with follow-up visits would be more optimal. Finally, it is advisable to consider whether existing inspection checklists appropriately examine a wide range of specific work exposures.

BACKGROUND

The influences of biomechanical and psychosocial work factors on employee health, risk of sickness absence and disability retirement have been firmly established.¹⁻⁴ In Norway, musculoskeletal and mental disorders are a major cause of years lived with disability,⁵ with 40% of the cases involving lower back pain⁶ and 25% of the cases involving mental distress⁷ among employees being attributable to psychosocial and biomechanical work factors.

Musculoskeletal pain and mental distress are prevalent in health and social care services, particularly in the home care services.⁸⁻¹⁰ Studies show that home care staff perceive strenuous work tasks, a changing and uncontrollable physical and psychosocial work environment, and organisational challenges as the main risks to their occupational health.¹¹ These services also face increasing demands due to current demographic developments, with a growing elderly population.¹² Additionally, the services are increasingly facing restructuring due to a shift in focus from care in institutions to care at home, for example, due to



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Finnanger Garshol B, Knardahl S, Emberland JS, et al. *Occup Environ Med* 2022;**79**:807-815.

the government pursuing the concept of ageing in place.¹³ The challenges in the sector, together with increasing and changing demands, necessitate an increasing focus on how to improve working conditions for employees in the home care services. Previous studies have focused on influencing the work environment in home care services through accident prevention,¹⁴ and interventions involving organisational change, education and training, digitalisation or scheduling.¹⁵ Interventions based on the enforcement of occupational safety and health (OSH) regulations in home care settings has so far garnered little attention.

Enforcement of OSH regulations is viewed as essential to ensuring the safety and health of employees,^{16, 17} and labour inspection is a common enforcement tool. Previous research has found that labour inspections can improve compliance with OSH regulations and have the potential to reduce occupational injuries.^{18–21} However, existing research has predominantly focused on construction and industrial workplaces,²⁰ and to a lesser degree on health and social care services. The need for more research on the effect of labour inspections on psychosocial work factors has been particularly highlighted,¹⁸ given the influence of these factors on employee health.

Therefore, the aim of this study is to determine the effect of the Labour Inspectorate Authority's (LIA's) labour inspections and guidance-through-workshops on psychosocial and biomechanical work factors in Norwegian home care services. Based on previous research on the effect of regulatory tools on compliance and injuries, we hypothesise a favourable effect of inspections and workshops on psychosocial and biomechanical work factors among employees in the home care services.

DESIGN AND METHODS

This study is a cluster-randomised controlled trial including home care service workers from a probability sample of municipalities in Norway. We chose a cluster design because the work environments of home care services are inherently clusters. The study is part of a larger project, and a full description can be found in the published protocol.²² In addition, we conducted a process evaluation.²³ This evaluated, using questionnaires, whether the interventions had been conducted as planned. Further, it evaluated how the participants perceived the utility of the interventions and whether it enhanced their knowledge of OSH management. Finally, it investigated whether these perceptions were associated with intentions to implement changes to the work environment.

Recruitment and participants

Recruitment began by identifying eligible clusters, which were municipalities with more than 20 and less than 100 care workers. This range was chosen to reduce intracluster variability and thus reduce the needed sample size.²² Ineligible municipalities were municipalities that had recently, in 2017–2018, had labour inspections. Based on sample size calculations (see protocol²²), 132 of the 187 eligible municipalities were randomly assigned to one of four trial arms. The project lead conducted the randomisation using random numbers assigned to each municipality, followed by sorting, and allocating the first 33 to the first arm, the next 33 to the second arm, etc. Eligible municipalities were informed about the study, both through letters and email and were invited to participate. Municipalities that elected to participate were asked to provide a contact person from the municipality's home care services. All employees were eligible for participation and contact persons were requested to provide an employee overview with contact information. This was

subsequently used to invite employees to participate in the study through email and text messages.

Originally, three intervention arms were planned, but due to fewer recruited municipalities ($n=104$) than expected those in the third intervention arm (online risk assessment) were randomly reallocated to the two remaining interventions and the control group using the same method as the original randomisation. As 8 municipalities dropped out of the study before the interventions, we were left with 96 municipalities. Thus, 35 municipalities with 1771 potential participants were allocated to the control group, 30 municipalities with 1034 potential participants to the inspection intervention group and 31 municipalities with 1180 potential participants to the guidance-through-workshop group.

Of these, 673 participants in the control group, 517 in the inspection group and 479 in the guidance group participated at baseline. Six months post interventions, the numbers were 363, 285 and 269 for the 3 groups, respectively, while at 12 months, the numbers were 220, 185 and 172, respectively. The dropout rates were 67.3%, 64.2% and 64.1% for the control, inspection and guidance groups, respectively. [Figure 1](#), adapted from the study protocol,²² presents a flowchart of the interventions and data collection process for this study.

Interventions

This study encompasses two interventions, labour inspection and guidance-through-workshop and one control group. The interventions were implemented in the assigned municipalities, that is, at the cluster level.

Inspection intervention

The LIA's standard labour inspections constituted the inspection intervention. The participating workplaces received written information about impending inspections 3 weeks prior to the inspections. Two trained inspectors visited the offices of each participating home care unit. The individual home care service clients and their homes were not included in the inspections. Using a standardised checklist addressing psychosocial and biomechanical work exposures, they observed workplace compliance with the requirements of the Working Environment Act and the Internal Control Regulation. In addition, the inspectors also provided information and advice on how to comply with labour regulations. After the inspection, the inspectors prepared a report on the work environment at each of the participating services, which identified relevant work factors, any cases of non-compliance, and how the organisations should follow up these cases of non-compliance.

Guidance-through-workshop intervention

The guidance-through-workshop intervention consisted of one-time workshops hosted by the LIA to which they invited leaders and representatives of employees at the allocated services to participate. Based on geographical regions, five to seven home care services were assigned to joint workshops. Before attending the workshop, each of the participating services received information on the relevant topics, that is, work environment and employee health, and were also asked to prepare a presentation of relevant issues related to these topics at their workplace. Based on the issues presented at the workshop, the two attending trained labour inspectors would provide guidance to the home care services. This primarily consisted of information and advice based on OSH legislation and regulations.

Control group

The control group had 'care as usual', meaning that no interventions from the LIA were implemented in the services allocated

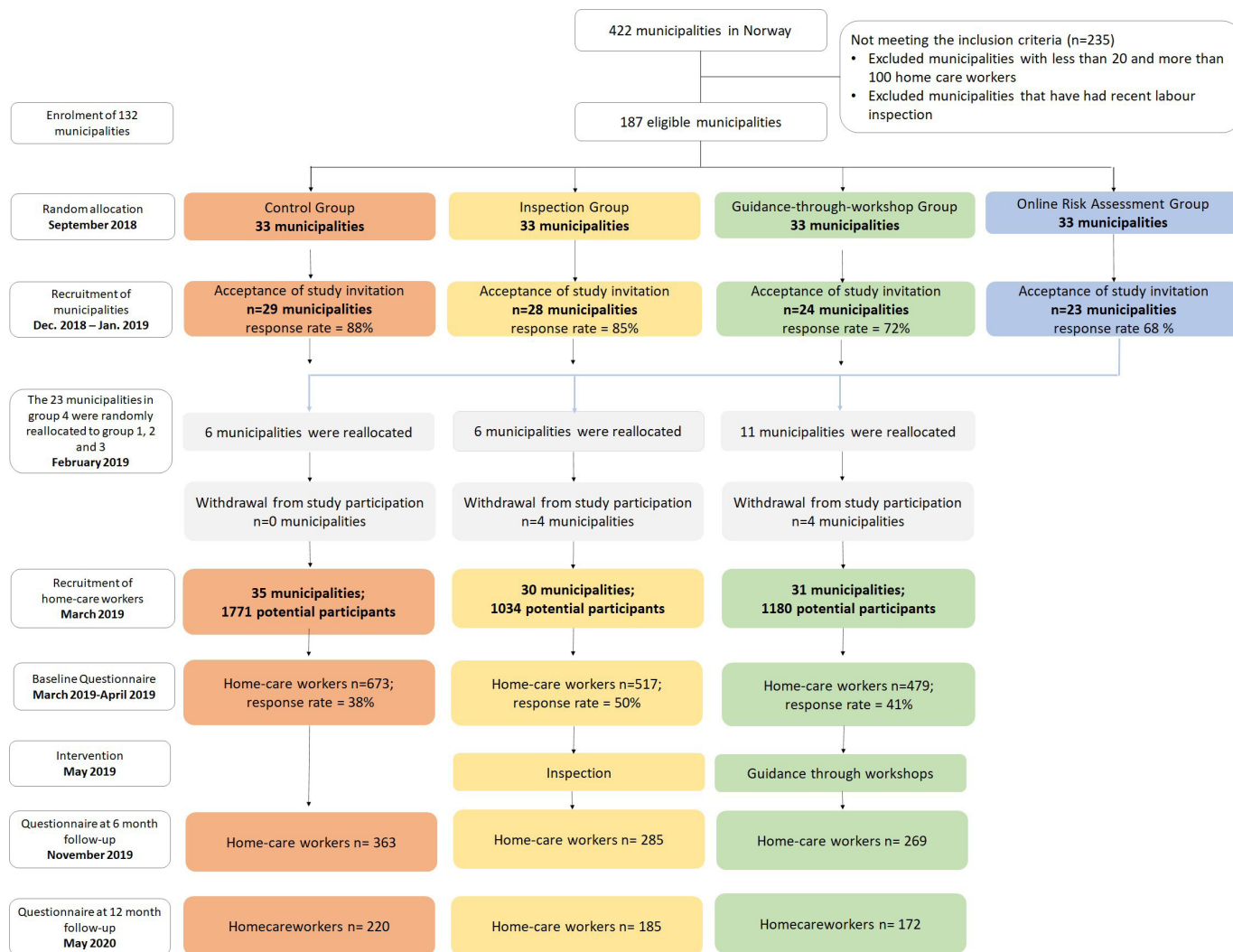


Figure 1 Flowchart illustrating cluster allocation, intervention implementation and data collection, adapted from Indregard *et al.*²²

to this group. The control group completed the same questionnaires as the intervention groups and at the same intervals and periods.

Data collection

We collected data through a proprietary web-based questionnaire developed by the National Institute of Occupational Health in Norway, which was administered to individual participants. The questionnaire could be completed in multiple sessions and accessed through a unique code, which was assigned to each participant in advance. Optionally, the participants could fill out a paper version of the questionnaire and return it by mail (prepaid). Data collection was conducted at baseline prior to the intervention implementation, and at 6 months and 12 months post intervention for all three groups.

Measures

The self-report questionnaire measured psychosocial and biomechanical work factors. Additionally, demographic characteristics, such as age, gender, education level, type of employment and percentage of full-time equivalent employment (FTE), were recorded. Further, job titles were also recorded based on the International Standard Classification of Occupations 2008, which were condensed into six categories: (1) nurses, (2) nurses'

aides, (3) other healthcare professionals, (4) other care staff, (5) leaders and (6) others.

Psychosocial work factors

We measured psychosocial work factors using scales from the General Questionnaire for Psychological and Social Factors at Work (QPS^{Nordic}), which is a comprehensive instrument based on theories of work motivation, job satisfaction, job stress, well-being and health.²⁴ The QPS^{Nordic} has good psychometric properties and high validity and reliability.^{24 25}

In this study, 14 factors were measured with scales from the QPS^{Nordic}, namely: quantitative demands, decision demands, learning demands, role clarity, role conflict, decision control, control over work intensity, positive challenges at work, fair leadership, empowering leadership, support from immediate superior, support from coworkers, focus on human resources and predictability in the coming month. Each scale comprises three to five items. Each item was rated from 1 to 5, where 1=very seldom or never, 2=seldom, 3=sometimes, 4=often and 5=very often or always. The scales were based on the average of the items on each scale.

Additionally, we included five items, developed by Statistics Norway,²⁶ to measure experiences of adverse social behaviour over the last 6 months, at baseline over the last 12 months.

Table 1 Characteristics of study participants at baseline, split into the inspection, guidance-through-workshop and control groups

	Inspection (n=517)	Guidance-through-workshop (n=479)	Control (n=673)
Gender (%*)			
Male	22 (4.26)	22 (4.59)	28 (4.16)
Female	495 (95.74)	457 (95.41)	645 (95.84)
Age (SD)	46.12 (11.62)	44.66 (12.22)	45.30 (12.05)
Marital status (%*)			
Unmarried	70 (13.67)	64 (13.56)	98 (14.89)
Married/cohabiting	398 (77.73)	362 (76.69)	508 (77.20)
Widow/widower	12 (2.34)	7 (1.48)	7 (1.06)
Divorced/separated	32 (6.25)	39 (8.26)	45 (6.84)
Type of employment (%*)			
Permanent	482 (94.14)	434 (92.74)	619 (93.50)
Temporary	16 (3.13)	16 (3.42)	18 (2.72)
Substitute/on-call	11 (2.15)	16 (3.42)	23 (3.47)
Other	3 (0.59)	2 (0.43)	2 (0.30)
Percentage employment [†] (SD)	79.01 (22.09)	78.25 (22.58)‡	81.22 (21.54)
Job title (%)			
Nurse	190 (37.18)	154 (32.15)	229 (35.18)
Nursing assistant	230 (45.01)	226 (47.18)	283 (43.47)
Other health professions	10 (1.96)	9 (1.88)	14 (2.15)
Other care staff	64 (12.52)	75 (15.66)	105 (16.13)
Leader	13 (2.54)	13 (2.71)	15 (2.30)
Other	4 (0.78)	2 (0.42)	5 (0.77)
Leader responsibilities (%*)			
Top tier leader	89 (17.69)	92 (19.74)	106 (16.31)
Middle tier leader	44 (8.75)	37 (7.94)	48 (7.38)
No leadership responsibilities	370 (73.56)	337 (72.32)	496 (76.31)

*Valid percentages.

†Percentage employment is the percentage of a full-time equivalent position.

‡Significantly different from controls, $p \leq 0.05$.

These were (1) bullying by coworkers, (2) bullying by superior, (3) violence, (4) threats and (5) unwanted sexual attention. Each item was rated from 1=never to 5=yes, on a daily basis.

Biomechanical work factors

To measure biomechanical work factors, we included five items, also developed by Statistics Norway.²⁶ These items assessed the time spent at work (1) squatting/kneeling, (2) standing, (3) leaning forward without support, (4) awkward lifting and (5) heavy lifting. Items 1, 2 and 3 were rated from 1=never to 6=almost all the time, while items 4 and 5 were rated from 1=never to 5=at least 20 times a day.

We adapted four items from Smedley *et al*²⁷ to measure biomechanical work factors known to be especially relevant for home care settings. These were how often in a shift one would; (1) manually transfer clients/patients between a bed and a chair; (2) manually move clients/patients around on a bed, chair or wheelchair; (3) perform physically demanding tasks without the use of aids; and (4) perform physically demanding tasks without the use of aids, despite them being available. These were rated from 1=never to 5=at least 20 times a day. We also included one item on perceived physical intensity while at work, rated from 1 (not at all) to 10 (extremely heavy) based on Borg.²⁸ Lastly, we included one item measuring allocation of physically demanding work: 'To what degree is physically demanding work appropriately allocated among the staff?'. This was rated from 1=small degree to 5=very large degree.

Statistical analyses

Statistical analyses were performed using STATA V.16 (Stata Corp, College Station, Texas, USA). Logistic regression was used to assess attrition bias based on baseline demographics, whereas t-tests were conducted to compare responders and non-responders. T-tests were also used to compare the two intervention groups separately with the control group at baseline. Changes in the outcome variables were analysed separately using linear mixed models. Time, time×group and the percentage of FTE were included as independent variables. The percentage of FTE was included due to differences in baseline between the guidance group and the control group, and we considered the variable to be intrinsically linked with the exposure. To account for clustering, participants nested within municipalities were included as random effects. The analyses were adjusted for the outcome variable at baseline as recommended for randomised controlled trials.²⁹ To adjust for multiple testing, we used the Benjamini-Hochberg test³⁰ to provide adjusted p values. The level of significance was set to 0.05.

Ethics

This study was conducted in accordance with the principles of the Declaration of Helsinki.³¹ All participants provided informed, written consent and were informed about their right to withdraw from the study at any time. The study was assessed by the regional committees for medical and health research ethics, and the Norwegian Centre for Data Research approved data handling and storage (566128). All self-reported data were

Table 2 Baseline mean values for all groups and linear mixed models for the effect of the interventions on psychosocial and organisational work factors at 6 and 12 months

	Baseline				6 months				12 months				ICC*
	Inspection		Control		Inspection		Guidance		Inspection		Guidance		
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI	
Quantitative demands† (1–5)	2.96 (0.76)	2.97 (0.73)	3.08 (0.78)	3.08 (0.78)	0.05	-0.06 to 0.17	-0.02	-0.14 to 0.08	0.11	-0.02 to 0.24	-0.01	-0.13 to 0.13	0.104
Decision demands† (1–5)	3.57 (0.65)	3.58 (0.65)	3.62 (0.64)	3.62 (0.64)	0.01	-0.08 to 0.09	-0.02	-0.11 to 0.06	-0.06	-0.17 to 0.04	-0.02	-0.13 to 0.08	0.019
Learning demands† (1–5)	2.52 (0.58)	2.52 (0.60)	2.54 (0.59)	2.54 (0.59)	0.04	-0.03 to 0.11	-0.01	-0.09 to 0.06	0.06	-0.03 to 0.16	-0.01	-0.10 to 0.09	0.008
Role clarity‡ (1–5)	4.37 (0.60)	4.28 (0.63)	4.27 (0.70)	4.27 (0.70)	0.01	-0.07 to 0.10	0.06	-0.02 to 0.14	-0.05	-0.16 to 0.06	0.03	-0.07 to 0.14	0.006
Role conflict (1–5)	2.64 (0.79)	2.58 (0.79)	2.68 (0.85)	2.68 (0.85)	-0.01	-0.13 to 0.11	-0.07	-0.19 to 0.05	0.10	-0.04 to 0.25	0.07	-0.07 to 0.22	0.029
Decision control‡ (1–5)	2.79 (0.73)	2.75 (0.67)	2.80 (0.70)	2.80 (0.70)	-0.07	-0.16 to 0.01	0.08	-0.01 to 0.17	0.01	-0.10 to 0.11	0.16	0.04 to 0.27	0.002
Control over work intensity‡ (1–5)	2.29 (0.85)	2.23 (0.76)	2.36 (0.87)	2.36 (0.87)	0.01	-0.09 to 0.10	0.14	0.03 to 0.24	-0.01	-0.14 to 0.10	0.16	0.04 to 0.29	0.001
Positive challenges at work‡ (1–5)	4.20 (0.66)	4.20 (0.60)	4.19 (0.63)	4.19 (0.63)	0.01	-0.07 to 0.10	0.04	-0.04 to 0.13	-0.03	-0.14 to 0.08	0.03	-0.07 to 0.15	0.010
Fair leadership‡ (1–5)	4.00 (0.85)	4.11 (0.79)	3.99 (0.83)	3.99 (0.83)	-0.05	-0.19 to 0.08	0.11	-0.02 to 0.25	-0.05	-0.22 to 0.11	0.07	-0.09 to 0.24	0.040
Empowering leadership‡ (1–5)	3.22 (1.05)	3.27 (1.00)	3.18 (1.01)	3.18 (1.01)	-0.01	-0.18 to 0.15	0.10	-0.06 to 0.26	-0.05	-0.25 to 0.14	0.23	0.03 to 0.43	0.053
Support from immediate superior‡ (1–5)	3.81 (1.02)	3.89 (0.97)	3.71 (1.02)	3.71 (1.02)	-0.06	-0.22 to 0.10	0.08	-0.08 to 0.24	-0.13	-0.32 to 0.06	0.16	-0.03 to 0.36	0.049
Support from coworkers‡ (1–5)	4.27 (0.80)	4.24 (0.80)	4.17 (0.82)	4.17 (0.82)	-0.01	-0.11 to 0.10	-0.01	-0.11 to 0.10	-0.05	-0.18 to 0.08	0.10	-0.03 to 0.24	0.001
Focus on human resources‡ (1–5)	2.95 (0.98)	3.12 (0.91)	2.97 (0.96)	2.97 (0.96)	0.01	-0.14 to 0.17	0.02	-0.13 to 0.17	-0.13	-0.31 to 0.05	0.02	-0.16 to 0.21	0.046
Predictability in the coming month‡ (1–5)	3.49 (0.97)	3.50 (0.90)	3.47 (0.95)	3.47 (0.95)	2.10	-0.02 to 0.27	0.02	-0.12 to 0.17	0.01	-0.17 to 0.18	-0.05	-0.24 to 0.12	0.033

* Intraclass correlation (ICC) for the municipal cluster.

† A lower score is considered advantageous.

‡ A higher score is considered advantageous.

Table 3 Baseline mean values for all groups and linear mixed models for the effect of the interventions on adverse social behaviour at 6 and 12 months

	Baseline		6 months				12 months				ICC*		
	Inspection	Guidance	Control		Inspection		Guidance		Inspection			Guidance	
			Mean (SD)	Mean (SD)	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI		Coef.	95% CI
Bullying—coworkers† (1–5)	1.16 (0.50)	1.21 (0.55)	1.22 (0.58)	1.22 (0.58)	0.05	-0.01 to 0.13	0.02	-0.05 to 0.10	0.09	-0.01 to 0.19	-0.01	-0.10 to 0.08	0.001
Bullying—superior† (1–5)	1.11 (0.45)	1.12 (0.45)	1.12 (0.42)	1.12 (0.42)	-0.01	-0.07 to 0.04	-0.02	-0.09 to 0.06	0.05	-0.02 to 0.13	-0.01	-0.09 to 0.06	0.001
Violence† (1–5)	1.17 (0.50)	1.17 (0.51)	1.15 (0.45)	1.15 (0.45)	0.01	-0.07 to 0.09	0.03	-0.05 to 0.11	0.01	-0.09 to 0.10	0.01	-0.05 to 0.11	0.035
Threat† (1–5)	1.14 (0.43)	1.17 (0.49)	1.14 (0.41)	1.14 (0.41)	-0.05	-0.11 to 0.01	-0.03	-0.09 to 0.03	-0.04	-0.12 to 0.03	-0.04	-0.12 to 0.03	0.006
Unwanted sexual attention† (1–5)	1.32 (0.68)	1.41 (0.72)	1.38 (0.74)	1.38 (0.74)	0.01	-0.10 to 0.12	0.05	-0.05 to 0.16	0.06	-0.07 to 0.19	0.08	-0.04 to 0.22	0.038

* Intraclass correlation (ICC) for the municipal cluster.
 † A lower score is considered advantageous.

stored electronically and kept separate from any identifying information. The participating services were not offered any incentives or compensation, but individual participants could win a 15 000 Norwegian krone gift certificate.

RESULTS

Table 1 presents the background characteristics of each group at baseline. There were no statistically significant group differences in age, gender, marital status, educational background, type of employment, job titles or leadership responsibilities. However, there was a difference in the percentage of FTE between the guidance-through-workshop and the control groups. We observed some statistically significant differences between those who dropped out of the study and those who remained. Those who were older (OR: 1,01, p<0.001), had more education (OR: 1.18, p=0.05) and a higher percentage of FTE (OR: 1,007, p=0002) had higher odds of remaining in the study. In addition, ‘other care staff’ had lower odds of remaining in the study at 12 months (OR: 0.59, p=0.003). Those remaining at 12 months were on average 2.3 years older, had 0.06 levels higher education and 3.59% more employment than those who stopped responding. No other differences were observed and the between-group composition remained similar to that at baseline.

We found no significant effects of the inspection intervention on the psychosocial factors compared with the control group (table 2). For the guidance-through-workshop group, 13 of the 14 factors showed some development in a potentially positive direction. There were increases in decision control and empowering leadership at 12 months and control over work intensity at 6 and 12 months compared with the control group. However, after adjusting for multiple testing, none of the variables were statistically significant.

We found no statistically significant effects of the interventions on adverse social behaviour (table 3).

Regarding biomechanical factors, we found that the inspection group spent more time squatting or kneeling at 6 months than the control group (table 4). This effect was not present at 12 months, and after adjusting for multiple testing, it was not statistically significant at either time point. We found no statistically significant effects of the interventions on any of the other variables

DISCUSSION

This study aimed to determine the effect of labour inspections and guidance-through-workshops conducted by the Labour Inspection Authority on psychosocial and biomechanical work factors. We found small, potentially positive, changes in 13 of the 14 psychosocial factors in the guidance-through-workshop intervention, with significant effects on the factor control over work intensity for all follow-ups, and for decision control and empowering leadership at the 12-month follow-up. However, these were not statistically significant after adjusting for multiple testing. For all other variables, we found no significant effects of the interventions.

We observed no substantial effect of the interventions on psychosocial and biomechanical work factors even though the study process evaluation indicated that most aspects of the implementation of the interventions went as planned.²³ Additionally, participants who responded to the process evaluation rated the utility of the interventions as high and reported enhanced knowledge after attending. As such, the findings are similar to those of Weissbrodt *et al*³² who found that inspections mostly led to increased knowledge of and ability in psychosocial OSH

Table 4 Baseline mean values for all groups and linear mixed models for the effect of the interventions on biomechanical work factors at 6 and 12 months

	Baseline			6 months			12 months			ICC*		
	Inspection Mean (SD)	Guidance Mean (SD)	Control Mean (SD)	Inspection Coef.	95% CI	Guidance Coef.	95% CI	Inspection Coef.	95% CI		Guidance Coef.	95% CI
Time spent—squatting or kneeling† (1–6)	2.67 (1.04)	2.83 (1.06)	2.85 (1.17)	0.17	0.02 to 0.32	0.09	-0.05 to 0.23	-0.02	-0.19 to 0.15	0.02	-0.14 to 0.20	
Time spent—walking or in an upright position† (1–6)	4.64 (1.23)	4.59 (1.20)	4.49 (1.35)	0.06	-0.12 to 0.25	-0.16	-0.35 to 0.02	-0.01	-0.24 to 0.21	-0.15	-0.38 to 0.07	
Time spent—leaning forward without support† (1–6)	3.12 (1.23)	3.08 (1.27)	3.09 (1.32)	-0.01	-0.18 to 0.17	-0.07	-0.25 to 0.10	0.01	-0.21 to 0.22	-0.01	-0.23 to 0.19	
Lifting in an uncomfortable position† (1–5)	2.06 (0.71)	2.10 (0.72)	2.03 (0.75)	0.06	-0.03 to 0.14	0.02	-0.06 to 0.11	0.07	-0.03 to 0.19	0.11	-0.01 to 0.22	
Lifting more than 10 kg† (1–5)	1.97 (0.76)	2.02 (0.81)	1.92 (0.77)	0.04	-0.06 to 0.15	0.01	-0.10 to 0.11	0.03	-0.10 to 0.16	0.13	-0.01 to 0.27	
Manually moving patients/clients† (1–5)	2.09 (0.75)	2.04 (0.73)	2.02 (0.74)	-0.01	-0.10 to 0.09	-0.09	-0.19 to 0.01	0.01	-0.10 to 0.14	0.03	-0.09 to 0.16	
Lifting/supporting patients/clients† (1–5)	2.15 (0.79)	2.11 (0.73)	2.08 (0.75)	0.03	-0.06 to 0.13	0.01	-0.08 to 0.11	0.02	-0.10 to 0.14	-0.06	-0.18 to 0.06	
Physical exertions without aids† (1–5)	1.81 (0.69)	1.78 (0.68)	1.75 (0.67)	0.03	-0.08 to 0.14	0.04	-0.06 to 0.15	-0.01	-0.14 to 0.11	-0.03	-0.16 to 0.09	
Physical exertions despite available aids† (1–5)	1.55 (0.61)	1.55 (0.61)	1.55 (0.69)	0.07	-0.02 to 0.17	0.06	-0.03 to 0.15	0.01	-0.10 to 0.13	0.06	-0.05 to 0.18	
Perceived physical intensity/demand at work† (0–10)	3.71 (1.93)	3.91 (2.15)	3.86 (2.19)	0.19	-0.07 to 0.45	-0.01	-0.27 to 0.25	0.26	-0.05 to 0.57	0.08	-0.23 to 0.39	
Appropriate allocation of physically demanding work† (1–5)	2.83 (1.09)	2.81 (1.10)	2.79 (1.08)	0.01	-0.18 to 0.20	-0.03	-0.23 to 0.15	-0.07	-0.31 to 0.15	-0.07	-0.31 to 0.16	

* Intraclass correlation (ICC) for the municipal cluster.

† A lower score is considered advantageous.

‡ A higher score is considered advantageous.

management; however, this did not manifest into improvements in working conditions or employee participation.

Some accidents and injuries are caused by breaches of rules and inadequate barrier functions related to physical hazards, for example, a lack of railing, which inspections and checklists might easily uncover. However, the inherent complexity of addressing psychosocial risk factors could explain the lack of any observed effects of the interventions. Jespersen *et al*³³ argued that psychosocial risk factors are characterised by unclear cause-effect relationships and can have unclear solutions. As such, inspections and workshops might just be part of the solution. They could perhaps contribute more substantively with a longitudinal perspective, for example, through follow-up inspections or guidance-through-workshops, or in conjunction with other interventions. It could also be argued that these tools do not adequately address specific psychosocial work factors in their current form.

Another potential explanation, linked with this complexity, could be different barriers to managing psychosocial work factors that the interventions might not overcome. One suggested barrier is small organisation size,³⁴ as this might affect the resources available for managing psychosocial work factors.³⁵ Larger organisations (more than 100 employees) have been linked with better outcomes after labour inspections than smaller organisations.³² The services in our sample had between 20 and 100 care workers on staff and as such might have limited resources to systematically improve psychosocial factors. Another potential barrier is restructuring or organisational changes.³⁶ Several of the municipalities in this study merged with other municipalities as a part of municipal reform during the study period. As all participating services in this study were municipal services, this may have led to organisational changes and potentially caused a shift in attention from working on psychosocial factors to handling these organisational changes. Finally, the setting itself might have been a barrier, as implementing changes in the work environment might be challenging across different homes being served. Home care services are less well-defined settings than, for example, nursing homes, and have a greater spread, both geographically and in different home environments encountered.¹⁵

The relatively short follow-up period of 12 months may also have been insufficient to observe substantive changes in psychosocial and biomechanical work factors. Previous research on the impact of enforcement tools on work-related injuries²¹ suggests that they have an effect in the long term (>3 years) but not in the short term (≤ 1 year). It is not known whether the effects of enforcement on psychosocial and biomechanical work factors follow a similar trajectory; however, this might explain the observed lack of substantial changes. Lastly, the intervention was administered only once, and it could be argued that repeated interventions might have led to an increased effect. However, such repeated interventions would have taxed the resources of the LIA and the available research on inspections suggest that repeated inspections would not necessarily have resulted in improved compliance²¹ and thus potentially would not influence the different work factors either.

Strengths and limitations

The cluster-randomised controlled trial design is a major strength of the present study allowing us to limit potential confounding factors and to make causal inferences about the effects of the interventions. Further, we have based our data collection on validated, standardised measures, which should reduce measurement error.²⁴ The study had a rather large

attrition rate, which might have influenced the findings. This could somewhat be explained by both the high turnover rate (10.9%) and high sickness absence (11%) among nurses in the Norwegian home care sector.³⁷ There were some statistically significant differences between those who continued to respond and those who stopped. Those who stopped responding were generally younger, had a lower level of education, had a lower FTE-percentage and were more often in the 'other healthcare staff' category. However, the actual differences were quite small, the group distributions remained similar to baseline and no new differences were found between the groups at follow-up. This suggests that they are missing at random. Linear mixed models, used in this study, are considered one suitable way of addressing this.³⁸ Lastly, as this study is cluster randomised at a municipal level, we cannot guarantee that there has not been any intervention contamination across municipalities that might have influenced the results. More than 95% of the participants in this study were women, which reflects the gender balance among employees in the home care services,¹⁵ and as such indicates that the findings are generalisable across settings with similar gender distributions in the health and care services. Additionally, while there are differences in home care provisions between countries, the findings could also be applicable to countries with similar legal requirements regarding psychosocial work environments, such as the EU.³⁹

Implications for practice and future research

The lack of substantial effects suggests that there is a need to evaluate and potentially revise existing practice. The initial positive effects of the guidance-through-workshop intervention, although not statistically significant, could indicate a potential new avenue worth exploring. The factors decision control, control over work intensity and empowering leadership could potentially be related to each other, as a key factor of empowering leadership is facilitating and supporting employee autonomy.⁴⁰ This conceptual congruence could also indicate that the initial findings were more than randomly significant due to multiple testing. Thus, further exploring the potential of providing guidance-through-workshops, together with investigating how inspections could influence psychosocial and biomechanical work factors, are possible future paths of research.

CONCLUSION

The present study found no substantial effects of labour inspections on psychosocial and biomechanical work factors. Guidance-through-workshops produced a positive effect on psychosocial work factors, but these effects were not statistically significant when adjusting for multiple testing. Given the lack of observed effect, further research is needed to elucidate on labour inspections and other regulatory tools can enable effective monitoring and influence psychosocial and biomechanical work factors.

Acknowledgements The current project was conceived in collaboration with the Norwegian Labour Inspection Authority. The authors thank the Norwegian Labour Authority, Gunn Robstad Andersen, Marianne Elvsaa Nordtømme and Monica Seem for their contributions in conducting the EAVH trial. The authors also thank Shahrooz Elka and Anne-Marthe R. Indregard for their assistance with participant recruitment and survey administration.

Collaborators The EAVH project is a collaboration between the Norwegian Labour Inspection Authority and the National Institute of Occupational Health in Norway (STAMI). The Labour Inspection Authority was responsible for providing the interventions, while STAMI was responsible for the trial design, randomisation, data collection, statistical analysis, data interpretation and drafting of the present manuscript.

Contributors BFG conducted the analyses, participated in data interpretation, wrote the manuscript. HAJ is project lead and guarantor, and drafted the first study design. SK, JE, ØS and HAJ participated in designing the study and participated in the analyses and data interpretation. JE and HAJ collected the data. All authors read, revised and approved the final manuscript.

Funding The project is funded by the National Institute of Occupational Health in Norway and the Norwegian Labour Inspection Authority.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study was conducted in accordance with the principles of the Declaration of Helsinki. This study involves human participants. The study was assessed by the Regional Committees for Medical and Health Research Ethics (REC Southeast) (2018/2003/ REK Sør-Øst C). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data will be available 3 years after study completion. Data access request will be reviewed by NSD - Norwegian Centre for Research Data. URL: <https://nsd.no/nsd/english/index.html>.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Bjørnar Finnanger Garshol <http://orcid.org/0000-0003-3201-6608>

REFERENCES

- Knardahl S, Johannessen HA, Sterud T, *et al.* The contribution from psychological, social, and organizational work factors to risk of disability retirement: a systematic review with meta-analyses. *BMC Public Health* 2017;17:176.
- Knardahl S, Sterud T, Nielsen MB, *et al.* Arbeidsplassen og sykefravær - Arbeidsforhold av betydning for sykefravær. *Tidsskrift for velferdsforskning* 2016;19:179–99.
- Taibi Y, Metzler YA, Bellingrath S, *et al.* A systematic overview on the risk effects of psychosocial work characteristics on musculoskeletal disorders, absenteeism, and workplace accidents. *Appl Ergon* 2021;95:103434.
- Duchaine CS, Aubé K, Gilbert-Ouimet M, *et al.* Psychosocial stressors at work and the risk of sickness absence due to a diagnosed mental disorder: a systematic review and meta-analysis. *JAMA Psychiatry* 2020;77:842–51.
- Tollånes MC, Knudsen AK, Vollset SE, *et al.* Disease burden in Norway in 2016. *Tidsskr Nor Laegeforen* 2018;138. doi:10.4045/tidsskr.18.0274. [Epub ahead of print: 02 10 2018].
- Sterud T, Tynes T. Work-related psychosocial and mechanical risk factors for low back pain: a 3-year follow-up study of the general working population in Norway. *Occup Environ Med* 2013;70:296–302.
- Johannessen HA, Tynes T, Sterud T. Effects of occupational role conflict and emotional demands on subsequent psychological distress: a 3-year follow-up study of the general working population in Norway. *J Occup Environ Med* 2013;55:605–13.
- Carneiro P, Braga AC, Barroso M. Work-related musculoskeletal disorders in home care nurses: study of the main risk factors. *Int J Ind Ergon* 2017;61:22–8.
- Sterling MR, Li J, Cho J, *et al.* Prevalence and predictors of home health care workers' general, physical, and mental health: findings from the 2014–2018 behavioral risk factor surveillance system. *Am J Public Health* 2021;111:2239–50.
- Bakke B, Degerud EMM, Gravseth HMU. *Faktabok om arbeidsmiljø og helse 2021. Status og utviklingstrekk [Norwegian Fact Book on Work Environment and Health 2021 – Status and Recent Developments]*. STAMI-rapport, 2021.
- Gronoset Grasmø S, Frostad Liaset I, Redzovic SE. Home health aides' experiences of their occupational health: a qualitative meta-synthesis. *Home Health Care Serv Q* 2021;40:148–76.
- Quinn MM, Markkanen PK, Galligan CJ, *et al.* Occupational health of home care aides: results of the safe home care survey. *Occup Environ Med* 2016;73:237–45.
- Ministry of Health and Care Services. *Leve hele livet - En kvalitetsreform for eldre [Meld. St. 15 (2017-2018)] [Living a full life – a quality reform for older people]*. Oslo Ministry of Health and Care Services, 2018.
- Muramatsu N, Sokas RK, Chakraborty A, *et al.* Slips, Trips, and falls among home care aides: a mixed-methods study. *J Occup Environ Med* 2018;60:796–803.
- Rydenfält C, Holgersson C, Östlund B, *et al.* Picking low hanging fruit - A scoping review of work environment related interventions in the home care sector. *Home Health Care Serv Q* 2020;39:223–37.
- World Health Organization. Declaration on workers health - approved at the seventh meeting of who collaborating centers for occupational health. *Stress*; 2006.

- 17 International Labour Office. Global strategy on occupational safety and health—conclusions adopted by the International labour conference at its 91st session. Geneva; 2004.
- 18 Andersen JH, Malmros P, Ebbehoj NE, *et al.* Systematic literature review on the effects of occupational safety and health (OSH) interventions at the workplace. *Scand J Work Environ Health* 2019;45:103–13.
- 19 Tompa E, Kalcevich C, Foley M, *et al.* A systematic literature review of the effectiveness of occupational health and safety regulatory enforcement. *Am J Ind Med* 2016;59:919–33.
- 20 Johannessen HA, Løchting I, Bakke B. *Effekter av myndighetstiltak på arbeidsmiljø og helse. En systematisk kunnskapsoppsummering [Effects of authorities' efforts to improve work environment and health – a systematic literature review]*. STAMI-rapport, 2017.
- 21 Mischke C, Verbeek JH, Job J, *et al.* Occupational safety and health enforcement tools for preventing occupational diseases and injuries. *Cochrane Database Syst Rev* 2013:CD010183.
- 22 Indregard A-MR, Knardahl S, Emberland JS, *et al.* Effectiveness of the labour inspection authority's regulatory tools for work environment and employee health: study protocol for a cluster-randomised controlled trial among Norwegian home-care workers. *BMJ Open* 2019;9:e031226.
- 23 Johannessen HA, Knardahl S, Emberland JS. Do regulatory tools instigate measures to prevent work-related musculoskeletal pain and mental distress? A process evaluation of a labour inspection authority trial in the home-care services
- 24 Dallner M, Elo A, Gamberale F. *Validation of the general Nordic questionnaire (QPSNordic) for psychological and social factors at work*. Copenhagen: Nordic Council of Ministers [Nordiska ministerrådet], 2000.
- 25 Wännström I, Peterson U, Åsberg M, *et al.* Psychometric properties of scales in the general nordic questionnaire for psychological and social factors at work (QPs): confirmatory factor analysis and prediction of certified long-term sickness absence. *Scand J Psychol* 2009;50:231–44.
- 26 Statistics Norway. *Samordnet levekårsundersøkelse 2009 – Tverrsnitt. Tema: Arbeidsmiljø (Coordinated living conditions survey 2009 - Cross sectional. focus: work environment)*. Oslo: Statistics Norway, 2010.
- 27 Smedley J, Egger P, Cooper C, *et al.* Manual handling activities and risk of low back pain in nurses. *Occup Environ Med* 1995;52:160–3.
- 28 Borg G. Psychophysical scaling with applications in physical work and the perception of exertion. *Scand J Work Environ Health* 1990;16 Suppl 1:55–8.
- 29 J T, L B, T H, *et al.* Different ways to estimate treatment effects in randomised controlled trials. *Contemp Clin Trials Commun* 2018;10:80–5.
- 30 Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B* 1995;57:289–300.
- 31 World Medical Association. World Medical association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA* 2013;310:2191–4.
- 32 Weissbrodt R, Arial M, Graf M, *et al.* Preventing psychosocial risks at work: an evaluation study of labour inspectorate interventions. *Saf Sci* 2018;110:355–62.
- 33 Jespersen AH, Hasle P, Nielsen KT. The wicked character of psychosocial risks: implications for regulation. *NJWLS* 2016;6:23–42.
- 34 Weissbrodt R, Giauque D. Labour inspections and the prevention of psychosocial risks at work: a realist synthesis. *Saf Sci* 2017;100:110–24.
- 35 Pinder J, Gibb A, Dainty A, *et al.* Occupational safety and health and smaller organisations: research challenges and opportunities. *Policy Pract Health Saf* 2016;14:34–49.
- 36 Mellor N, Mackay C, Packham C, *et al.* 'Management standards' and work-related stress in Great Britain: progress on their implementation. *Saf Sci* 2011;49:1040–6.
- 37 Gautun H. For få på jobb? Sykepleierbemanning I sykehjem OG hjemmesykepleien. *Søkelys på arbeidslivet* 2021;38:142–57.
- 38 Fielding S, Fayers P, Ramsay CR. Analysing randomised controlled trials with missing data: choice of approach affects conclusions. *Contemp Clin Trials* 2012;33:461–9.
- 39 Chirico F, Heponiemi T, Pavlova M, *et al.* Psychosocial risk prevention in a global occupational health perspective. A descriptive analysis. *Int J Environ Res Public Health* 2019;16. doi:10.3390/ijerph16142470. [Epub ahead of print: 11 07 2019].
- 40 Amundsen S, Martinsen Øyvind L. Empowering leadership: construct clarification, conceptualization, and validation of a new scale. *Leadersh Q* 2014;25:487–511.