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A multilevel study on the association of observer-assessed working conditions with depressive symptoms among female eldercare workers from 56 work units in 10 care homes in Denmark

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ABSTRACT

Objectives: Eldercare workers in Denmark have a higher prevalence of poor psychological health than other occupational groups. We examined the association between working conditions assessed by trained observers and depressive symptoms assessed by self-report in a study of female Danish eldercare workers.

Methods: Working conditions were observed based on action regulation theory and defined as (1) regulation requirements, a workplace resource providing opportunity for decision-making and skill development and (2) barriers for task completion. We examined the associations of individual and work unit averaged working conditions with depressive symptoms in a sample of 95 individually observed eldercare workers. Further, we examined the association of work unit averaged working conditions with depressive symptoms in a sample of 205 care workers, including both observed and non-observed individuals. We used regression models that allowed for correlations within work units and care homes and adjusted these models for demographics, job characteristics and stressful life events.

Results: Higher levels of regulation requirements were associated with lower depressive symptoms at the individual level (p=0.04), but not at the workplace level. Barriers were not associated with depressive symptoms at the individual level. At the workplace level, a higher number of qualitatively different barriers (p=0.04) and a higher number of barriers for equipment use (p=0.03) were associated with lower levels of depressive symptoms in the age and cohabitation adjusted model, however statistical significance was lost in the fully adjusted model.

Conclusions: Low level of regulation requirements was associated with a high level of depressive symptoms. The study highlights the importance of examining both individual and workplace levels of working conditions.

Strengths and limitations of this study

- Eldercare workers in Denmark have higher levels of depressive symptoms and use more antidepressant medication than the general workforce.
- Most other studies on psychosocial working conditions and depressive symptoms assessed working conditions by self-report rendering results vulnerable to reporting bias and bias due to common method variance.
- This study assessed working conditions by external workplace observation and thus the assessment of working conditions was independent of the individual care worker's depressive symptom score.
- The study shows that a high level of regulation requirements, that is working conditions that allow decision-making, being creative in work practices and developing skills, are beneficial for mental health of eldercare workers.
- Limitations of the study are a relatively small sample and a cross-sectional design that makes it difficult to conclude on the direction of causality.

INTRODUCTION

Eldercare workers in Denmark have a higher prevalence of poor psychological health and psychiatric disorders than the general Danish workforce. Wieclaw *et al*[1 2] and Hannerz *et al*[3] found that care workers have heightened hospitalisation rates for mood disorders. Madsen *et al*[4 5] reported higher treatment rates for antidepressants and higher self-reported depressive symptoms among eldercare workers.

Whether the reduced psychological health of eldercare workers is due to poorer working conditions or other factors remains

a matter of debate. Several studies suggested that adverse working conditions in eldercare, such as work-related violence,[6] bullying, threats and unwanted sexual attention,[7 8] emotional demands,[5] detachment problems,[9] care orientation[10] and time pressure and unclear work demands[11 12] may contribute to risk of reduced psychological health. However, selection mechanisms may also play a role, as one study found that eldercare workers had high antidepressant treatment rates even before they started working in eldercare.[4]

The vast majority of studies on working conditions and psychological health assessed working conditions by self-report. As poor psychological health may cause a negative appraisal of the working conditions, this may lead to spurious associations.[13 14]

Concerns about the validity of self-reported working conditions have been voiced for decades.[15 16] Some studies addressed this concern by averaging self-reported individual-level data to either work unit or occupational group.[14 17 18] However, averaging data has both advantages and disadvantages. An advantage is that averaging allows measuring the shared work environment. For example, Weber and Lampert[19] conceptualised 'collective task requirements' where workers work on tasks in teams. Such collective tasks may create a work environment where the working conditions of one worker influence the working conditions of another worker within the same team or unit. In such work organisational circumstances averaging would provide an appropriate measure. Other working conditions may best be understood at the level of the individual exposure to the work factor, and averaging would cancel out the meaningful variation. Further, in most studies averaged data also originally stem from self-report and the estimated association between an exposure and a self-reported outcome may still be biased due to the shared source of information.

Observing working conditions in accordance with action regulation theory

In this article, we use workplace observations by trained observers to assess eldercare workers' working conditions. Consequently, these assessments are independent of the workers' own appraisal.

Our approach is based on action regulation theory (ART) which posits that human behaviour is goal oriented. According to ART, human beings assess the conditions under which a task must be completed and then plan and act accordingly.[20 21] A work activity can be regulated simultaneously at different levels of conscious awareness: (1) an automated, unconscious mode of regulation that takes care of simple and/or repetitive tasks, (2) a knowledge based and possibly conscious mode of regulation that takes care of more complex, but mostly rule-based tasks and (3) a strictly conscious intellectual mode that is invoked in new situations or in executing highly complex tasks.[21] An action is considered to be hierarchically complete when action regulation includes all three modes.

According to ART, regulation requirements constitute a resource in the work environment that provides possibilities of influencing and controlling the work environment and of being creative in work practice, learning new things and developing skills. Regulation requirements are a measure of the structural possibilities in the work task and not an assessment of the individual ability. A low level of regulation requirements reflects work tasks that only require an automated mode of regulation. In these situations the conditions and activities are determined and decisions are not required from the workers. A high level of regulation requirements reflects work tasks that require a conscious intellectual mode. In these situations workers can plan their work tasks and change the conditions forming these work tasks. Higher levels of regulation requirements are therefore considered a positive working condition and are expected to lead to better health.[22 23]

In ART, stressors in the work environment are defined as barriers that impede or interrupt the mental or physical regulation of action. The worker cannot complete the work task as intended and needs to perform extra work or engage in risky behaviour to overcome the barrier. For an event to constitute a true barrier, the workers' action in response to the barrier has to fulfil three criteria: it has to be necessary in order to complete the task; it cannot be part of the task, that is, the time to deal with the barrier is not provided for; and there cannot be another way of dealing with the event, that is, removing the hindrance. The severity of the barrier is measured as minutes of extra work necessary to overcome the barrier. Barriers are expected to have a negative effect on health.[22 23]

Whereas most other psychosocial work environment theories led to the development of questionnaires to measure work characteristics,[24–26] ART formed the basis for the development of observational job analysis methods such as the RHIA-VERA instrument (RHIA-VERA is the German acronym for the analysis of regulation problems and regulation requirements in the work activity). The instrument follows a strict protocol for assessing the level of regulation requirements and the frequency and severity of work barriers.[23] RHIA-VERA has been used to analyse the working conditions of German industrial workers,[27] German office workers,[28] American urban transit operators[29–31] and British civil servants.[32] These studies showed that regulation requirements and extra work due to barriers were associated with various health outcomes such as mental well-being, hypertension and psychosomatic symptoms.

To the best of our knowledge, two studies to date have analysed whether working conditions assessed by the RHIA-VERA instrument are associated with depressive symptoms. Leitner and Resch[28] found that a composite score of various barriers was associated with a heightened depressive symptom score after 1 and 2 years in a

prospective study with German office workers. Griffin *et al*[32] found that regulation requirements but not the composite measure for barriers was associated with caseness of depression and anxiety in a cross-sectional study of British civil servants. In a similar study based on ART, but using a different observational instrument, Rau *et al*[33] found that expert-rated job demands, but not expert-rated job control was related to major depression. Waldenström *et al*[34] also based their assessment of working conditions on ART but used interviews rather than observations to externally assess working conditions. They found that lack of instrumental support from colleagues and supervisors and deterioration in work characteristics was associated with depression.[34]

To summarise, research on working conditions, defined by ART and risk of depressive symptoms is sparse and inconsistent. Further studies are needed that test the relation of ART and depressive symptoms in other occupational and cultural settings. With this study, we aim to contribute with new knowledge on the association of working conditions, defined by ART and measured by RHIA-VERA, with depressive symptoms in the setting of eldercare work in Denmark.

We analysed the association of the individual level of depressive symptoms with regulation requirements and barriers at the individual level as well as at the work unit averaged level. The working conditions for an individual care worker may be split into the work unit average representing the shared working conditions across the unit and the individual deviation from this average representing the relative working conditions of the care worker compared to her closest colleagues. We therefore also investigated whether the association differed between these two levels. We hypothesise that a low level of regulation requirements and a high level of barriers is associated with a higher depressive symptoms score at both levels.

METHODS

Study design

This study analyses the associations of working conditions assessed by external observers with employees' self-reported depressive symptoms. The associations are analysed in (1) a sample of 95 individually observed female eldercare workers and (2) a sample where work unit averaged working condition scores were applied to 205 female eldercare workers working in one of the 56 observed work units across 10 care homes. Raters observed the working conditions and in the final phase of observation, a self-administered depressive symptom rating scale was mailed to the eldercare workers. Although assessment of the exposure preceded assessment of the end point we regard our study as cross-sectional, because the time period between observation and assessment of depressive symptoms was relatively brief (median: 5 weeks and 5 days, range: 0–21 weeks).

Study sample

We collected observational and questionnaire data from 10 care homes in Denmark. The care homes represented different care home environments in terms of resident types, care philosophy, physical surroundings and management style.

At the 10 care homes we observed 124 individual eldercare workers from 56 work units. We defined a work unit according to ward and shift as previous research has shown that there are marked differences between day and evening shifts.[35] Thus, the day and the evening shift of one ward were regarded as two separate work units. All female eldercare workers who either worked as social and healthcare helpers (SH, 19 months of job training) or social and healthcare assistants (SA, 39 months of job training) were eligible and were invited to participate. Most work tasks are similar for SH and SA. The main difference is that SAs have the principal responsibility for medication and medical care.

Of the 124 observed care workers 70 workers had responded to a mailed invitation. Another 54 workers were recruited directly by the observers who contacted them by telephone and invited them to participate. Participants recruited by mail and participants recruited directly by observers were similar in the level of depressive symptoms and for most working conditions. The only exception was that care workers recruited by the mailed invitation had significantly fewer minutes of extra work due to barriers compared to care workers who were approached by observers.

Questionnaires about depressive symptoms, cohabitation, work hours and stressful life events were sent to all eldercare workers working at the 10 care homes. Of the 551 employees who received the questionnaire, 317 responded (57%).

We constructed two data samples: an individual level sample and a work unit averaged level sample. The individual level sample contained 95 eldercare workers who were directly observed and who had complete questionnaire data. Of the 124 observed eldercare workers, 25 did not respond to the questionnaire, 2 had missing data on depressive symptoms, 1 scored 50 points on the depressive symptom scale indicating a likely incorrect completion of the questionnaire and 1 had missing data on cohabitation, yielding a final individual level sample of 95 eldercare workers. The work unit averaged sample contained 205 female eldercare workers with complete questionnaire data working in one of the 56 work units observed, and included the observed eldercare workers in the individual level sample. In the sample there were 1–8 respondents in each unit (mean: 3.5 respondents). Of the 317 respondents, 81 were not female SH or SA working day or evening shifts; 24 belonged to a work unit that had not been observed; 2 had missing data on depressive symptoms; 1 scored a probably incorrect score of 50 points on the depressive symptom scale; and 4 had missing data on cohabitation, yielding a final work unit averaged sample of 205 eldercare workers.

Measurement of working conditions with the observational instrument

We developed the RHIA-VERA-eldercare instrument by modifying existing RHIA-VERA instruments of other occupational groups[22 23] and testing the new instrument in a pilot study. The instrument development was supervised by Dr Birgit Greiner[22 29–32], who had previously developed and applied RHIA-VERA instruments in studies in Germany, the USA and the UK. We first conducted six interviews with managers and eldercare workers from three different care homes. Using the information from these interviews, we modified the instrument and presented it to eldercare workers in three subsequent interviews for validation and further input generation. Finally, the instrument was tested in 10 pilot study observations.

For data collection in the main study, we thoroughly trained seven observers, who participated in a 30 h training programme, performed a trial observation at a pilot study care home and received detailed feedback on the work analysis.

The observations were conducted from February to October 2012. We observed 10–16 eldercare workers in each of the 10 care homes for entire day or evening shifts with observations lasting 5–8 h (median 8 h, 10th centile: 6 h, 90th centile: 8 h). The observers shadowed the assigned eldercare workers throughout the shift and recorded regulation requirements and barriers. Observers were instructed not to interfere with the work, but could ask clarifying questions. The eldercare workers introduced the observer to the residents and explained the observer's presence. All observers were unaware of the worker's depressive symptom level.

Regulation requirements measured the level of mental regulation required by the work task on five ordinal levels: (1) unconscious sensory–motor control of action as required in simple repetitive tasks (eg, folding clothes); (2) action planning in one step from beginning to end in simple tasks (eg, plan and perform personal hygiene for residents), (3) subgoal planning in several steps for more complicated tasks (eg, developing plans for daily routines for residents), (4) coordination of several action areas in complex tasks (eg, developing interdisciplinary action plans for challenging residents) and (5) creation of new areas for action with unknown challenges (eg, development of new care units).[36] Each level was further differentiated in two sublevels resulting in a 10-level scale.[36] For the analyses, a nine-level scale was used after collapsing the two highest levels.

Barriers were categorised in four main groups: (1) barriers for locomotion, movement and resident handling, (2) barriers for information processing such as lack of necessary information, (3) barriers related to equipment handling such as poorly functioning equipment and (4) interruptions by colleagues, residents or external contacts. The observers described in detail the situation that was identified as a barrier. To quantify the severity of the barrier, the observer assessed the amount of extra work necessary to overcome each barrier. In the analysis we used two summary measures: (1) number of qualitatively different barrier types (range 0–4), that is, each barrier subgroup counted as one barrier regardless of the actual number of identified barriers within the subgroup and (2) total amount of extra work across all barriers in minutes per week (range 0–275). These summary measures correspond to measures used in previous studies using the RHIA-VERA observational strategy.[28 32] To assess the possibly differential impact of different barrier types, we performed separate analysis on each of the four barrier subgroups.

Work unit averaged level

We calculated average levels of regulation requirements, barriers and extra work for each of the 56 units in the 10 care homes. Company personnel files allowed us to allocate respondents to each work unit and assign the averages of each exposure to the 205 respondents with complete questionnaire data. The averaged data represent the general level of working conditions in a particular unit. Thus, the averaged data allow us (1) to evaluate the effect of the general working conditions compared to the individual level working conditions relative to their closest colleagues and (2) to evaluate the association between individual level depressive symptoms and the observed work unit level of working conditions for 205 respondents and hereby include a larger population of care workers in the analysis.

Measurement of depressive symptoms

Depressive symptoms were measured by the Major Depression Inventory (MDI), a validated self-administered 10-item rating scale for assessing both major depression and level of depressive symptoms.[37 38] We assessed depressive symptoms as a continuous variable on a scale from 0 to 50 with higher scores indicating more depressive symptoms. This allowed us to examine lower levels of depressive symptoms and to avoid the problems of using a crude cut-off point for identifying cases.

Measurement of covariates

As covariates, we considered demographics (age, cohabitation), job variables (job group, work hours, shift) and stressful life events, because previous studies have shown that they are related to depressive symptoms, working conditions or both.[39–43]

Participants' *age* and *job group* were derived from personnel files. *Cohabitation* was assessed with the questionnaire.

Work hours and *shift* were measured by questionnaire and cross-checked with the personnel files. A few respondents had indicated that they worked mixed shifts. We re-categorised them as belonging to either day or evening shift based on information from the personnel files and the observations.

Stressful life events were measured by questionnaire. We created a composite measure indicating whether the

respondent had experienced one of the following events during the past year: serious illness of their children, serious conflicts with grown children, serious relationship problems, divorce, serious illness or death among family members or serious economic difficulties.

Data analysis

In the analysis, we used log-transformed level of depressive symptoms as the outcome as this showed a better fit with the assumption of a normal distribution. In this process, respondents with the value 0 on the MDI-scale were grouped with respondents with the value 1 on the MDI-scale.

We analysed data with multilevel regression models that allowed for correlations within work units and care homes, first using observed working conditions at the individual level as the exposure of interest (n=95) and then using the work unit averaged working conditions as the exposure of interest (n=205). To compare the effect of individual versus work unit averaged working conditions, we also included the work unit average and the individual deviation from the work unit average in the analysis of the 95 directly observed respondents. Analysing the work unit averaged working conditions and the individual deviation from this average allowed us to estimate if an individual's depressive symptoms were associated equally with the general working conditions in the unit and the individual level compared to coworkers, or if one of those was more important than the other.

We used a compound symmetry structured covariance matrix within the work unit that allowed for a potentially negative correlation within the work unit. The care home was included as a random effect. Regulation requirements, each barrier summary measure and each barrier subscale were evaluated in separate regression models. The analyses were incrementally adjusted for three sets of confounders: demographics (age and cohabitation) in model I; job characteristics (job group, shift and work hours) in model II; stressful life events in model III. In the reporting of the results the estimates were transformed to percentage increase or decrease in depressive symptom scores to allow for easy interpretation.

We performed three separate robustness evaluations. First, to assess whether there was an effect by the observers, we subtracted all systematic differences between observers from the observations. This was carried out for both the individual-level and the work-unit-averaged analyses by replacing the observed value for the working conditions with the residuals from an analysis of variance of the effect of the observer on the observed value of the working conditions. Second, to examine whether dropout due to high level of depressive symptoms affected the results, we assigned an imputed MDI-score of 31 resembling the highest MDI-score in the data set to all observed non-responders (n=25) in the individual-level analyses. Third, to examine possible differences in working conditions between responders and non-responders, we excluded non-responders from the calculation of work unit averages for working conditions.

All data analyses were conducted using Proc Mixed in SAS V.9.2, except the calculation of observer residuals that was conducted using Proc GLM.

RESULTS

Working conditions for responders and non-responders

Table 1 shows the individual-level distribution of working conditions for all observed care workers and separately for observed responders and non-responders of the questionnaire. For responders the table also shows the distribution of the depressive symptoms score. There was no systematic non-response concerning regulation requirements, extra work, qualitatively different barriers, barriers for locomotion or barriers for equipment use. However, there was a tendency towards higher non-response among care workers with many barriers for information processing and for care workers with few interruptions.

Study sample characteristics and their association with depressive symptoms

Table 2 shows the study sample characteristics for all invited care workers and the characteristics and depressive symptom scores for all responders of the questionnaire. The response rates generally were similar within working conditions and covariates with the exceptions of age and job group. Response rates were higher among older than among younger care workers and higher among SA than among SH.

Working conditions and depressive symptoms scores of the 95 directly observed care workers

Table 3 shows the associations of depressive symptom scores with regulation requirements and barriers among the 95 directly observed responders. Lower depressive symptoms scores were seen for higher levels of regulation requirements, that is, for care workers with greater possibilities for decision-making and skill development. Adjustment for covariates did not change the association. None of the barrier measures were associated with depressive symptoms.

When we analysed the work unit averaged working conditions and the individual deviation from the work unit average, we found that the corresponding associations between depressive symptoms and interruptions were in opposite directions. Thus, a high work unit averaged level of interruptions was associated with a higher level of depressive symptoms, while a relatively higher number of interruptions compared to colleagues were associated with lower level of depressive symptoms (table 3, last 4 columns).

Working conditions and depressive symptoms at the work unit level

Table 4 shows the association of work unit averaged regulation requirements and barriers with individual

Table 1 Observed work environment measures among observed eldercare workers (non-responders* and responders)

	All observed care workers (n=124)		Observed non-responders (n=29)		Observed responders (n=95)		MDI-score among responders (n=95)	
	N	(%)†	N	(%)‡	N	(%)‡	Median	(min;max)
Resources								
Regulation requirements								
1–3	16	(13)	4	(25)	12	(75)	8.0	(1.0;31.0)
4	53	(43)	10	(19)	43	(81)	6.0	(0.0;26.0)
5	24	(19)	9	(38)	15	(63)	4.0	(0.0;19.0)
6–9	31	(25)	6	(19)	25	(81)	5.0	(0.0;23.0)
Stressors								
Extra work (minutes per week)								
0–30	30	(24)	7	(23)	23	(77)	6.0	(1.0;31.0)
31–60	34	(27)	4	(12)	30	(88)	5.0	(0.0;14.4)
61–90	23	(19)	7	(30)	16	(70)	5.5	(0.0;19.0)
91–120	13	(10)	6	(46)	7	(54)	3.0	(0.0;16.0)
121–150	10	(8)	1	(10)	9	(90)	4.0	(0.0;13.0)
151–275	14	(11)	4	(29)	10	(71)	4.5	(0.0;26.0)
Qualitatively different barriers								
0	3	(2)	2	(67)	1	(33)	6.0	(6.0;6.0)
1	39	(31)	6	(15)	33	(85)	6.0	(1.0;31.0)
2	46	(37)	15	(33)	31	(67)	5.0	(0.0;23.0)
3–4	36	(29)	6	(17)	30	(83)	4.5	(0.0;26.0)
Barrier subscales								
Barriers for locomotion, movement and resident handling								
0	90	(73)	22	(24)	68	(76)	6.0	(0.0;26.0)
1	29	(23)	5	(17)	24	(83)	4.0	(0.0;31.0)
2–3	5	(4)	2	(40)	3	(60)	5.0	(3.0;5.0)
Barriers for information processing								
0	43	(35)	7	(16)	36	(84)	6.0	(0.0;31.0)
1	46	(37)	11	(24)	35	(76)	5.0	(0.0;16.0)
2	20	(16)	6	(30)	14	(70)	4.0	(0.0;14.0)
3–4	15	(12)	5	(33)	10	(67)	7.8	(1.0;26.0)
Barriers for equipment use								
0	52	(42)	14	(27)	38	(73)	5.0	(1.0;31.0)
1	37	(30)	9	(24)	28	(76)	5.0	(0.0;23.0)
2	23	(19)	3	(13)	20	(87)	6.0	(0.0;26.0)
3–5	12	(10)	3	(25)	9	(75)	5.0	(0.0;19.0)
Interruptions								
0	68	(55)	19	(28)	49	(72)	5.0	(0.0;31.0)
1	41	(33)	8	(20)	33	(80)	4.0	(0.0;26.0)
2–4	15	(12)	2	(13)	13	(87)	7.0	(1.0;10.0)

*Includes 25 observed eldercare workers who did not respond to the questionnaire, 3 observed eldercare workers who responded to the questionnaire but had missing information on depressive symptoms and 1 observed eldercare worker with missing information on cohabitation
†Column percent, that is, within all care workers.
‡Row percent, that is, percent in each group within each level of work environment measure.

level of depressive symptoms among 205 (95 observed and 110 non-observed) eldercare workers. Work unit averaged regulation requirements and sum of extra work were not related to individual level depressive symptoms. A higher number of qualitatively different barriers on the work unit level were statistically significantly associated with a lower depressive symptom score when adjusting for demographics (model I) and job variables (model II). Further adjustment for stressful life events (model III) did not substantially change the estimate, however the CI widened and the association was no longer statistically significant.

The exploration of barrier subscales showed that barriers for equipment use were statistically significantly related to lower levels of depressive symptoms when adjusting for demographics in model I, but that statistical significance was lost in the subsequent models. None of the other barrier subscales showed a statistically significant association with depressive symptoms.

Table 2 Characteristics and work unit level of working conditions of responders compared with all invited eldercare workers

	Invited care workers (N=392)	Proportion of responders among invited care workers (N=205)		Distribution of variables among responders (N=205)		MDI-score among responders (N=205)	
	N	Per cent	(N)	Per cent	(N)	Median	(min;max)
Covariates							
Age (years)							
21–35	67	40	(27)	13	(26)	8.5	(2.0;31.0)
36–50	159	53	(85)	40	(83)	6.0	(0.0;30.0)
51–66	166	60	(100)	47	(96)	5.0	(0.0;23.0)
Cohabitation							
Yes	†	†	†	72	(148)	5.0	(0.0;31.0)
No	†	†	†	28	(57)	7.0	(0.0;30.0)
Job group*							
Social and healthcare assistant	133	62	(83)	40	(83)	5.0	(0.0;30.0)
Social and healthcare helper	256	50	(129)	60	(122)	6.0	(0.0;31.0)
Shift							
Day	229	55	(125)	59	(121)	6.0	(0.0;31.0)
Evening	163	53	(87)	41	(84)	5.0	(0.0;23.0)
Work hours							
[20–32)	†	†	†	38	(78)	5.0	(0.0;23.0)
[32–37]	†	†	†	54	(110)	6.0	(0.0;31.0)
(37–56]	†	†	†	8	(17)	7.0	(1.0;30.0)
Stressful life events							
No	†	†	†	47	(96)	4.0	(0.0;31.0)
Yes	†	†	†	53	(109)	7.0	(0.0;30.0)
Resources (work unit level)							
Regulation requirements							
[1–4]	135	48	(65)	31	(64)	4.5	(0.0;22.0)
(4–4.5]	69	65	(45)	21	(43)	6.0	(0.0;30.0)
(4.5–5]	99	59	(58)	27	(56)	5.0	(0.0;26.0)
(5–9]	89	49	(44)	20	(42)	6.0	(0.0;31.0)
Stressors (work unit level)							
Extra work (minutes per week)							
[0–40.67]	104	48	(50)	24	(50)	6.0	(0.0;16.7)
(40.67–75]	95	62	(59)	26	(54)	5.8	(0.0;28.0)
(75–97.5]	97	44	(43)	20	(41)	6.0	(0.0;22.0)
(97.5–190]	96	63	(60)	29	(60)	5.0	(0.0;31.0)
Qualitatively different barriers							
[0–1.5]	153	48	(74)	34	(70)	6.0	(0.0;31.0)
(1.5–2]	114	61	(69)	32	(66)	6.5	(0.0;28.0)
(2–2.5]	30	67	(20)	10	(20)	5.0	(0.0;23.0)
(2.5–3.5]	95	52	(49)	24	(49)	4.0	(0.0;30.0)
Barrier subscales							
Barriers for locomotion							
[0]	211	52	(109)	51	(105)	7.0	(0.0;30.0)
(0–0.5]	108	57	(62)	29	(60)	4.5	(0.0;31.0)
(0.6–0.67]	30	50	(15)	7	(15)	5.0	(0.0;19.0)
(0.67–2]	43	60	(26)	12	(25)	6.0	(0.0;17.0)
Barriers for information processing							
[0–0.33]	88	53	(47)	22	(45)	6.0	(0.0;16.0)
(0.33–1]	128	55	(70)	33	(67)	6.0	(0.0;19.0)
(1–1.67]	95	54	(51)	24	(50)	6.0	(0.0;28.0)
(1.67–4]	81	54	(44)	21	(43)	4.0	(0.0;31.0)
Barriers for equipment use							
[0–0.33]	86	53	(46)	21	(43)	6.0	(0.0;31.0)
(0.33–1]	185	50	(93)	44	(90)	6.0	(0.0;28.0)
(1–1.5]	25	60	(15)	7	(15)	5.0	(0.0;16.7)
(1.5–3.5]	96	60	(58)	28	(57)	5.0	(0.0;30.0)

Continued

Table 2 Continued

	Invited care workers (N=392)	Proportion of responders among invited care workers (N=205)		Distribution of variables among responders (N=205)		MDI-score among responders (N=205)	
	N	Per cent	(N)	Per cent	(N)	Median	(min;max)
Interruptions							
[0]	104	55	(57)	26	(54)	6.0	(0.0;28.0)
(0–0.5]	119	46	(55)	26	(54)	5.0	(0.0;22.0)
(0.5–1]	123	59	(73)	35	(71)	5.0	(0.0;26.0)
(1–3]	46	59	(27)	13	(26)	7.0	(0.0;31.0)

*For 3 care workers among all invited, we do not have information on educational level.
†Information on these variables comes from questionnaires and is known only for responders.

Robustness evaluation

None of the conclusions changed when we (1) calculated an alternative set of working condition scores where we had extracted systematic differences between raters; (2) imputed the value of 31 for the depressive symptom score for observed non-responders; or (3) excluded non-responders from the calculation of the work unit averages (data not shown).

DISCUSSION

A high level of regulation requirements, that is, greater opportunity for decisionmaking and skill development during work, measured at the individual level, was associated with lower levels of depressive symptoms in this study of eldercare workers. For most barrier measures, we did not find an association with depressive symptoms. The exceptions were work unit averaged number of qualitatively different barriers and barriers for equipment use that both were associated with lower levels of depressive symptoms. These associations were statistically significant in some analyses, but lost statistical significance in the fully adjusted model.

Regulation requirements

The association between a higher level of regulation requirements at the individual level and a lower level of depressive symptoms concurs with the theoretical assumptions of ART. According to ART, regulation requirements are a key feature of hierarchically and sequentially complete actions, which are regarded as essential for humanised work and as important buffers against negative consequences of high work load.[21] Opportunities for planning, deciding and using acquired knowledge and skills may also be essential in the development and maintenance of a 'healthy' personality.[44]

Our results on regulation requirements and depressive symptoms among Danish eldercare workers are in accordance with the results by Griffin *et al*[32] among British civil servants, highlighting the importance of regulation requirements across occupational groups. The results are also in line with previous research using self-reported measures of constructs related to regulation requirements, such as influence at work, decision latitude and skill discretion.[45–50]

The association of regulation requirements and depressive symptoms was statistically significant in the individual-level analysis but not in the work unit averaged analysis. As the measurement of regulation requirements was thought to reflect the general level of regulation requirements for all workers in the work unit, we had expected an association also in the work unit averaged data.

However, our results suggest that depressive symptoms may not to be affected by the general level of regulation requirements in a unit, but rather by the individual care worker's possibilities for decision-making and creative practice. Thus, individual regulation requirements may protect against depressive symptoms, but working in a unit with a generally higher level of regulation requirements does not seem to be protective.

Barriers

At the individual level none of the barriers were significantly associated with depressive symptoms. This is akin to the study by Griffin *et al*[32] Moreover, in the data set with work unit averaged exposure measurements we found a tendency for a higher number of qualitatively different barriers and barriers related to use of equipment to be associated with lower levels of depressive symptoms. These results are contrary to the assumption of ART that barriers are risk factors, and to findings of other studies using the same or similar methods.[28 32–34] Thus, the results from this study suggest that previous results on the association of externally assessed barriers with depressive symptoms[28 33] cannot be extended to female Danish eldercare workers. It is possible that barriers in eldercare work have a different quality than barriers in other occupational groups. If this is confirmed in future studies, the definition and operationalisation of barriers in ART in relation to care work needs to be re-considered.

Table 3 Associations between depressive symptoms and observed individual working conditions among 95 directly observed eldercare workers

	Model I*			Model II†			Model III‡			Individual deviation from work unit average§		Work unit average§	
	Relative difference (%)	95% CI	p Value	Relative difference (%)	95% CI	p Value	Relative difference (%)	95% CI	p Value	Relative difference (%)	95% CI	Relative difference (%)	95% CI
Resources													
Regulation requirements	−14	(−25% to −1%)	0.031	−16	(−28% to −1%)	0.032	−15	(−27% to −1%)	0.043	−19	(−34% to −2)	−7	(−28% to 19%)
Stressors													
Extra work due to barriers (difference per 30 min)	−4	(−13% to 7%)	0.481	−2	(−12% to 10%)	0.764	−2	(−13% to 9%)	0.689	2	(−12% to 18%)	−6	(−20% to 10%)
Sum of qualitatively different barriers	−3	(−21% to 21%)	0.809	0	(−20% to 24%)	0.989	−1	(−20% to 23%)	0.933	−4	(−32% to 35%)	2	(−25% to 38%)
Barrier sub-scales													
Locomotion, movement and resident handling	−9	(−35% to 27%)	0.565	−10	(−36% to 26%)	0.531	−11	(−37% to 25%)	0.488	6	(−30% to 61%)	−36	(−63% to 11%)
Information processing	1	(−16% to 21%)	0.896	4	(−14% to 25%)	0.694	4	(−14% to 25%)	0.692	−1	(−22% to 26%)	10	(−15% to 44%)
Equipment use	2	(−16% to 24%)	0.847	3	(−16% to 26%)	0.760	4	(−14% to 28%)	0.664	8	(−21% to 49%)	2	(−19% to 30%)
Interruptions	0	(−21% to 27%)	0.967	3	(−19% to 31%)	0.825	1	(−20% to 29%)	0.909	−26	(−47% to 3%)	45	(0% to 109%)

*Model I: adjusted for age in splines (<35. 36–50. 50<) and cohabitation.
†Model II: adjusted for covariates in model I and further adjusted for job group, shift and work hours.
‡Model III: adjusted for covariates in model II and further adjusted for stressful life events.
§Model III: where both work unit average and individual deviation from work unit average is included in the same regression analysis.

Table 4 Associations between individual depressive symptoms and observed work unit averaged working conditions among 205 eldercare workers from 56 units

	Model I*			Model II†			Model III‡		
	Relative difference (%)	95% CI	p Value	Relative difference (%)	95% CI	p Value	Relative difference (%)	95% CI	p Value
Resources									
Regulation requirements	−3	(−16% to 12%)	0.689	−2	(−16% to 14%)	0.804	−3	(−16% to 13%)	0.712
Stressors									
Extra work (difference per 30 min)	−6	(−13% to 1%)	0.103	−6	(−13% to 2%)	0.154	−6	(−13% to 2%)	0.143
Sum of qualitatively different barriers	−15	(−28% to −1%)	0.037	−15	(−28% to 0%)	0.049	−14	(−27% to 2%)	0.073
Barrier sub-scales									
Locomotion, movement and resident handling	−7	(−31% to 26%)	0.641	−10	(−34% to 24%)	0.525	−12	(−35% to 19%)	0.390
Information processing	−6	(−18% to 9%)	0.408	−5	(−18% to 10%)	0.489	−5	(−18% to 10%)	0.458
Equipment use	−13	(−23% to −2%)	0.027	−12	(−23% to 0%)	0.054	−9	(−20% to 3%)	0.142
Interruptions	6	(−13% to 29%)	0.571	8	(−13% to 34%)	0.491	7	(−14% to 32%)	0.532

*Model I: adjusted for age in splines (<35. 36–50. 50<) and cohabitation.
†Model II: adjusted for covariates in model I and further adjusted for job group, shift and work hours.
‡Model III: adjusted for covariates in model II and further adjusted for stressful life events.

The analyses of the work unit averaged working conditions and the individual deviation from these working conditions point to the possibility for different mechanisms on different analytical levels. In the case of interruptions it seems that a high work unit averaged level was associated with higher levels of depressive symptoms, while interruptions at the individual level were associated with lower levels of depressive symptoms. When the number of interruptions on average is high, it indicates that interruptions were common in the unit. It is therefore possible that the work unit averaged level of interruptions reflect the general level of interruptions over time which may have increased the care workers' risk of developing depressive symptoms. The observed association with the individual level on the other hand may reflect that care workers who have a low level of depressive symptoms were more likely to be engaged and enthusiastic about work and were therefore more accessible and more often interrupted.

The comparison of work unit average data with individual level data opens an interesting discussion for the future development of ART and observational measures. It may not just be the individual working conditions of a particular person that affect this person's health but also the working conditions of close colleagues within this unit (the 'collective' working conditions) that influences health. In work environments where workers work closely together, such as in care work, it may be necessary to assess the regulation requirements and barriers for 'collective work tasks' or 'systems of work tasks' within one unit as well as the individual tasks.[19] Whether this explanation for the differential findings on interruptions and depressive symptoms is appropriate, needs to be examined in further studies.

Methodological considerations

Although all observers were thoroughly trained in the RHIA-VERA method, it is possible that individual characteristics of the observers have influenced the observations and subsequently the ratings of working conditions. We therefore conducted a robustness analysis that removed systematic differences between observers. This did not change the conclusions, indicating that observer differences had not affected the results.

Strengths

The main strength of the study is the external measurement of working conditions. The measurement was novel in eldercare research as we assessed working conditions independently from the eldercare workers' own assessment. Thus, the detected associations are not affected by common method bias. In addition, the comprehensive workplace observations provided detailed information about the working conditions that can be used to design targeted interventions.

Limitations

Of the directly observed care workers, 25 did not respond to the questionnaire. Full data on these eldercare workers would have strengthened the analyses. However, when we assigned a high depressive symptom score to the directly observed non-responders, the conclusions did not change. Excluding the observations from the non-responders among the observed, when calculating work unit averages, did not change conclusions either.

The study in general had a moderate response rate. We examined the similarities and differences between responders and non-responders regarding age, job group, shift and work unit averaged working conditions. The two groups were similar on shift and working conditions but differed on age and job group. If the difference in response rates was due to depressive symptoms, we may have underestimated the association between age and depressive symptoms and overlooked a possible association between job group and depressive symptoms. Further, we cannot rule out that non-responders may also have differed on other unmeasured characteristics.

We only included the primary work tasks in the analysis and did not consider secondary work tasks beyond taking care of residents, for example, management and training functions. However, since direct care tasks form the major part of the eldercare worker's daily work, it seems likely that we sufficiently covered the most important working conditions.

Finally, as we observed working conditions and measured depressive symptoms at the same point in time, we cannot rule out the possibility for reversed causation. We therefore recommend a replication of our study with a prospective design.

As our study included only female eldercare workers in Danish care homes the results are not generalisable beyond this setting. It is possible that the associations may be different for male eldercare workers and for men and women in other occupations. However, the findings may be applicable to women in other types of healthcare settings where care workers take on similar social and healthcare tasks.

Concluding remarks

The study shows that the evidence from questionnaire studies on the importance of influence and skill discretion for depressive symptoms also holds when a similar construct, regulation requirements, is externally assessed by observation. Creating work organisations where care workers can make decisions, be creative in their work practices and develop their skills seems important for care workers' mental health. The study also highlights the importance of examining both individual and work unit levels of working conditions, when investigating the contribution of work to depressive symptoms.

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Contributors LMJ designed the study, developed the observational instrument, collected and analysed the data, and drafted the manuscript. AFBJ developed the observational instrument, collected the data and interpreted the results. BLT advised on statistical analysis and interpreted the results. BAG developed the observational instrument, advised on data collection and interpreted the results. RR designed the study, advised on data collection and interpreted the results. All authors critically discussed and revised the draft of the manuscript and approved its final version for submission.

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