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What characterises work and workplaces that retain their employees following acquired brain injury?

Systematic review

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ABSTRACT

Objectives The objective of this study was to conduct a systematic review assessing workplace factors related to work retention (or return to work) in employees with acquired brain injury (ABI). Additionally, we aimed to synthesise the evidence and state of knowledge on this subject.

Methods A database search was performed in nine relevant electronic databases. Inclusion criteria were quantitative peer-reviewed publications empirically investigating the relationship between work/workplace factors and work retention in employees following ABI. The methodological quality was determined by Effective Public Health Practice Project scoring, and evidence was synthesised narratively.

Results Thirteen studies were included. We found moderate evidence for a negative relationship between manual work and work retention. We also found limited evidence for a U-shaped relationship between workload and complete work retention at 6 months and no relationship at 12 months; a positive relationship between managers, compared with non-managers, and faster work retention; a positive relationship between large enterprise size defined as ≥ 250 employees, and no relationship between large enterprise size, defined as ≥ 1000 employees, and work retention.

Conclusion Relative to individual factors, there is little evidence on specific workplace factors' relationship to work retention among employees with ABI. For most workplace factors, there were too few high-quality studies to designate evidence as more than limited or insufficient. Future studies should replicate rigorous studies of well-defined modifiable workplace factors related to work retention.

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INTRODUCTION

Acquired brain injury (ABI) is defined as damage to the brain caused by traumatic or non-traumatic injury.¹ *Traumatic* brain injury (TBI) refers to non-congenital and nondegenerative damage to the brain that is inflicted by an external force. *Non-TBI*, on the other hand, refers to a range of neurological illnesses (eg, stroke, tumours, brain infections and hypoxia). Although the distinction between TBI and non-TBI is essential for defining early patient management programmes, research suggests that patients suffering from any of the two types of brain injuries report similar challenges

Key messages

What is already known about this subject?

► Most single studies and reviews on factors related to return to work for employees with acquired brain injury (ABI) focus on unmodifiable, individual factors such as age, gender and medical characteristics. Although important, individual factors alone cannot translate into guidelines for adaptations at workplaces in order to increase work retention.

What are the new findings?

► This is the first review to focus and systematically summarise evidence on workplace factors associated with work retention after ABI. The review identified few studies and little sound evidence regarding the specific workplace factors of importance. We found moderate evidence that manual work was negatively associated with work retention, while there was limited and equivocal evidence for the relationship between managerial role, workload and enterprise size, and work retention.

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

► Future studies should examine specific modifiable workplace factors by using rigorous designs and well-defined and comparable definitions of work retention. This is necessary to enable the transfer of evidence synthesis into clinical and policy impact. Until then, we suggest that workplaces pay special attention to manual workers after ABI, researchers replicate the strong-quality and moderate-quality studies identified in this review to increase evidence base, and that employers temporarily rely on review findings from other diagnostic groups.

when returning back to work. Some of the similar and important barriers are cognitive disabilities, emotional problems and fatigue.¹ Further, individuals with ABI tend to shift focus from work to their social networks, struggling to return to a state of normality at the workplace, and perceiving a threat to their competence and work identity. These similarities justify our approach to combine both types

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of brain injuries when studying work retention, as other studies have done.

Both traumatic and non-traumatic ABI can lead to permanent or temporary disabilities that may limit individuals in their daily activities at home and at work. The prevalence of long-term disability resulting from TBI has been estimated at 3.32 million² to 5.3 million³ in the USA, and 7.7 million people in the European Union.⁴ For stroke, the estimated global burden included more than eight million survivors in 2016.⁵ Hence, ABI imposes a heavy societal burden due to the healthcare and social and vocational support costs, as well as disability pensions involved.^{6,7}

Approximately 70% of patients with ABI are of working age.² Studies show that both types of ABI negatively affect work retention or return to work (RTW). People with ABI are employed less often, and when employed, they frequently experience difficulties in meeting the physical, cognitive or psychosocial demands of the workplace.^{8,9} To improve work participation rates after ABI, we need to increase the understanding of what characterises workplaces that retain their employees following ABI.

The complexity of the relationship between brain injury and RTW has been underlined in different reviews.^{9–12} Shwarz *et al*¹⁰ pointed out four types of factors predicting RTW: individual, workplace, rehabilitation and their interaction. The authors proposed that a model predicting RTW after stroke should include diverse factors and stakeholders, such as employees, employers, vocational therapists and families.

Most studies investigating work retention after ABI include only individual factors.^{13–22} Well-established individual factors related to increased work retention are lower injury severity, higher education and male gender. Although undoubtedly important, individual factors alone cannot translate into guidelines for adaptations at workplaces to increase work retention. Compared with individual factors, specific workplace factors are relatively scarce in original studies. Studies that do include workplace factors tend to include them across vast patient populations (all types of injuries),²³ in general terms (eg, as one of many overarching factors²⁴ or parts of a complex intervention),^{8,20,25,26} and lack specificity as to which particular workplace factors are effective. For instance, Donker-Cools *et al* found strong evidence of the effectiveness of work-directed interventions combined with education or coaching,⁸ while other general reviews report that interventions were similarly effective.^{20,25,26} Although informative, reviews including general workplace factors do not identify specific workplace factors associated with work retention. In addition to the skill-advancing programme that aids RTW, there is a need to develop programmes that address the struggles faced by former patients with ABI to retain work. A deeper understanding of the workplace factors that facilitate work retention among former patients with ABI is thus necessary for the development of such programmes. However, to the best of our knowledge, there are no systematic reviews examining the relationship between workplace factors and work retention after ABI. The objective of the current study was thus to fill this gap with a comprehensive systematic review to assess the evidence and state of knowledge regarding workplace factors' role in work retention after ABI.

METHODS

A systematic search using keywords and medical subject heading terms was conducted in February 2018, in the electronic databases Ovid, Web of Science, Scopus, Embase, PsycINFO, SocIndex, Cinahl, Academic search premier, Cochrane Library and Norart. We combined two clusters of keywords and

subject headings related to (1) the participants (eg, brain injury, acquired, traumatic and stroke) and (2) the outcome (eg, work/job/employment maintenance, tenure, retention, hours and RTW). This combination of search words enabled any workplace factor (including terminology from other disciplines) to be identified during screening. We collaborated closely with librarians who specialised in systematic reviews and tried out different words and combinations that enabled the identification of as many relevant workplace factors as possible (see appendix 1 for the complete search strategy for each database). At least two reviewers screened the abstracts independently of each other with the online tool Covidence.²⁷ In cases of disagreement, the reviewers discussed until concordance was reached, or a third reviewer was involved. Relevant full texts were retrieved and read.

This systematic review is registered with International Prospective Register of Systematic Reviews (PROSPERO).²⁸ Guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols checklist²⁹ and the 'PICO' approach were used.³⁰ The review team was multidisciplinary and consisted of researchers within the field of occupational psychology, work sociology and neurorehabilitation. In the original protocol, the review included both quantitative and qualitative studies. To improve coherence when synthesising data, we split the original mixed-method review into two manuscripts: one including quantitative studies (the current review) and one including qualitative studies to be published later. Qualitative studies are characterised 'wrong study design' in the current review (see figure 1), and deviation from protocol is documented in PROSPERO.

Inclusion and exclusion criteria

Inclusion criteria were peer-reviewed publications quantitatively and empirically investigating the relationship between workplace factors and work retention/RTW in adult employees (ages 18–65 years) in paid employment at the time of ABI. The exposure of interest included all types of workplace factors. Examples of workplace factors were work accommodation, work adaptation, flexible work hours, workplace size, interventions involving the workplace, and social support by coworkers and managers. Occupational role was included in the framework of workplace factors because it describes characteristics of the occupation that are related to work retention and can be modified by the workplace to adapt work for employees with brain injury. Individual factors not pertaining to the workplace (eg, personality, age, injury characteristics and medical variables) were excluded from this review. The outcome of interest was work retention (eg, maintenance, tenure and persistent RTW) operationalised in measure of time (eg, days and years) and dichotomous outcomes (eg, work participation 6 months after RTW: yes/no). Studies were included if the relationship between exposure and the outcome variables was tested for statistical significance. There was no publication year limit, as we expected to find few studies investigating the same specific workplace factor and aimed for a wide search. Language was restricted to English, Norwegian, Danish, Swedish, Spanish and Portuguese.

Data extraction

One reviewer extracted data from the included studies, which was double-checked by another reviewer. The data were extracted with a preagreed-upon standardised form covering (1) any workplace factor ('the exposure factor') investigated in relationship to the outcome; (2) operationalisation of the work

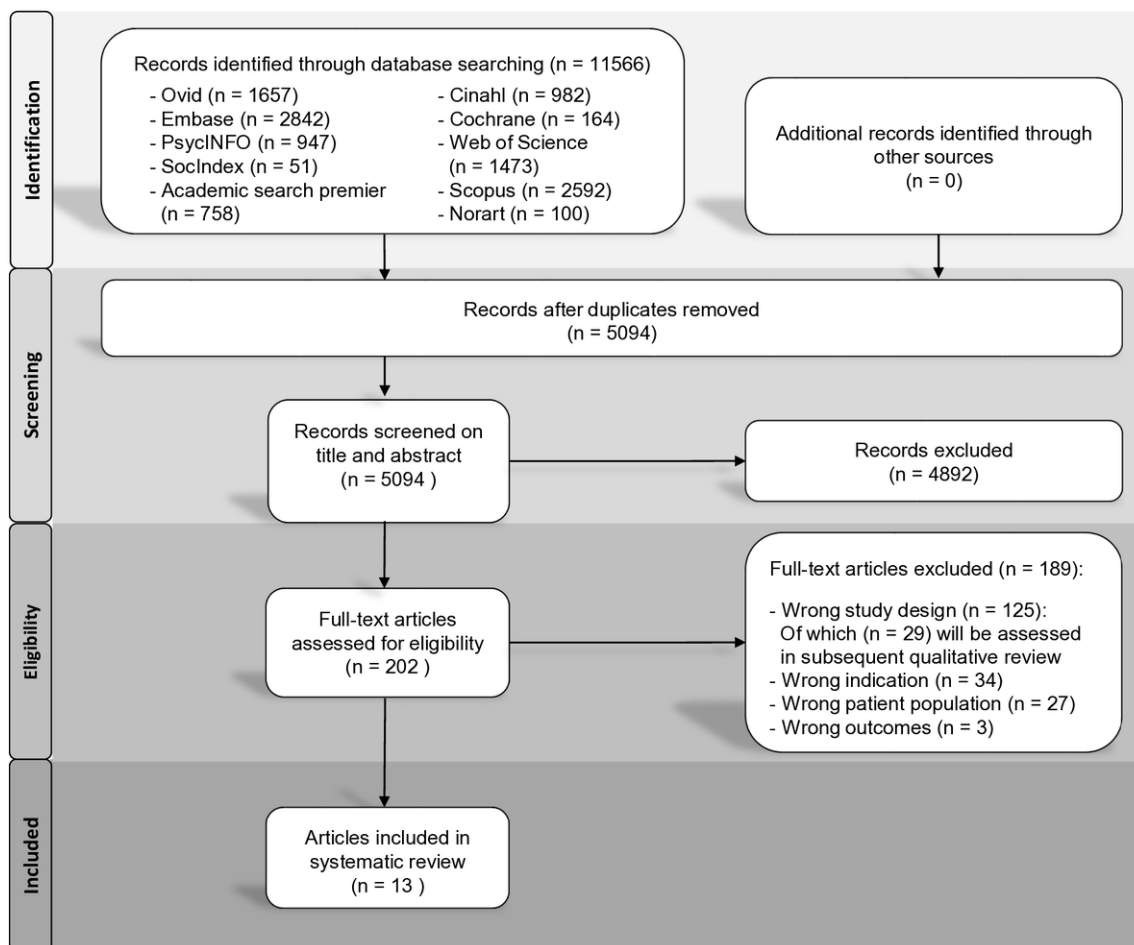


Figure 1 Flow chart of steps in systematic review.

retention and overlapping terms, such as job tenure or RTW ('the outcome'); (3) quantitative finding of the relationship between the exposure and the outcome; (4) the study characteristics (ie, sample size, study design and response rate); (5) country of origin; and (6) main findings. We grouped studies according to the type of workplace factors investigated in relation to work retention. Studies were then assessed for quality and synthesised for evidence within each workplace factor through a narrative synthesis (see further).

Quality assessment

The Effective Public Health Practice Project (EPHPP, appendix 2) checklist³¹ was used to assess the quality of the included quantitative studies. Two independent reviewers (authors DEA and SCRF), assessed the quality of each quantitative study into strong, moderate or poor quality. Studies were rated in terms of different components (A–F, see further) and in terms of global ratings. Discrepancies were resolved by discussions or involving a third reviewer (WN). The following six components were evaluated: (A) selection bias, (B) study design, (C) confounders, (D) blinding, (E) data collection methods and (F) withdrawals and drop-outs. A global score was given by transforming each component rating into scores: strong=3, moderate=2, weak=1 or not applicable=0, and summing component ratings, yielding a total score ranging from 5 to 18 for each study. According to its global rating, each study was designated strong (no weak component ratings), moderate (no more than one weak component rating) or weak (more than one weak rating).³¹

Evidence synthesis

Finally, we synthesised findings for each specific workplace factors following each study's EPHPP global rating, and the systematic review evidence synthesis guide (appendix 3).³² The guide's synthesis algorithm ranges the level of evidence from strong to insufficient.^{32–34} Evidence is rated *strong* if three strong studies agree, or if more than three studies, three-fourths of the moderate and strong studies agree. *Moderate* evidence refers to two strong studies agreeing, or two moderate studies and one strong study agreeing (if more than three studies, more than two-thirds of the moderate and strong studies agree). *Limited* evidence refers to two moderate and/or strong studies agreeing (if more than two studies, more than one-half of the moderate and strong studies agree). *Mixed* evidence refers to moderate and strong studies showing contradictory results. *Insufficient* evidence refers to no strong studies, only one moderate study and/or any number of weak studies.

RESULTS

The search revealed 5094 records after removing duplicates. After screening abstracts, 202 titles matched the inclusion criteria and were read in full text. Thirteen studies examined statistical associations between workplace factors and work retention after ABI and were included after reading full-text articles^{35–47} (see figure 1 for the full Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart and reasons for exclusion).

Table 1 Summary of studies included in the systematic analysis*

Study	Sample (response rate)	Study design, follow-up time	Exposure(s)	Outcome(s)
Autret <i>et al</i> (2015)	76 French patients with ABI aged 18–60 years from a rehabilitation clinic followed up by an occupational therapist (N/A)	Longitudinal, >2 years' follow-up	Blue collar versus white collar	RTW versus no RTW
Bonner <i>et al</i> (2016)	141 Indian patients with stroke aged 18–60 years from tertiary medical centres (NR)	Cross-sectional, N/A	Manual labour versus business or professional labour (written/oral self-report)	RTW versus no RTW
Bonneterre <i>et al</i> (2013)	100 French TBI adult participants enrolled in a programme for work reintegration ('SPASE'†), wishing to RTW (N/A)	Longitudinal, 'short term' (2–3 years) and 'medium term' (over 3 years) 2-year follow-up	1. Workplace support (present or absent). 2. Occupational assistance (sporadic or regular).	RTW 2–3 years after injury and over 3 years after injury
de Koning <i>et al</i> (2017)	319 Dutch employees with mild TBI at the emergency department (74%)	Longitudinal; 6 and 12 months after injury	1. Professional/managerial (eg, executive or managerial function) or skilled (eg, sales and administrative support) or manual labour (eg, machine operators and private household). 2. Workload in hours per week (40 hours/week=full time).	Complete RTW (same work hours preinjury and postinjury) versus no/part RTW (less work hours postinjury than preinjury), 6 and 12 months after injury
Endo <i>et al</i> (2016)	382 Japanese employees with stroke (N/A)	Longitudinal; 2, 4, 6 and 12 months after first sickness absence day	1. Manual versus desk worker. 2. Manager versus non-manager. 3. Company size (≤999 employees or ≥1000 employees).	(1) Full RTW or (2) resignation for the 365-day period following first day of sickness absence
Hannerz <i>et al</i> (2011)	19903 Danish employees with stroke, aged 20–57 years (99.6%)	Longitudinal, 2 years after stroke	Occupational class (DISCO-88 classification: (1) Legislators, senior officials and managers; (2) technicians and associate professionals; (3) workers in occupations that require basic skills; (4) workers in elementary occupations; (5) gainfully occupied people with unknown occupation)	Odds of returning to work
Hannerz <i>et al</i> (2012)	12 106 Danish employees with stroke, aged 21–57 years (92%)	Longitudinal, 2 years after stroke	Enterprise size (micro, 1–9 employees; small, 10–49; medium, 50–249; large, ≥250)	Odds of returning to work
Johnson (1987)	47 British employees with severe TBI (NR)	Longitudinal, mean follow-up time 3.5 years after injury (minimum of 2.5 years)	1. Normal work conditions (normal full-time and part time). 2. Return under special conditions (easier work, testing of employees' capability, informal return, liaison with the rehab. unit, work training and workplace support).	Continuous employment for at least 1 year after injury
Ntsiea <i>et al</i> (2015)	80 South African patients with stroke, aged 18–60 year (96.4%)	Randomised controlled trial, 6 months after intervention (circa 8 months after injury)	Workplace intervention tailored according to functional ability and workplace challenges	RTW 6 months after intervention (circa 8 months after injury)
Saeki <i>et al</i> (1995)	183 Japanese patients with stroke, younger than 65 years (N/A)	Longitudinal; 6, 12 and 18 months and up to approximately 3 years after hospital admission for injury	White collar versus blue collar	RTW 1 month or more in active employment after stroke
van Dongen <i>et al</i> (2018)	58 Dutch patients with ABI (87.9%)	Longitudinal, follow-up 3–6 years after the vocational rehabilitation (around 4–7 years after injury)	Vocational rehabilitation programme with multidisciplinary assessment, stakeholder meetings (including family, employer and coworker), on-the job training and coaching	RTW (performing paid work: yes/no)
Vestling <i>et al</i> (2003)	120 Swedish patients with stroke, younger than 60 years (N/A)	Longitudinal, minimum of 6 months poststroke (average of 2.7 years after injury)	White-collar and blue-collar dichotomised (yes/no) (Swedish socioeconomic classification)	Work/no work
Walker <i>et al</i> (2006)	1926 North American patients with TBI, aged 18–62 years (100%)	Longitudinal, follow-up 1 year postinjury	Professional/managerial, skilled or manual labour (The International Standard Classification of Occupations)	Competitive employment at 1 year postinjury

Only exposures and outcomes tested for statistical significance are presented in table 1.

DISCO-88 is an acronym for Denmark's Standard Classification of Occupations.

*Sample refers to the number of participants according to response rate. N/A, for example, response rate for retrospective studies. NR, for example, response rate in registry cross-sectional study.

† SPASE is a non-English abbreviation of 'personalized service of accompaniment and follow-up to employment'.

ABI, acquired brain injury; N/A, not applicable; NR, not relevant; RTW, return to work; TBI, traumatic brain injury.

Table 1 summarises the study design and operationalisations of workplace factors and work retention in the 13 included studies. All studies were published in English between 1987 and 2017. The majority of the studies used a longitudinal

design (n=11); one used a randomised controlled trial (RCT) design (n=1)⁴³; and one cross-sectional design (n=1).³⁶ The duration of follow-up or time since injury varied from 6 months to 7 years. The studies gathered data from nine

Table 2 Workplace factors related to work retention

Workplace factors	Sample (n)	Country	Findings	Source
Work accommodation	47, severe TBI	Great Britain	Combination of work trials, assistance from coworker or fewer working hours during a period after RTW related to continuous employment for at least 1 year since injury ($p=0.05$).	Johnson (1987)
Workload (hours/week) (40 hours/week=full time)	319, mild TBI	The Netherlands	Work load related to complete RTW after 6 months in a U-shaped curve: less than 25 hours a week related to highest odds of RTW, 32 hours a week related to lowest odds of complete RTW, followed by increased odds with increasing work load (OR 1.25, 95% CI 0.71 to 2.20). Workload not related to complete RTW 12 months after injury	de Koning <i>et al</i> (2017)
Regularity of occupational assistance (sporadic vs regular)	100, TBI	France	Regular versus sporadic occupational assistance: threefold increase in RTW 2–3 years after injury ($\chi^2=3.73$, $p<0.05$), no significant increase after 4–8 years	Bonnetterre <i>et al</i> (2013)
Workplace intervention tailored according to functional ability and workplace challenges	80, stroke	South Africa	Intervention group 5.2 times greater odds of returning to work at 6 months than control group	Ntsiea <i>et al</i> (2015)
Vocational rehabilitation programme with multidisciplinary assessment, stakeholder meetings (including family, employer and coworker), on-the-job training and coaching	58, ABI	The Netherlands	Average increase of 5.3 hours of work per week at long-term (circa 4–7 years postinjury) compared with immediately after (around 1 year after injury, $p<0.01$) the intervention. On average, employees worked 5.9 hours of work per week less than before the injury ($p<0.01$); no control group	van Dongen <i>et al</i> (2018)
Workplace support (present vs not present)	100, TBI	France	Support at the workplace related to RTW 2–3 years after injury (adjusted OR 15.13, 95% CI 3.17 to 61.74) and 4–8 years (adjusted OR 6.47, 95% CI 1.96 to 21.34)	Bonnetterre <i>et al</i> (2013)
Blue collar ('manual' activity) vs white collar ('intellectual' activity)	76, ABI	France	Blue-collar and white-collar workers demonstrated circa the same rate of RTW (blue collar 28/49=57%, white collar 15/27=55%; $p>0.99$)	Autret <i>et al</i> (2015)
Manual, business or professional labour*	141, stroke	India	Higher RTW in professional and business jobs (adjusted OR 3.02, 95% CI 1.44 to 6.34) compared with manual jobs	Bonner <i>et al</i> (2016)
Professional/managerial (eg, executive or managerial function) or skilled (eg, sales and administrative support) or manual labour (eg, machine operators and private household)*	319, mild TBI	The Netherlands	Manual and professional (compared with skilled) labour related to the lowest odds of complete RTW after 6 months (both OR 0.38), occupational status not related to complete RTW after 12 months	de Koning <i>et al</i> (2017)
Manual versus desk worker, manager versus non-manager*	382, stroke	Japan	Manual workers had a longer time to resignation than non-manual workers (HR=0.24, 95% CI 0.07 to 0.80). Managers had shorter time to full RTW than non-managers 1 year after the first day of sick leave postinjury (HR=1.68, 95% CI 1.02 to 2.78). Controlled for age and sex in both models, and for desk worker/non-desk-worker in second model	Endo <i>et al</i> (2016)
Occupational class (DISCO-88 classification: (1) legislators, senior officials and managers; (2) technicians and associate professionals; (3) workers in occupations that require basic skills; (4) workers in elementary occupations; (5) gainfully occupied people with unknown occupation)*	19903, stroke	Denmark	Lower odds of RTW among workers in elementary occupations (reference group) than those with occupations requiring basic skills 1.50 (95% CI 1.38 to 1.64), technicians and associated professionals 2.33 (95% CI 2.05 to 2.65), and professionals 3.04 (95% CI 2.70 to 3.43)	Hannerz <i>et al</i> (2011)
White-collar versus blue-collar occupations	183, stroke	Japan	Higher adjusted OR of successful RTW among white-collar compared with blue-collar workers (OR 5.16, $p<0.05$)*	Saeki <i>et al</i> (1995)
White-collar, blue-collar and self-employed dichotomised (yes/no) (Swedish socioeconomic classification)*	120, stroke	Sweden	Higher OR of RTW for white-collar workers (compared with others) was 2.99 ($p<0.063$),* and non-significant for blue-collar workers (0.59, $p=0.83$) 6 months postinjury. Self-employed was not analysed further after non-significant relationship with RTW on preliminary analysis	Vestling <i>et al</i> (2003)
Professional/managerial, skilled or manual labour (The International Standard Classification of Occupations)*	1926, TBI	USA	Higher odds of RTW for professional/managerial workers (OR 2.959, $p<0.05$) and skilled workers (OR 1.536, $p<0.05$) compared with manual workers. ORs adjusted for age, gender, education and severity are 3.155 and 1.706, respectively	Walker <i>et al</i> (2006)
Enterprise size (micro, 1–9 employees; small, 10–49; medium, 50–249; large, ≥ 250 employees)	12106, stroke	Denmark	Large enterprise (≥ 250 employees) size related to RTW after 2 years ($p=0.034$). Each increase in enterprise size category was followed by an increase in the odds of RTW.	Hannerz <i>et al</i> (2012)
Enterprise size (≤ 999 or ≥ 1000 employees)	382, stroke	Japan	Enterprise size unrelated to RTW and resignation 1 year after first sickness absence day when controlled for age and sex	Endo <i>et al</i> (2016)

*Studies assessing manual occupational role included in evidence synthesis (strong or moderate). Sample refers to the number of participants according to the response rate. Only exposures and outcomes fulfilling inclusion criteria and tested for statistical significance are presented. ABI, acquired brain injury; RTW, return to work; TBI, traumatic brain injury.

countries covering four continents: Denmark ($n=2$),^{40 41} France ($n=2$),^{35 37} Japan ($n=2$),^{39 44} Netherlands ($n=2$),^{38 45} Great Britain ($n=1$),⁴² India ($n=1$),³⁶ South Africa ($n=1$),⁴³ Sweden ($n=1$)⁴⁶ and the USA ($n=1$).⁴⁷

Sample sizes ranged from 47⁴² to 19 903.⁴¹ The majority of the studies examined stroke ($n=7$),^{36 39–41 43 44 46} followed by TBI ($n=4$),^{37 38 42 47} while two studies investigated ABI of mixed aetiologies.^{35 45} Among studies collecting self-report data ($n=10$),^{35–38 42–47} only data from employees were collected, while none of the studies included self-reported data from employers or occupational workers/vocational staff. Three studies included national registry data,^{40 41 47} and nine studies collected data from clinical, occupational or

hospital registries.^{35 37–39 42–46} The included studies examined a total of 16 workplace factors and work retention after ABI (table 2).

Two studies assessed work adaptations with onsite assistance (assistance found within the workplace, eg, coworkers, managers and human resources).^{38 42} Three studies investigated work adaptations with external assistance (ie, assistance from outside the workplace, eg, therapist and employment counselor),^{37 43 45} while only one study specifically investigated workplace social support.³⁷ The majority of the studies ($n=8$) were concerned with occupational role,^{35 36 38 39 41 44 46 47} and two studies investigated enterprise size.^{39 40}

Table 3 Quality assessment of studies based on Effective Public Health Practice Project criteria: total score and quality according to global and component ratings*

Source, country	Total score (4–18)	Global rating	Selection bias	Study design	Control of confounders	Blinding	Data collection methods	Withdrawals and drop-outs
Autret <i>et al</i> (2015), France	9	Weak	Weak	Moderate	Weak	N/A	Moderate	Strong
Bonner <i>et al</i> (2016), India	8	Moderate	Moderate	Weak	Strong	N/A	Moderate	N/A
Bonneterre <i>et al</i> (2013), France	9	Weak	Weak	Moderate	Moderate	N/A	Weak	Strong
de Koning <i>et al</i> (2017), The Netherlands	12	Strong	Moderate	Moderate	Strong	N/A	Strong	Moderate
Endo <i>et al</i> (2016), Japan	14	Strong	Strong	Moderate	Strong	N/A	Strong	Strong
Hannerz <i>et al</i> (2011), Denmark	12	Moderate	Strong	Moderate	Weak	N/A	Strong	Strong
Hannerz <i>et al</i> (2012), Denmark	14	Strong	Strong	Moderate	Strong	N/A	Strong	Strong
Johnson (1987), Great Britain	11	Moderate	Weak	Moderate	Moderate	N/A	Strong	Strong
Ntsiea <i>et al</i> (2015), South Africa	14	Moderate	Moderate	Strong	Weak	Moderate	Strong	Strong
Saeki <i>et al</i> (1995), Japan	7	Weak	Moderate	Moderate	Weak	N/A	Weak	Weak
van Dongen <i>et al</i> (2018), The Netherlands	9	Weak	Weak	Moderate	Weak	N/A	Moderate	Strong
Vestling <i>et al</i> (2003), Sweden	10	Moderate	Moderate	Moderate	Strong	N/A	Moderate	Weak
Walker <i>et al</i> (2006), USA	12	Strong	Moderate	Moderate	Strong	N/A	Strong	Moderate

*Total score computed by converting strong=3, moderate=2, weak=1 and N/A=0, and computing a sum score. Global rating was assigned according to the EPHPP guidelines (strong=no weak ratings, moderate=one weak rating, weak=two or more weak ratings). N/A, not applicable.

Quality assessment

Most studies (n=8) adjusted for potential confounders and had an acceptable response rate of 60% or more at baseline (n=9). As seen in table 3, only one-third of the studies (n=4) were rated as strong on the global rating of quality (using EPHPP)^{38–40 47}; five studies were rated moderate^{36 41–43 46}; and four studies were rated weak.^{35 37 44 45}

Evidence synthesis

In line with the best evidence synthesis guideline, we found that the level of evidence was mostly insufficient, since most specific work factors were only examined in one study (see Evidence synthesis in the Methods section). Only single studies rated as strong are described here since they yield limited evidence on their own (single moderate studies yield insufficient evidence). Studies rated as moderate are only described when they provide evidence in combination with strong studies.

de Koning *et al*³⁸ was rated as strong and assessed workload in hours and complete RTW (same number of hours 6 and 12 months after mild TBI). The strong study found that workload in hours per week, which formed a nonlinear U-shaped effect, was predictive for 6-month complete RTW following mild TBI. The curvilinear relationship designates less than 25 work hours a week to the highest odds of complete work retention, 32 hours a week as the lowest odds, followed by increased odds with increased workload. The employees who worked less than 25 hours and more than 32 hours were more likely to fully retain work 6 months after mild TBI. Six months later, workload was not predictive for complete RTW in the same study. According to the systematic review evidence synthesis guide, we found *limited evidence that workload was unrelated to complete work retention (in terms of the same number of work hours as preinjury) 1 year after ABI. Six months after ABI, we found limited evidence that workload was related to complete work retention in a U-shaped curve.*³⁸

Among eight studies assessing occupational role and work retention, six studies were rated as strong or moderate (equally divided).^{36 38 39 41 46 47} Although the studies used different definitions of occupational role (see table 2), all categorised manual (or blue-collar) work as having less educational requirements than non-manual (white-collar, skilled or professional) comparisons. Among these studies, four had straightforward findings that manual workers were less likely to RTW than non-manual workers.^{36 41 46 47} Walker and colleagues' strong study⁴⁷ and Hannerz *et al*'s moderate study⁴¹ found higher odds of work retention with increased educational requirements of the job. Two strong studies contained findings pointing in different directions.^{38 39} De Koning *et al*'s strong study also found that manual work reduced the probability of full RTW 6 months after mild TBI, compared with skilled work, an effect that was no longer present 1 year after the injury.³⁸ However, professional workers (higher than skilled work in educational requirement) also reduced the probability of full RTW, compared with skilled workers.³⁸ Endo *et al*'s strong study found that non-manual (desk) workers resigned faster after stroke than manual workers, measured from the first day of sick leave to 1 year after.³⁹ In the same study, another occupational role was investigated: managers returned to work faster than non-managers during the same period. Thus, in the four studies^{36 41 46 47} (one strong and the remaining moderate) that assessed RTW (as opposed to 'time to resignation' or complete RTW), we found *moderate evidence that manual work, compared with non-manual work, increased the likelihood of work retention after ABI. We also found limited evidence (one strong study)³⁹ that managers, compared with non-managers, were more likely to retain work after ABI.*

Two strong studies assessed enterprise size and work retention.^{39 40} However, the studies defined enterprise size so differently that they were evaluated as single studies. One study reported that large enterprise size (≥ 250 employees) was positively related to RTW 2 years after injury. Each increase in enterprise size (micro, 1–9 employees; small, 10–49 employees;

medium, 50–249 employees; and large, ≥ 250 employees) was followed by an increase in the odds of work retention, 2 years after stroke. In contrast, the other study found that enterprise size (dichotomised as ≤ 999 employees or ≥ 1000 employees) was unrelated to RTW 1 year after stroke. Thus, we found *limited evidence that large enterprise size defined as ≥ 250 employees is positively related to work retention, while large enterprise size defined as ≥ 1000 employees was not related to work retention after ABI.*

DISCUSSION

This is the first systematic review to comprehensively screen and synthesise evidence of studies examining specific workplace factors and work retention after ABI. Based on 13 included studies, we found moderate evidence of manual work's negative relationship with work retention. We also found limited evidence for (1) a U-shaped relationship between workload and complete RTW at 6 months, and no relationship between workload and complete RTW at 12 months; (2) a manager role, compared with a non-manager role; and RTW; (3) large enterprise size (defined as ≥ 250 employees) as positively related to RTW; and (4) large enterprise size (defined as ≥ 1000 employees) as unrelated to RTW.

These findings point towards several necessities and some limitations in the field that should be addressed in future studies. First, onsite workplace adaptations are potential avenues for increased RTW. Examples of work adaptations found in our review are a combination of work trials, assistance from coworkers and adapting work hours,⁴² as well as tailoring workplace interventions according to functional ability and workplace challenges.⁴³ Still, there is a lack of a robust evidence base concerning the association between these modifiable workplace factors and work retention after experiencing ABI. Illustrating this, we found that the relationship between work hours and RTW was complex (U-shaped relation), with both employees working less than 25 and more than 32 hours more likely to fully retain work after 6 months, in one study.³⁸ Because most specific workplace factors were only assessed in one study; more studies with methodological robust study designs are essential to bring this research front forward.

Second, the under-representation found in our review of manual workers among those who retain work after ABI is supported in new single studies,^{48 49} as well as studies with other patient groups.⁵⁰ No included studies empirically examined potential mechanisms behind this possible link.⁵¹ Lower job control and higher job strain,⁵² socioeconomic disadvantage,⁵⁰ premorbid cognitive reserves less conducive to RTW^{38 53} and the underdetection of physical impairments (eg, balance problems and fine motor skills) after injury^{54 55} have been suggested as potential pathways from manual work to reduced RTW. Other possible pathways could be insecure work attachment and less work adaptation by employers for manual compared with non-manual workers.

The only specific workplace factors examined in more than one original study in this review were descriptive aspects of workplaces, such as occupational role (eg, manual labour vs non-manual labour) and enterprise size. Although these descriptive factors might be informative, there is a clear need to further examine modifiable aspects of work. Until more strong studies among employees with ABI are conducted and replicated, studies on work retention among other patient groups may be useful in indicating modifiable work factors that might be useful after ABI. Access to multidisciplinary resources¹¹; better assessment

of work capacities, clarity on the rights and obligations of employers and workers alike, and the setup of a positive discrimination employment policy⁵¹; and job control and (reversed) job strain⁵² are examples of modifiable workplace factors related to work retention found in other patient groups. Our review is thus a reply to the vocational research community's former calls for greater focus on the workplace following many types of injury, not only ABI.^{11 12 15 23 24 51 55 56} Our findings also demonstrate the need to examine mechanisms and processes at the workplace.

Strengths and limitations of the systematic review

The current study used a transparent and comprehensive systematic approach in searching, screening and quality assessing the studies according to predefined criteria with at least two independent reviewers. Also, the standardised EPHP was used to assess study quality, which has been found to have good inter-rater reliability.³⁴ Still, there are some limitations that should be addressed. The few included studies with heterogeneous samples spanning different cultures, patient groups (ie, in type and severity of ABI) and different operationalisation of exposure and outcome variables warrant caution in generalising the findings. We would particularly like to note that the review contains studies from a diversity of contexts ranging from industrialised (eg, Japan) to low-income countries, thus most probably reflecting different labour practices and protections across study settings. This limits the generalisability of findings.

Although we are confident that we found most peer-reviewed studies after conducting a comprehensive librarian-assisted search in 11 electronic databases, we did not explicitly search for 'grey literature' (ie, unpublished studies, such as master or doctoral thesis).⁵⁷ This poses a risk of publication bias, although grey literature may have little impact on the results.⁵⁷ Another limitation of the current (and most) review, is that quality assessments are based on the explicit information in the articles and not the actual conduct of the study. This makes it difficult to know the extent of selective reporting (ie, not reporting null findings of some variables).

Implications for practice and research

Our findings suggest that manual workers might be more in need of work adaptation or vocational rehabilitation services after ABI, which is of importance for employers. Efforts should be taken by employers to understand which types of work adaptations or other intervention efforts employees need to be able to retain work. Although current evidence is mostly limited, possible modifiable efforts might be tailoring work tasks, supplying workplace support and adapting work hours. If possible, employers should team up with researchers to conduct more robust scientific evaluations of such efforts to increase the evidence-based knowledge on the field.

The majority of the included studies used longitudinal designs, adjusted for potential confounders, and mostly used valid and reliable instruments. Still, there are several methodological gaps. Some studies had small sample sizes ($n < 80$),^{35 42 45} thus restricting statistical power and increasing the risk of false-negative findings (ie, 'type II error'), while others had an unknown response rate (unreported eligible sample).^{37 42} The majority of the included studies relied on employee data only. Adding a multi-informant perspective, such as employers and vocational support staff, could reduce self-report bias.

In sum, the studies showed large discrepancies in their operationalisation of both the workplace and RTW factor (eg, cut-off in enterprise size).³⁹ Aiming at conducting comparable

operationalisation is important for the possibility to compare across studies and lift the evidence base beyond single studies.

Despite the advantages of RCT designs for minimising selection bias and gaining reliable knowledge to be used for policy and practice, only one of the included studies used an RCT design.⁴³ Still, practice-based evidence from large longitudinal cohort studies are also needed to define the effective workplace factors related to RTW and the work retention following ABI,⁵⁸ and temporal associations can be built on to design interventions that are tested with RCT designs.

Finally, the studies were mostly conducted in high-income countries proposing caution in generalising as national policies, welfare and social security systems vary considerably, also across high-income countries. The findings are also limited by the inability to account for societal factors such as national welfare provisions and labour market forces known to impact RTW following ABI.

CONCLUSION

It is highly notable that the vast majority of research on work retention after ABI almost solely relies on individual and medical factors,^{13–22} while we have access to very little sound evidence regarding the specific workplace factors involved.

This is the first systematic review that maps and evaluates evidence of specific workplace factors associated with work retention after ABI. We find moderate evidence that manual work is associated with lower work retention, but a need to go further and examine potential mechanisms thereof. There is a need to conduct methodologically robust studies of workplace interventions focusing on modifiable workplace factors to increase RTW among employees with ABI. Compared with the quite extensive literature regarding individual and medical factors, only one RCT regarding workplace variables was identified in this review. This demonstrates that the field of workplace adaptations after ABI is still a long way from taking into account the full complexity of factors that contribute to increasing or decreasing the chance of individuals retaining work after ABI. Also, clinical practice should take into account not only that individual and injury-related factors are at play but also that many aspects related to the workplace will be important to address when helping patients return to their previous workplace.

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