ARBEJDSKLIMA OG HELBRED VED OMSTRUKTURERING I DEN OFFENTLIGE SEKTOR

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REGION

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1 Forord

Arbejdsmiljøforskningsfonden finansierede dette forskningsprojekt med 1,8 mio. DKK (projektnr.: 13-2015-03). Undersøgelsen blev gennemført som et ph.d.-projekt af psykolog Johan Høy Jensen fra 1. december 2015 til 15. februar 2019 ved Arbejds- og Miljømedicinsk Afdelingen (AMED), Bispebjerg Hospital (BBH). Ph.d.-projektet blev vejledt af Jens Peter Bonde, Esben Meulengracht Flachs (AMED, BBH), Naja Hulvej Rod, (Institut for Folkesundhedsvidenskab, Københavns Universitet [KU]) og Janne Skakon (Institut for Psykologi, KU). Johans forskningsophold ved *T.H. Chan School of Public Health, Harvard University*, Boston, USA, fra 1. februar til 30. juni 2018 blev støttet økonomisk af KU, Julie von Müllens Fond, Else & Mogens Wedell-Wedellborgs Fond og *Graduate School of Public Health*, KU.

Projektet bruger data fra trivselsundersøgelsen, *TrivselOP,* gennemført i marts 2014 blandt alle ansatte i Region Hovedstaden. Der blev indhentet supplerende oplysninger om organisationsændringer på arbejdsenhedsniveau via spørgeskemaer udsendt til lederne for alle arbejdsenheder. Data på personaleomsætning fra arbejdsenheden og sygefravær blev udtrukket fra regionale lønregistre. Oplysninger om udskrivelse af udskrivelse af psykofarmaka og iskæmisk hjertesygdom blev indhentet fra nationale forskningsregistre. Af anonymitetshensyn blev alle dataanalyser foretaget via opkobling til Danmarks Statistik, hvorfor forskerne ikke har haft adgang til personidentificerbare data.

Arbejdsmiljøkonsulenterne Charlotte Hyldtoft og Jesper Strøyer Andersen fra Region Hovedstaden har været behjælpelige med at muliggøre overførsel af data til Danmarks Statistik og løbende sparring gennem forskningsprocessen. Der skal derfor rettes en særlig tak til Charlotte og Jesper for deres engagement og bidrag til forskningsprojektet.

Projektets fremdrift har været drøftet årligt ved nedsatte følgegruppe med deltagelse af Laura Thors Calaña, Malene Vestergaard Sørensen (Danske Regioner), Charlotte Bredahl (FOA), Lars Andersen, Nanna Simone Jensen (Lederne), Karin Kell Nielsen (Udviklingsafdelingen, BBH), Charlotte Hyldtoft, Sven Skovmand Eriksen (Center for HR, Region Hovedstaden), Per Åkesson Malmros, Esben Meulengracht Flachs, Jens Peter Bonde (AMED, BBH).

Forfatterne, *marts 2019*

2 Summary in English

Background: Organizational change at work is common. Such changes are often implemented to meet demands for increased productivity and improved service. However, there seem to be a price to pay for the affected employees. An increasing body of research suggest that organizational changes have a negative impact on the psychosocial work environment, and studies indicate higher employee turnover and higher risk of adverse health following such changes. Previous research on employee outcomes of organizational changes has mainly focused on major company restructuring or staff downsizing. This study evaluated the impact of specific types of organizational changes in the work unit and subsequent employee exit from the work unit and health (i.e., sickness absence, prescription for psychotropic medication, and incident ischemic heart disease). The explaining roles of specific psychosocial factors were assessed for associations with employee exit from the work unit and incident ischemic heart disease.

Methods: Data were based on a work-environment survey conducted throughout March 2014 among all employees in the Capital Region of Denmark (*N*=37 720; 84% response). One self-reported item assessed perceived stress. Social capital (i.e., collaboration, organizational justice, and trust) aggregated at the work-unit level were based on eight self-reported items. From April through June 2016, the managers provided information on specific types of organizational change occurring in their work unit in each semester of 2013 (59% response) regarding mergers, demergers/split-ups, relocation, change in management, employee layoff, and selective budget cuts. The reference group comprised employees not exposed to any organizational change.

Data on employee exit from the work unit, total and long-term (≥29 consecutive days) sickness absence, prescriptions for psychotropic medication (anxiolytics [ATC code: N05B], hypnotics/sedatives [N05C] or antidepressants [N06A]), and ischemic heart disease (ICD-10: I20-I25) in 2014 were extracted via linkage to national research and regional salary registers. Logistic, zero-inflated Poisson, and hazard/survival regression models as well as multilevel techniques analyzed associations between organization changes in 2013 and employee exit and health in 2014.

Results: Some indicators of organizational change, but not all, were associations with 10-50% higher rates of employee exit from the work unit relative to no changes. Organizational changes were associated with 85-265% higher relative risk of low work-unit social capital. There was an inverse relationship between lower work-unit social capital and higher employee exit from the work unit. Associations between organizational changes and employee exit did not diminish notably when adjusting for work-unit social capital in the regression models, suggesting that this psychosocial factor did not explain the relationship.

Relative to no change, organizational changes were associated with up to 40% higher risk of sickness absence and prescriptions for psychotropic medication in the following year among employees. Associations with psychotropic prescriptions were strongest for change in management and for prescriptions in the latter semester of the 12-months follow-up period. Finally, exposure to relocation, change in management, or employee layoff in the work unit was associated with 120-190% higher risk of incident ischemic heart disease among employees relative to no changes. Adjusting these associations for potential mediation of effects via perceived stress did not reduce the point estimates notably, indicating that this psychosocial factor did not explain the relationship.

Conclusions: Organizational changes in the work unit were associated with higher employee turnover and higher risk of adverse health among the employees. There were no convincing indications suggesting that specific types of organizational changes were particularly related to all studied employee outcomes, although changes involving employee layoffs were more consistently associated with higher risk of adverse employee health. Work-unit social capital did not explain the associations between organizational changes and employee turnover. Bias or other confounding factors were not regarded as likely explanations of the current findings. Policy and decision makers should increase prioritization of strategies to prevent detrimental employee effects of organizational changes as such effects may not only a burden to the individual, but also to society.

3 Resumé på dansk

Baggrund: Organisatoriske ændringer på arbejdspladsen er almindelige og bliver ofte iværksat for at imødekomme krav om øget produktivitet og bedre service. Imidlertid lader der til at være en pris at betale for de berørte ansatte. En stigende mængde forskning peger på, at organisatoriske ændringer har en negativ indflydelse på det psykosociale arbejdsmiljø, og studier indikerer højere personaleomsætning og dårligt medarbejderhelbred efter sådanne ændringer. Tidligere forskning i medarbejderkonsekvenser af organisatoriske ændringer har hovedsagelig fokuseret på større omstruktureringer i virksomheder eller personalenedskæringer. Denne undersøgelse evaluerer indflydelsen af specifikke former for organisationsændringer i arbejdsenheden for efterfølgende medarbejder-exit fra arbejdsenheden og helbred blandt de ansatte (dvs. sygefravær, udskrivelse af psykofarmaka og incident iskæmisk hjertesygdom). Den forklarende betydning af specifikke psykosociale faktorer blev vurderet for associationer med medarbejder-exit fra arbejdsenheden og nyopstået iskæmisk hjertesygdom.

Metoder: Datamaterialet tog udgangspunkt i en arbejdsmiljøundersøgelse gennemført i marts 2014 blandt alle ansatte i Region Hovedstaden (*N*=37 720; 84% svarede). Et selv-rapporteret item målte oplevet stress. Mål for social kapital (samarbejde, organisatorisk retfærdighed, tillid) aggregeret på arbejdsenheds-niveau var baseret på otte selv-rapporterede items. Fra april til juni 2016 gav lederne information om hændelse af specifikke former for organisatoriske ændringer i deres arbejdsenhed for hvert semester i 2013 (59% svarede) vedrørende sammenlægninger, opsplitninger, flytning, lederskifte, afskedigelse af medarbejdere og selektive besparelser. Referencegrupperne omfattede ansatte, der ikke var eksponeret for nogen organisationsændringer. Data på medarbejder-exit fra arbejdsenheden, total og langtidssygefravær (≥29 konsekutive dage), udskrivelse af psykofarmaka (anxiolytica [ATC-kode: N05B], hypnotica/sedativa [N05C], antidepressiva [N06A]), og iskæmisk hjertesygdom (ICD-10: I20-I25) i 2014 blev udtrukket via opkobling til regionale løn- og nationale forskningsregistre. Logistisk-, *zero-inflated Poisson*- og overlevelses-regressionsanalyser analyserede sammen med multilevel teknikker relationer mellem organisationsændringer i 2013 og medarbejder-exit og -helbred i 2014.

Resultater: Nogle typer organisationsændringer, men ikke alle, var forbundet med 10-50% højere rater for medarbejder-exit fra arbejdsenheden. Organisatoriske ændringer var konsistent forbundet med 85-265% højere relative risiko for lav social kapital i arbejdsenheden. Der var en omvendt dosis-responssammenhæng mellem lavere social kapital i arbejdsenheden og højere medarbejder-exit fra arbejdsenheden. Associationen mellem organisatoriske ændringer og medarbejder-exit fra arbejdsenheden blev ikke reduceret nævneværdigt ved justering for social kapital i regressionsmodellen. I forhold til ingen ændringer var eksponering for organisationsændringer associeret med op til 40% højere risiko for langtidssygefravær eller udskrivelse af psykofarmaka i det følgende år blandt ansatte uanset køn. Sammenhængene med psykofarmaka var stærkest for ledelsesskift og for udskrivelser i sidste semester af den 12 måneder lange opfølgningsperiode. Eksponering for flytning, lederskifte og afskedigelse i arbejdsenheden var forbundet med 120-190% højere risiko for incident iskæmisk hjertesygdom blandt ansatte i det følgende år sammenlignet med ingen ændringer. Justering for oplevet stress mindskede ikke disse risikoestimater nævneværdigt.

Konklusion: Organisatoriske ændringer i en arbejdsenhed var associeret med højere personaleomsætning og højere risiko for dårligt helbred blandt. Der var ingen overbevisende indikationer på at specifikke former for organisatoriske ændringer var særligt associeret med samtlige af de undersøgte medarbejderudfald, om end ændringer, der involverede afskedigelse af ansatte, var mere konsistent associeret med højere risiko for dårligt medarbejderhelbred. Arbejdsenhedens sociale kapital forklarede ikke sammenhængene mellem organisatoriske ændringer og medarbejder-exit fra arbejdsenheden. Bias eller andre faktorer blev ikke anset som sandsynlige forklaringer på nærværende fund. Politikere og beslutningstager bør øge prioriteringen af strategier til at forebygge skadevirkninger på ansatte af organisatoriske ændringer, idet sådanne negative virkninger ikke blot kan være en byrde for den enkelte, men også for samfundet.

4 Introduktion og baggrund

4.1 Organisationsændringer

Vedvarende krav om højere produktivitet og bedre service presser både offentlige og private virksomheder til omorganisering af arbejdspladsen.[1,2] Det er åbenlyst, at omorganiseringer ikke blot påvirker den organisatoriske struktur, men også arbejdsbetingelserne for de ansatte. Det anslås, at op mod halvdelen af danske ansatte over en 3-årig periode har været udsat for en organisatorisk ændring, der havde gennemgribende betydning for deres arbejde.[3] Der er ikke udsigt til at ændringstakten bliver mindre, og det synes rimeligt at betragte organisationsændringer som en præmis i det moderne arbejdsliv.[4,5]

Omorganiseringer på arbejdspladsen kan have positive såvel som negative konsekvenser for de ansatte. Positive konsekvenser kan fx omfatte øget jobberigelse, mere indflydelse på arbejdsgangene eller udbedring af et dårligt arbejdsmiljø.[6] Omvendt kan de negative konsekvenser udgøre forringet jobsikkerhed, intensivering af arbejdsbyrden eller mindsket indflydelse på indholdet af arbejdet.[7–9] Imidlertid peger et stigende antal epidemiologiske studier på, at organisationsændringer hovedsageligt er forbundet med højere risiko dårlig helbredsstatus,[10–16] ringe mentalt helbred[17–20] indikeret ved højere forbrug af psykofarmaka til behandling af affektive lidelser,[21–23] og højere kardiovaskulær dødelighed,[24,25] selvom ikke alle fund peger i samme retning.[26–29] Ikke overraskende finder andre undersøgelser også højere personaleomsætning fra arbejdspladsen efter effektuering af organisationsændringer.[30–35] Udover at være omkostningsfuldt,[36] er en høj personaleomsætning på arbejdspladsen forbundet med flere arbejdsfejl og dårligt mentalt helbred blandt de tilbageværende ansatte.[31,37]

Litteraturen vedr. sådanne medarbejderkonsekvenser efter organisationsændringer synes at være begrænset af at måle eksponeringen på virksomhedsniveauet uden nøjagtig specificering af forandringsindholdet. Dette kan øge usikkerheden for, hvorvidt den ansatte i virkeligheden blev berørt af omorganiseringen. Derudover er en betydelig del af forskningslitteraturen baseret på selvrapporterede informationer, hvilket kan have bidraget til at fejlestimere konsekvenserne af organisationsændringer for medarbejderne.[38,39]

Der er således behov for forskning i medarbejderkonsekvenser af organisationsændringer, der, ved brug af objektive data fra uafhængige kilder, undersøger personaleomsætnings- og helbredskonsekvenser efter specifikke typer organisationsændringer, som er målt på et lavt niveau i organisationsstrukturen. En sådan undersøgelse kan tage udgangspunkt i organisationsændringer i arbejdsenhederne, da disse udgør det laveste organisationsniveau på arbejdspladsen.

4.2 Psykosocialt arbejdsmiljø

En systematisk undersøgelse af 39 studier om organisationsændringer og psykosocialt arbejdsmiljø konkluderede, at omstruktureringer på arbejdspladsen hovedsagelig har negative konsekvenser for de ansatte. Disse konsekvenser omfattede lavere jobtilfredshed, dårligere tillid på arbejdspladsen såvel som højere jobusikkerhed og *job strain*.[40] Job strain henviser til kombinationen af høje krav på jobbet og ringe indflydelse på jobindhold og udviklingsmuligheder,[41] hvilket lader til at være en særlig risikofaktor for angst og depression[29,42,43] samt hjerte-kar-sygdomme.[1,44–46] Endvidere er større stressfulde livsbegivenheder relateret til akutte kardiovaskulære tilfælde.[47–49] Det menes, at opbrud af arterielle fedtaflejringer, som kan tilstoppe blodforsyningen til hjertet (iskæmisk hjertesygdom), trigges af sådanne livsbegivenheder hos personer med åreforkalkning, og at stressfulde organisationsændringer på arbejdspladsen kan udgøre en sådan trigger.[48] Oplevet stress kan således være en mulig forklarende psykosocial faktor for sammenhængen mellem organisationsændringer og udvikling af iskæmisk hjertesygdom.

Virksomhedens sociale kapital er en anden psykosocial faktor. Denne faktor henviser til den sociale sammenhængskraft, tillid og forventningen om gensidighed mellem medarbejder og ledere på arbejdspladsen. Gensidighed referer til forventningen om at få noget igen, hvis man gør noget for andre. Social kapital er således en ressource på arbejdspladsen, som den enkelte ansatte kan få adgang til.[50,51] Lav social kapital på arbejdspladsen er blandt de ansatte forbundet med højere risiko for langtidssygefravær,[52,53] ringere patientbehandling,[54] forhøjet blodtryk (blandt mænd)[55] og endda højere dødelighed.[56] Organisationsændringer kan tilskynde til sociale konflikter mellem ansatte og ledelsen på arbejdspladsen. Nedskæringer er forbundet med efterfølgende mis-

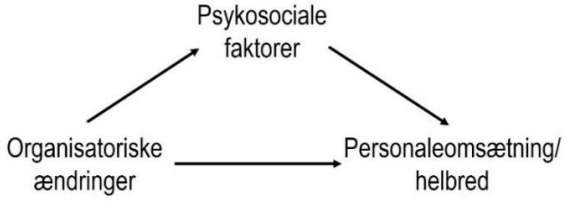
tillid og mangel på samarbejde mellem sygeplejersker og læger.[57] Personalenedskæringer, fysisk flytning eller organisatorisk opsplitninger kan opbryde sociale venskabsbånd mellem kolleger, hvilket kan give oplevelsen af organisatorisk uretfærdighed og efterfølgende øge medarbejderflugten fra arbejdspladsen.[58–61] Således kan arbejdsenhedens sociale kapital muligivis forklare (noget) af forbindelsen mellem organisationsændringer og højere personaleomsætning. Sådanne egenskaber for social kapital kan berettige denne psykosociale faktor som mål for strategier til at mindske utilsigtede medarbejderkonsekvenser af organisationsændringer på arbejdspladsen.

5 Projektets formål

Det overordnede formål med nærværende undersøgelse er at afdække konsekvenser af specifikke typer af organisationsændringer for medarbejder-exit fra arbejdsenheden (personaleomsætning) og helbred blandt de ansatte. I tillæg hertil blev den forklarende betydning af (psykosociale faktorer) – oplevet stress og social kapital – undersøgt for disse sammenhænge (Figur 1):

- Medarbejder-exit fra arbejdsenheden og sygefravær.
- Den forklarende betydning af den sociale kapital i arbejdsenheden for medarbejder-exit fra arbejdsenheden.
- Tidslige aspekter i udskrivning af psykofarmaka blandt de ansatte.
- Nyopstået iskæmisk hjertesygdom og forklaring af sammenhæng ved graden af oplevet stress.

Figur 1. Påvirkningen af organisationsændringer på personaleomsætning og -helbred (delvist) forklaret ved faktorer i det psykosociale arbejdsmiljø.



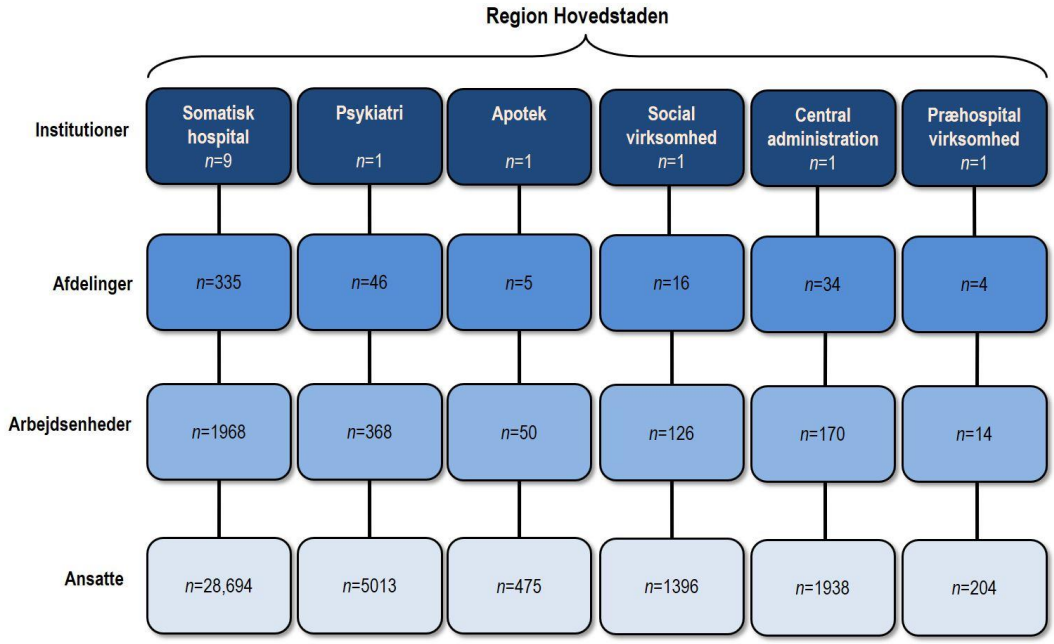
6 Fremgangsmåde

6.1 Datamateriale for ansatte i Region Hovedstaden

Organisationsændringer i 2013 blev undersøgt i forhold til medarbejder-exit fra arbejdsenheden og helbredsudfald i 2014 med baseline sat til 1. januar 2014.

De anvendte data er en del af WHALE-kohorten (*Well-being in HospitAL Employees*).[62] Kildepopulationen omfattede alle ansatte i Region Hovedstaden, som blev inviteret til besvarelse af en arbejdsmiljøundersøgelse, TrivselOP, gennemført i perioden fra 1. til 31. marts 2014 (*N*=37 720; 84% svarede; Figur 2). Størstedelen af spørgeskemaerne blev distribueret via arbejdsmail, mens papir-og-pen versioner blev uddelt til ansatte uden arbejdsmail. Der blev udsendt op til 3 reminders om at besvare spørgeskemaet. Data fra undersøgelsen omfattede spørgsmålsbesvarelser samt beskæftigelses- og organisationsdata for de ansatte. Undersøgelsen blev oprindeligt udført af overvågnings- og interventionshensyn og ikke til forskning.

Figur 2. I 2014 var alle 37 720 ansatte fordelt på 2686 arbejdsenheder (fx Forskningsenheden) over 440 afdelinger (fx Arbejds- og Miljømedicinsk Afdeling) på tværs af 14 institutioner (fx Bispebjerg og Frederiksberg Hospitaler).



1105 ansatte var ikke tildelt et afdelings-niveau.

Data på organisationsændringer blev indsamlet via en spørgeskemaundersøgelse udsendt til lederne for alle arbejdsenheder gennemført i perioden april-juni 2016 (59% svarede). Informationer om personaleomsætning og helbred blev udtrukket via regionale lønregistre og nationale forskningsregistre.

For at deltage i undersøgelsen skulle hver medarbejder arbejde mindst 18,5 timer om ugen i den samme arbejdsenheden gennem hele 2013. Hver arbejdsenhed skulle bestå af mindst tre ansatte, som alle refererede til den samme nærmeste leder. I alt var 25 897 ansatte kvalificeret til undersøgelsen. Studiepopulationen indeholdt mindst 15 038 ansatte fordelt på 1284 arbejdsenheder med data på alle relevante variable (Tabel 1).

Tabel 1. Karakteristika for den kvalificerede population, studiepopulationen og gruppen udsat for organisationsændringer (baseline 1. januar 2014).

	Kategoriske variable	Kvalificeret population		Studiepopulation		Eksponeret for organisationsændringer	
		n	% of *N*	*n*	% of *N*	*n*	% of *N*
Medarbejder-niveau, *N*		25 897	100	15 038	100	8242	100
Alder, gennemsnit (SD)		47 (10,7)	-	47 (10,6)	-	47 (10,7)	-
Køn	Kvinder	19 808	76,5	11 507	76,5	6299	76,4
	Mænd	6089	23,5	3531	23,5	1943	23,6
Faggruppe	Sygeplejersker mm.	11 174	43,1	6534	43,4	3682	44,7
	Læger/tandlæger	2791	10,8	1464	9,7	758	9,2
	SOSU'er	3242	12,5	1966	13,1	1055	12,8
	Pædagogisk personale	761	2,9	401	2,7	217	2,6
	Service/teknik	3091	11,9	1864	12,4	975	11,8
	Administration	4838	18,7	2809	18,7	1555	18,9
Deltidsansættelse	Nej	16 676	64,4	9613	63,9	5238	63,6
	Ja	9221	35,6	5425	36,1	3004	36,4
Ledelsesansvar	Nej	24 053	92,9	14 040	93,4	7591	92,1
	Ja	1843	7,1	998	6,6	651	7,9
Kontraktansættelse	Nej	1965	7,6	1066	7,1	487	5,9
	Ja	23 932	92,4	13 972	92,9	7755	94,1
Forudgående sygefravær, dage	0	7209	27,8	4132	27,5	2274	27,6
	1--3	5582	21,6	3242	21,6	1760	21,4
	4--6	3928	15,2	2292	15,2	1271	15,4
	7-13	4927	19	2877	19,1	1517	18,4
	14≤	4251	16,4	2495	16,6	1420	17,2
Anciennitet, år, gennemsnit (SD)		13 (10,3)	-	13 (10,3)	-	13 (10,3)	-
Personlig bruttoindkomst, gennemsnit (SD)		449 423 (241 795)	-	442 995 (218 870)	-	442 995 (223 643)	-
Arbejdsenheds-niveau, *N*		2318	100	1284	100	642	100
Antal ansatte i arbejdsenhed, gennemsnit (SD)		16 (12,9)	-	16 (13,3)	-	18 (14,3)	-
Social kapital, lav-høj (0-100), gennemsnit (SD)		68 (9,8)	-	69 (9,8)	-	68 (9,8)	-
Institutions-niveau, *N*		13	100	13	100	13	100

Forkortelser: SD = standardafvigelse

6.2 Organisationsændringer

Data på organisationsændringer i perioden 2011-2013 blev indsamlet via en Internet-spørgeskemaundersøgelse udført fra april til juni 2016. Baseret på baggrundsdata fra arbejdsmiljøundersøgelsen i marts 2014 blev Internet-undersøgelsen distribueret til lederne for samtlige arbejdsenheder. Lederne gav informationer om hændelse af følgende typer organisationsændringer i deres arbejdsenhed for hvert af de seks semestre i perioden fra 1. januar 2011 til 31. december 2013:

- Sammenlægning
- Opsplitning
- Fysisk flytning
- Lederskift
- Afskedigelse i arbejdsenheden
- Selektive besparelser

Gennem 2013 var 55% af alle ansatte i studiepopulationen udsat for hvilken som helst organisationsændring (Tabel 2).

Tabel 2. Fordeling af organisationsændringer i arbejdsenheden gennem 2013 oplevet af ansatte i studiepopulationen (N=15 038).

	Ansatte, *n* (% af *N*)
Ingen ændring	6796 (45)
Hvilken som helst ændring	8242 (55)
1 ændring	4332 (29)
2 ændringer	2228 (15)
3≤ ændringer	1682 (11)
Sammenlægninger	2560 (17)
Opsplitninger	956 (6)
Fysisk flytning	1872 (12)
Lederskift	3781 (25)
Afskedigelse af ansatte	3204 (21)
Selektive besparelser	2401 (16)

6.3 Personaleomsætning og helbred

Månedsopgjort data for medarbejder-exit fra arbejdsenheden og sygefravær i 2014 blev udtrukket via opkobling til regionale lønregistre. Medarbejder-exit fra arbejdsenheden blev defineret som den måned i 2014, hvor en ansat ophørte i arbejdsenheden uanset årsagen. Sygefraværsdata omfattede både det totale sygefravær og langtidssygefravær á minimum 29 dage. Sygefravær blev udregnet som procentandelen af fraværende arbejdstimer hvilket som helst sygefravær (totalt sygefravær) og langtidssygefravær.

Dagsopgjorte information om indløsning af recept på psykofarmaka (anxiolytika [WHO ATC: N05B], hypnotika/sedativa [N05C] og antidepressiva [N06C]) og nyopstået iskæmisk hjertesygdom (WHO ICD-10: I20-I25) blev indhentet via opkobling til Lægemiddelstatistikregistret[63] og Landspatientregistret[64,65] (Figur 3).

Figur 3. Grafisk oversigt over anvendte data for organisationsændringer (lyseblå), psykosociale faktorer (mellemblå) samt og medarbejder-exit fra arbejdsenheden og helbred (mørkeblå).

6.4 Psykosociale faktorer

Besvarelser på ni spørgsmål i arbejdsmiljøundersøgelsen blev brugt til at måle arbejdsenhedens sociale kapital og medarbejdernes oplevede stress. Spørgsmålene blev ratet med 5- eller 7-points skala (1="*Slet ikke*" til 5/7= "*I meget høj grad*"). Social kapital omfattede dimensionerne: tillid/organisatorisk retfærdighed og samarbejde. Målet for arbejdsenhedens sociale kapital blev inddelt i fire lige store grupper rangerende fra lav til høj i tråd med en tidligere undersøgelse (Figur 3).[52]

Tabel 3. Spørgsmål fra arbejdsmiljøundersøgelsen anvendt til etablering af psykosociale faktorer.

Psykosocial faktor	Underdimension	Spørgsmål (5-/7-point Likert-skala)
Oplevet stress		*Har du følt dig stresset inden for det seneste halve år? (5)*
Social kapital	Tillid/organisatorisk retfærdighed	*I hvilken grad har du tillid til de udmeldinger, der kommer fra ledelsen? (7)*
		I hvilken grad oplever du, at ledelsen stoler på, at medarbejderne gør et godt stykke arbejde? (7)
		I hvilken grad bliver konflikter løst på en retfærdig måde? (7)
		I hvilken grad bliver arbejdsopgaverne fordelt på en retfærdig måde? (7)
		I hvilken grad bliver din faggruppe respekteret af andre faggrupper på arbejdspladsen? (7)
	Samarbejde	*I hvilken grad er du og dine kolleger gode til at komme med forslag til forbedring af arbejdsgangene på din arbejdsplads? (5)*
		I hvilken grad tager du og dine kolleger medansvar for, at der er en god stemning og omgangstone på arbejdspladsen? (5)
		I hvilken grad får du hjælp og støtte fra dine kolleger, når du har bruge for det? (5)

5-/7-point Likert-skala: 1: "*Slet ikke*" til 5/7: "*I meget høj grad*".

6.5 Andre forklarende faktorer

De statistiske analyser tog højde for andre mulige faktorer, der kunne forklare sammenhængene med medarbejder-exit fra arbejdsenheden og helbred: alder, køn, faggruppe, personlig bruttoindkomst, forudgående sygefravær i 2012, fravær relateret til barns første eller anden sygedag, anciennitet, kontraktansættelse, arbejdstid, ledelsesansvar, arbejdsenhedens størrelse og andre typer organisationsændringer.

6.6 Statistisk analyse

Overlevelsesanalyser estimerede risikoen for medarbejder-exit fra arbejdsenheden, udskrivelse af psykofarmaka og nyopstået iskæmisk hjertesygdom i 2014 i henhold til organisationsændringer i 2013.[66–68] For at undersøge tidslige aspekter i udskrivelse af psykofarmaka blev sammenhænge yderligere undersøgt for udskrivelse i hhv. første og andet semester i 2014. Oplevet stress blev undersøgt som forklarende faktor for sammenhængen mellem organisationsændringer og hjertesygdom ved at justere for effekten via oplevet stress i analysemodellen.[69]

For at tage højde for den store andel af ansatte uden sygefravær underopfølgningsperioden blev *zero-inflated Poisson regressionmodeller* anvendt til analyserne af totalt sygefravær og langtidssygefravær. Disse regressionsmodeller estimerede både risikoen for at få sygefravær (ja/nej) og mængden af sygefravær i procent.[70]

Logistiske regressionsmodeller blev anvendt til at vurdere risikoen for lav social kapital i arbejdsenheden efter organisationsændringer i 2013. Derudover blev overlevelsesanalyser brugt til at analysere arbejdsenhedens sociale kapital som forklarende faktor for sammenhængen mellem organisationsændringer og medarbejder-exit fra arbejdsenheden.[69,71,72]

Tærsklen for statistisk signifikans blev sat til 0.05. Alle statistiske analyser blev foretaget i SAS version 9.4 software (SAS Institute Inc., Cary , North Carolina, USA) eller STATA version 14.2 software (Stata Corp., College Station, Texas, USA).

7 Hovedresultater

7.1 Totalt sygefravær og langtidssygefravær

Tabel 4 viser den risikoen for hvilken som helst sygefravær (totalt) og langtidssygefravær i mindst 29 dage blandt de ansatte efter organisationsændringer ift. ansatte, der ikke oplevede nogen ændringer.

Resultaterne viste ikke højere risiko for at få hvilken som helst type sygefravær efter organisationsændringer. Derimod var der omkring 15-30% højere risiko for langtidssygefravær efter hvilken som helst type ændring, sammenlægninger og afskedigelse i arbejdsenheden blandt de tilbageværende ansatte. Endvidere var nogle – men ikke alle – typer organisationsændringer forbundet med mere totalt og langtidssygefraværs blandt de ansatte, som havde sygefravær under opfølgningsperioden i 2014 (Tabel 4).

Tabel 4. Justeret odds ratio (OR) for sygefraværs-event og justeret rate ratio (RR) for højere sygefraværsprocent i forhold til normeret arbejdstid i året efter organisationsændringer ift. ingen ændringer. TS = Total sygefravær (ja/nej); TS, % = Total sygefraværsprocent ift. normeret arbejdstid; LS = Langtidssygefravær (ja/nej); LS, % = Langtidssygefraværsprocent ift. normeret arbejdstid; 95% CI = 95% konfidensinterval; SD = Standardafvigelse.

		TS			TS, %			LS			LS, %		
	Ansatte, n	% of *n*	OR	95% CI	Med sygefravær af N, gennemsnit (SD)	RR	95% CI	% of *n*	OR	95% CI	Med sygefravær af N, gennemsnit (SD)	RR	95% CI
Ingen ændring (reference)	8471	78,68	1,00		5,58 (8,75)	1,00		5,55	1,00		23,26 (21,24)	1,00	
Hvilken som helst ændring	5688	79,32	1,01	0,92-1,10	5,94 (9,19)	1,05	1,03-1,06	6,43	1,15	1,00-1,33	23,46 (20,22)	1,00	0,97-1,03
1 ændring	3766	80,75	1,05	0,94-1,17	5,85 (8,70)	1,01	0,99-1,03	6,45	1,13	0,96-1,33	21,82 (18,90)	0,93	0,90-0,96
2 ændringer	1197	79,37	1,09	0,92-1,28	6,20 (9,80)	1,13	1,10-1,16	6,68	1,23	0,96-1,58	26,10 (21,00)	1,13	1,07-1,19
3≤ ændringer	725	71,83	0,77	0,63-0,93	6,02 (10,76)	1,13	1,08-1,17	5,93	1,13	0,81-1,56	28,00 (24,89)	1,18	1,11-1,25
Sammenlægninger	1058	74,20	0,87	0,74-1,03	5,78 (9,30)	1,09	1,06-1,13	6,52	1,31	1,00-1,72	24,18 (19,00)	1,05	0,99-1,11
Opsplitninger	496	76,81	0,86	0,68-1,08	5,51 (8,62)	1,00	0,96-1,05	5,65	1,00	0,67-1,50	22,32 (15,00)	0,89	0,82-0,97
Fysisk flytning	961	77,52	0,99	0,83-1,18	5,47 (9,09)	1,01	0,98-1,05	4,89	0,91	0,66-1,24	26,30 (23,45)	1,09	1,03-1,16
Lederskift	2195	78,59	0,96	0,85-1,09	5,94 (9,24)	1,05	1,03-1,08	6,29	1,10	0,90-1,34	23,30 (20,82)	1,01	0,97-1,05
Afskedigelse af ansatte	2181	78,68	1,02	0,89-1,16	6,54 (10,83)	1,16	1,13-1,18	7,11	1,31	1,08-1,59	27,41 (24,01)	1,17	1,13-1,21
Selektive besparelser	1762	76,90	0,93	0,82-1,08	5,74 (8,78)	1,03	1,01-1,06	6,02	1,09	0,87-1,36	22,76 (19,00)	0,99	0,95-1,04

7.2 Social kapital – tillid/retfærdighed og samarbejde

Tabel 5 viser risikoen for lavere social kapital i arbejdsenheden efter organisationsændringer. Tabel 6 viser risikoen for medarbejder-exit fra arbejdsenheden ift. lavere niveauer af social kapital i arbejdsenheden.

Samtlige undersøgte indikatorer for organisationsændringer, på nær fysisk flytning, var forbundet med ca. 85-265% højere risiko for lav social kapital i arbejdsenheden (Tabel 5). Desuden fandt vi, at jo lavere social kapital der var, jo højere var risikoen for medarbejder-exit fra arbejdsenheden med op til 65% højere risiko (Tabel 6).

Tabel 5. Justeret odds ratio (OR) for lavere social kapital (end høj) i arbejdsenheden efter organisationsændringer ift. ingen ændringer. 95% CI = 95% konfidensinterval; SK = arbejdsenhedens sociale kapital.

		SK, lav			SK, moderat-lav			SK, moderat-høj		
	Arbejdsenheder, n	% of *n*	OR	95% CI	% of *n*	OR	95% CI	% of *n*	OR	95% CI
Ingen ændring (reference)	786	18			20			24		
Hvilken som helst ændring	430	23	2,04	1,86-2,23	22	1,51	1,39-1,64	24	1,51	1,39-1,65
1 ændring	272	22	2,05	1,85-2,27	22	1,60	1,45-1,76	25	1,58	1,44-1,75
2 ændringer	99	26	1,85	1,58-2,16	21	0,92	0,78-1,08	21	1,23	1,06-1,42
3≤ ændringer	59	20	2,30	1,87-2,82	24	2,30	1,91-2,76	25	1,70	1,41-2,06
Sammenlægninger	88	26	2,24	1,88-2,66	27	1,89	1,60-2,22	22	1,52	1,28-1,79
Opsplitninger	44	25	3,66	2,85-4,70	32	3,33	2,62-4,22	20	1,50	1,16-1,95
Fysisk flytning	89	24	1,13	0,96-1,33	19	1,10	0,95-1,28	18	0,67	0,57-0,79
Lederskift	166	25	2,58	2,28-2,93	25	1,78	1,57-2,01	23	1,72	1,52-1,94
Afskedigelse af ansatte	161	21	1,86	1,63-2,11	22	1,67	1,48-1,89	26	1,72	1,52-1,94
Selektive besparelser	126	22	1,92	1,68-2,15	15	0,87	0,75-1,01	29	1,90	1,68-2,15

Tabel 6. Justeret hazard ratio (HR) for medarbejder-exit fra arbejdsenheden i henhold til niveauer af social kapital i arbejdsenheden. 95% CI = 95% konfidensinterval; SK= Arbejdsenhedens sociale kapital.

SK	Ansatte, n	% of *n*, exit	HR	95% CI
Høj (reference)	3715	14	1,00	
Moderat-høj	3566	17	1,29	1,15-1,45
Moderat-lav	3372	17	1,34	1,18-1,51
Lav	3406	20	1,65	1,46-1,86

7.3 Medarbejder-exit fra arbejdsenheden

Tabel 7 viser risikoen for medarbejder-exit fra arbejdsenheden efter eksponering for organisationsændringer relativt til ingen ændringer. Arbejdsenheds sociale kapital blev vurderet som forklarende faktor ved at justere for evt. effekt via denne psykosociale faktor.

Resultaterne viste ca. 10-50% højere risiko for medarbejder-exit fra arbejdsenheden efter specifikke typer organisationsændringer. Ved yderligere justering for arbejdsenhedens sociale kapital blev der kun observeret mindre fald i risikoestimaterne, hvilket ikke indikerer, at social kapital ikke er en vigtig forklarende psykosocial faktor for sammenhængen (Tabel 7).

Yderligere analyser viste, at de to under-dimensionerne af social kapital (tillid/organisatorisk retfærdighed og samarbejde) heller ikke forklarede sammenhængen mellem organisationsændringer og medarbejder-exit fra arbejdsenheden hver for sig.

Tabel 7. Justeret hazard ratio (HR) for medarbejder-exit fra arbejdsenheden i året efter organisationsændringer ift. ingen ændringer hhv. uden og med** justering for potentiel mediering via social kapital. 95% CI = 95% konfidensinterval.*

	Ansatte, *n*	% of *n*, exit	HR*	95% CI	HR**	95% CI
Ingen ændring (reference)	8410	16,7	1,00		1,00	
Hvilken som helst ændring	5649	18,0	1,10	1,01-1,19	1,07	0,98-1,16
1 ændring	3728	17,1	1,04	0,95-1,15	1,01	0,92-1,11
2 ændringer	1170	17,4	1,03	0,89-1,20	0,99	0,85-1,15
3≤ ændringer	751	22,9	1,53	1,30-1,80	1,48	1,26-1,73
Sammenlægninger	1085	21,3	1,29	1,12-1,49	1,24	1,08-1,43
Opsplitninger	508	21,7	1,41	1,16-1,72	1,33	1,09-1,62
Fysisk flytning	978	19,4	1,17	1,00-1,36	1,16	0,99-1,35
Lederskift	2149	19,3	1,23	1,10-1,38	1,17	1,05-1,31
Afskedigelse af ansatte	2163	16,4	1,03	0,91-1,16	1,00	0,89-1,13
Selektive besparelser	1757	17,9	1,10	0,97-1,25	1,08	0,96-1,23

7.4 Udskrivelse af psykofarmaka

Tabel 8 viser den risikoen for, at ansatte fik udskrevet psykofarmaka til behandling af søvnproblemer, angst eller depression gennem hele 2014 efter eksponering for organisationsændringer i 2013 ift. ingen ændringer.

Resultaterne viste, at eksponering for hvilken som helst type organisationsændring og specifikt lederskift var associeret med ca. 15-25% højere risiko for udskrivelse af psykofarmaka i hele 2014. Andre typer organisationsændringer havde samme risiko-tendens, om end der var større usikkerhed forbundet med sådan tolkning af resultaterne (Tabel 8).

Tabel 8. Justeret hazard ratio (HR) for udskrivelse af psykofarmaka blandt medarbejdere gennem hele året efter organisationsændringer ift. ingen ændringer. 95% CI = 95% konfidensinterval.

	Ansatte, *n*	% of *n*, udskrivelser	HR	95% CI
Ingen ændring (reference)	6796	10,1	1,00	
Hvilken som helst ændring	8242	10,7	1,14	1,02-1,26
Sammenlægninger	2560	11,4	1,14	0,97-1,34
Opsplitninger	956	10,2	0,98	0,78-1,23
Fysisk flytning	1872	10,3	1,02	0,84-1,24
Lederskift	3781	12,1	1,23	1,07-1,41
Afskedigelse af ansatte	3204	11,8	1,15	0,98-1,35
Selektive besparelser	2401	11,6	1,12	0,95-1,31

Tabel 9 viser den risikoen for, at ansatte fik udskrevet psykofarmaka til behandling af affektive lidelser i hhv. første og andet semester af året efter eksponering for organisationsændringer gennem 2013 ift. ingen ændringer.

Resultaterne viser, at eksponering for lederskift var særligt forbundet med en højere risiko for, at ansatte fik udskrevet psykofarmaka i første semester af det efterfølgende år. Sammenlignet med første semester steg samtlige risikoestimater for udskrivelse af psykofarmaka i andet semester af året efter organisationsændringer. Eksponering for hvilken som helst type organisationsændring, sammenlægninger, selektive besparelser og afskedigelse af ansatte i arbejdsenheden var forbundet med ca. 20-25% højere risiko for udskrivelse af psykofarmaka i andet semester af det efterfølgende år. Dette tal var ca. 40% for lederskift under samme periode (Tabel 9).

Tabel 9. Justeret hazard ratio (HR) for førstegangsudskrivelse af psykofarmaka blandt medarbejdere for hhv. første (1257 udskrivelser) og andet semester (1269 udskrivelser) i året efter organisationsændringer ift. ingen ændringer. 95% CI = 95% konfidensinterval.

		Første semester			Andet semester		
	Ansatte, *n*	% of n, udskrivelse	HR	95% CI	% of n, udskrivelse	HR	95% CI
Ingen ændring (reference)	6796	8,0	1,00		7,5	1,00	
Hvilken som helst ændring	8242	8,6	1,09	0,97-1,22	9,3	1,25	1,11-1,41
Sammenlægninger	2560	8,2	1,05	0,88-1,26	9,3	1,26	1,06-1,50
Opsplitninger	956	7,2	0,87	0,67-1,14	7,9	1,02	0,79-1,31
Fysisk flytning	1872	7,8	1,02	0,82-1,28	8,6	1,16	0,93-1,44
Lederskift	3781	9,2	1,20	1,03-1,41	10,3	1,42	1,22-1,65
Afskedigelse af ansatte	3204	9,0	1,16	0,97-1,39	9,6	1,23	1,03-1,46
Selektive besparelser	2401	8,5	1,04	0,87-1,24	9,5	1,19	1,00-1,41

7.5 Nyopstået iskæmisk hjertesygdom

Tabel 10 viser risikoen for, at ansatte udviklede nyopstået iskæmisk hjertesygdom efter eksponering for organisationsændringer ift. ingen ændringer (Tabel 10).

Resultaterne viste, at fysisk flytning, lederskift og afskedigelse af ansatte i arbejdsenheden var forbundet med 120-190% højere risiko for nyopstået iskæmisk hjertesygdom blandt de ansatte i det følgende år. Ved yderligere justering for oplevet stress var der kun marginale fald i hazard ratioen for de

forskellige ændringstyper, hvilket ikke indikerer, at oplevelsen af stress ikke var en forklarende faktor for sammenhængen mellem organisationsændringer og højere risiko for nyopstået iskæmisk hjertesygdom i denne undersøgelse (Tabel 10).

Tabel 10. Justeret hazard ratio for (HR) nyopstået iskæmisk hjertesygdom (IHS) blandt medarbejdere gennem året efter organisationsændringer ift. ingen ændringer uden og med** justering for potentiel mediering via oplevet stress. 95% CI = 95% konfidensinterval.*

	n	IHS, *n*	HR*	95% CI	HR**	95% CI
Ingen ændring (reference)	6712	18	1,00		1,00	
Hvilken som helst ændring	8130	31	1,50	0,81-2,77	1,45	0,78-2,69
Sammenlægninger	2532	4	0,75	0,24-2,37	0,72	0,23-2,30
Opsplitninger	950	≤2	0,90	0,20-4,07	0,87	0,19-3,95
Fysisk flytning	1852	7	2,91	1,07-7,90	2,81	1,06-8,03
Lederskift	3726	14	2,18	1,02-4,68	2,10	0,97-4,54
Afskedigelse af ansatte	3155	20	2,90	1,36-6,16	2,78	1,29-5,96
Selektive besparelser	2364	6	0,93	0,35-2,50	0,91	0,34-2,48

Jf. retningslinjer for hjemsendelse af analyseresultater fra Danmarks Statistiks forskerordning skal tabeller mindst indeholde tre observationer pr. celle.

8 Vurdering og kommentarer

8.1 Personaleomsætning, sygefravær og social kapital

Specifikke typer organisationsændringer havde tilsyneladende en dobbelt, negativ indflydelse på fastholdelse af medarbejdere i arbejdsenheden samt højere risiko for både alle slags sygefravær og langtidssygefravær blandt de tilbageværende ansatte i året efter organisationsændringer. Der kan være flere årsager til alle slags sygefravær, såsom sporadisk sygdom og ikke-sygdomsrelateret fravær, hvorimod langtidssygefravær i højere grad tyder på mere alvorlig sygdom.[73–75] Der kan også være flere årsager til, at ansatte forlader arbejdspladsen – frivillige såvel som ufrivillige – hvilket vi ikke havde data på. Frivillige årsager kan omfatte ønsket om at gå på efterløn,[76,77] som vi tidligere har påvist,[78] mens ufrivillige årsager til forlade arbejdspladsen kan skyldes dårligt helbred eller fyrring.[77,79]

Endvidere fandt vi, at jo lavere social kapital der var i arbejdsenheden, jo højere risiko var der også for, at medarbejderne forlod arbejdsenheden. Dette fund er i tråd med teorien om social kapital, idet denne psykosociale faktorer bl.a. betegner den sociale sammenhængskraft på en arbejdsplads.[51] Organisationsændringer var tilmed også forbundet med højere risiko for efterfølgende dårlig social kapital i arbejdsenheden. Dette er dog ikke ensbetydende med, at organisationsændringen nødvendigvis har *forårsaget* lav social kapital, da det kan tænkes, at arbejdsklimaet allerede var dårligt før ændringen, blev iværksat.

Selvom både organisationsændringer var forbundet med lav social kapital og at lav social kapital var forbundet med højere personaleomsætning, fandt vi ikke, at social kapital forklarede sammenhængen mellem organisationsændringer og højere personaleomsætning. Social kapital betegner bl.a. samarbejdskarakteristika ved en organisation, og det er rimeligt at forestille sig, at evt. forandringer i social kapital sker over en længere periode end de to år, som undersøgelsen varede. Et tidligere studie blandt finske kommunalansatte fandt, at ca. halvdelen af sammenhængen mellem større personalenedskæringer og mere langtidssygefravær blev forklaret ved højere jobkrav og -usikkerhed samt lavere jobkontrol.[13] De samme psykosociale faktorer kunne givetvis også spille en rolle for personaleomsætning, om end yderligere forskning er nødvendig for at underbygge denne hypotese.

8.2 Udskrivelse af psykofarmaka og iskæmisk hjertesygdom

Vi fandt, at eksponering for hvilken som helst ændring – og især lederskift – var forbundet med højere risiko for udskrivelse af psykofarmaka. De undersøgte kategorier af psykofarmaka (fx benzodiazepiner, SSRI-præparater) anvendes til håndtering af søvnproblemer og stemningsregulering ved mentale lidelser (fx angst, depression) og kræver recept udskrevet af en læge. Den højere risiko for udskrivelse af sådan medicin peger på en stigning i stressrelaterede mentale helbredsproblemer af en sådan sværhedsgrad, at der kræves medicinsk behandling. Mentale helbredsproblemer kan også behandles på anden vis (fx psykoterapi) og nærværende fund afspejler derfor ikke alle diagnosticerede tilfælde med mentale lidelser under opfølgningsperioden. Lederen spiller en central rolle ift. organisering af arbejdet. Med et lederskift kan

følge nye arbejdsgange (fx øget dokumentation), hvilket giver anledning til yderligere psykosociale belastninger.[80,81] Dette kan forklare, at lederskift tilsyneladende var særligt forbundet med udskrivelse af psykofarmaka til behandling af stress-relaterede tilstande.

Risikoen for udskrivelse af psykofarmaka steg i andet semester af året efter organisationsændringer, hvilket peger på en latenstid før stigningen i forbrug af psykofarmaka blandt de eksponerede ansatte. Denne latenstid indikerer ikke nødvendigvis, at mentale helbredsproblemer opstår i andet semester, men at der kan gå noget tid før den ansatte reagerer på sin mentale tilstand, får tid hos sin læge og bliver diagnosticeret.

Endeligt fandt vi en markant højere risiko for nyopstået iskæmisk hjertesygdom efter eksponering for fysisk flytning, lederskift og afskedigelse af ansatte i arbejdsenheden. Dette fund er i tråd med andre undersøgelser af den offentlige sektor i Finland[25] og Grækenland[24]. Tidligere undersøgelser har påvist, at episodiske stressfulde begivenheder kan føre til kardiovaskulære tilfælde i en arbejdsmæssig kontekst,[47,48,82] og det synes rimeligt at antage, at en organisationsændring kan udgøre sådan en stressor blandt ansatte. Imidlertid fandt vi ikke, at oplevet stress var en vigtigt forklarende faktor for sammenhængen mellem organisationsændringer og hjertesygdom i dette studie. Dette kan dels skyldes det beskedne antal nyopståede hjertesygdomstilfælde (n=49), dels at oplevet stress kun blev målt med et enkelt spørgsmål, hvilket ikke giver megen statistisk styrke til at afdække forklaring af sammenhængen via oplevet stress.

8.3 Metodiske overvejelser

Information om hændelse for organisationsændringer blev indsamlet tre år efter, at de rent faktiske skete, hvilket kan have medvirket til manglende oplysninger på disse data i undersøgelsen. Organisationsændringer i 2013 kan have ført til nedlægning eller afskedigelse af lederen for arbejdsenheden og derved hindre besvarelse af spørgeskemaet vedr. organisationsændringer i 2016. Dog bliver arbejdsemail-adressen ikke ændret, når en medarbejder får en anden stilling i Region Hovedstaden. Lederen ville således modtage spørgeskemaet, selvom vedkommende skulle have fået nyt job siden ændringer ske-

te. Der var ikke nævneværdige forskelle mht. karakteristika mellem grupperne med og uden data på organisationsændringer, hvilket tyder på, at de manglende data ikke var et kritisk problem.[83]

En anden mulig begrænsning ved undersøgelsen er, at data for organisationsændringer vedrørte tidspunktet for deres *hændelse* og ikke datoen for, hvornår de blev *iværksat*. Dette giver en vis usikkerhed for varigheden af latenstiden for den højere risiko for udskrivelse af psykofarmaka blandt de ansatte. Endvidere begrænser denne upræcise information om organisationsændringer undersøgelsen i at belyse de mere akutte effekter blandt medarbejderne efter organisationsændringer. Opfølgningsperioden var begrænset til ét år (2014), selvom der var personaleomsætnings- og helbredsdata tilgængelige to år efter organisationsændringerne (2014-2015). Vi valgte dog ikke at bruge informationer for andet opfølgningsår (2015), eftersom disse data med al sandsynlighed var påvirket af organisationsændringer i det foregående år (2014), hvilket vi ikke havde informationer på. Den begrænsede opfølgningsperiode kan især have underestimeret risikoestimaterne for udskrivelse af psykofarmaka, idet risikoen var særlig høj i andet semester af opfølgningsåret.

Denne undersøgelse har en række styrker. Styrkerne omfatter de komplette data mht. baggrundsinformation, personaleomsætning og helbred, samt det store antal forsøgsdeltagere. Andre styrker ved undersøgelsen er, at data for eksponering og udfald blev indsamlet af objektive kilder uafhængig af den undersøgte forsøgsdeltager. Derudover blev informationer om eksponering og udfald blev målt på flere niveauer, hvilket gør evt. indflydelse af andre forklarende faktorer til et mindre problem.

Endvidere kan den høje svarprocent for arbejdsmiljøundersøgelen (84%) fremhæves som endnu en styrke ved denne undersøgelse. Ved anvendelse af et aggregeret mål for social kapital på arbejdsenhedsniveauet mindskedes risikoen for manglende data på social kapital, således at næsten alle ansatte fra studiepopulationen blev inkluderet i analyserne (98%).

Det var også en styrke, at organisationsændringerne blev målt på det laveste niveau i organisationsstrukturen. Dette øger sandsynligheden for, at de ansatte rent faktisk blev berørt/ikke-berørt af organisationsændringerne. Slutteligt var det en styrke, at vi undersøgte adskillige typer af hyppigt forekommende organisationsændringer, hvilket bidragede til renheden af referencegruppen

bestående af ansatte, der ikke blev eksponereret for nogen (af de undersøgte) organisationsændringer.

8.4 Generaliserbarhed

Kvalifikation til undersøgelsen omfattede, at de ansatte skulle arbejde mindst 18,5 timer om ugen i den samme arbejdsenhed gennem hele 2013, hvor de ansatte var under risiko for organisationsændringer. Med disse kriterier vil mange midlertidigt ansatte givetvis ikke være repræsenteret i undersøgelsen (fx praktikanter, studerende). På den anden side er det uklart, hvorvidt sådanne faggrupper overhovedet bliver påvirker af organisationsændringer pga. deres kortvarige tilknytning til arbejdsenheden.

Studiepopulationen bestod hovedsageligt af kvinder, hvilket er et generelt karakteristikum for ansatte i sundhedssektoren. Generalisering af fundene til andre sektorer skal derfor foretages med en vis påholdenhed. Der kan være kønsmæssige forskelle i de underliggende (psykosociale) mekanismer for skadevirkninger af organisationsændringer,[84–86] om end resultaterne fra nærværende undersøgelse ikke indikerede sådanne forskelle.[83,87]

Endvidere er det rimeligt at forestille sig, at underliggende psykosociale skademekanismer ved organisationsændringer er forskellige for ansatte på offentlige og private arbejdspladser (fx ift. jobusikkerhed, indsat/udbytte etc.).[88] Arbejde i den offentlige sundhedssektor i Danmark anses traditionelt for at være en mere sikker og stabil ansættelse, hvorimod der kan være større jobusikkerhed forbundet med ansættelse i den private sektor.

Endeligt er resultaterne samstemmende med tidligere fund fra populationsbaserede studier af både den private og offentlige sektor i Danmark[23] og Sverige.[10,21,22] Dette understøtter, at nærværende fund er generaliserbare til andre arbejdsmæssige kontekster end Region Hovedstaden.

9 Konklusioner og perspektiver

Organisationsændringer i arbejdsenheden var relateret til højere personaleomsætning og højere risiko for (langtids-) sygefravær, udskrivelse af psykofarmaka og – i særdeleshed – nyopstået iskæmisk hjertesygdom (fx blodprop i hjertet). Specifikke typer organisationsændringer havde ikke særlig betydning for både personaleomsætning og dårligt helbred blandt de ansatte. Organisationsændringer som involverede afskedigelse af ansatte i enheden var dog mere gennemgående forbundet med højere risiko for dårligt helbred. Den sociale kapital i arbejdsenheden forklarede ikke sammenhængen mellem organisationsændringer og personaleomsætning fra arbejdsenheden. Imidlertid var organisationsændringer relateret til efterfølgende dårlig social kapital, mens dårlig social kapital i arbejdsenheden også var relateret til højere personaleomsætning.

Der er således rationelt grundlag for at medtænke personaleomsætnings- og helbredshensyn, når fremtidige organisationsændringer planlægges og iværksættes. Politikere og beslutningstager bør øge fokus på strategier til at minimere evt. skadevirkninger på ansatte af organisatoriske ændringer, idet sådanne negative virkninger ikke blot kan være en byrde for den enkelte, men også for samfundet.

10 Referencer

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11.1 Publikationer i internationale tidsskrifter med peer-review

Jensen JH, Flachs EM, Skakon J, Rod NH, Bonde JP. Dual impact of organisational change on subsequent exit from work unit and sickness absence: a longitudinal study among public healthcare employees. Occup Environ Med, 2018;75(7):479-485. Open Access. doi:10.1136/oemed-2017-104865

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Jensen JH, Flachs EM, Skakon J, Rod NH, Bonde JP, Kawachi I. Work-unit organizational changes and risk of ischemic heart disease: a prospective study of public healthcare employees in Denmark. BMJ Open. In review.

11.2 Ph.d.-afhandling

Jensen JH. Organizational Change at Work, Employee Turnover, and Health – a longitudinal study among employees in the Capital Region of Denmark. November 2018. ISBN: 978-87-970125-3-6.

11.3 Rapporter

Clark AJ, Aust B, Bonde JP, Hoffmann S, Jensen JH, Laursen LL, Nordentoft M, Rugulies R, Vejlstrup S, Viberg-Tecza K, Rod NH. Psykosocialt arbejdsmiljø på

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11.4 Offentlig omtale

Arbejdstitel: *Forandringer koster på trivselskontoen* (af journalist Søren Svith), forår 2019 (planlagt).

Berlingske Tidende, *Medarbejdere bliver syge af forandringer på arbejdspladsen*, november 2017

Magisterbladet, *Flere langtidssygemelder efter fusioner*, november 2017

Sygeplejersken, *Organisationsændringer gør de ansatte syge*, november 2017

Magasinet Pleje, *Nye strukturer gør medarbejdere syge*, oktober 2017

Webmagasinet VIDEN+, *Medarbejderne bliver syge af organisationsændringer*, oktober 2017.

11.5 Præsentationer ved konferencer (foredrag, posters og abstracts)

Work, Stress and Health Conference (American Psychological Association), Philadelphia, PA, USA, november 2019 (planlagt).

33rd Annual Conference of the European Health Psychology Society, Dubrovnik, Kroatien, september 2019 (planlagt).

Closing the Loop – Injury Prevention and Return to Work Conference (Self Insurers of South Australia), Adelaide, Australien, juli 2019, Inviteret key-note speaker (planlagt).

Dansk Selskab for Arbejds- og Miljømedicin (DASAM), årsmøde 2019. *Organisationsændringer på arbejdet og risiko for iskæmisk hjertesygdom og udskrivelse af psykofarmaka blandt 14 842 ansatte i Region Hovedstaden*. Nyborg, Danmark, marts 2019 (planlagt).

Ph.d.-forsvar, Bispebjerg Hospital. *Organizational change at work, employee turnover, and health – a longitudinal study among employees in the Capital Region of Denmark*. København, Danmark, 15. februar 2019.

Bispebjerg og Frederiksberg Hospitalers forskningsdag, Lassen-dagen, *Organizational change at work and risk of ischemic heart disease and prescription for psychotropic medication.* Foredrag, København, Danmark, 7. december 2018.

Den 15. Stressforskningskonference, *Organizational changes and risk of ischemic heart disease among employees in the Capital Region of Denmark*. København, Danmark, 25. oktober 2018.

EPICOH 2017, *The impact of organisational change on sickness absence: how much of the effects are mediated by workplace social capital?* Foredrag, Edinburgh, Skotland, 29. august 2017.

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Bispebjerg og Frederiksberg Hospitalers forskningsdag, Lassen-dagen, *Organizational change psychosocial work environment, and voluntary non-disability early retirement: a prospective study among senior employees in the Capital Region of Denmark.* Foredrag, København, Danmark, 7. december 2016.

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11.6 Formidling ved møder

Oplæg og ekspertrådgivning for Aalborg Kommune, Sundheds- og Kulturforvaltningen. *Arbejdsklima og helbred ved omstrukturering i den offentlige sundhedssektor.* København, Danmark, Københavns Universitet, april 2019 (planlagt).

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11.7 Priser

2. præmie i foredragskonkurrencen ved Bispebjerg og Frederiksberg Hospitalers forskningsdag, Lassen-dagen 7. december 2018, *Organizational change at work and risk of ischemic heart disease and prescription for psychotropic medication*

3. præmie i foredragskonkurrencen ved Bispebjerg og Frederiksberg Hospitalers forskningsdag, Lassen-dagen 7. december 2016, *Organizational change psychosocial work environment, and voluntary non-disability early retirement: a prospective study among senior employees in the Capital Region of Denmark*

12 Videnskabelige publikationer

OPEN ACCESS

ORIGINAL ARTICLE

Dual impact of organisational change on subsequent exit from work unit and sickness absence: a longitudinal study among public healthcare employees

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ABSTRACT

Objectives We investigated work-unit exit, total and long-term sickness absence following organisational change among public healthcare employees.

Methods The study population comprised employees from the Capital Region of Denmark (n=14 388). Data on reorganisation at the work-unit level (merger, demerger, relocation, change of management, employee layoff or budget cut) between July and December 2013 were obtained via surveys distributed to the managers of each work unit. Individual-level data on work-unit exit, total and long-term sickness absence (≥29 days) in 2014 were obtained from company registries. For exposure to any, each type or number of reorganisations (1, 2 or ≥3), the HRs and 95% CIs for subsequent work-unit exit were estimated by Cox regression, and the risk for total and long-term sickness absence were estimated by zero-inflated Poisson regression.

Results Reorganisation was associated with subsequent work-unit exit (HR 1.10, 95% CI 1.01 to 1.19) in the year after reorganisation. This association was specifically important for exposure to ≥3 types of changes (HR 1.52, 95% CI 1.30 to 1.79), merger (HR 1.29, 95% CI 1.12 to 1.49), demerger (HR 1.41, 95% CI 1.16 to 1.71) or change of management (HR 1.24, 95% CI 1.11 to 1.38). Among the employees remaining in the work unit, reorganisation was also associated with more events of long-term sickness absence (OR 1.15, 95% CI 1.00 to 1.33), which was particularly important for merger (OR 1.31, 95% CI 1.00 to 1.72) and employee layoff (OR 1.31, 95% CI 1.08 to 1.59).

Conclusions Specific types of reorganisation seem to have a dual impact on subsequent work-unit exit and sickness absence in the year after change.

Key messages

What is already known about this subject?

- Previous studies examining the impact of organisational change mainly focused on downsizing or merger at the company level to find that these types of reorganisation were related to employee exit from the workplace *or* a higher risk of sickness absence among the remaining employees.
- However, the potential dual impact of subsequent workplace exit *and* sickness absence following various types of organisational change remains to be examined at the work-unit level.

What are the new findings?

- This study demonstrates a dual impact of individual-level subsequent employee exit from the work unit and sickness absence in the year after six types of organisational change measured at the work-unit level among 14 388 healthcare employees in the Capital Region of Denmark.

How might this impact on policy or clinical practice in the foreseeable future?

- Decision and policy makers should consider the potential adverse effects of organisational change in a work unit.

INTRODUCTION

Organisational change at the workplace is common and may be regarded as a feature of modern work life.[1 2] Evidence indicates that organisational changes are associated with deleterious health and psychosocial outcomes,[3–7] and consequently, subsequent employee exit from the workplace[8–11] and higher risk of sickness absence (SA).[12–16] Reorganisation may become counterproductive since workplace exit and SA are highly costly due to long-term stress-related illness, loss of productivity and costs related to replacement of employees.[9 17–19]

Studies of the healthcare sector have shown higher exit rates following implementation of new workflows[10] and hospital mergers across occupational groups regardless of employee health.[11] Also, higher exit rates have been found, especially among senior employees, following merger of computer companies[9] in line with other findings of higher rates of voluntary early retirement among senior employees exposed to various types of reorganisation.[8]

Regarding SA, epidemiological studies found major downsizing (ie, staff reduction) and workplace expansion to be associated with more SA[13] and a higher risk of long-term SA.[5] A study from Norway demonstrated that merger, demerger, relocation and creation or shut-down of units

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aggregated at the hospital level was associated with total and long-term SA, but the various types of reorganisation were not examined separately.[14] Another study found modest risks of long-term SA during hospital merger and 2, 3 and 4 years after merger.[16] Although there is some evidence that reorganisation adversely affects SA,[15] other studies found SA rates to be unaffected[20] or even decreased in women[21] following downsizing or expansion.

A limitation of previous studies of SA is that they mainly focused on employees who remained at the workplace[7] without studying the potential accompanied effect of employees subsequently exiting their workplace after reorganisation. Indeed, one study has linked higher rates of workplace exit and long-term SA to self-reported negative consequences of reorganisation,[22] whereas another study found no higher risk of long-term SA after privatisation of public-sector work units without major downsizing.[23]

We examine the impact of various types of organisational change on subsequent employee exit from the work unit, total SA and long-term SA among public healthcare employees in Denmark.

METHODS AND MATERIALS

Population and study design

This longitudinal study used data from the *Well-being in Hospital Employees* (WHALE) cohort.[24] The target population was established 13 January 2014 for distribution of a work-environment survey to 37 720 employees nested in 2696 work units during March 2014.

The source population comprised employees each actively occupied in the same work unit of ≥3 employees with an average of ≥18.5 fixed working hours per week through 2013. To ensure that all employees worked in the same work unit through 2013 (although some work units changed their name), we applied the criteria that ≥3 employees *and* ≥30% of all employees from a given work unit must remain together after a change to be included. In the source population, there were 25 922 employees nested in 2322 work units (figure 1).

Organisational change

Between April and June 2016, semi-annual binary data on organisational change at the work-unit level (ie, merger, demerger, relocation, change of management, employee layoff(s), budget cuts) from 2011 to 2013 were obtained via a survey (see online supplementary material 1) emailed to the work-unit managers (response rate: 59%). The measures of organisational change included exposure to no change (reference group), any type of change, each of the six types of change (not mutually exclusive) or the number of simultaneous changes (only 1, 2 or ≥3 types of changes) in the last six months of 2013.

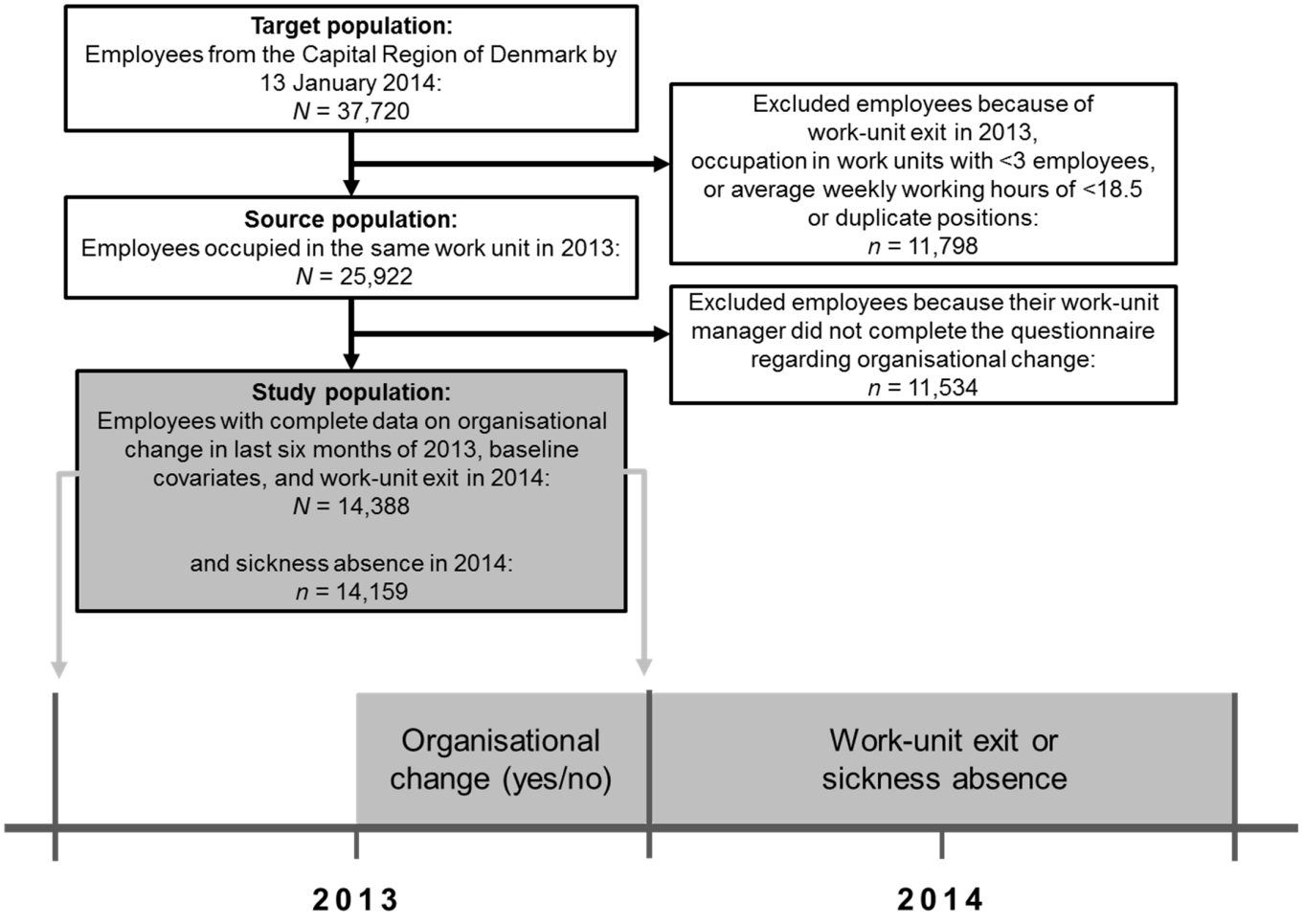

Figure 1 Diagram representing the flow of participants and the study design. The study population of employees occupied in the same work unit in 2013 were potentially exposed to organisational change in the last six months of 2013 with follow-up on subsequent work-unit exit, total sickness absence or long-term sickness absence in 2014. Data on organisational change were collected between April and June 2016.

Work-unit exit and sickness absence

Monthly work-unit affiliation and absence data for each individual employee occupied in the period from 1 January 2012 to 31 December 2014 were recorded from registries in the Capital Region of Denmark. Data on absence included total SA (ie, all types), long-term SA (ie, ≥29 consecutive days) and absence related to child's first or second sick day. Data on background information included age, sex, occupational group, number of employees in the work units and fixed working hours. Based on the work-unit criteria stated above, we calculated subsequent monthly work-unit exit at the individual level between January and December 2014.

The two measures of SA were computed as percentages of the working hours missed in 2014 until work-unit exit due to total and long-term SA. The SA measures were calculated relative to the working hours to account for sickness periods overlapping with days off work and work-unit exit in 2014. For example, if an employee was sick on Monday (one working day), but was free from work the following Tuesday through Thursday and returned to work on Friday, it would otherwise appear in the records as the employee had 4 days of SA (ie, Monday through Thursday). Moreover, if an employee exited the work unit by 28 February 2014 during follow-up, the percentages of missed working hours due to SA were calculated relative to the fixed working hours between baseline at 1 January 2014 and work-unit exit by 28 February 2014. We examined both total and long-term SA because the total measure focuses on all types of SA (eg, short-term sickness, intermittent disorder), whereas the long-term measure focuses only on severe SA.

Covariates

The following variables were a priori considered as potential confounders for the association between organisational change and subsequent work-unit exit or total or long-term SA: age (quartiles), sex, number of employees in the work units (quartiles), occupation (six groups), days of SA in the year prior to reorganisation in 2012 (divided into five groups), child-related absence between 2012 and 2013 and personal gross income (quartiles) in 2012.

The study population of 14 388 employees was nested in 1245 work units. There were SA data on 14 159 employees, as 229 employees (1.59% of the study population) exited their work unit by 1 January 2014 (figure 1).

Statistical analyses

To assess the a priori impact of missing data on exposure to organisational change, we estimated the differences in subsequent work-unit exit, SA and baseline characteristics between employees with and without data on change. χ^2 tests were used for categorical variables and two-way t-tests were used for continuous variables.

The employees were followed from 1 January 2014 to work-unit exit, censoring (ie, death) or end of the study by 31 December 2014, whichever came first. Using Cox proportional hazards regression analyses, we estimated work-unit exit rates in 2014 related to each measure of change compared with no change through 2013.

Since a large proportion of employees had no SA (ie, 0 percentage), we used zero-inflated Poisson regression analyses to assess the risk of total and long-term SA after organisational change. The zero-inflated Poisson regression comprises two components in the same operation: in this study, a zero model that generates the OR and 95% CI for SA events[i] (sick: yes/no) and a Poisson model that account for the excess count of zeros and generates the rate ratio (RR) and 95% CI for a higher percentage of SA relative to the fixed working hours among the sick-listed.[25] In sum, this adds up to four absence outcomes: ORs and RRs for the event and percentage, respectively, of total SA, and ORs and RRs for the event and percentage, respectively, of long-term SA.

The reference group for all Cox and zero-inflated Poisson analyses employees who did not experience any organisational change in the last six months of 2013. Exposure to any organisational change (yes/no) was entered in the models as one variable. Exposure to each of the six types of change was estimated in separate models with each single change variable (yes/no) entered in turn. To avoid potential overadjustment, we did not include any of the remaining types of changes in the model, because the relationships between each change measure and the others are unclear (eg, they could be mediators or confounders). Exposure to the number of changes performed simultaneously (1, 2, ≥3) was modelled as one variable.

Crude Cox regression analyses were controlled for age only. Adjusted Cox and all zero-inflated Poisson regression analyses were controlled for age, sex, number of employees within work unit, occupation, previous SA, child-related absence and personal income.

All statistical analyses were conducted using SAS V.9.4 (SAS Institute, Cary, North Carolina, USA).

RESULTS

Table 1 shows for the study population, the distribution and prevalence of exposure to any organisational change across covariate levels.

Table 2 shows for the employees exposed to organisational change, the prevalence and distribution of exposure to each type of change across number of simultaneous changes. This table indicates that employee layoff and budget cuts were often exclusively featured together or alone. Of the 8847 changes experienced by all employees, 5022 (57%) changes were experienced in combination with ≥1 other type of change. A correlation matrix between all types of change showed that no measures were completely overlapping (r=0.07–0.33, p<0.001; online supplementary material 2).

In total, seven employees in the study population were censored due to death during follow-up in 2014. Table 3 shows the work-unit exit rates following exposure to any, each type and number of organisational changes relative to no change. Employees exposed to change in the last six months of 2013 were more likely to exit the work unit in 2014 relative to no change in the same period.

Table 4 shows the risks of the event and higher percentages of missed working hours in 2014 due to total and long-term SA following organisational change through 2013 relative to no change. Employees exposed to reorganisation had an elevated rate of total SA percentage and were more likely to have SA periods of at least 29 days in 2014 compared with employees who underwent no change.

[i]For interpretation reasons, we inverted the output values to predict the OR of having sickness absence (one divided by output values).

Table 1 Distribution of the study population with complete data on all relevant variables and the prevalence of organisational change across covariate levels at baseline at 31 December 2013

	Study population		Exposed to any change	
	N	% of total N	n	% of N
Total	14 388	100	5794	40.27
Female	10 951	76.11	4375	39.95
Age group (years)				
18–40	3630	25.23	1468	40.44
40–48	3605	25.06	1423	39.47
48–56	3578	24.87	1439	40.22
56–75	3575	24.85	1464	40.95
Employees in work unit				
3–12	3480	24.19	1066	30.63
13–22	3636	25.27	1435	39.47
23–32	3633	25.25	1531	42.14
33–142	3639	25.29	1762	48.42
Occupational group				
Nurses	6216	43.20	2564	41.25
Administrative staff	2643	18.37	1074	40.64
Social/healthcare workers	1883	13.09	667	35.42
Service/technical staff	1812	12.59	757	41.78
Medical doctors and dentists	1449	10.07	601	41.48
Pedagogical workers	385	2.68	131	34.03
Days of sickness absence 2012				
0	3988	27.72	1628	40.82
1–3	3101	21.55	1242	40.05
4–6	2185	15.18	869	39.77
7–13	2742	19.05	1041	37.96
14–363	2372	16.48	1014	42.75
Sick child 2012–2013	4322	30.04	1690	39.10
Personal income (gross, Kr)				
<345 000	3668	25.49	1528	41.66
345 000–400 000	3736	25.97	1492	39.94
400 000–480 000	3525	24.50	1381	39.18
>480 000	3459	24.04	1393	40.27

The X^2 tests revealed that employees with data on change were less likely to subsequently exit their work unit ($\chi^2(1)=22.90$, $p<0.001$); however, they had comparable events of long-term SA ($\chi^2(1)=0.32$, $p=0.57$) in 2014 relative to employees without data on change. The two-way t-test showed that the employees with data on change had a significantly lower percentage of total SA in 2014 (M=4.52, SD=8.30, t(14 161)=65.02, $p<0.001$) compared with the employees without change data (M=4.65, SD=9.04). This points to underestimation of the effects reported in tables 3–4. There were no noteworthy differences between employees with and without change data regarding the remaining outcomes and selected baseline characteristics (see online supplementary material 3).

Table 3 Rates of subsequent employee exit from the work unit in the year after organisational change

			Crude, exit	Adjusted, exit
	N	% of N, exit	HR (95% CI)	HR (95% CI)
No change*	8594	16.65	1.00	1.00
Any change	5794	17.95	1.09 (1.01 to 1.18)	1.10 (1.01 to 1.19)
1 type of change	3826	17.12	1.03 (0.94 to 1.13)	1.04 (0.95 to 1.15)
2 types of changes	1212	17.49	1.06 (0.92 to 1.22)	1.04 (0.90 to 1.20)
≥3 types of changes	756	22.88	1.44 (1.23 to 1.69)	1.52 (1.30 to 1.79)
Merger	1093	21.32	1.33 (1.16 to 1.53)	1.29 (1.12 to 1.49)
Demerger	508	21.65	1.36 (1.12 to 1.64)	1.41 (1.16 to 1.71)
Relocation	985	19.39	1.19 (1.02 to 1.38)	1.16 (1.00 to 1.35)
Change of management	2236	19.68	1.20 (1.08 to 1.34)	1.24 (1.11 to 1.38)
Employee layoff	2226	16.58	1.00 (0.89 to 1.12)	1.03 (0.91 to 1.15)
Budget cut	1799	17.90	1.09 (0.96 to 1.23)	1.09 (0.97 to 1.24)

Crude Cox analyses controlled for age. Adjusted Cox analyses controlled for age, sex, number of employees in the work unit, occupational group, sickness absence in 2012, child-related absence and personal gross income.
*Reference group.

In post hoc, we examined potential differential effects for men and women on subsequent work-unit exit or SA by including an interaction term between any organisational change and sex. The results did not support that sex interacted on the multiplicative scale in the relations between exposure to any change and total SA, long-term SA or subsequent work-unit exit (results not shown).

DISCUSSION

We show higher rates of subsequent work-unit exit among employees in the year following reorganisation, especially for exposure to ≥3 types of changes, merger, demerger, relocation or change of management. Interestingly, exposure to employee layoff or budget cut was not associated with subsequent work-unit exit. Reorganisation was also associated with a higher risk of long-term SA and elevated rates of total and long-term SA percentages after exposure to 2 or ≥3 types of changes. All findings should be interpreted in the context of a relatively low unemployment rate of 5.3% through 2014 in the Capital Region

Table 2 Prevalence and distribution of types of organisational change across number of organisational changes performed simultaneously

	Study population (n=14 388)		1 type of change		2 types of changes		≥3 types of changes	
	n	% of N	n	% of total n within subgroup	n	% of total n within subgroup	n	% of total n within subgroup
Total of any change	5794	40.28	3826	26.59	1212	8.42	756	5.25
Merger	1093	7.60	225	5.88	308	25.41	560	74.07
Demerger	508	3.53	119	3.11	113	9.32	276	36.51
Relocation	985	6.85	356	9.30	290	23.93	339	44.84
Change of management	2236	15.54	1177	30.76	515	42.49	544	71.96
Employee layoff	2226	15.47	1062	27.76	673	55.53	491	64.95
Budget cut	1799	12.50	887	23.18	525	43.32	387	51.19

Table 4 Risk of sickness absence event and higher percentage of sickness absence relative to working hours in the year after organisational change.

	N	Total SA event		Total SA percentage*		Long-term SA event		Long-term SA percentage*	
		% of N	OR (95% CI)	With SA of N, mean (SD)	RR (95% CI)	% of N	OR (95% CI)	With SA of N, mean (SD)	RR (95% CI)
No change†	8471	78.68	1.00	5.58 (8.75)	1.00	5.55	1.00	23.26 (21.24)	1.00
Any change	5688	79.32	1.01 (0.92 to 1.10)	5.94 (9.19)	1.05 (1.03 to 1.06)	6.43	1.15 (1.00 to 1.33)	23.46 (20.22)	1.00 (0.97 to 1.03)
1 type of change	3766	80.75	1.05 (0.94 to 1.17)	5.85 (8.70)	1.01 (0.99 to 1.03)	6.45	1.13 (0.96 to 1.33)	21.82 (18.90)	0.93 (0.90 to 0.96)
2 types of changes	1197	79.37	1.09 (0.92 to 1.28)	6.20 (9.80)	1.13 (1.10 to 1.16)	6.68	1.23 (0.96 to 1.58)	26.10 (21.00)	1.13 (1.07 to 1.19)
≥3 types of changes	725	71.83	0.77 (0.63 to 0.93)	6.02 (10.76)	1.13 (1.08 to 1.17)	5.93	1.13 (0.81 to 1.56)	28.00 (24.89)	1.18 (1.11 to 1.25)
Merger	1058	74.20	0.87 (0.74 to 1.03)	5.78 (9.30)	1.09 (1.06 to 1.13)	6.52	1.31 (1.00 to 1.72)	24.18 (19.00)	1.05 (0.99 to 1.11)
Demerger	496	76.81	0.86 (0.68 to 1.08)	5.51 (8.62)	1.00 (0.96 to 1.05)	5.65	1.00 (0.67 to 1.50)	22.32 (15.00)	0.89 (0.82 to 0.97)
Relocation	961	77.52	0.99 (0.83 to 1.18)	5.47 (9.09)	1.01 (0.98 to 1.05)	4.89	0.91 (0.66 to 1.24)	26.30 (23.45)	1.09 (1.03 to 1.16)
Change of management	2195	78.59	0.96 (0.85 to 1.09)	5.94 (9.24)	1.05 (1.03 to 1.08)	6.29	1.10 (0.90 to 1.34)	23.30 (20.82)	1.01 (0.97 to 1.05)
Employee layoff	2181	78.68	1.02 (0.89 to 1.16)	6.54 (10.83)	1.16 (1.13 to 1.18)	7.11	1.31 (1.08 to 1.59)	27.41 (24.01)	1.17 (1.13 to 1.21)
Budget cut	1762	76.90	0.93 (0.82 to 1.08)	5.74 (8.78)	1.03 (1.01 to 1.06)	6.02	1.09 (0.87 to 1.36)	22.76 (19.00)	0.99 (0.95 to 1.04

Total sickness absence comprises any sickness absence and long-term sickness absence comprises only spells of ≥29 days.
Zero-inflated Poisson analyses controlled for age, sex, number of employees in the work unit, occupational group, previous sickness absence, child-related absence and personal gross income.
*Percentage of missed fixed working hours due to sickness absence.
†Reference group.
RR, rate ratio; SA, sickness absence.

of Denmark,[26] as unemployment rates are negatively correlated with turnover rates[27] and long-term SA.[28]

Work-unit exit

The present findings of higher exit rates are similar to a study examining voluntary early retirement among senior employees in the Capital Region of Denmark. This study found higher retirement rates following merger, change of management and relocation at the work-unit level[8] concurrent with the present findings. Among 54 787 hospital employees in Norway, Ingelsrud[11] found a higher exit rate from the hospital sector only in the second year following hospital merger, whereas we found higher exit rates in the first year after the work-unit merger. Exposure to employee layoff and budget cut were not significantly associated with higher rates of subsequent work-unit exit. This may be explained by the observation that this pair of changes was commonly featured together or alone. Building on this, we found that exposure to only 1 or 2 types of changes were not significantly associated with subsequent work-unit exit, whereas exposure to ≥3 types of changes was associated with a 1.52-fold higher exit rate relative to no change.

The reasons of work-unit exit were not examined in the present study. Some employees may voluntarily exit after changes,[8] whereas some changes may have the tacit or explicit purpose of 'pushing out' employees of the workplace. Demerger may be such latter example as it was related to a particularly large exit effect and no effect of SA. The large exit effect after demerger could also be due to co-occurring changes since about half of the employees exposed to demerger were exposed to ≥3 simultaneous changes.

We added to this literature by distinguishing and comparing the impact of various types of reorganisations, and we found that some, but not all, types of reorganisations are related to higher rates of subsequent work-unit exit.

Sickness absence

In all SA analyses, more Poisson-model estimates were statistically significant than zero-model estimates. This pattern may be explained by the larger statistical power introduced by the Poisson distribution compared with the binary distribution as indicated by the 95% CIs in table 4.

The present results of higher rates of total SA following reorganisation correspond to previous findings after major downsizing only in permanent employees.[13] Kjekshus *et al*[16] found elevated ORs for long-term SA of 1.05 during hospital merger and 1.04 in the second year after merger, which are smaller than the OR for long-term SA of 1.33 in the year following work-unit merger demonstrated in this study. The difference between these findings may be due to the work-unit approach applied presently ensuring that the exposed employees did de facto experience the merger. Our findings of higher risk for long-term SA of ≥29 days among various occupational groups after reorganisation are inconsistent with other findings[23] of no higher risk for long-term SA of ≥91 days among hospital laboratorians and radiographers. This inconsistency may be explained by the social gradient in health between the populations studied and the conservative measure of long-term SA applied by Kokkinen *et al*.[23]

In general, those types of organisational changes associated with a higher exit rate were also associated with a higher risk of SA. This suggests that organisational change has a dual impact on subsequent work-unit exit and SA. Interestingly, employee layoff was not associated with a higher work-unit exit rate, but it was associated with a large OR for events of long-term SA and a relatively

large RR for a higher percentage of SA among the remaining employees. This may be explained by the potentially higher job insecurity and lower job control among the remaining employees after a staff reduction,[29] which may manifest as more SA. To the extent of our knowledge, only a single study has investigated potential work-environmental mediators between organisational change and SA, which found that higher job insecurity, physical demands and lower job control mediated the longitudinal association between downsizing and higher risk of long-term SA.[30] Recent findings imply that supporting and redeploying employees as a part of downsizing is important for well-being of the workers.[31] Thus, it is reasonable that workplace social capital may mediate adverse effects of organisational change since this concept is linked to health status[32 33] and comprises aspects of organisational justice, trust and collaboration.[8]

We did not find differential adverse effects of organisational change between men and women in contrast to another study in the context of downsizing.[34] This study showed that female employees with depression had a higher risk of exit out of employment, whereas unemployment in male employees was unaffected by their health status. Therefore, the lack of interaction between organisational change and sex in the present analyses may be ruled out by adjusting for previous SA.

In sum, the present findings of higher exit rates and SA following change seem to be related to specific types of change rather than a dose-response relation of the number of changes performed simultaneously. More studies are needed to examine the dual effects of reorganisation on health among employees exiting and remaining on the workplace, as the literature point to poor health outcomes in both groups.[35] A Swedish study found that job loss predicted new events of subsequent major depression in both sexes with a larger effect size in men,[34] yet the present study did not demonstrate an interaction between any change and sex. Future research should elucidate potential mediators of the detrimental effects from organisational change as such factors may comprise targets for interventions to buffer these effects.

Strengths and limitations

This study has several strengths. First, we examined employee exit and SA simultaneously as these job withdrawal behaviours depend on each other. Second, data on organisational change were obtained from a different source than the outcomes, which hamper common method bias.[36] Third, following of the participants and measurement of organisational change were conducted at the work-unit level ensuring that the participants were actually affected by the organisational change in question. Fourth, it was also a strength that we were able to distinguish between six common types of organisational change adding to the detailed nature of the study.

Potential limitations are stated in the following. First, missing data on organisational change may contribute to an underestimation of the outcome effects, since the rate of subsequent work-unit exit and the percentage of total SA were slightly lower during 2014 among employees with data on change than employees without these data. Indeed, there was no significant difference between these employee groups regarding events of long-term SA in 2014. Second, data on reorganisation were retrieved retrospectively, which may have biased these data as organisational change itself could have affected the managers to leave their job and thus not provide reorganisation information in the online survey. However, we were able to contact managers who remained in the organisation, because their email address was not changed. Third, we were unable to examine the potential effects of work-unit exit and SA before or during the actual reorganisation. Indeed, findings from post hoc analyses showed only a minor effect on total SA in the first quarter of 2014 (results not shown), suggesting that the SA effects—if any—were small before or during exposure to organisational change. Fourth, the analyses did not take into account the multilevel organisational structure of the data. For consistency reasons, we choose not to use multilevel modelling as this approach was unable to converge in a zero-inflated Poisson regression model. A post hoc Cox analysis clustering employees within work units revealed an exit rate after any change of 1.12 (vs 1.10 in table 3), which suggests only a small underestimation by using a single-level approach. Fifth, a zero-inflated *negative binomial* Poisson model showed a superior fit with long-term SA as outcome compared with the present approach, suggesting potential overdispersion in the Poisson distribution of the long-term sickness data. Indeed, the zero-inflated *negative binomial* Poisson model was unable to converge with total SA as outcome. Finally, the present results cannot be attributed exclusively to each type of change as some changes are likely to be performed simultaneously and each type of change were modelled separately. Entering all six types of change variables into the same model would likely result in overadjustment because some changes may mediate other changes. Tentatively, we explored the relationships between changes by mutually adjusting for the four most correlated pair of changes in the correlation matrix (see online supplementary material 2), which generally showed similar findings, although merger/demerger adjustment seemed to have a marked role in exit rates towards null (merger: HRs from 1.29 to 1.14; demerger: HRs from 1.41 to 1.00). This could be due to the observation that 92% of the 232 employees exposed to both merger and demerger were exposed to a total of ≥3 changes. Hence, overadjustment is introduced due to impurity of the change variables, which is supported by the finding that simultaneous changes was strongly related to subsequent exit, whereas 1 or 2 changes were not.

These findings indicate that specific types of organisational change frequently occurring in the public healthcare sector have a dual impact on subsequent employee exit from the work unit and total and long-term SA among remaining employees in the year following reorganisation. Generalisations to other public sectors should be made cautiously due to various contextual factors, including sex composition.

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Contributors JHJ had full access to all data provided in the present study and takes responsibility for the integrity and the accuracy of the data analyses. All authors were responsible for the current study design. JHJ wrote the initial draft of the manuscript. All authors contributed to the present study and approved the final draft of the manuscript.

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Supplementary material 1. Between April and June 2016, semiannual binary data on organizational change at the work-unit level from 2011 to 2013 were obtained via the following online survey emailed to the managers of all work units.

This questionnaire relates to the work unit "<name of work unit>" in <name of hospital>.

	Yes	No
Were you a manger in the above-stated work unit during the *TrivselOP* in March 2014?	□	□

In the work unit you manage/managed, have there been following organizational changes in the period 1.1.2011-31.12.2013?

If yes, please specify when:

	1. half-year 2011	2. half-year 2011	1. half-year 2012	2. half-year 2012	1. half-year 2013	2. half-year 2013	No	Do not know
Merger with another work unit	□	□	□	□	□	□	□	□
Division into other work units	□	□	□	□	□	□	□	□
Change of management in the work unit	□	□	□	□	□	□	□	□
Physical relocation of the work unit	□	□	□	□	□	□	□	□
Layoff of employee(s) in the work unit	□	□	□	□	□	□	□	□
Selective budget cuts in the work unit	□	□	□	□	□	□	□	□

Supplementary material 2. Spearman's *r*-correlation coefficients between the six types of organizational change.

	Merger	Demerger	Relocation	Change of management	Employee layoff	Budget cuts
Merger		0.28	0.33	0.23	0.15	0.14
Demerger	0.28		0.18	0.17	0.09	*-0.01
Relocation	0.33	0.18		0.14	0.07	*0.01
Change management	0.23	0.17	0.14		0.09	0.09
Employee layoff	0.15	0.09	0.07	0.09		0.25
Budget cuts	0.14	*-0.01	*0.01	0.09	0.25	

$p<0.001$, * $p\geq0.21$

Supplementary material 3. Differences between employees with data on organizational change (i.e., study population) and employees without change data from the source population regarding work-unit exit, sickness absence, covariate levels, and number of work units.

	Source population* (*N*=25,922)		
	With change data (study population), *n* (%)	Without change data, *n* (%)	*p*
Total number of employees	14,388 (100)	11,534 (100)	
Subsequent work-unit exit 2014	2471 (17.17)	2247 (19.48)	<0.001
Total SA 2014			
With SA event	11,177 (78.94)	8910 (78.52)	0.42
Mean (SD)	4.52 (8.30)	4.65 (9.04)	<0.001
Long-term SA 2014			
With SA event	836 (5.90)	689 (6.07)	0.57
Mean (SD)	1.38 (7.47)	1.53 (8.20)	<0.001
Female, n (%)	10,951 (76.11)	8876 (76.96)	0.11
Age group			0.69
18-40	3630 (25.23)	2842 (24.64)	
40-48	3605 (25.06)	2886 (25.02)	
48-56	3578 (24.87)	2889 (25.05)	
56-75	3575 (24.85)	2917 (25.29)	
Number of small-large work units, employees	1245 (100)	1077 (100)	0.20
3-12	645 (51.81)	593 (55.06)	
13-22	294 (23.86)	260 (24.14)	
23-32	187 (15.02)	133 (12.35)	
33-142	116 (9.32)	91 (8.45)	
Employees in work unit			<0.001
3-12	3480 (24.19)	3151 (27.32)	
13-22	3636 (25.27)	3092 (26.81)	
23-32	3633 (25.25)	2505 (21.72)	
33-142	3639 (25.29)	2786 (24.15)	
Occupational group			<0.001
Nurses	6216 (43.20)	4967 (43.06)	
Administrative staff	2643 (18.37)	2199 (19.07)	
Social/healthcare workers	1883 (13.09)	1369 (11.87)	
Service/technical staff	1812 (12.59)	1280 (11.10)	
Medical doctors and dentists	1449 (10.07)	1343 (11.64)	
Pedagogical workers	385 (2.68)	376 (3.26)	
Days of sickness absence 2012			0.99
0	3988 (27.72)	3226 (27.97)	
1-3	3101 (21.55)	2487 (21.56)	
4-6	2185 (15.19)	1748 (15.16)	
7-13	2742 (19.06)	2189 (18.98)	
14-363	2372 (16.49)	1884 (16.33)	

χ^2 *or t*-test applied as appropriate. Total and long-term sickness absence were calculated as the percentage of missed working hours due to all sickness absence or spells of $\geq$29 days, respectively.

* No missing data except on organizational change.

Abbreviations: SA = sickness absence, SD = standard deviation.

Original article

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Longitudinal associations between organizational change, work-unit social capital, and employee exit from the work unit among public healthcare workers: a mediation analysis

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Jensen JH, Flachs EM, Skakon J, Rod NH, Bonde JP. Longitudinal associations between organizational change, work-unit social capital, and employee exit from the work unit among public healthcare workers: a mediation analysis. *Scand J Work Environ Health*. 2019;45(1):53–62. doi:10.5271/sjweh.3766

Objectives Organizational changes are associated with higher rates of subsequent employee exit from the workplace, but the mediating role of social capital is unknown. We examined the associations between organizational changes and subsequent employee exit from the work unit and mediation through social capital.

Methods Throughout 2013, 14 059 healthcare employees worked in the Capital Region of Denmark. Data on work-unit changes (yes/no) from July−December 2013 were collected via a survey distributed to all managers (merger, split-up, relocation, change of management, employee layoff, budget cuts). Eight employee-reported items assessing social capital were aggregated into work-unit measures (quartiles: low-high). Data on employee exit from the work unit in 2014 were obtained from company registries.

Results We found a somewhat higher rate of employee exit from the work unit after changes versus no changes [hazard ratio (HR) 1.10, 95% confidence interval (CI) 1.01–1.19] and an inverse dose−response relationship between social capital and employee-exit rates (low versus high: HR 1.65, 95% CI 1.46–1.86). We also showed a higher risk of low social capital in work units exposed to changes [low versus high: odds ratio (OR) 2.04, 95% CI 1.86–2.23]. Accounting for potential mediation through social capital seemed slightly to reduce the association between changes and employee-exit rates (HR 1.07, 95% CI 0.98–1.16 versus HR 1.10).

Conclusions Work-unit organizational changes prospectively predict lower work-unit social capital, and lower social capital is associated with higher employee-exit rates. Detection of weak indications of mediation through social capital, if any, were limited by inconsistent associations between changes and employee exit from the work unit.

Key terms downsizing; health care; longitudinal study; mediator; merger; organisational change; psychosocial work environment; public sector; reorganisation; reorganization; restructuring; turnover

Restructuring of workplaces is widely performed to keep up with increasing demands for productivity and cost-efficiency. However, there seems to be a downside to organizational changes in terms of poor employee health and well-being (1–6). Elevated rates of employee exit (ie, turnover) from the workplace following reorganization have been reported consistently in the literature (7–13), and studies suggest that organizational changes may have a dual impact on employee exit and health (11, 14). Specifically, quarterly employee-exit rates increased from 3.1% to 3.4% after implementation of new healthcare workflows (9), and − relative to no change − excess employee-exit rates of 15–50% have been demonstrated in the years following merger, split-up, relocation, change of management, and ≥3 changes performed simultaneously in the healthcare sector (11, 12). Such higher employee-exit rates have been associated with adverse psychosocial outcomes among the remaining employees as well as high replacement costs and loss of productivity (15).

Social capital refers to the "*resources that are accessed by individuals as a result of their membership of a net-*

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work or a group" (16) and manifests as trust, reciprocity and social cohesion within a group of co-workers (16). The literature on workplace social capital in the context of reorganization is limited. However, since the workplace can be seen as having social dimensions among coworkers, it is reasonable to assume that reorganizations disrupt work-related social networks and friendship ties in a work unit. Employees can perceive such processes as being unfair, lowering their attachment to the workplace (17–20). This is supported by findings of a 4% decrease in trust of management after reorganization involving change of top management (21) as well as distributive justice partially mediating the association between trust and intention to quit in the context of downsizing (20).

Low social capital has been linked to a higher risk of mental-health problems (22, 23), sickness absence (24–26), early retirement (12), and poor self-rated health (27). A study found that self-reported poor health was associated with a 2.3-fold higher "risk" of intention to quit, whereas good collaboration among colleagues as well as trustworthiness and support from managers were associated with 60–80% lower chance of intention to quit (28). Indeed, the associations of workplace social capital on the pathway between organizational changes and employee exit from the workplace remain unclear.

We aimed to investigate the hypothesized (objective a) prospective associations between organizational changes and low work-unit social capital, (objective b) the association between low social capital and higher rates of employee exit from the work unit (EFW), and (objective c) work-unit social capital as a mediator on the associations between organizational changes and higher rates of subsequent EFW (figure 1). In this study, EFW refers to an employee terminating employment in a work unit regardless of the reason. A mediator refers to a factor that explains the impact of an exposure on a given outcome (29). Such mediation may highlight social capital as a target of intervention to prevent adverse effects of organizational changes.

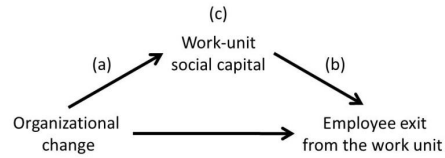

Figure 1. Diagram of the associations examined in the present study. (a) Association between organizational change and work-unit social capital. (b) Association between work-unit social capital and employee exit from the work unit. (c) Work-unit social capital mediates the association between organizational change and subsequent employee exit from the work unit.

Methods

Study design and data collection

This longitudinal study was based on the Well-being in Hospital Employees (WHALE) cohort (30) and examined the associations between work-unit organizational change in the last six months of 2013, work-unit social capital in March 2014, and employee EFW during 2014.

The source population comprised 37 720 employees from the Capital Region of Denmark who were invited to complete a work-environment questionnaire in March 2014 (response rate: 84%). From April through June 2016, we distributed a survey to the managers of all 2696 work units to collect data on six types of organizational changes occurring in the last six months of 2013 (response rate: 59%). Sociodemographic and occupational background information for every employee holding a paid position between January 2012 through December 2014 was recorded from company registers, and information on income during 2013 were extracted via linkage to national registers. These data were applied to estimate monthly employee EFW in 2014 as well as employee- and work-unit-level covariates at baseline (31 December 2013).

Study population

At baseline, 25 926 eligible employees had at least one year of seniority in the current work unit (or one of its associated unit[s] if merger and/or split-up had occurred) and a minimum of 18.5 weekly fixed working hours in average (ie, part-time working hours) during 2013. We excluded 279 work units with fewer than three employees. Some work units changed their name during 2013. Thus, to ensure that the employees had at least one year of seniority in the current work unit at baseline (31 December 2013), we included employees in the study population if they were affiliated to a work unit where a significant proportion of the staff (ie, ≥30% and ≥3 employees) remained in the new-named work unit. For instance, if work unit *A* with six employees split-up into work unit *B* with two employees and work unit *C* with four employees, only the four employees in work unit *C* were included in the study population.

The study population comprised 14 059 employees nested in 1216 work units with complete data on work-unit organizational change in the last six months of 2013, work-unit social capital in March 2014, employee EFW from January through December 2014, and covariates (figure 2).

Employee exit from the work unit

We estimated monthly EFW from January through December 2014 at the employee level. This was defined

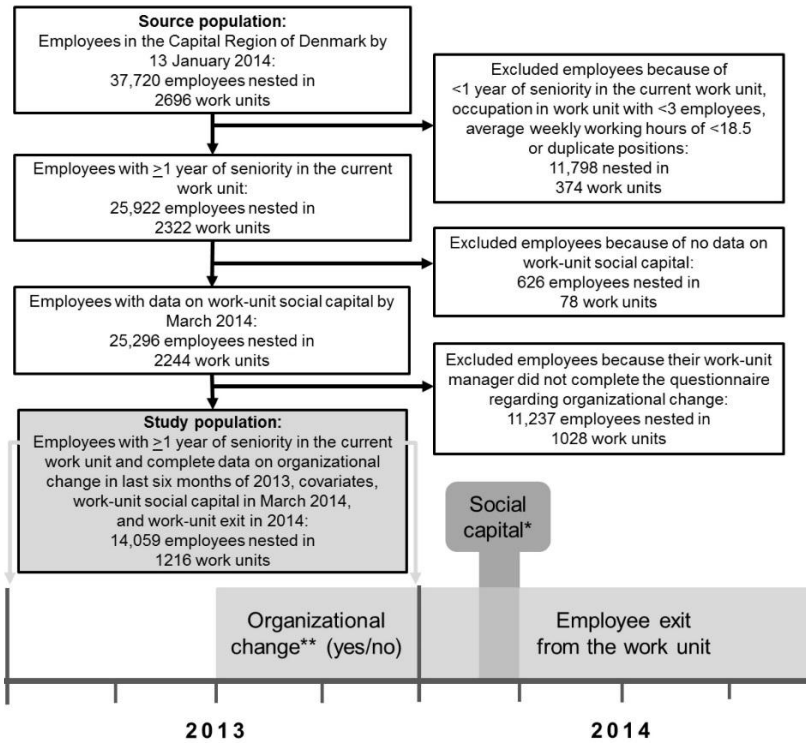

Figure 2. Diagram showing the study design and the flow of employees and work units. * Data collected in March 2014. ** Data collected from April–June 2016.

as an employee's loss of affiliation to the current work unit at baseline. Because we presumed that some work units also changed name during 2014, we did not regard it as an EFW if an employee was affiliated to a work unit where a significant proportion of the staff (ie, ≥30% and ≥3 employees) worked in a renamed work unit.

Work-unit organizational change

In the survey on organizational changes, the managers were invited to provide semi-annual information on six types of changes (yes/no) at the work-unit level occurring from January 2011 to December 2013 (Q "In the work unit you manage/managed, have there been the following organizational changes in the period 1 January 2011 and 31 December 2013?"): (A1) merger, (A2) demerger, (A3) relocation of a work unit, (A4) change of management, (A5) employee layoff or (A6) budget cuts. This study used measures of organizational changes in the last six months of 2013, including no change (reference category), change (any/no change), number of changes performed simultaneously (1, 2 or ≥3 changes/no change), and each type of change (yes/no change). Exposure to each of these six types of change were modelled separately.

Work-unit social capital

The social capital scale ranging 0–100 was based on eight employee-reported items from the work-environment survey in March 2014 assessing collaboration ("To what degree…:" Q1"…are you and your colleagues good at coming up with suggestions for improving work procedures?", Q2 "…do you get help and support from your colleagues when needed?", Q3 "…do you and your colleagues take responsibility for a nice atmosphere and tone of communication?") and trust/organizational justice ("To what degree…:" Q4 "…does the management trust the employees to do their work well?", Q5 "…can you trust the information that comes from the management?", Q6 "… are conflicts resolved in a fair way?", Q7 "…is the work distributed fairly?", Q8 "…is your staff group respected by the other staff groups at the workplace?"). Five of these items originated from the Copenhagen Psychosocial Questionnaire (31), whereas the remaining three items were selected by four specialists in occupational medicine. Responses on ≤50% of the social-capital items were set to missing. Cronbach's alpha was 0.85 and correlation coefficients between all items ranged 0.24–0.74 (P-values<0.001). The work-unit-level social capital measure was computed by averaging the employee-level social capital scores in work units with ≤50% missing data. The work-unit social capital measure was categorized into quartiles (level I–IV: low–high) and assigned to each individual employee in a given work unit. This approach was consistent with previous studies using WHALE cohort data (12, 26, 30).

Employee- and work-unit-level covariates at baseline

We used the following a priori confounder variables at the employee level: age (quartiles), sex, occupational groups, previous absence related to sick child between 2012–2013 (yes/no), previous number of sickness-absence days in 2012 (quartiles), and personal gross income in 2013 (quartiles). Absence due to sick child was a proxy variable for having a child. Number of previous sickness-absence days was a proxy variable for health status. Employees with no observed sickness absence were allocated to the lower-quartile category. Personal gross income in Danish kroner were divided by 7.5 to express these values in euros (€).

We used the following a priori confounder variables aggregated at the work-unit level: number of employees within work unit (quartiles), mean of employee age (continuous), mean of personal gross income in 2013 (continuous), mean of sickness-absence days in 2012 (continuous), proportion of females within work unit (continuous), proportion of employees with child-related absence between 2012−2013 within work unit (continuous), and proportion of each occupation group within work unit (continuous).

Statistical main analysis

Work-unit organizational changes and work-unit social capital. Logistic regression models were used to estimate the risk of low social capital in March 2014 according to each measure of organizational changes in the last six months of 2013 (objective a). Analyses were weighted by the number of employees within each work unit (continuous variable). We adjusted for *all* work-unit-level confounders (except the categorical variable for number of employees within work unit) because exposure and outcome were both measured at the work-unit level.

Work-unit social capital and employee exit from the work unit. Marginal Cox models were used to assess the rate of EFW during 2014 associated with each lower level of social capital in March 2014 relative to the highest level (objective b). The employees were followed on the month-scale from 1 January 2014 until EFW, censoring by death, or end of study (31 December 2014), whichever came first. We adjusted for all employee-level covariates and the number of employees at the work-unit level. Since the variables in the marginal Cox models were measured at multiple levels, we used the COVSANDWICH option on the work-unit level to obtain robust 95% confidence intervals (CI). We fitted marginal models with no distributional assumptions instead of mixed-effects models because the latter require assumptions about the joint distribution and the random effects, which are unclear (eg, due to new changes and seasonal variances in EFW during follow-up) (32).

Mediation through work-unit social capital. Marginal Cox models were also used to assess the rate of EFW during 2014 after organizational changes in the last six months of 2013 relative to no change. We used the same covariates and criteria during follow-up on EFW as those described above for the marginal Cox models addressing objective b. To establish mediation (objective c), the mediator variable (social capital) must be associated with both the exposure (organizational changes) and the outcome (EFW). We interpreted a reduction in the EFW rate when including the social-capital variable in model as evidence of mediation (29).

Sensitivity analyses

We conducted four sensitivity analyses using the same methods as above unless otherwise stated.

First, because social capital was measured in March 2014 and follow-up on EFW started on January 2014, we assessed potential reverse causation by splitting the follow-up into two periods: one period from January through March 2014, and a second period from April through December 2014 (excluding employees EFW in the first period). Two analyses assessed the association between social capital and EFW in each follow-up period (relating to objective b). Four analyses assessed the associations between organizational changes and EFW in each period with and without social capital included in the model (relating to objective c).

Second, we explored if work-unit collaboration and trust/organizational justice (comprising social capital) separately mediated the association between organizational changes and EFW during 2014. This was assessed with two analyses for the association between changes and EFW including work-unit-aggregated collaboration and trust/organizational justice, respectively, in comparison to a model without any mediator.

Third, we analyzed the association between organizational changes and subsequent employee exit from the company instead of EFW. We calculated employee exit from the company as months to loss of affiliation to the Capital Region of Denmark from January through December 2014.

Fourth, to assess the impact of missing data on organizational changes, we used a two-way *t*-test and a χ^2-test to analyze if work-unit social capital and employee EFW rates differed among work units and employees, respectively, with and without data on changes.

All statistical analyses were performed using SAS Software 9.4 (SAS Institute Inc, Cary, NC, USA).

Results

Table 1 shows the distribution of the study population on exposure to organizational changes and low/high social capital across covariate levels. Exposure to organizational changes was more prevalent in work units with low social capital and those with more employees. Male employees, work units with more employees, and employees with a lower income were mostly represented in work units with low social capital. In contrast, female employees, work units with fewer employees, and employees with a higher income were mostly represented in work units with high social capital.

Table 1. Distribution of the study population and the prevalence of organizational changes, work-unit social capital level I (low) and level IV (high), exit from the work unit (EFW), and covariate levels. [WSC=work-unit social capital.]

	Study population		Employees exposed to change		WSC level I (lowest)		WSC level IV (highest)	
	N	%	N	%	N	%	N	%
Employee level								
Total employees	14 059	100	5649	40	3406	24	3715	26
EFW	2383	17	999	18	680	20	504	14
Female	10 727	76	4258	75	2278	67	2948	79
Male	3332	24	1391	25	1128	33	767	21
Age group (years)								
18–40	3469	25	1378	24	908	27	792	21
40–48	3550	25	1400	25	837	25	1010	27
48–56	3530	25	1424	25	825	24	986	27
56–75	3510	25	1447	26	836	25	927	25
Occupational group								
Nurses	6038	43	2444	43	1195	35	1769	48
Administrative staff	2615	19	1060	19	581	17	710	19
Social/healthcare workers	1865	13	665	12	593	17	369	10
Service/technical staff	1777	13	751	13	789	23	280	8
Medical doctors and dentists	1379	10	598	11	137	4	451	12
Pedagogical workers	385	3	131	2	111	3	136	4
Days of sickness absence during 2012								
0–3	6897	49	2787	49	1440	42	2102	57
4–6	2141	15	851	15	504	15	576	16
7–13	2687	19	1015	18	722	21	607	16
14–363	2334	17	996	18	740	22	430	12
Child–related absence during 2012 and 2013 (yes)	4222	30	1645	29	1026	30	1134	31
Personal gross income (€)								
<46 000	3602	26	1501	27	1039	31	727	20
46 000–53 333	3630	26	1427	25	929	27	817	22
53 333–64 000	3455	25	1346	24	861	25	952	26
>64 000	3372	24	1377	24	577	17	1219	33
Work-unit level								
Total work units	1216	100	430	35	238	20	434	36
No organizational change	786	65	.	.	139	58	303	70
Organizational change	430	35	.	.	99	42	131	30
1 type of change	272	22	.	.	61	26	82	19
2 types of changes	99	8	.	.	26	11	31	7
≥3 types of changes	59	5	.	.	12	5	18	4
Merger	88	10	.	.	23	14	22	7
Split–up	44	5	.	.	11	7	10	3
Relocation	89	10	.	.	21	13	35	10
Change of management	166	17	.	.	41	23	45	13
Employee layoff	161	17	.	.	33	19	51	14
Budget cuts	126	14	.	.	28	17	42	12
Number of employees in work unit								
3–12	634	52	186	43	98	41	300	69
13–22	289	24	113	26	62	26	72	17
23–32	182	15	81	19	46	19	44	10
33–142	111	9	50	12	32	13	18	4
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Employee age (years)	48	6	48	6	47	5	48	6
Proportion of females	74	30	73	29	66	35	77	28
Personal gross income (€)	61 946	23 127	63 548	25 519	57 182	19 038	65 495	24 562
Proportion with child–related absence	30	22	28	19	29	21	30	25
Days of sickness absence during 2012	8	8	9	10	10	9	6	9
Proportion of nurses	34	42	36	43	28	40	36	41
Proportion of administrative staff	24	36	25	37	23	37	25	35
Proportion of social/healthcare/pedagogical workers	19	33	14	29	21	36	19	32
Proportion of service/technical staff	13	31	23	31	20	38	9	26
Proportion of medical doctors and dentists	11	28	12	29	7	23	12	27

Work-unit organizational change and social capital

Table 2 shows that work units had an excess risk of lower social-capital levels relative to high social capital after organizational changes. However, this pattern was not observed for exposure to relocation.

Work-unit social capital was slightly lower in work units without data on changes [mean 68, standard deviation (SD) 10] than work units with data on changes [mean 69, SD 10; $t(2242) = -3.6$, P<0.001], indicating some underestimation.

Work-unit social capital and employee exit from the work unit

Table 3 shows an inverse dose–response relationship between social capital and EFW through 2014. In total, 7 employees were censored from the analyses due to death in 2014. Of the 2471 employees who exited their work unit in 2014, 785 employees (32%) exited before the assessment of social capital in March 2014. Only 35 of these 785 employees (4%) had missing data on work-unit social capital. Splitting the follow-up on EFW during 2014 into January–March and April–December yielded similar inverse dose–response relationships between social capital and EFW. However, the associations were slightly stronger in the period after assessment of social capital (supplementary table S1, www.sjweh.fi/show_abstract.php?abstract_id=3766).

Mediation through work-unit social capital

Table 4 shows that only some change indicators were associated with a higher rate of subsequent EFW, specifically ≥3 types of simultaneous changes, merger, split-up, relocation, and change of management. Including social capital in the models reduced the EFW rates only slightly, suggesting no convincing indications of mediation through social capital on the inconsistent association between changes and EFW.

The EFW rate after changes were higher January–March than April–December 2014, but social capital did not consistently mediate the excess EFW rates in either of period (supplementary table S2, www.sjweh.fi/show_abstract.php?abstract_id=3766). Similar inconsistent indications of mediation were observed for collaboration and trust/organizational justice (supplementary table S3, www.sjweh.fi/show_abstract.php?abstract_id=3766). There was a ≈1.5-fold higher company-exit rate after ≥3 types of changes, merger or relocation relative to no change (supplementary table S4, www.sjweh.fi/show_abstract.php?abstract_id=3766), indicating the sensitivity of the EFW measure. The rate of EFW during 2014 was higher among eligible employees without data on changes (19%) than employees with data on changes (17%; χ^2=22.22 (1), P<0.001), pointing to some underestimation of the EFW rates.

Discussion

We found that work units had an excess risk of low social capital after organizational changes relative to no change. There was an inverse dose–response relationship between social capital and EFW regardless of the reason. Some change measures were associated with a higher rate of employee EFW, but there were no convincing indications of mediation via social capital on these inconsistent associations.

Work-unit organizational change and social capital

Previous findings showed significant declines on a 3-point trust scale at the employee level associated with reorganization of divisions/sections (β=-0.075) and change of management (β=-0.085) (33) pointing to the

Table 2. Odds ratios (OR) of lower work-unit social capital (level I, II or III) than the highest level of work-unit social capital (level IV) as reference after exposure to organizational change. Logistic regression analyses were adjusted for work-unit level mean of employee age, proportion of females, mean personal gross income, proportion of employees with previous child-related absence, mean of sickness absence days in 2012, and proportion of each occupational group within work unit. [WSC=work-unit social capital; CI=confidence interval]

Organizational change	N	WSC level I			WSC level II			WSC level III		
		%	OR	95% CI	%	OR	95% CI	%	OR	95% CI
No change	786	18			20			24		
Change	430	23	2.04	1.86–2.23	22	1.51	1.39–1.64	24	1.51	1.39–1.65
1 change	272	22	2.05	1.85–2.27	22	1.60	1.45–1.76	25	1.58	1.44–1.75
2 changes	99	26	1.85	1.58–2.16	21	0.92	0.78–1.08	21	1.23	1.06–1.42
>3 changes	59	20	2.30	1.87–2.82	24	2.30	1.91–2.76	25	1.70	1.41–2.06
Merger	88	26	2.24	1.88–2.66	27	1.89	1.60–2.22	22	1.52	1.28–1.79
Split-up	44	25	3.66	2.85–4.70	32	3.33	2.62–4.22	20	1.50	1.16–1.95
Relocation	89	24	1.13	0.96–1.33	19	1.10	0.95–1.28	18	0.67	0.57–0.79
Change of management	166	25	2.58	2.28–2.93	25	1.78	1.57–2.01	23	1.72	1.52–1.94
Employee layoff	161	21	1.86	1.63–2.11	22	1.67	1.48–1.89	26	1.72	1.52–1.94
Budget cuts	126	22	1.92	1.68–2.15	15	0.87	0.75–1.01	29	1.90	1.68–2.15

Table 3. Adjusted hazard ratios (HR) and robust 95% confidence intervals (CI) of employee exit from the work unit through 2014 associated with levels of work-unit social capital (level IV–I: high–low) compared to high work-unit social capital as reference. Marginal Cox regression analyses were adjusted for employee-level age, sex, occupational group, previous sickness absence, child-related absence and personal gross income, and work-unit level number of employees. [WSC=work-unit social capital.]

WSC level	Study population (N=14 059)				Source population (N=25 296) [a]			
	N	Exited (%)	HR	95% CI	N	Exited (%)	HR	95% CI
IV	3715	14	1.00		6323	15	1.00	
III	3566	17	1.29	1.15–1.45	6277	17	1.16	1.06–1.26
II	3372	17	1.34	1.18–1.51	6349	18	1.26	1.15–1.37
I	3406	20	1.65	1.46–1.86	6347	21	1.60	1.47–1.74

[a] Including participants with and without missing data on exposure to organizational change.

Table 4. Adjusted hazard ratios (HR) and 95% confidence intervals (CI) of employee exit from the work unit after organizational change relative to no change. Main model additionally adjusted for potentially mediated effects via work-unit social capital. Marginal Cox regression analyses were adjusted for employee-level age, sex, occupational group, previous sickness absence, child-related absence and personal gross income, and work-unit level number of employees. [WSC=work-unit social capital.]

Organizational change	N	%	Main model		Adjusted for WSC	
			HR	95% CI	HR	95% CI
No change (reference)	8410	17	1.00		1.00	
Change	5649	18	1.10	1.01–1.19	1.07	0.98–1.16
1 change	3728	17	1.04	0.95–1.15	1.01	0.92–1.11
2 changes	1170	17	1.03	0.89–1.20	0.99	0.85–1.15
>3 changes	751	23	1.53	1.30–1.80	1.48	1.26–1.73
Merger	1085	21	1.29	1.12–1.49	1.24	1.08–1.43
Split-up	508	22	1.41	1.16–1.72	1.33	1.09–1.62
Relocation	978	19	1.17	1.00–1.36	1.16	0.99–1.35
Change of management	2149	19	1.23	1.10–1.38	1.17	1.05–1.31
Employee layoff	2163	16	1.03	0.91–1.16	1.00	0.89–1.13
Budget cuts	1757	18	1.10	0.97–1.25	1.08	0.96–1.23

same direction as the present findings of 1.5–3.7-fold excess risk of lower social capital after merger, split-up or change of management versus no change. Work units with high social capital may have difficulties including outsiders (16), which could decrease social cohesion and trust, for instance, in the context of a merger. However, relocation did not predict lower social capital, which could be explained by the fewer social ties being disrupted in relation to this type of change.

One interpretation of these associations is that organizational changes adversely impact the work-unit social capital, which is consistent with conclusions of a review on other psychosocial factors (1). An alternative interpretation of lower social capital after organizational changes may be due to reverse causality. Lower social capital has been linked to lower quality of patient care (34) and productivity (35), which may encourage reorganization. However, changing a work unit with low social capital may arguably have some positive influence on the psychosocial work environment (eg, change of a distrusted management), which is in contrast to our consistent demonstrations of low social capital after changes.

Work-unit social capital and employee exit from the work unit

We found an inverse dose–response relationship between social capital and EFW concurrent with a meta-analysis on 190 studies concluding strong significant inverse correlations between procedural/distributive justice and intention to quit (weighted *r*-values = -0.40) (36). Our findings also corroborate demonstrations of a 1.3 times higher rate of early retirement associated with a 20-point decrease on a 100-point social-capital scale (12) and an inverse dose–response relationship between social capital and long-term sickness absence (26). Previous findings show that good collaboration among employees and trust in managers were associated with a 60–80% lower chance of intention to quit (28). Collaboration and trust may be prerequisites for a well-functioning workplace and a decline in these factors could lower job satisfaction and lead to EFW.

Although 785 employees exited their work unit before/during assessment of social capital in March 2014, only 4% of these employees had missing data on work-unit social capital since this score was assigned to each employee regardless of survey participation. Sensitivity analyses showed comparable EFW rates before/during and after assessment of social capital. Indeed, employees exiting before assessment of social capital due to changes would likely respond more critically to the social-capital items than their participating colleagues, and thus the time gap between organizational changes and assessment of social capital may contribute to some underestimation of the association.

Work-unit social capital as a potential mediator

There were no convincing indications of mediation through social capital (objective c) on the rather inconsistent association between changes and EFW demonstrated in this study. Although the relative reduction in the EFW rate for change versus no change comprised ≈30% when including social capital in the model, mediation should also be interpreted in keeping with the absolute reduction (HR 1.10 versus 1.07). It is likely that the inconsistent association between changes and EFW limited the statistical power to detect a potential mediation through social capital. Indeed, a sensitivity analysis on a stronger association between changes and EFW in the first three months of follow-up neither showed convincing indications of mediation through social capital (15%; HR 1.27 versus HR 1.23). These indications are somewhat comparable to other findings

showing no mediation by employee-level social conflict between downsizing and self-rated health (37).

A previous study found that trust partially mediated the association between lower distributive justice and intention to quit among employees remaining at the workplace after downsizing (from r = -0.64 to r = -0.50) (20). However, we showed a higher rate of EFW only in the first three months after employee layoff, which seemed not to be mediated convincingly by social capital. Another study (38) found that about half of the association between major staff reduction and long-term sickness absence were reduced when adjusting for mediation through job control, job insecurity, and physical demands. These factors may also be mediators on EFW, but this remains to be investigated.

Social capital may as well buffer the adverse effects of organizational change as such properties were found between high job strain and smoking status (39). However, since social capital was measured after the organizational changes occurred, we refrained from examining the potential modifying effects of social capital between changes and EFW.

EFW may be considered as a less problematic outcome than exit out of the healthcare sector: the latter would more likely predict severe illness, long-term unemployment, disability retirement etc. Although job rotation within the healthcare sector may comprise a healthy work life, the literature on organizational change mainly show adverse impacts on employees. Thus, employee EFW to another work unit may likely be motivated by deteriorated well-being and/or health among some employees. In addition, high EFW rates seem also to adversely affect those who remain in the work unit in terms of mental health problems, lower job satisfaction, and excess risk of medical errors (40).

Strengths and limitations

It was a strength of this longitudinal study that we tracked the work-unit affiliation of all employees (despite some work-unit names being changed) reducing loss to follow-up mainly among employees exposed to organizational changes. Also, data on exposure, outcome and mediation were obtained from independent data sources, which reduces common-method bias in the associations examined (41). By collecting data on changes from the work-unit managers and assigning these to each employee, we obtained valid information on organizational changes since managers may recall the organizational history more accurately than the employees. Using data from independent sources is particularly important in mediation analysis, and therefore a major strength of this study, because mediated effects found in data from the same source could be due to the common method applied (41). Additionally, we included employees regardless of survey participation as social capital was aggregated at the work-unit level, which also makes the findings less influenced by individual factors (eg, lifestyle).

This study has some potential limitations. We assessed the sensitivity of EFW by analyzing associations between changes and company exit. These associations attenuated compared to results in table 4, but some change measures, including merger, remained significantly associated with company exit, which is contrary to previous findings (10). Not examining EFW during or before the organizational changes occurred could have underestimated the results. It has been demonstrated that the adverse effects of reorganization can be observed shortly after a merger is announced (42). Although data on EFW were available during occurrence of the changes, we did not use these because it was unclear when the changes were announced. Moreover, we were unable to adjust for effects of organizational change during the follow-up on EFW through 2014 due to lack of data. This may have underestimated the results as work units not changed during 2013 may more likely be changed in the following year. Assessment of mediation through social could be limited by focusing on a 2-year period, since changes in social capital may occur over a longer period. However, choosing this narrow time frame was pivotal to capture the immediate prospective associations on EFW soon after organizational changes. Finally, the differences in EFW rates and social capital among employees and work units with/without data on changes suggest that these missing data may somewhat contribute to some underestimate the findings.

In conclusion, we demonstrated a higher risk of low work-unit social capital after organizational change relative to no change and an inverse dose−response relationship between work-unit social capital and EFW. We found no convincing indications of mediation through social capital between organizational change and subsequent EFW. The inconsistent effects of change on EFW may have limited the statistical power to detect such – if any – mediation.

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Longitudinal associations between organizational change, work-unit social capital, and employee exit from the work unit among public healthcare workers: a mediation analysis [1]

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1. *Supplementary tables*
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Supplementary Table S1. Adjusted hazard ratios and robust 95% confidence intervals of employee exit from the work unit (EFW) in 2014 associated with levels work-unit social capital (level IV-I: high-low) measured through March 2014. Follow-up is split-up into two periods: one period before/during measurement of social capital (i.e., January-March 2014) and one period after measurement of social capital (i.e., April-December).

	EFW, follow-up January-March 2014				EFW, follow-up April-December 2014			
WSC level	*N*	% of *N*	HR	95% CI	*N*	% of *N*	HR	95% CI
IV	3715	26.4	1.00		3560	26.8	1.00	
III	3566	25.4	1.24	1.00-1.53	3380	25.4	1.32	1.14-1.52
II	3372	24.0	1.26	1.01-1.56	3191	24.0	1.38	1.19-1.60
I	3406	24.2	1.59	1.28-1.97	3178	23.9	1.68	1.44-1.94

Cox regression analyses were adjusted for age, sex, number of employees in the work unit, occupational group, previous sickness absence, child-related absence, and personal gross income.
Abbreviations: EFW = exit from the work unit, WSC = work-unit social capital.

Supplementary Table S2. Adjusted hazard ratios and robust 95% confidence intervals of employee exit from the work unit (EFW) in 2014 associated with organizational changes relative to no change in the last six months of 2013. Follow-up on work-unit exit was split-up into two periods: one period before/during measurement of social capital (i.e., January-March 2014) and one period after measurement of social capital (i.e., April-December). Main models additionally adjusted for mediating effects of social capital.

	EFW, follow-up January-March 2014						EFW, follow-up April-December 2014					
			Main model		Adjusted for social capital				Main model		Adjusted for social capital	
	N	% of *N*	HR	95% CI	HR	95% CI	*N*	% of *N*	HR	95% CI	HR	95% CI
No change (reference)	8410	4.9	1.00		1.00		8000	12.2	1.00		1.00	
Change	5649	6.0	1.27	1.10-1.47	1.23	1.07-1.43	5309	12.4	1.03	0.93-1.14	0.99	0.90-1.10
1 type of change	3728	5.4	1.13	0.95-1.34	1.10	0.93-1.31	3526	12.1	1.01	0.90-1.13	0.98	0.87-1.10
2 types of changes	1170	5.6	1.18	0.91-1.52	1.14	0.88-1.47	1104	12.0	0.96	0.80-1.15	0.92	0.77-1.11
≥3 types of changes	751	9.6	2.18	1.69-2.81	2.11	1.64-2.72	679	14.6	1.25	1.02-1.54	1.21	0.98-1.48
Merger	1085	8.5	1.79	1.42-2.26	1.74	1.38-2.20	993	13.7	1.08	0.90-1.29	1.03	0.86-1.24
Split-up	508	8.5	1.79	1.30-2.45	1.72	1.25-2.38	465	14.4	1.25	0.97-1.59	1.17	0.91-1.49
Relocation	978	6.3	1.39	1.06-1.81	1.37	1.05-1.79	916	13.8	1.08	0.90-1.30	1.07	0.89-1.29
Change of management	2149	6.0	1.30	1.07-1.59	1.26	1.03-1.53	2020	14.0	1.20	1.05-1.37	1.13	0.99-1.30
Employee layoff	2163	6.1	1.23	1.01-1.51	1.21	0.99-1.48	2031	10.9	0.93	0.81-1.08	0.91	0.79-1.05
Budget cut	1757	6.2	1.33	1.08-1.65	1.30	1.05-1.61	201	12.2	1.00	0.85-1.16	0.98	0.84-1.15

Cox regression analyses were adjusted for age, sex, number of employees in the work unit, occupational group, previous sickness absence, child-related absence, and personal gross income.
Abbreviations: EFW = exit from the work unit

Supplementary Table S3. Adjusted hazard ratios and 95% confidence intervals of employee exit from the work unit (EFW) throughout 2014 after organizational change relative to no change. Main models additionally adjusted in turn for potentially mediated effects via dimensions of trust/organizational justice and collaboration (comprising social capital).

			EFW, main model		EFW, adjusted for trust/ organizational justice		EFW, adjusted for collaboration	
	N	% of *N*	HR	95% CI	HR	95% CI	HR	95% CI
No change (reference)	8410	17	1.00		1.00		1.00	
Change	5649	18	1.10	1.01-1.19	1.07	0.99-1.16	1.08	1.10-1.17
1 type of change	3728	17	1.04	0.95-1.15	1.02	0.93-1.13	1.03	0.93-1.13
2 types of changes	1170	17	1.03	0.89-1.20	0.99	0.85-1.15	1.01	0.86-1.16
≥3 types of changes	751	23	1.53	1.30-1.80	1.46	1.25-1.72	1.52	1.29-1.78
Merger	1085	21	1.29	1.12-1.49	1.25	1.07-1.42	1.27	1.10-1.46
Split-up	508	22	1.41	1.16-1.72	1.35	1.11-1.64	1.39	1.14-1.70
Relocation	978	19	1.17	1.00-1.36	1.16	1.04-1.30	1.17	1.10-1.36
Change of management	2149	19	1.23	1.10-1.38	1.15	1.03-1.29	1.20	1.08-1.35
Employee layoff	2163	16	1.03	0.91-1.16	1.01	0.90-1.14	1.02	0.90-1.15
Budget cut	1757	18	1.10	0.97-1.25	1.09	0.96-1.23	1.09	0.96-1.23

Cox regression analyses were adjusted for age, sex, number of employees in the work unit, occupational group, previous sickness absence, child-related absence, and personal gross income.
Abbreviations: EFW = exit from the work unit

Supplementary Table S4. Adjusted hazard ratios and 95% CI robust confidence intervals of subsequent employee exit from the company (i.e., the Capital Region of Denmark) throughout 2014 associated with organizational changes relative to no change in the last six months of 2013.

		Company exit		
	N	% of *N*	HR	95% CI
No change (reference)	8410	9.8	1.00	
Change	5649	10.1	0.99	0.89-1.10
1 type of change	3728	9.6	0.90	0.79-1.02
2 types of changes	1170	9.2	0.94	0.77-1.15
≥3 types of changes	751	14.1	1.59	1.30-1.93
Merger	1085	13.0	1.40	1.19-1.68
Split-up	508	10.0	1.05	0.79-1.40
Relocation	978	16.6	1.55	1.32-1.82
Change of management	2149	9.9	1.04	0.90-1.21
Employee layoff	2163	10.4	1.06	0.91-1.23
Budget cut	1757	7.9	0.76	0.63-0.91

Cox regression analyses were adjusted for age, sex, number of employees in the work unit, occupational group, previous sickness absence, child-related absence, and personal gross income.

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ORIGINAL ARTICLE

Work-unit organisational changes and subsequent prescriptions for psychotropic medication: a longitudinal study among public healthcare employees

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ABSTRACT

Objectives We examined exposure to different types of organisational changes at work as risk factors for subsequent prescription for psychotropic medication among employees.

Methods The study population included 15 038 public healthcare employees nested within 1284 work units in the Capital Region of Denmark. Multilevel mixed-effects parametric survival models were developed to examine time to prescription for psychotropic medications (anxiolytics/hypnotics/sedatives/antidepressants) during the 12-month interval following exposure to organisational changes relative to no change from January to December 2013. Data on work-unit level organisational changes (including mergers, split-ups, relocation, change in management, employee lay-offs and budget cuts) were collected from work-unit managers (59% response).

Results Any organisational change versus no change was associated with a higher risk of psychotropic prescription (HR: 1.14, 95% CI: 1.02 to 1.26), especially change in management (HR: 1.23, 95% CI: 1.07 to 1.41). Splitting the 12-month follow-up period into two halves yielded particularly high rates of psychotropic prescription in the latter half of the follow-up, for example, any change (HR: 1.25, 95% CI: 1.11 to 1.41), change in management (HR: 1.42, 95% CI: 1.22 to 1.65), mergers (HR: 1.26, 95% CI: 1.06 to 1.50), employee lay-off (HR: 1.23, 95% CI: 1.03 to 1.46) and budget cuts (HR: 1.13, 95% CI: 1.00 to 1.41). The associations did not vary by sex.

Conclusions Organisational changes in the workplace, especially change in management, may be associated with increased risk of psychotropic prescription among employees regardless of sex.

Key messages

What is already known about this subject?

- Different types of organisational changes at work may have different negative effects on stress-related prescriptions for psychotropic medication among male and female employees.

What are the new findings?

- Organisational changes in the workplace were associated with higher risk of prescription for psychotropic medication in the following year relative to no change in the workplace.
- This association was particularly strong for exposure to change in management and prescriptions for antidepressants, but results did not vary by sex or previous history of psychotropic medication prescription.
- Splitting the 12-month follow-up period into two halves yielded the strongest effects during the latter period after different types of change, suggesting a latency period before excess use of psychotropic medication.
- Factors at the work-unit level accounted for 6% of the total variance in prescriptions for psychotropic medication, indicating that this level is an important contributor to use of psychotropic medication among employees.

How might this impact on policy or clinical practice in the foreseeable future?

- Decision-makers and policy-makers should consider that different types of organisational change in the workplace may pose risks for employee mental health.

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INTRODUCTION

Depressive and anxiety disorders are estimated to be the third and ninth leading causes, respectively, of disability globally.[1] Most people spend many of their waking hours in an occupational setting, and workplace conditions thus play a key role for employee well-being. Organisational changes in the workplace (eg, downsizing or mergers) are often implemented as a strategy to maximise competitiveness in a globalised economy.[2 3]

Organisational changes at work seem to have adverse impacts on employee health and well-being.[4–8] Although evidence supports an association between individual reporting of higher psychosocial stress and excess risk of depression,[9] anxiety[10 11] and disturbed sleep,[12] longitudinal associations between organisational changes and stress-related clinical psychiatric disorders remain unclear.[13]

Some studies found excess self-reported psychiatric symptoms following changes including downsizing and mergers,[14–17] but inconsistent

findings have also been reported.[13 18] Negative appraisals of mergers has been linked to 1.60-fold higher risk of a psychiatric event[19]; however, this association may likely be inflated due to underlying negative affectivity influencing both exposure and outcome.[20] Another study found 1.03–1.16-fold higher relative risk of total sickness absence for ≥2 simultaneous change types, mergers, change in management and budget cuts,[5] suggesting that employees react differently to different change types.[21]

Studies on organisational changes and prescriptions for psychotropic medication[22–25] mainly focused on major company downsizing (≥18% staff reduction) to find associations with higher relative risk of psychotropic prescriptions.[22–24] Associations stratified by sex showed similar patterns of prescriptions in Swedish studies,[23 24] with higher relative risk for prescriptions among male employees (RR: 1.49, 95% CI: 1.10 to 2.02) compared with female employees (RR: 1.12, 95% CI: 1.00 to 1.27) in the Finnish study.[22] This sex difference could be due to greater job demands and lower social support among men.[26]

A Danish study on company changes targeting specific dimensions showed that changes regarding cooperation/coordination and, especially, those targeting multiple dimensions were associated with higher prescription rates,[25] suggesting a cumulative effect of multiple changes. These prescription effects were stronger in the first year than the 2-year period after changes. No associations were found for changes targeting effectiveness, adaptation/turbulence or skill/knowledge enhancement.[25]

Indeed, these prior studies of organisational changes and psychotropic prescriptions may be subject to exposure misclassification (ie, employees not experiencing the changes personally) since change data were defined at the company level. Also, none of the studies used multilevel modelling to account for potential clustering of psychotropic prescriptions within the organisational structure of workplaces[27] which may elevate risk of type-I error.[28]

The literature highlights organisational changes as a heterogenous short-term risk factor for clinical mental health problems among employees since specific and multiple simultaneous changes seem to be associated with higher risk of psychotropic prescriptions in the years closer to the change event. Sex differences in this association remain unclear although some evidence suggest more adverse effects among men. To better understand and potentially mitigate development of negative employee effects of organisational changes, there is a need to examine the short-term associations between objective measures of specific change types and prescriptions for psychotropic medication accounting for multilevel clustering.

This study contributes to the literature by using multilevel modelling to investigate the putative associations between specific types of work-unit organisational changes and excess rates of prescription for psychotropic medication among employees during the subsequent year. We hypothesised excess prescription rates to vary immediately after specific types of organisational change. Stronger cumulative prescription effects were expected after multiple simultaneous changes. Also, we hypothesised more adverse change effects on psychotropic prescriptions among males relative to females. We examined these potential sex differences in terms of both *additive* (ie, absolute risk) and *multiplicative interaction* between changes and males (ie, relative risk) since these two types of interaction may be observed independently.[29]

METHODS

Study design, data sources and population

We examined the prospective association between exposure to work-unit organisational changes during the observation period through 2013 and prescription of psychotropic medication during the ensuing 12-month follow-up period among employees (between 1 January 2014 (baseline) and 31 December 2014). All participants were part of the ongoing *Well-being in Hospital Employees* cohort study.[30] The source population included all 37 720 healthcare employees nested in 2696 work units from 14 institutions comprising the capital region of Denmark. A work unit was defined as a group of employees referring to same immediate manager. Data on organisational changes were gathered April–June 2016 via a survey distributed to all managers of these work units (59% response). Complete data on occupational/sociodemographic information at baseline and prescription of psychotropic medication from 2011 to 2014 were extracted via linkage to company and national registers, respectively.

Eligible employees (n=25 897) nested in 2318 work units at baseline were identified based on the following inclusion criteria: working in work units with ≥3 employees, ≥1 year of seniority in the same work unit, ≥18.5 weekly working hours throughout 2013, not working multiple positions, not working in Denmark or aged ≥18. We allowed for ≥1 year of seniority in a work unit changing name during the observation period of organisational changes by including employees if ≥3 co-workers and ≥30% of the work-unit staff remained in the work unit after the name change. These criteria were applied in keeping with a previous approach.[5 31] We excluded 10 859 eligible employees with missing data on organisational changes. The study population comprised 15 038 employees nested in 1284 work units (figure 1).

There were no significant differences between the source population, eligible employees and the study population regarding sex composition (p=0.15) or prescriptions for psychotropic medication (p=0.62) as indicated by χ^2 tests. Nurses were slightly overrepresented in the groups of eligible and studied employees (43%) relative to the source population (41%), whereas medical doctors/dentists were somewhat under-represented among eligible (11%) and studied employees (10%) compared with the source population (14%) (p<0.001).

Work-unit level organisational changes

We collected data on exposure to different types of organisational changes at the work-unit level by administering a questionnaire via working email to all work-unit managers from April to June 2016. The managers provided information on *occurrence* of the following specific types of organisational changes in their work unit for each semester during 2013, viz, mergers, split-ups, relocation, change in management, employee lay-off or budget cuts. Responses for 2013 were collapsed because we did not collect information on when the changes were announced or initiated within the company. We created seven change-indicator variables at the work-unit level: six variables for each of the types of organisational changes and one variable for 'any changes' (yes/no change). None of the individual types of changes were completely overlapping as co-occurrence rates were ≤56% (online supplementary material 1).

Employee-level prescriptions for psychotropic medication

For outcome purposes, we used information from 1 January to 31 December 2014 on the date of psychotropic prescriptions

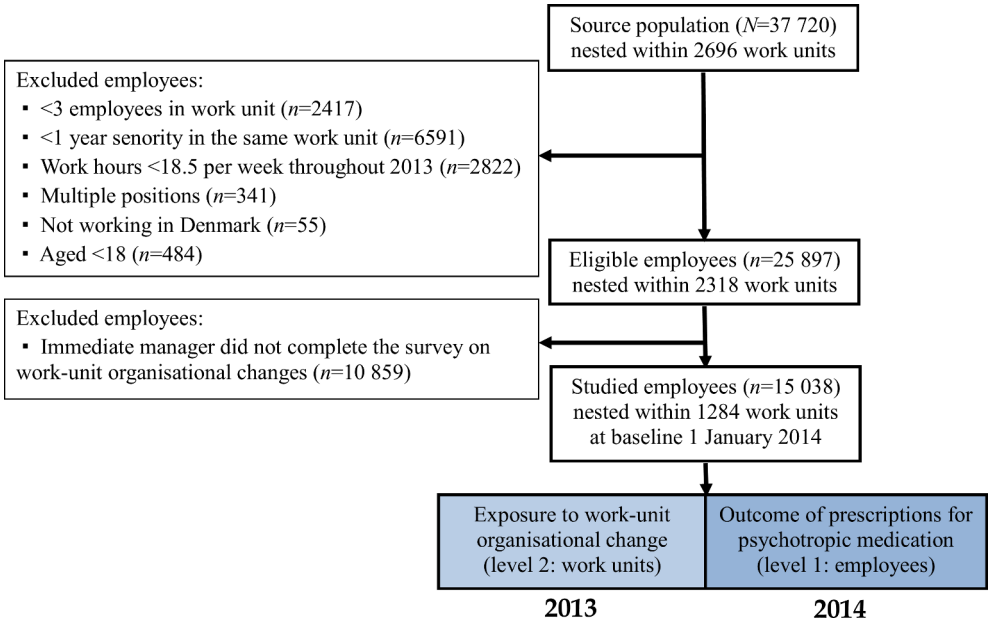

Figure 1 Flow of the study population and study design. Employees could fulfil multiple exclusion criteria.

including anxiolytics (WHO Anatomical Therapeutic Chemical (ATC) code: N05B), hypnotics/sedatives (N05C) and antidepressants (N06A). These data were used regardless of the prescribed daily dose or period for intended use. Although follow-up data on psychotropic prescriptions in 2015 were available, we did not use these because we presumed that psychotropic prescriptions in 2015 would be highly impacted by organisational changes in 2014, on which we had no information.

Employee and work-unit level covariates

We used the following employee-level variables as a priori covariates: age, sex, occupational group, manager, personal gross income, fixed weekly working hours, contractual employment, years of seniority and days of sickness absence in 2012. We did not consider prior psychotropic prescriptions to be a potential confounder because we presumed no causal impact of employee-level psychotropic prescriptions on subsequent work-unit organisational changes.

As work-unit level a priori covariates, we used the number of employees within the work unit and selected types of organisational changes confounding other types of changes (online supplementary material 2). For example, we regarded work-unit mergers and split-ups as confounders for the relation between change in management and psychotropic prescriptions. All covariates were categorical variables (table 1).

Statistical analysis

We estimated HR and 95% CI using multilevel mixed-effects parametric survival models to study the association between organisational changes in 2013 and psychotropic prescriptions in 2014. Employees (level 1) were nested within work units (level 2). Analyses were unable to converge in three-level models nesting work units within institutions. Employees were followed from 1 January 2014 to the first psychotropic prescription (event), death (censoring) or end of study by 31 December 2014, whichever came first. The relative impact of each change-indicator variable (adjusted for other changes as appropriately) were evaluated in separate models.

Parametric survival models follow a specified distribution from which residual variance at multiple levels is estimated. In a null model, residual variance at the work-unit level reflects the relative importance of any work-unit factors for psychotropic prescriptions among employees. We fitted a Weibull distribution to the survival models as we expected the hazard of psychotropic prescriptions to either increase or decrease during follow-up[32] since the magnitude and exact date of the change announcements were unclear. We applied Acceleration Failure Time parametrisation for the Weibull models which allows for estimation of the intraclass correlation coefficient (ICC) for work units.[33] We interpreted $ICC * 100$ as the proportion of any work-unit factors—observed and unobserved—explaining the total variance in psychotropic prescriptions among employees.

A four-step sequential modelling strategy with incremental adjustment for covariates was used to assess confounding and variation in prescriptions explained by the work-unit level (online supplementary material 3).

We analysed the association between any changes and each subgroup of psychotropic medication (ie, anxiolytics, hypnotics/sedatives and antidepressants) first prescribed in 2014 to assess their relative importance. Sex differences in change effects on psychotropic prescriptions were evaluated in additive interaction analysis (ie, combined effect) by calculating the synergy index (S)[34] and 95% CI[35] as well as in multiplicative interaction analysis by including an interaction term between indicator variables of any change and male adjusted for the separate main effects of change and sex. We estimated additive interaction between any changes and *females* since we were unable to calculate 95% CI to S for any changes and males (online supplementary material 4).

Sensitivity analyses

We reran the analysis for any changes and psychotropic prescriptions during 2014 additionally adjusting for potential confounding

Table 1 The two-level data structure and distribution of variables for the study population and employees/work units exposed to any organisational changes

	Categories	Study population, n (% of N)	Exposed to any changes, n (% of N)
Level 1: employees, N		15 038 (100)	8242 (55)
Prescription for psychotropic medication in 2014		1616 (11)	931 (11)
Days to first prescription, M (SD)		107 (101)	109 (103)
Age group	19–40*	3821 (25)	2093 (25)
	40–48	3780 (25)	2056 (25)
	48–56	3728 (25)	2027 (25)
	56–75	3709 (25)	2066 (25)
Sex	Female*	11 507 (77)	6299 (76)
	Male	3531 (23)	1943 (24)
Occupational group	Nurses*	6534 (43)	3682 (45)
	Medical doctors/dentists	1464 (10)	758 (9)
	Social/healthcare workers	1966 (13)	1055 (13)
	Pedagogical workers	401 (3)	217 (3)
	Service/technical workers	1864 (12)	975 (12)
	Administration workers	2809 (19)	1555 (19)
Seniority, years	1–4*	3125 (21)	173 (21)
	5–10	3818 (25)	2076 (25)
	11–20	4097 (27)	2239 (27)
	21≤	3998 (27)	2197 (27)
Manager	No*	14 040 (93)	7591 (92)
	Yes	998 (7)	651 (8)
Weekly working hours	18.5–32*	2662 (18)	1511 (18)
	32–37	3643 (24)	2023 (25)
	37≤	8733 (58)	4708 (57)
Contractual employment	No*	1066 (7)	487 (6)
	Yes	13 972 (93)	7755 (94)
Personal gross income, DKK	≤345 000*	4427 (29)	2458 (30)
	345 000–400 000	3862 (26)	2124 (26)
	400 000–480 000	3471 (23)	1852 (22)
	≥480 000	3278 (22)	1808 (22)
Sickness absence in 2012, days	No days*	4132 (27)	2274 (28)
	1–3	3242 (22)	1760 (21)
	4–6	2292 (15)	1271 (15)
	7–13	2877 (19)	1517 (18)
	≥14	2495 (17)	1420 (17)
Level 2: work units, N		1284 (100)	
Organisational changes	No changes*	642 (50)	
	Any changes	642 (50)	
	Mergers	195 (15)	
	Split-ups	75 (6)	
	Relocation	157 (12)	
	Change in management	294 (23)	
	Employee lay-off	245 (19)	
	Budget cuts	191 (15)	
Number of employees within work unit	3–12*	654 (51)	283 (44)
	13–22	306 (24)	164 (26)
	23–32	198 (15)	116 (18)
	33–142	126 (10)	79 (12)

*Reference category.
DKK, Danish Krone; M, mean.

by prior psychotropic prescriptions between 2011 and 2012 (ie, preceding changes that occurred in 2013) to evaluate confounding by prior psychotropic prescriptions. To assess if the association between change in management and psychotropic prescriptions was driven by (eg, laid-off) managers, we reran this analysis excluding all managers (n=14 040) for comparison with the analysis on the total study population. Associations with prescriptions through 2014 were analysed according to any changes in each semester of 2013 to evaluate possible temporality in change exposure. Finally, we analysed exposure

to 1, 2 or 3≤ types of simultaneous changes compared with no changes to explore the potential cumulative effect on psychotropic prescriptions.

We used a significance level of 0.05 throughout. All statistical analyses were conducted using STATA V.14.2 software.

RESULTS

Table 1 presents the hierarchical data structure and distribution of employee- and work-unit level variables for the study population (n=15 038) and among employees/work units exposed to any organisational changes (n=8242). The study population predominantly comprised female employees, nurses, employees with ≥37 weekly working hours (ie, full-time employment). Employees with prior psychotropic prescriptions between 2011 and 2012 were similarly distributed in the study population (14%, n=2049) and among employees exposed to any changes (14%, n=1173), indicating no confounding by prior psychotropic prescriptions. Among the study population, 1616 employees (11%) were prescribed psychotropic medication in 2014. More antidepressants (52%, n=833) and hypnotics/sedatives (38%, n=614) were prescribed than anxiolytics (13%, n=202). During the follow-up in 2014, eight employees died, and four of these deaths occurred before a psychotropic prescriptions (censoring).

Table 2 shows that any organisational changes in 2013 was associated with an HR of 1.14 (95% CI: 1.02 to 1.26) for psychotropic prescriptions in 2014 relative to no changes. Medical doctors/dentists and employees aged 56–75 had particularly high HRs of psychotropic prescriptions. As reflected by the ICC, the correlation of psychotropic prescriptions between work units explained 6% of the total variation in psychotropic prescriptions. This indicates that work units are an important contributor to prescriptions for psychotropic medication among employees. Adjustment for employee and work-unit level covariates led to slightly higher HR of psychotropic prescriptions after any changes. Additional adjustment for potential confounding by prior psychotropic prescriptions in this model attenuated the association (HR: 1.08, 95% CI: 0.97 to 1.20).

Following any organisational changes, there was a higher rate ratio for prescription of antidepressants (HR: 1.21, 95% CI: 1.05 to 1.40) and indications of a higher rate ratio for prescription of anxiolytics (HR: 1.25, 95% CI: 0.93 to 1.69), but no association for prescription of hypnotics/sedatives (HR: 1.00, 95% CI: 0.85 to 1.19).

We only found weak indications of an additive interaction between any changes and females (S: 1.36, 95% CI: 0.32 to 5.84; supplementary material 5) and no multiplicative interactions (p=0.69). This indicates no differential effects of organisational changes regarding sex.

In table 3, the fully adjusted model 4 shows that change in management in 2013 was associated with a HR of 1.23 (95% CI: 1.07 to 1.41) for psychotropic prescriptions in 2014 relative to no changes. This excess HR of psychotropic prescriptions remained in a sample excluding all managers (n=14 040; HR: 1.24, 95% CI: 1.07 to 1.42), indicating that the effect was not attributable to managers laid off. There were indications of higher prescription rates after mergers, employee lay-off or budgets cuts, but these findings were not statistically significant. Indeed, employee lay-off and budget cuts were statistically significantly associated with a higher rate of psychotropic prescriptions in model 3 adjusted for age, sex and socio-occupational factors. However, these effects attenuated in model 4 when additionally adjusting for mergers, change in management and budget cuts as confounders on the association between employee lay-offs and psychotropic prescriptions.

Table 4 presents the rate ratios of psychotropic prescriptions splitting the 12-month follow-up period into two halves. In the former follow-up period, only change in management was associated with a higher rate of psychotropic prescriptions. In the second period, exposure to any changes, mergers, change in management, employee lay-off or budget cuts were statistically significantly associated with a 1.19–1.42 times higher rate of psychotropic prescriptions relative to no change. Any changes occurring in the former and latter semester of 2013 were similarly associated with excess rates of psychotropic prescriptions through 2014 (HR: 1.11, 95% CI: 0.99 to 1.24 and HR: 1.16, 95% CI: 1.04 to 1.29, respectively), suggesting a comparable effect of the exposure on outcome over time. There were no meaningful differences between prescription rates following exposure to 1, 2 or 3≤ types of simultaneous changes relative to no change in either half follow-up period, indicating no cumulative effects by multiple changes (data not shown).

DISCUSSION

More than half of the studied employees were exposed to organisational changes. We found higher risk of prescriptions for psychotropic medication among employees in the year after they remained in the work unit during any organisational changes compared with no changes. This association was particularly strong following change in management and in relation to prescription of antidepressants. Splitting the follow-up period into two halves yielded a stronger association in the latter half of the 12-month follow-up compared with the former half, indicating a latency period before an increase in prescriptions. The observed association did not vary according to sex.

Our findings of a 1.09-fold and 1.25-fold higher rate ratio of psychotropic prescriptions in the former and the latter halves of the year after any changes, respectively, corroborate with prior findings from another Danish study of a 1.09-fold higher rate of psychotropic prescriptions which was strongest in the year immediately after the changes.[25] In our study, this association was particularly strong for change in management which, to our knowledge, has not been reported before. Among both men and women, we found a roughly 1.15-fold higher rate over the 12-month follow-up which is comparable with the Finnish 10-Town study estimate of a 1.12 times higher rate of psychotropic drug prescription after major downsizing among women. In that same study, the prescription rates were notably higher among male employees (1.49),[22] whereas in our study the interaction analyses yielded no sex differences in line with other studies.[23 24] In fact, sex did not predict psychotropic prescriptions significantly in the present study. This could be due to limited statistical power since only 357 (2%) male employees were prescribed psychotropic medications during follow-up. Also, we found no cumulative effects of exposure to multiple changes (1, 2 or 3≤) which contradicts previous findings of comprehensive changes being particularly associated with excess risk of psychotropic prescriptions.[25] This may be explained by excess employee turnover rates during a greater number simultaneous changes as indicated by a prior study.[5]

Adjusting the association between changes and psychotropic prescriptions during 2014 for prior psychotropic prescriptions between 2011 and 2012 attenuated the HR from 1.14 to 1.08; however, this reduction towards the null may be explained by the introduction of an index event bias[36] as episodes of mental disorders are highly recurrent in a workplace context.[37] Index

Table 2 HR of prescription for psychotropic medication in 2014 (n=1616) among the study population (n=15 038)

	Prescription, follow-up 1 January to 31 December 2014				
	Model 1	Model 2		Model 3	
Fixed part		HR	95% CI	HR	95% CI
Work-unit level variables (level 2)					
Any organisational changes*		1.13	1.02 to 1.26	1.14	1.02 to 1.26
Number of employees within work unit†					
13–22				1.00	0.86 to 1.15
23–32				0.95	0.81 to 1.10
33–142				0.82	0.70 to 0.96
Individual-level variables (level 1)					
Age group‡					
40–48				1.41	1.19 to 1.69
48–56				1.68	1.40 to 2.00
56–75				2.09	1.73 to 2.51
Male§				0.88	0.77 to 1.02
Occupational group¶					
Medical doctors/dentists				2.33	1.85 to 2.88
Social/healthcare workers				0.95	0.80 to 1.13
Pedagogical workers				0.89	0.63 to 1.25
Service/technical workers				0.94	0.77 to 1.16
Administrative workers				1.17	1.00 to 1.35
Seniority, years**					
5–10				1.10	0.94 to 1.28
11–20				1.00	0.85 to 1.19
≥21				0.99	0.82 to 1.19
Manager, yes††				0.97	0.79 to 1.21
Weekly working hours‡‡					
32–37				1.00	0.85 to 1.17
≥37				0.77	0.68 to 0.88
Contractual employment, yes§§				1.00	0.82 to 1.22
Personal gross income, DKK¶¶					
345 000–400 000				0.90	0.79 to 1.04
400 001–480 000				0.85	0.72 to 0.98
≥480 001				0.86	0.71 to 1.03
Sickness absence in 2012, days***					
1–3				0.91	0.77 to 1.07
4–6				1.20	1.01 to 1.42
7–13				1.52	1.30 to 1.78
≥14				2.33	2.01 to 2.70
Random part					
ICC (p value), work-unit level (level 2)	0.06 (<0.01)	0.05 (<0.01)		0.02 (0.13)	

Model 1: Null model with a random intercept for the work-unit level. Model 2: As model 1, but the 'Any changes' variable in the fixed part. Model 3: As model 2, but effects of the 'Any changes' variable were fully adjusted for all employee-level covariates and number of employees within the work unit.
Reference categories
*No change; †3–12 employees within the work unit; ‡age group 19–40; §female; ¶nurses; **1–4 seniority years; ††not manager; ‡‡18.5–32 weekly working hours; §§no contractual employment; ¶¶personal gross income ≤345 000 DKK; ***no days of sickness absence in 2012.
DKK, Danish Krone; ICC, intraclass correlation coefficient.

event bias refers to the selection of participants based on index events (prior prescriptions) for whom the putative risk factor (changes) is associated with an observed lower probability of new events (new prescriptions). Conditioning on prior psychotropic prescriptions could actually 'protect' against new psychotropic prescriptions as associated with organisational changes because employees with mental illness would likely adapt their working life according to their limited occupational capacity (eg, not working full-time) which thus induces dependence between otherwise independent confounder variables. In support to this perspective, the descriptive statistics indicated no confounding by prior psychotropic prescriptions, and the proportion of full-time employees was in fact smaller among those *with* prior psychotropic prescriptions (53% of n=2049) than employees *without* prior prescriptions (59% of n=12 989).

It has previously been highlighted that adverse effects of organisational changes at the workplace are primarily driven by changes in job insecurity among employees.[38] This is in line with findings of excess psychotropic prescription rates after change in management or employee lay-off as such changes may elevate uncertainty about future employment and new down-sizing waves in the work unit. In addition, mergers were also

Table 3 HR of prescription of psychotropic medication in 2014 (n=1616) according to each type of organisational changes in 2013 among the study population (n=15 038)

	Prescription, follow-up 1 January to 31 December 2014				
		Model 3		Model 4	
	N (% prescriptions)	HR	95% CI	HR	95% CI
No changes	6796 (10.1)	1.00		1.00	
Mergers	2560 (11.4)	1.11	0.95 to 1.28	1.14*	0.97 to 1.34
Split-ups	956 (10.2)	0.98	0.79 to 1.23	0.98†	0.78 to 1.23
Relocation	1872 (10.3)	1.00	0.85 to 1.19	1.02‡	0.84 to 1.24
Change in management	3781 (12.1)	1.19	1.05 to 1.35	1.23‡	1.07 to 1.41
Employee lay-off	3204 (11.8)	1.20	1.05 to 1.38	1.15§	0.98 to 1.35
Budget cuts	2401 (11.6)	1.15	1.00 to 1.34	1.12¶	0.95 to 1.31

Results for covariates omitted as no noteworthy changes in estimates were observed relative to table 2.
Model 3: Each type of change indicator adjusted for all employee-level covariates and number of work-unit employee and in the fixed part and a random intercept for the work-unit level. Model 4: As model 3, but each type of organisational changes additionally adjusted for other changes as potential confounders on the association with psychotropic prescriptions:
*Split-ups and Budget cuts; †budget cuts; ‡mergers and Split-ups; §mergers, change in management and budget cuts; ¶change in management.

associated with an excess rate of psychotropic prescriptions in the latter half of the 12-month follow-up period which could be hypothetically explained by subsequent reduction in redundant staff following mergers. We had, however, no data on changes during follow-up to test this. Adverse effects of organisational changes are also previously found to be mediated by changes in job strain.[39] Hence, long-term changes in job strain may explain why the excess rate ratios of psychotropic prescriptions were observed to be stronger in the latter period of follow-up than the earlier period immediately following organisational changes. Managers have a key role in organising work, and a change in management may follow increased demands in work procedures (eg, excess work documentation) inducing further psychosocial repercussions among employees. In addition, demands of work-unit productivity may not be adjusted to the staff composition after employee lay-offs which could lead to workload intensification among the remaining employees.

Strengths and limitations

The associations found in the present study may be underestimated because we were unable to adjust for organisational changes occurring during the 12-month follow-up on psychotropic prescriptions. Neither did we assess the effects on psychotropic prescriptions during or before the observation of organisational changes in 2013. It is, however, reasonable to assume that the majority of employees prescribed psychotropic medication in 2013 would extend their medical treatment into the follow-up period in 2014. Indeed, if an employee exited the work unit during 2013 (eg, due to common mental disorder), the participant would not be included in the study population. Data on changes in 2013 obtained from managers 3 years later may be influenced by recall bias; however, since the managers most likely executed the changes, this bias is considered minor. Finally, using composite change measures for 2013 limits conclusions on the duration of the latency period.

This study benefited from assessing the relative impact of various and frequently occurring types of organisational changes. These changes were measured at the work-unit level among employees who remained in the work unit during the observation of the changes. This approach ensured that the employees personally experienced the changes. Assessing various types of changes also allowed us to create a purer reference group not

Table 4 HR of prescription for psychotropic medication in the former period from January to June 2014 or in the latter period from July to December 2014 according to organisational changes in 2013 among the study population (n=15 038)

		Prescription, follow-up 1 January to 30 June 2014			Prescription, follow-up 1 July to 31 December 2014		
			Fully adjusted model			Fully adjusted model	
	N	Prescriptions (n=1257), % of N	HR	95% CI	Prescriptions (n=1268), % of N	HR	95% CI
No changes	6796	8.0	1.00		7.5	1.00	
Any changes	8242	8.6	1.09	0.97 to 1.22	9.3	1.25	1.11 to 1.41
Mergers	2560	8.2	1.05*	0.88 to 1.26	9.3	1.26*	1.06 to 1.50
Split-ups	956	7.2	0.87†	0.67 to 1.14	7.9	1.02†	0.79 to 1.31
Relocation	1872	7.8	1.02‡	0.82 to 1.28	8.6	1.16‡	0.93 to 1.44
Change in management	3781	9.2	1.20‡	1.03 to 1.41	10.3	1.42‡	1.22 to 1.65
Employee lay-off	3204	9.0	1.16§	0.97 to 1.39	9.6	1.23§	1.03 to 1.46
Budget cuts	2401	8.5	1.04¶	0.87 to 1.24	9.5	1.19¶	1.00 to 1.41

Results for covariates omitted as no noteworthy change in estimates were observed relative to table 2.
Fully adjusted model: 'Any changes' adjusted for all employee-level covariates and number of work-unit employee and in the fixed part and a random intercept for the work-unit level (model 3). Each type of organisational changes additionally adjusted for other changes as potential confounders on the association with psychotropic prescriptions:
*Split-ups and budget cuts; ‡budget cuts; ‡mergers and split-ups; §mergers, change in management and budget cuts; ¶change in management (model 4).

exposed to any of these changes as opposed to previous studies focusing on a single type of change. In addition, the nesting of employees within work units enabled us to adjust for clustering within work units. It was also a strength of the study that we used independent data sources hampering bias due to common variance regarding the exposure and outcome variables. Finally, data on psychotropic prescriptions were extracted from highly reliable national registers adding to the validity of the findings.

More research and practitioner attention should be devoted to the temporality in adverse effects of specific change types since mental health effects may develop over an extended period following the change event. The present study has highlighted change in management as a particular risk factor for employee mental health, and elucidating the underlying psychosocial mechanisms on this longitudinal association is an objective for future studies.

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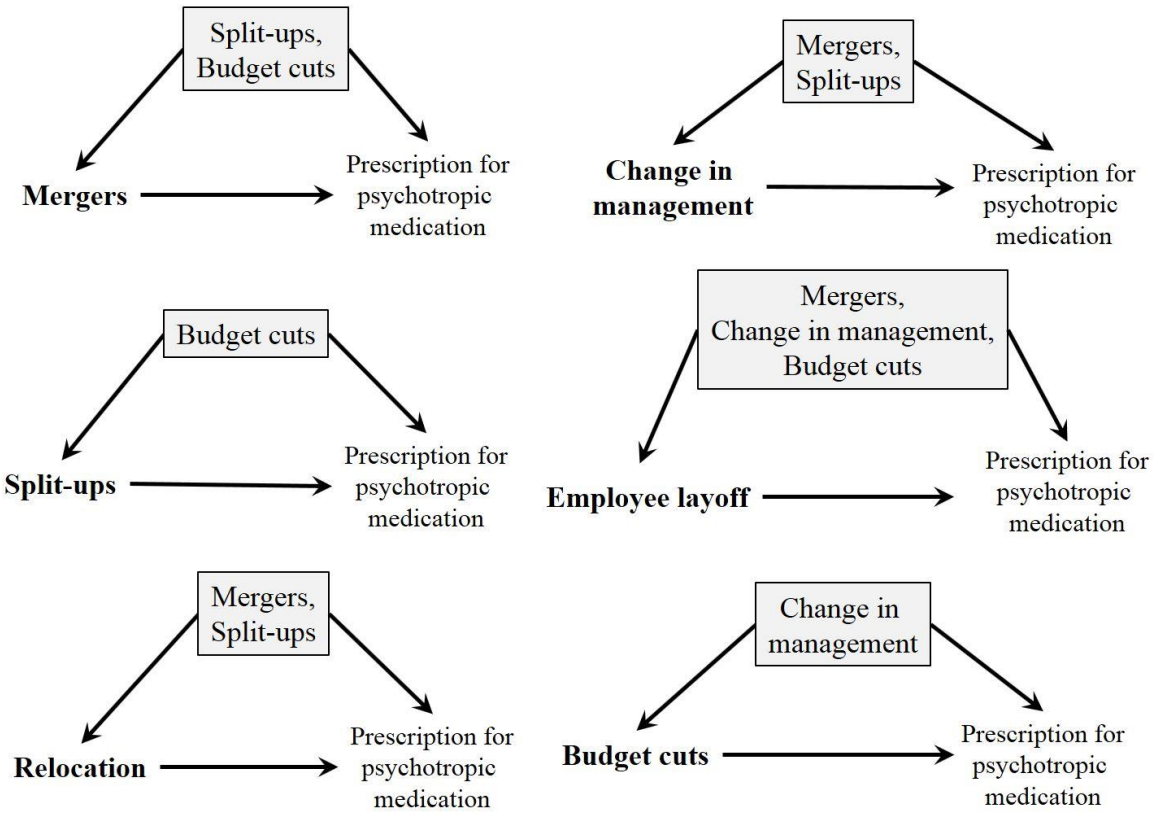
Supplementary material 1. *Co-occurring types of organisational changes at the employee-level among the study population* (*N*=15 038).

	Employees, *N*	Mergers, %	Split-ups, %	Relocation, %	Change in management, %	Employee layoff, %	Budget cuts, %
Any changes	8242	31	12	22	46	39	29
Mergers	2560		20	41	53	28	25
Split-ups	956	54		46	55	31	21
Relocation	1872	56	23		46	27	17
Change in management	3781	36	14	23		28	22
Employee layoff	3204	22	9	16	33		45
Budget cuts	2401	27	8	13	35	45	

Table should be read horizontally.

Supplementary material 2. *Association between work-unit organisational changes and prescriptions for psychotropic medication confounded by other types of changes.*



Supplementary material 3. *Four-step sequential modelling strategy used to assess confounding and variation in psychotropic prescriptions explained by the work-unit level.*

Model 1 (null): A model with a random-part intercept for the work-unit level to assess the variation in psychotropic prescriptions explained by any work-unit-level factors.
Model 2 (crude): As model 1, but entering an indicator of work-unit organisational changes in the fixed part to assess the crude association with psychotropic prescriptions for later comparison.
Model 3 (adjusted): As model 2, but adjusting for all employee-level covariates and number of employees within each work unit to assess confounding and the association between any organisational changes and psychotropic prescriptions conditioned on these covariates.
Model 4 (additionally adjusted for other changes): As model 3, but entering other relevant work-unit changes as covariates to assess the fully adjusted association between each type of change and psychotropic prescriptions relative to no change.

Supplementary material 4. *Additive and multiplicative interaction analyses.*

Differential effects of any changes on psychotropic prescriptions due to sex were evaluated with additive (i.e., combined effects) and multiplicative interaction analyses in terms of absolute and relative risk, respectively.
For additive interaction analysis, a new composite variable with three categories (a^-b^+, a^+b^-, and a^+b^+) were created for any change (a; no: $^-$, yes: $^+$) and sex (b; male: $^-$, female: $^+$). As recommended for survival models, we calculated the synergy index (S) for the combined effect of any changes and female using the following formula:

$$S = \frac{HR(a^+b^+)-1}{(HR(a^+b^-)-1)+(HR(a^-b^+)-1)}.$$

We estimated *S* for any changes and females since we were unable to calculate 95% CI to *S* for any changes and males. Given $S \neq 1$, *S* reflects the presence of additive interaction of both risk factors (any change and female) relative to both exposures *without* their additive interaction (de Mutsert et al., *Kidney Int*, 2009). We calculated 95% CIs as proposed by Andersson and colleagues (*Eur J Epidemiol*, 2005).

For multiplicative interaction analysis, differential effects of any changes on prescriptions for sex were evaluated by including an interaction term between indicator variables of any change and male in the regression model adjusted for the separate main effects of change and sex.

Supplementary material 5. *Hazard ratio (HR) and 95% confidence intervals (CI) for prescription of psychotropic medication in 2014 for females and males according to exposure to any organisational changes through 2013.*

	Male employees			**Female employees**		
	n	HR	95% CI	*n*	HR	95% CI
No changes	1588	1.00		5208	1.10	0.90-1.34
Any changes	1943	1.10	0.88-1.36	6299	1.26	1.01-1.48

Title: Work-unit organizational changes and risk of ischemic heart disease: a prospective study of public healthcare employees in Denmark

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ABSTRACT

Objectives: We prospectively examined the associations between different types of work-unit organizational changes and risk of ischemic heart disease (IHD) among public employees from the Capital Region of Denmark.

Methods: We used multilevel mixed-effects parametric survival models to assess the risk of incident IHD (hospital admission) during 2014 according to organizational changes in 2013 among 14,842 employees working in the same work unit from January through December 2013. We excluded employees with pre-existing IHD. Data on organizational changes defined as mergers, split-ups, relocations, change in management, employee layoffs, and budget cuts were obtained from work-unit managers (59% response).

Results: Specific indicators of organizational changes were associated with excess risk of IHD relative to no change, viz, relocation (HR 2.91, 95% CI: 1.07-7.90), employee layoff (HR 2.90, 95% CI: 1.36-6.16) and change in management (HR 2.18, 95% CI: 1.02-4.68). Including perceived stress as mediator in the regression models attenuated the relative risk only slightly (HR 2.81, 95% CI: 1.06-8.03, HR 2.78, 95% CI: 1.29-5.96, and HR 2.10, 95% CI: 0.97-4.54, respectively). No association with IHD was found for any changes (HR 1.50, 95% CI: 0.81-2.75), mergers (HR 0.75, 95% CI: 0.24-2.37), split-ups (HR 0.90, 95% CI: 0.20-4.07), or budget cuts (HR 0.93, 95% CI: 0.35-2.50).

Conclusions: Relocation, change in management or employee layoff at the work-unit level were associated with excess risk of incident IHD among the remaining employees relative to no change. Other types of organizational changes presently examined were not associated with excess relative risk of IHD.

Keywords: cardiovascular; downsizing; hospital employees; layoff; multilevel; organisational changes; reorganisation; reorganization; restructuring

WHAT THIS PAPER ADDS

What is already known about this subject?

- The potential adverse impacts of organizational changes on employee health are unclear.

What are the new findings?

- Exposure to relocation, change in management or employee layoff in the work unit were associated with higher risk of ischemic heart disease among employees from the same work unit relative to no work-unit organizational changes.
- Higher stress perceived by the individual employees did not appear to mediate these associations.
- Factors at the work-unit level accounted for 40% of the association between organizational changes and ischemic heart disease.

How might this impact on policy or clinical practice in the foreseeable future?

- Detrimental effects of organizational changes are not only a burden to the individual, but also to society.

INTRODUCTION

Organizational changes in workplaces have become a part of many employees' lives. Such changes seem to be motivated by a combination of rapid technological developments (e.g., digitalization of workflows) as well as globalization processes (e.g., flexibility of labor) and increasing concentration of capital.[1–3] Public-sector workplaces are no exception against these forces. During the last two decades, all public-sector hospitals in Denmark were required by the government to increase annual treatment rates by 1.5-2.0% without parallel budget adjustments.[4] This has led to numerous organizational changes (e.g., mergers, downsizing, implementation of new technology etc.) attempting to maximize efficiency. Increasingly, there are indications that organizational changes are extracting a cost in terms of employee health and psychological well-being.[5–8] The existing epidemiological literature on organizational changes and health is mainly based in Nordic studies and focuses on single types of changes (e.g., downsizing).[6] The majority of these studies show deleterious health effects among employees remaining after the changes,[5,6,9,10] although inconsistent evidence exists.[11,12] The Finnish 10-town study demonstrated a doubled risk of cardiovascular mortality among permanent employees related to major downsizing (i.e., >18% staff reduction). Interestingly, this excess risk of cardiovascular mortality was observed soon after downsizing, indicating a triggering effect.[13] No studies have yet focused on cardiovascular outcomes following other types of organizational changes, but there are reports of higher long-term sickness-absence rates following mergers, split-ups, reallocation of employees, and the establishment or shutting down of work units.[8,14]

Researchers have argued in favor of a causal relation between perceived stress and cardiovascular diseases,[15] and a meta-analysis found a 1.3-fold increased risk of coronary heart disease related to high perceived stress in the general population.[16] Also, there is evidence of increased use of medications for stress-related disorders following various types of organizational changes,[7] including downsizing.[17] One study found common stressful work-related events (e.g., pressure of deadlines, perceived competition) to trigger heart attacks, whereas no higher risks due to self-reported events of being laid-off/quitting.[18] Moreover, levels of blood pressure and mental distress have been found to be elevated shortly before and after reorganization involving change in management with strongest effects among employees reporting most future job uncertainty.[19]

In sum, organizational changes may be associated with a higher risk of cardiovascular diseases that is potentially mediated through work stress. Yet, there is a need for studies

examining these complex associations and distinguishing between different types of organizational changes.

We sought to investigate the prospective relations between work-unit organizational changes and ischemic heart disease (IHD) among public healthcare employees in the Capital Region of Denmark.

METHODS AND MATERIALS

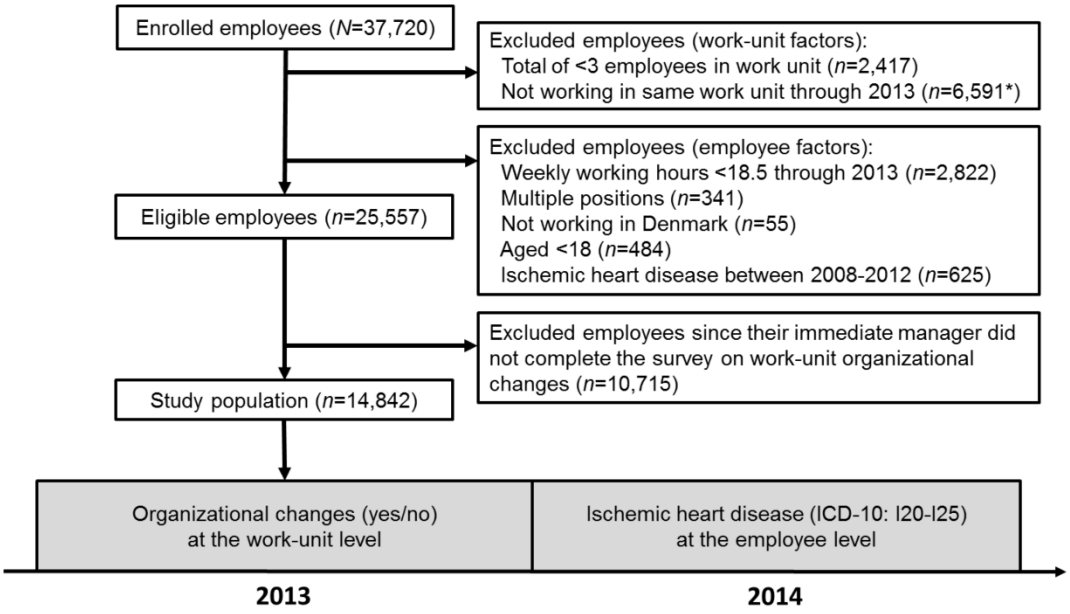
Data sources and population

This study used data from the *Well-being in Hospital Employees* (WHALE) cohort[20] to examine work-unit organizational change observed from 1 January through 31 December 2013 with follow-up on IHD among employees from baseline at 1 January through 31 December 2014. The source population was established when all 37,720 employees (nested in 2,696 work units nested in 14 institutions) in the Capital Region of Denmark were invited to take part in a work-environment survey in March 2014 (84% response). The vast majority of the surveys were administered by working email, and paper versions were distributed to employees with no working email (e.g., cleaning staff). The employees received up to 3 reminders on completing the survey.

We extracted complete sociodemographic and occupational information at baseline from company registers. Complete data on cause of death, date of hospital admission for IHD (ICD-10 codes: I20-I25), and personal gross income were obtained via linkage to national registers.

We included employees aged $\geq$18 years with $\geq$18.5 weekly working hours in the same work unit (or its derived unit if changes had occurred). We included employees from a work unit if $\geq$3 employees and $\geq$30% of the staff remained in the same unit throughout the period of observation on organizational changes. For example, if work-units *A* and *B* (each with 3 employees) merged into work-unit *C*, we included all 6 employees in the study population. We excluded smaller work units (fewer than 3 employees) as well as individuals with a personal history of IHD between 2008-2012 and employees working in a department in Spain. The final study population with complete data on work-unit organizational changes, event of IHD, and covariates included 14,842 employees nested in 1,283 work units nested in 13 institutions (Figure 1 and Supplementary material 1).

Figure 1. Study flow and design. Employees could have multiple causes of exclusion.



* Of these 5,442 employees did not work in the Capital Region of Denmark by 1 January 2013.

Work-unit organizational changes

From April through June 2016, we collected data on work-unit-level organizational changes by distributing an email survey to every manager in the source population. In this survey, each manager was asked to provide semi-annual information (yes/no) on the work unit that they managed regarding the occurrence of mergers, split-ups, relocation, change in management, employee layoff(s), and budget cuts in 2013 (59% response). At the work-unit level (level 2), we created an indicator variable (yes/no) for each of the six types of organizational changes occurring throughout 2013. Also, we created an indicator variable for any of these changes in the same period.

Ischemic heart disease

Employees were followed from baseline at 1 January 2014 to first-time hospital admission or death due to IHD (i.e., event), death not due to IHD (i.e., censoring) or end of study by 31

December 2014, whichever came first. Although data on IHD during 2015 were available, we did not use these because IHD-events in 2015 would likely be confounded by organizational changes occurring in 2014, which we had no data on.

Covariates

The following employee-level variables were included as potential confounders of the relation between work-unit organizational changes and IHD: age, sex, occupational group, seniority, full-time employment, manager status, contractual employment, personal gross income, and days of sickness absence in 2012. We also included number of employees within work units as a potential work-unit-level confounder. Since different types of organizational changes were partially overlapping, we included a priori selected work-unit level variables as potential confounders (Supplementary materials 2-4). For example, confounders for employee layoff and IHD included mergers, change in management, and budget cuts.

Employee perceived stress was measured with the item *"To what degree have you been stressed for the last six months?*" using a 5-point scale ranging 1=*"Not at all"* to 5=*"Very high degree"*. Non-respondents in the study population (15%) were included in the analyses.

Statistical analyses

Hazard ratios (HR) and 95% confidence intervals (CI) from multilevel mixed-effects parametric survival models were used to assess the relations between work-unit organizational changes in 2013 and days to IHD through 2014. Employees (level 1) were nested within work units (level 2), which again were nested within institutions (level 3) to account for clustering in the hierarchical structure of the data.

We fitted models with a Weibull distribution because we expected the effect of organizational changes on subsequent IHD to decrease monotonically during follow-up.[21] Employees that experienced organizational change would likely establish stressful new workflows as standard during the following year. We assessed the proportion of variance explained by the organizational higher levels as this could be a target of intervention. This was done by rerunning the Weibull model but with Accelerated-Failure Time (AFT) parametrization to calculate the Intraclass Correlation Coefficient (ICC) using the following formula for work unit *j* and institution *k*:

$$ICC_{j,k} = \frac{\sigma_j^2+\sigma_k^2}{\sigma_i^2+\sigma_j^2+\sigma_k^2} \text{ and } ICC_k = \frac{\sigma_k^2}{\sigma_i^2+\sigma_j^2+\sigma_k^2}, \text{ respectively, where } \sigma_i^2 = \frac{\pi^2}{6 * \exp(\rho^2)}$$

and ρ is the ancillary parameter from the Weibull model.[22] Using AFT parametrization does not change the fitted Weibull model – only the interpretation of the output[21]. The $ICC * 100$ can be interpreted as the percentage of total variance in IHD-event explained by each higher organizational level.[23] This could be any factor differing between work units (e.g., organizational changes, medical specialties) and between institutions (e.g., local policies on working environment).

We used a six-step sequential modeling strategy as follows:

Model 1: A null model with a random intercept for the work-unit level. Assesses the proportion of IHD-variation explained by factors at the work-unit level.

Model 2: As model 1, but nesting the work-unit level within the institutional level (null multilevel model with three levels). Assesses the proportion of IHD-variance explained by factors at the work-unit (nested within institutions) and the institutional level.

Model 3: As model 1, but entering only the indicator variable for any work-unit organizational change (random-intercepts model with two levels). Assess the crude association between any organizational change and risk of IHD for future comparison.

Model 4: As model 3, but entering work-unit-level organizational change variables in the fixed part (random-intercepts model with two levels). Assesses the risk of IHD explained by the organizational-change indicators conditioned on employee-level confounders and latent work-unit-level factors.

Model 5: As model 4, but nesting the work-unit level within the institutional level (random-intercepts model with three levels). Risk estimates of IHD additionally conditioned on latent institutional-level factors.

Model 6: As model 5, but entering work-unit level confounder(s) when modeling each type of change (random-intercepts model with three levels). Allows interpretation of the relative IHD-risk associated with each change conditioned on employee-level factors, confounding work-unit-level changes, and latent work-unit and institutional-level factors.

The mediating roles of perceived stress were assessed by comparing the risk estimates from each model with and without the perceived-stress variable. A reduced risk estimate when included was taken as evidence of mediation.[24]

A significance level of 0.05 was used throughout. The statistical analyses were performed in STATA version 14.2 software (Stata Corporation, College Station, TX, USA).

RESULTS

The descriptive statistics and data structure of the study population are shown in Table 1 and Supplementary material 1. The study sample predominantly comprised females, nursing-care workers, and employees with permanent employment, where about half of the work units (and employees) were exposed to any organizational changes. All 49 IHD-events in 2014 were due to hospital admission.

Table 1. Data structure and variables for the study population.

	Categories	Study population, *n* (% of *N*)	Exposed to any changes, *n* (% of *N*)
Level 1: Employees, *N*		14,842 (100)	8130 (100)
Hospital admission for ischemic heart disease, no / yes		14,793 / 49	8099 / 31
Days to event, *M* (SD)		200 (105)	203 (107)
Years of age, *M* (SD)		47 (10.6)	47 (10.7)
Sex	Females*	11,392 (77)	6226 (77)
	Males	3450 (23)	1904 (23)
Occupational group	Medical doctors/dentists*	1441 (10)	742 (9)
	Nursing-care workers	6472 (44)	3649 (45)
	Social/healthcare workers	2336 (16)	1255 (15)
	Service/technical workers	1820 (12)	955 (12)
	Administration workers	2773 (19)	1529 (19)
Seniority, years	1-4*	3097 (21)	1709 (21)
	4-10	3789 (26)	2057 (25)
	10-20	4048 (27)	2212 (27)
	20≤	3908 (26)	2152 (26)
Full-time employment	No*	5362 (36)	2964 (36)
	Yes	9480 (64)	5166 (64)
Manager	No*	13,862 (93)	7490 (92)
	Yes	980 (7)	640 (8)
Contractual employment	No*	1037 (7)	476 (6)
	Yes	13,805 (93)	7654 (94)
Personal gross income, DKK	<345,000*	4384 (30)	2430 (30)
	345,000-400,000	3805 (26)	2093 (26)
	400,000-480,000	3423 (23)	1829 (23)
	480,000<	3230 (22)	1778 (22)
Sickness absence in 2012, days	No days*	4095 (28)	2250 (28)
	1-3	3208 (22)	1739 (21)
	4-6	2269 (15)	1261 (16)
	7-13	2841 (19)	1499 (18)
	14≤	2429 (16)	1381 (17)
Perceived stress	*Not at all**	3341 (23)	1716 (21)
	Lesser degree	4724 (32)	2503 (31)
	Some degree	1420 (10)	794 (10)
	High degree	2284 (15)	1316 (16)
	Very high degree	937 (6)	585 (7)
	Non-respondents	2136 (14)	1216 (15)
Level 2: Work units, *N*		1283 (100)	642 (100)
Organizational changes	No changes*	641 (50)	
	Any changes	642 (50)	642 (100)

	Categories	Study population, *n* (% of *N*)	Exposed to any changes, *n* (% of *N*)
	Mergers	195 (15)	195 (30)
	Split-ups	75 (6)	75 (12)
	Relocation	157 (12)	157 (24)
	Change in management	294 (23)	294 (46)
	Employee layoff	245 (19)	245 (38)
	Budget cuts	191 (15)	191 (30)
Number of employees within work unit	3-12*	653 (51)	283 (44)
	13-22	306 (24)	164 (26)
	23-32	198 (15)	116 (18)
	33-142	126 (10)	79 (12)
Level 3: Institutions, *N*		13 (100)	13 (100)

* Reference group for categorical variables. DKK = Danish Kroner.

During follow-up through 2014, seven employees died due to other reasons than IHD and were thus censored. Table 2 shows the risk of IHD related to all employee-level confounders, exposure to any work-unit organizational change, and perceived stress. Models 1-2 indicate that the work-unit-level and the institutional-level accounted for ≈40% and ≈5%, respectively, of the total variance. Models 3-5 show that the HR estimates for any organizational change relative to no change increased slightly from 1.46 (95% CI: 0.79-2.69) to 1.50 (95% CI: 0.81-2.75) when including all employee-level variables in the fixed part and the institutional level in the random part. Models 4-5 show that the HR of IHD associated with any organizational change somewhat attenuated from 1.50 (95% CI: 0.81-2.75) to 1.45 (95% CI: 0.78-2.69) when accounting for perceived stress in the regression model. Despite weak statistical evidence, the direction of the HR-point estimate indicated a higher risk of IHD among employees reporting a very high degree of perceived stress relative to those reporting no stress at all.

Table 2. Hazard ratios (HR) and 95% confidence intervals (CI) for incident ischemic heart disease in 2014 (*n*=49) among the study population (*N*=14,842).

	Model 1 (null)	**Model 2 (null)**	**Model 3**		**Model 4**		**Model 5 (main model)**		**Model 5 + perceived stress**	
Fixed part			HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Work-unit-level variables (L 2)										
Any work-unit changes in 2013[a]			1.46	0.79-2.69	1.50	0.81-2.75	1.50	0.81-2.77	1.45	0.78-2.69
Number of employees in work unit[b]										
13-22					1.32	0.61-2.91	1.32	0.60-2.89	1.31	0.59-2.88
23-32					0.77	0.30-2.02	0.78	0.30-2.03	0.76	0.29-2.00
33-142					1.06	0.43-2.58	1.07	0.44-2.63	1.04	0.42-2.58
Individual-level variables (L 1)										
Age					1.09	1.04-1.13	1.09	1.05-1.13	1.09	1.05-1.14
Male[c]					2.59	1.25-5.34	2.59	1.25-5.34	2.65	1.27-5.50
Occupational group[d]										
Nursing-care workers					1.69	0.45-6.35	1.66	0.44-6.27	1.73	0.45-6.61
Social/healthcare workers					1.46	0.33-6.34	1.42	0.32-6.24	1.45	0.33-6.44
Service/technical workers					3.18	0.84-12.04	3.07	0.80-11.74	3.11	0.81-12.02
Administrative workers					2.13	0.59-7.67	2.08	0.57-7.62	2.15	0.58-7.95
Seniority, years[e]										
1-3					1.94	0.53-7.17	1.96	0.53-7.23	1.91	0.52-7.04
11-20					1.39	0.37-5.30	1.39	0.37-5.31	1.40	0.37-5.34
21≤					2.30	0.61-8.60	2.29	0.61-8.59	2.29	0.61-8.64
Full-time, yes[f]					0.73	0.35-1.53	0.73	0.35-1.52	0.72	0.34-1.51
Manager[g]					0.91	0.29-2.88	0.89	0.28-2.84	0.91	0.28-2.90
Contractual employment, yes[h]					0.84	0.35-2.01	0.83	0.35-2.01	0.84	0.35-2.05
Personal gross income, DKK[i]										
345,000-400,000					0.76	0.32-1.76	0.76	0.32-1.77	0.78	0.33-1.82
400,000-480,000					0.86	0.35-2.12	0.86	0.35-2.13	0.88	0.36-2.18
480,000<					1.46	0.55-3.84	1.45	0.55-3.82	1.49	0.57-3.93
Sickness absence in 2012, days[j]										
1-3					0.61	0.22-1.74	0.61	0.22-1.74	0.61	0.21-1.73
4-6					1.18	0.46-3.02	1.18	0.46-3.02	1.16	0.45-2.98
7-13					1.80	0.81-4.02	1.80	0.81-4.02	1.75	0.78-3.92
14≤					1.55	0.66-3.64	1.55	0.66-3.63	1.47	0.62-3.47
Perceived stress[k]										
"Lesser degree"									1.18	0.51-2.72
"Some degree"									0.99	0.26-3.71
"High degree"									1.30	0.47-3.55
"Very high degree"									2.64	0.91-7.61
Non-respondents									1.44	0.55-3.74
Random part										

	Model 1 (null)	Model 2 (null)	Model 3		Model 4		Model 5 (main model)		Model 5 + perceived stress	
Fixed part			HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
ICC for work units (L 2), (*p*-value)	0.41, (0.01)	0.42, (0.01)	0.41, (0.01)		0.28, (0.25)		0.30, (0.21)		0.32, (0.15)	
ICC for institutions (L 3), (*p*-value)		0.06, (0.65)					0.03, (0.67)		0.03, (0.63)	

Model 1: Random intercept for the work-unit level. *Model 2*: As model 1, but nesting the work-unit level within the institutional level. *Model 3*: As model 1, but entering work-unit-level organizational changes in the fixed part.. *Model 4*: As model 3, but entering all employee- and work-unit-level covariates to the model in the fixed part. *Model 5*: As model 4, but nesting the work-unit level within the institutional level.

Reference categories: [a]No work-unit changes in 2013, [b]3-12 employees in work unit, [c]Females, [f]Medical doctors and dentists, [e]1-4 years, [f]Part-time employment, [g]Not manager, [h]Permanent contract, [i]345,000> DKK, [j]No days, [k]*Not at all*.

DKK = Danish Kroner, L = Level, ICC = Intra-class Correlation Coefficient.

In Table 3, model 6 (main model) show that there was a higher risk of IHD following relocation (HR 2.91, 95% CI: 1.07-7.90), change in management (HR 2.18, 95% CI:1.02-4.68) or employee layoff (HR 2.90, 95% CI:1.36-6.16). Any change, mergers, split-ups, and budget cuts were not associated with a higher risk of IHD. When adjusting for other confounding work-unit organizational changes the HR point estimates of all change indicators increased (models 5-6). Including perceived stress as a potential mediator in model 6 attenuated the HR point estimates slightly.

Table 3. Hazard ratios and 95% confidence intervals for incident ischemic heart disease through 2014 after each type of changes relative to no changes through 2013. Intraclass correlation coefficients (ICC) for work-units (level 2) and institutions (level 3).

			Model 5				**Model 6 (main model)**				**Model 6 + perceived stress**			
					ICC, (*p*-value)				*ICC*, (*p*-value)				*ICC*, (*p*-value)	
	N	Cases, *n*	HR	95% CI	Work units	Institutions	HR	95% CI	Work units	Institutions	HR	95% CI	Work units	Institutions
No changes*	6712	18	1.00				1.00				1.00			
Mergers	2532	4	0.57	0.18-1.76	0.29, (0.24)	0.04, (0.55)	0.75[a]	0.24-2.37	0.23, (0.40)	0.06, (0.48)	0.72[a]	0.23-2.30	0.26, (0.30)	0.06, (0.46)
Split-ups	950	*≤2	0.80	0.18-3.60	0.28, (0.25)	0.03, (0.64)	0.90[b]	0.20-4.07	0.24, (0.40)	0.04, (0.59)	0.87[b]	0.19-3.95	0.32, (0.14)	0.04, (0.54)
Relocation	1852	7	1.61	0.63-4.11	0.30, (0.21)	0.03, (0.67)	2.91[c]	1.07-7.90	0.28, (0.25)	0.05, (0.52)	2.81[c]	1.06-8.03	0.30, (0.19)	0.05, (0.49)
Change in management	3726	14	1.50	0.72-3.12	0.30, (0.21)	0.03, (0.67)	2.18[c]	1.02-4.68	0.27, (0.27)	0.05, (0.51)	2.10[c]	0.97-4.54	0.30, (0.21)	0.05, (0.49)
Employee layoff	3155	20	2.19	1.12-4.30	0.25, (0.34)	0.02, (0.79)	2.90[d]	1.36-6.16	0.17, (0.57)	0.04, (0.57)	2.78[d]	1.29-5.96	0.20, (0.46)	0.05, (0.54)
Budget cuts	2364	6	0.91	0.35-2.36	0.26, (0.32)	0.03, (0.63)	0.93[e]	0.35-2.50	0.26, (0.32)	0.03, (0.64)	0.91[e]	0.34-2.48	0.29, (0.24)	0.04, (0.59)

* Reporting of cells with ≤2 observations is restricted by Statistics Denmark.

Results from the employee-level variables are omitted, because these did not change noteworthy relative to those reported in Table 2. * Reference category.

Model 5: In the fixed part, analyses adjusted for age, sex, occupation, seniority, full-time employment, manager status, contractual employment, personal income, previous sickness absence at the employee-level (level 1), and number of employees within work units (level 2) at the work-unit level. The work-unit (level 2) and the institutional level (level 3) were included as random intercepts. Exposure to each type of work-unit organizational change (level 2) were modeled separately in the fixed part.

Model 6: As model 5, but analyses were adjusted for other types of work-unit changes as potential confounders (level 2), accordingly:

[a]Split-ups and Budget cuts, [b]Budget cuts, [c]Mergers and Split-ups, [d]Mergers, Change in management, and Budget cuts, [e]Change in management.

Sensitivity analyses

To assess the impact of missing data on organizational changes, we conducted a sensitivity analysis where all eligible employees with missing data on changes were assigned to the reference category of "no changes". Similar results were found for any change (HR 1.54, 95% CI: 0.94-2.52) compared to those in Table 2 (HR 1.50, 95% CI: 0.81-2.77), indicating no impact of missing data on changes.

We assessed if the marked risk directions of the highest categories of seniority and income were due to residual age-confounding by stepwise adding age^2 and age^3 in models 3-5 (Table 2). Including neither age^2 nor age^2 and age^3 changed the point estimates for HR meaningfully, suggesting no residual confounding by age.

Study participation required working in the same work unit through 2013, but some laid-off employees could be included in the study population if their termination period extended into 2014. Employment termination periods ranged three to six months depending on seniority. To assess if the employee-layoff effects were attributed to poor health status among those laid off, we restricted model 6 for "employee layoff" to changes occurring only in the first semester of 2013 (i.e., exposure and covariates at level 2), while keeping the follow-up period through 2014 unaltered. An employee laid off in the first semester of 2013 would terminate the employment in the last semester 2013 and thus not be included for follow-up on IHD. Results from this sensitivity analysis supported the excess risk of IHD following employee layoff (HR 2.59, 95% CI 1.09-6.18) relative to no changes.

DISCUSSION

Relocation, change in management or employee layoff in the work unit were associated with a higher risk of hospital admission for IHD among the employees remaining during these changes relative to no changes. Indication of any changes, mergers, split-ups or budgets cuts were not associated with IHD. The HR point estimates of all change indicators decreased only slightly when adjusting for perceived stress, indicating that this psychosocial factor is not an important mediator of the association.

Previous findings and potential mechanisms

Our finding of a 2.9-fold higher risk of IHD in the year after employee layoff in the work unit is consistent with the 5.1-fold higher cardiovascular mortality in the first 4 years following major downsizing among employees who kept their job reported in a Finnish study.[13] In the same study, minor downsizing (8-18% staff reduction) was not associated with a higher risk of cardiovascular mortality (although estimates pointed in this direction),[13] indicating some sensitivity towards the proportion of laid-off employees. As termination periods extended up to six months in our study, some employees laid-off in 2013 may be included in the study population with follow-up on IHD in 2014. However, a sensitivity analysis showed that employee layoff occurring in the first semester of 2013 only was related to a similar high risk of IHD through 2014 (HR: 2.6 vs. HR: 2.9), suggesting that the present employee-layoff effects on IHD were attributed to the employees who kept their job in 2013.

We also found that relocation and change in management were associated with a marked excess risk of IHD. To the extent of our knowledge this is the first study to demonstrate associations between these types of organizational changes and cardiovascular diseases although there is some prior evidence of associations with other adverse outcomes.[8,14,25] The HR estimate of any changes pointed to a higher risk of IHD. Indeed, this result was inadequately supported in the data.

Episodic stressors (e.g., anger, emotional upset) could lead to cardiovascular events among individuals with advanced atherosclerotic plaque formation in coronary arteries.[26] Organizational changes inducing job insecurity could be regarded such stressor.[27] However, we found no convincing indications of perceived stress mediating the association between changes and IHD. Indeed, this could also be due to using a perceived-stress measure of 1 item only as indicated by the broad confidence intervals in Table 2. A previous study demonstrated that the effects of major downsizing on medically certified sickness absence were mediated by

changes in physical demands, job control, and job insecurity.[28] Working in the public sector of Denmark is generally considered as a secure employment. The relatively low unemployment rate in this region decreased from 6.0% to 5.3% between 2013-2014,[29] suggesting that long-term unemployment would not be a feared consequence following organizational changes among many of the employees examined.

We did, however, find that latent factors at the work-unit level explained a large proportion of the variation in IHD-events. Such factors may comprise the magnitude of the changes, communication to the employees about the changes or the management style. Future studies should examine mechanisms at the work-unit level potentially mediating the excess risk of cardiovascular diseases that may follow organizational changes, such as employee layoff, change in management or relocation.

Strengths and limitations

Limitations are highlighted in the following. First, the potential impacts of reorganization on IHD before and during the changes were not examined. We started follow-up at 1 January 2014 to ascertain that the IHD-event occurred after potential exposure to changes in 2013. Second, we did not have data to account for organizational changes during the follow-up period. This may have underestimated the results as the reference category of work units not changed through 2013 would be more likely to be reorganized in 2014 than work units changed recently. Third, the reorganization itself could layoff managers and therefore cause missing data on changes as these were collected retrospectively via email. Indeed, the email addresses was not changed if the managers remained employed within the Capital Region of Denmark, and a sensitivity analysis suggested no impact of missing data on changes. The statistical power of the analyses of specific types of changes is limited with a risk of type-II statistical error as evidenced by broad 95% CIs. Since the hypothesis is addressing short-term effects of organizational changes an extension of the follow-up period will not increase the power.

This study has several strengths. First, data on changes, event of IHD, and perceived stress originated from independent sources and thus common-method bias is not an issue.[30] Second, organizational changes were measured at the work-unit level ensuring that the employees did experience the potential reorganization. Third, we included only those employees, who worked in the same work unit during the observation of changes, which, again, ensured that the employees were actually affected by the changes. Fourth, we accounted for clustering on two higher levels in the organizational structure, which allowed us

to assess variance explained by latent institutional and work-unit-level factors. Finally, we consider it as a strength of the study that we assessed the relative risk of IHD following various and frequently occurring types of changes. This also allowed us to establish a purer reference group of no changes as compared to prior studies examining a single type of change.

We were surprised to find such excess relative risks of IHD after various changes given the widespread practice of workplace reorganization. Indeed, all findings should be interpreted cautiously since associations could be observed by chance given the somewhat few IHD-events examined (*n*=49).

This study demonstrated a higher risk of IHD among the employees who kept their job during relocation, change in management or employee layoff in the work unit relative to no organizational changes. There were no association with IHD after exposure to any change examined, mergers, split-ups or budget cuts. Inferences to other workplace contexts should be made cautiously because of the few IHD events and composition of the study population.

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Contributorship

JHJ had full access to all data provided in the present study, and JHJ takes responsibility for the integrity and the accuracy of the data analyses. All authors were responsible for the current study design. JHJ wrote the initial draft of the manuscript. All authors contributed to the present study and approved the final draft of the manuscript.

Competing interests

None declared.

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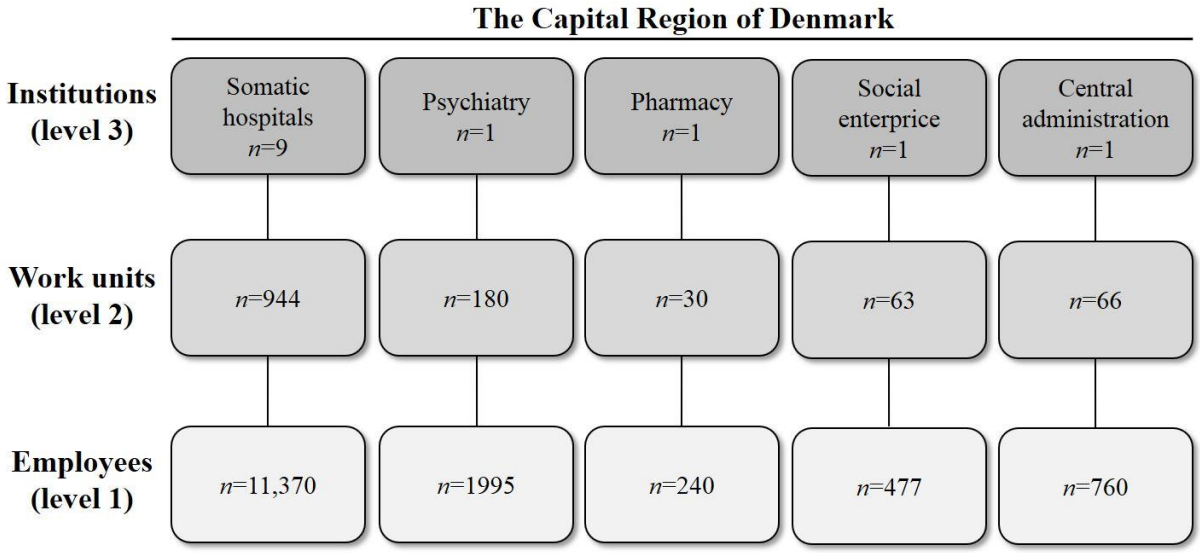
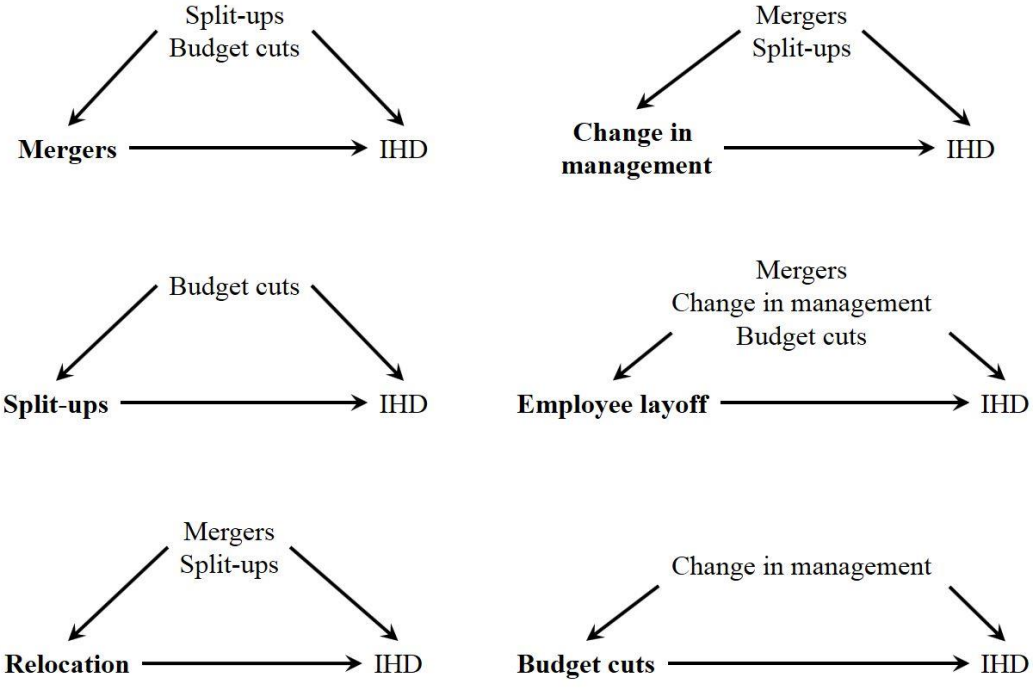
Supplementary materials 1-4

Supplementary material 1. Diagram of the 3-level organizational data structure of the study population.



Supplementary material 2. Directed acyclic graphs for other types of organizational changes (level 2) confounding the relation between each of the six types of changes examined and incident ischemic heart disease (IHD).



Supplementary material 3. Overlap in the six types of organizational change (level 2) experienced by the employees (level 1) in study population (*n*=14,842).

	Employees, *n*	Mergers, %	Split-ups, %	Relocation, %	Change in management, %	Employee layoff, %	Budget cuts, %
Any change	8130	31	12	23	46	39	29
Mergers	2532		20	41	53	28	25
Split-ups	950	54		46	55	31	21
Relocation	1852	56	23		46	26	17
Change in management	3726	36	14	23		28	22
Employee layoff	3155	22	9	15	33		33
Budget cuts	2364	27	8	13	35	45	

Supplementary material 4. Overlap in the six types of organizational change (level 2) experienced by the employees (level 1) with ischemic heart disease in 2014 (*n*=49).

	Employees with IHD-event, *n*	Mergers, %	Split-ups, %	Relocation, %	Change in management, %	Employee layoff, %	Budget cuts, %
Any change	31	13	6	23	45	65	19
Mergers	4		0	75	50	75	25
Split-ups	*≤2	-	-	-	-	-	-
Relocation	7	43	0		43	57	14
Change in management	14	14	14	21		64	7
Employee layoff	20	19	13	19	44		6
Budget cuts	6	17	17	17	17	17	

* Reporting of cells with ≤2 observations is restricted by Statistics Denmark.