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Low-quality employment trajectories and risk of common mental disorders, substance use disorders and suicide attempt: a longitudinal study of the Swedish workforce

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ABSTRACT (ENGLISH)

Objective High-quality longitudinal evidence exploring the mental health risk associated with low-quality employment trajectories is scarce. We therefore aimed to investigate the risk of being diagnosed with common mental disorders, substance use disorders, or suicide attempt according to low-quality employment trajectories. Methods A longitudinal register-study based on the working population of Sweden (N=2 743 764). Employment trajectories (2005-2009) characterized by employment quality and pattern (constancy, fluctuation, mobility) were created. Hazard ratios (HR) were estimated using Cox proportional hazards regression models for first incidence (2010-2017) diagnosis of common mental disorders, substance use disorders and suicide attempt as dependent on employment trajectories. Results We identified 21 employment trajectories, 10 of which were low quality (21%). With the exception of constant solo self-employment, there was an increased risk of common mental disorders (HR 1.07-1.62) and substance use disorders (HR 1.05-2.19) for all low-quality trajectories. Constant solo self-employment increased the risk for substance use disorders among women, while it reduced the risk of both disorders for men. Half of the low-quality trajectories were associated with a risk increase of suicide attempt (HR 1.08-1.76). Conclusions Low-quality employment trajectories represent risk factors for mental disorders and suicide attempt in Sweden, and there might be differential effects according to sex - especially in terms of self-employment. Policies ensuring and maintaining high-quality employment characteristics over time are imperative. Similar prospective studies are needed, also in other contexts, which cover the effects of the Covid-19 pandemic as well as the mechanisms linking employment trajectories with mental health.

FULL TEXT

Headnote

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Results We identified 21 employment trajectories, 10 of which were low quality (21%). With the exception of constant solo self-employment, there was an increased risk of common mental disorders (HR 1.07-1.62) and substance use disorders (HR 1.05-2.19) for all low-quality trajectories. Constant solo self-employment increased the risk for substance use disorders among women, while it reduced the risk of both disorders for men. Half of the low-quality trajectories were associated with a risk increase of suicide attempt (HR 1.08-1.76).

Conclusions Low-quality employment trajectories represent risk factors for mental disorders and suicide attempt in Sweden, and there might be differential effects according to sex - especially in terms of self-employment. Policies ensuring and maintaining high-quality employment characteristics over time are imperative. Similar prospective studies are needed, also in other contexts, which cover the effects of the Covid-19 pandemic as well as the mechanisms linking employment trajectories with mental health.

Key terms alcohol; anxiety; cohort study; depression; drug; employment transition; epidemiology; labor market trajectory; mental health; precarious employment; public health; Sweden.

Mental disorders are among the leading disease burdens in middle- and high-income countries such as Sweden (1). The indirect costs of mental disorders (ie, days of sick leave) have increased in recent years (2). Moreover, mental disorders are unequally distributed, being substantially more present among individuals in lower socioeconomic positions (3). It is thus imperative to analyze the causes of mental disorders to adopt appropriate preventive and health promotion policies. In this paper, we focus on low-quality employment through a multidimensional conceptualization and operationalization of precarious employment (PE), characterized by employment insecurity, income inadequacy and lack of rights and protection, features commonly included in PE (4). PE is a well-known social determinant of health and health inequalities (5) associated with poor mental health among workers all over the world (6).

Even in countries like Sweden - with strong and influential unions, high rates of collective bargaining agreement coverage and employment protection - PE is cause for concern. The proportions of unemployment as well as temporary employment have been relatively stable since the dramatic increases after the deep recession of 1990. However, in association with more relaxed employment protection legislation on temporary employment, its most precarious form, on-call employment, has continuously increased and replaced the more secure form of substitution positions. Since 2000, temporary and particularly on-call employment has grown in the lowest occupational wage strata, indicating that the lower end of the occupational structure is becoming more precarious (7).

To date, there are several knowledge gaps in terms of PE's relationship with poor mental health. For one, the association has largely been explored in studies using unidimensional measures of PE and/or a cross-sectional design. Indeed, a recent metanalysis of longitudinal studies found inconclusive results associated with a scarcity of high-quality studies and a lack of comparability between them (6). Furthermore, most studies do not adequately address reversed and bi-directional causality and rely heavily on self-reported data, which could lead to overestimation of associations. Additionally, an individual's working life course is complex (8) involving states with various combinations of employment conditions (characterized by lower or higher quality) as well as transitions between these, which could have further health implications. For example, employment trajectories characterized by upshifting from lower to higher employment quality or vice versa (upwards or downwards mobility), or alternating employment with unemployment (fluctuations), have shown associations with mental health (9, 10). However, although previous literature on trajectories and mental health generally is limited, there is a particular scarcity of studies assessing trajectories characterized by fluctuating patterns as well as outcomes of suicide attempt/suicide or abuse of non-alcoholic substances.

Furthermore, certain workforce subgroups are important to include and analyze properly when studying lowquality employment and health. Trends in precarious forms of self-employment (what ILO calls disguised employment relationships) such as those associated with the gig economy and/or bogus self-employment (workers falsely classified as self-employed by employers to avoid employment taxes) are increasing, in the EU as well as in Sweden (11). Low-quality self-employment has been associated with poor mental health in previous European studies (12, 13), making this an important group to study. Consideration also needs to be given to unemployment, a common occurrence for many workers in low-quality employment. A few published studies suggest that individuals who transition from PE to unemployment or the other way around, have higher odds of depression [eg, (14)]. Moreover, many labor markets today - including the Swedish one - are gender segregated (women and men have different occupational positions and are in different spheres of the labor market) (15), which necessitates a genderstratified approach.

Data-driven approaches such as latent class analysis (LCA) allows for the creation of employment typologies, ie, explorations of how employment conditions such as income level, temporariness, etc, cluster based on similarity. In Sweden (16) and Europe (12, 13), previous applications of LCA have resulted in numerous employment types with distinct features as well as indications of lower and higher quality. Applying LCA across time in an inclusive population (including salaried, self-employed, and unemployed individuals), not only as a total population but also separately for women and men, could serve as means to study more complex labor market trajectories and further our understanding of the effects of low-quality employment trajectories on mental health.

Consequently, our objective was to investigate the risk of being diagnosed with a common mental disorder, substance use disorder or suicide attempt according to low-quality employment trajectories. We expect that individuals in low-quality employment trajectories characterized by constancy (remaining in constant lowquality employment), fluctuation (moving in-and-out of low-quality, or in-and-out of low- and high-quality employment), or directional mobility (moving from one low-quality employment to another, moving from high- to low-quality employment) are at increased risk of poor mental health.

Methods

Study design, setting and data collection

This is a longitudinal register-study based on the Swedish Work, Illness, and Labour-market Participation (SWIP) cohort (16). The SWIP cohort is the result of linkage of multiple registers and includes all registered individuals in Sweden, aged 16-65 years (approximately 5.4 million individuals), in 2005 and followed until 2017. The present study uses a subpopulation of 2 743 764 individuals aged 18-61 years old residing in Sweden in 2005. For this cohort, employment trajectories were created for 2005-2009 and mental disorder diagnoses followed up between 2010-2017. Exclusion criteria for the study were: (i) incomplete information for measuring the exposure variable (2005-2009), (ii) yearly employer-based income of >100 SEK, (iii) death, emigration, or immigration during 2005-2009, (iv) any mental disorder diagnosis (ICD-10 codes: F00-F99) or suicide attempt (ICD-10: X60-X84 and Y10-Y34) occurring between 2003-2009 (ie, two years preceding, or occurring during, exposure assessment) in order to minimize risk of reverse causation. See flow chart of the total population in the supplementary material (https://www.sjweh.fi/article/3978) figure S1.

Sociodemographic and employment data were collected for 2003-2009 from the Longitudinal Integration Database for Health Insurance and Labor Market Studies register (LISA) (18). Date of diagnosis in inpatient and specialized outpatient care, serving as the outcome, was retrieved from the National Patient Register (NPR) for 1964-2017 (19). Linkage with parental data (both biological and adoptive) was conducted by means of the multi-generational register. Data on parental history of mental disorders were retrieved from the NPR (using inpatient data only), while socioeconomic data were retrieved from the population and housing censuses of 1960, 1970, 1980 and 1990. Statistics Sweden linked all data sources.

The Regional Ethics Board of Stockholm granted ethical permission for the study (no. 2017/1224-31/2 and 2018/1675-32).

Exposure assessment: Employment trajectories

Employment trajectories spanning 2005 to 2009, characterized by employment quality and pattern (constancy, fluctuation, direction of mobility), were created for the total population, as well as for women and men separately. This was done in two steps, as briefly described below. Complete details are provided in the supplementary material.

Step 1: Creating an employment typology

In order to extract a class-solution (employment typology) applicable to the entire period of 2005-2009, the Swedish Register-based Operationalization of Precarious Employment (SWE-ROPE) (16) was implemented for each year and thereafter a number of repeated measures latent class analyses (RMLCA) were performed. Briefly, SWE-ROPE includes the following dimensions and items: (i) employment insecurity, including contractual relationship insecurity (employment contract with employer or other party), contractual temporariness (stable or unstable employment), and multiple jobs and/ or in multiple sectors, (ii) income inadequacy, including yearly income level, and (iii) lack of rights and protection, including lack of unionization. SWE-ROPE is based on the employer providing the largest source of income. Further, SWE-ROPE was constructed based on a review of definitions of PE (4) and has previously been used to identify precarious employment/low-quality employment in Sweden (16). The final class-solution contained six classes (employment types). This decision was reached by comparing the three initially best class-solutions in terms of fit indices, classification diagnostics and data-patterns (entropy, average posterior probabilities (AVEPP), comparison of class homogeneity/ class separation, and plotting conditional itemprobabilities). The fit-indices indicated best fit for the seven-class solution and closely thereafter, the six-class solution, while the Entropy and AVEPP indicated best fit for the five-class solution. The six-class solution, however, showed the most distinct and meaningful classes and was thereby chosen as the final solution. The process was similar in the separate analyses of women and men. The classes were labelled based on information gained from the conditional item-probability plots, class homogeneity and class separation: precarious employment relationship (PER), solo self-employment (SSE), hybrid multiple job-holding (HMJH), business ownership (BO), standard employment relationship (SER), and standard employment relationship with high income (SER/HI). A seventh type, unemployment (UE), was added separately. This group was defined by unemployment >180 days during the year and having information on at least one employer (ie, they were still in the workforce). Fit statistics, characteristics of the employment typology, and conditional item-probabilities can be found in supplementary tables S1, S2 and S3 respectively.

Step 2: Creating employment trajectories

Employment trajectories were created by combining the employment types and UE (jointly referred to as employment states) across the five years. Trajectories were manually created to enable categorization of individuals in patterns of (i) constancy (spending 4-5 years in an employment state), (ii) fluctuation (spending ≥2 years in two employment states with fluctuating movement in-and-out between these), and (iii) direction of mobility (spending ≥1 year in an employment state at the beginning of the trajectory, and ≥2 years in another state at the end of the trajectory). If trajectories matched several patterns, grouping was done in the following hierarchy: fluctuation, constancy, mobility. The 8230 initial combinations were first reduced to 68 trajectories and, thereafter, further to 21 trajectories. In this process, for analytical feasibility, employment states were merged according to their perceived employment quality: (i) low (PER, SSE, UE), (ii) high (SER, SER/ HI, BO) and (iii) HMJH, which could not be determined to be either high or low quality in this study and hence kept separate. Similar interpretation of the quality of the employment types has been made in a previous study (16). Once the 21 trajectories were created, trajectories of low quality were identified as based on (i) the quality of employment states included in the trajectory, ie, the presence of low-quality employment states, and (ii) the pattern of the trajectory, ie, the direction could not entail an improvement in conditions across the trajectory (upwards mobility). As HMJH could be considered neither low nor high quality, all trajectories characterized by low-quality employment states and HMJH were considered to be low quality. See table 1 for details on how specific combinations of employment states were grouped under the patterns, and supplementary table S4 for details on the reduction of 68 to 21 trajectories.

Outcome assessment: diagnosis of common mental disorders, substance use disorders and suicide attempt

First incidence of diagnosis occurring 2010-2017 was identified in the NPR by the following ICD-10 codes: (i) common mental disorders - depression (F32-F33), anxiety (F41) and stress-related disorders (F43); substance use disorders - alcohol (F10), opioids (F11), cannabinoids (F12), sedatives or hypnotics (F13), cocaine (F14), other stimulants including caffeine (F15), hallucinogens (F16), volatile solvents (F18), and multiple drug use and other psychoactive substances (F19); (iii) suicide attempt - intentional self-harm (X60-X84) and events of undetermined intent (Y10-Y34) (20).

Potential confounders

We obtained the minimal sufficient set of variables for adjustment by drawing the causal assumptions in a directed acyclic graph (DAG) (supplementary figure S2). Confounders included: (i) age, highest completed education (primary and secondary school; tertiary education <3 years; tertiary education ≥3 years), country of birth (Sweden; within EU-28; outside EU-28), and marital status (married/cohabiting with children; married/ cohabiting without children; single with children; single without children). These were measured in 2005 (ie, the start of the exposure assessment); (ii) individual history of any mental disorder diagnosis (ICD-10: F00-F99; ICD-9: 290-316; ICD-8: 290-309) or suicide attempt (ICD-10: X60-X84, Y10-Y34; ICD-9: E950-E959, E980-E989; ICD-8: E950-E959 (21) (yes; no) registered in inpatient care between 1964-2002 (before exposure measurement and exclusion criteria); and (iii) parental history of any mental disorder diagnosis or suicide attempt, using the same ICD-codes as above (more than one parent; no parent), between 1964-2004 (before exposure assessment). Parental socioeconomic position in the individual's childhood (manual; non-manual; farmer/self-employed), measured in 1960, 1970, 1980 or 1990. Missing data on any of these confounders was categorized as "unknown".

Statistical analysis

Cox proportional hazard regression models were applied to estimate hazard ratios (HR) with 95% confidence intervals (CI) for the outcomes as dependent on employment trajectories. The trajectory "constant SER" was used as reference in all models. Person-time was calculated from the 1 January 2010, until first incidence of diagnosis, end of follow-up (31 December 2017), or until censoring due to death or emigration, whichever came first. The time-lag between the exposure and outcome assessment was chosen for capturing short-, mid- and long-term effects of the trajectories. One unadjusted model and two confounder-adjusted models were run for each outcome. The first adjusted model included individual characteristics and the second model both individual and parental characteristics. All analyses were conducted for the total population and women and men separately. Furthermore, additional analyses were performed to explore the effect of employment trajectories on five specific outcomes: depression (ICD-10 codes F32-F33), anxiety (F41), stress-related disorders (F43), alcohol disorders (F10), and other drug-related disorders (F11-F16, F18-F19). The RLMCA were run in Mplus version 8.4 (Muthén &Muthén, Los Angeles, CA, USA), while remaining data management and statistical analysis was conducted with SAS version 9.4.0 (SAS Institute Inc, Cary, NC, USA) and STATA version 16 (StataCorp LLC, College Station, TX, USA). Figures were produced in RStudio version 1.2.5033 (RStudio, PBC, Boston, MA, USA).

Results

We found six employment types in the total population and among women and men. Women and men had similar-sized types of PER and HMJH, whereas most women were in SER and the majority of men in SER/ HI. Further, both SSE and BO were more common among men. Women generally had lower income than men across all employment types, although particularly evident in the low-quality employment types of PER and SSE (supplementary table S3). Combining the employment types and UE resulted in 21 employment trajectories (table 1), 10 of which were considered low-quality (4 constant, 3 fluctuating, 3 of mobility), accounting for 20.6% of the cohort. Table 2 shows the characteristics of individuals in each trajectory (for full characteristics see supplementary table S5). Generally, individuals in low-quality trajectories were less often highly educated, born in Sweden and married/ cohabiting with a partner, while they more often had a history of mental disorders prior to 2003, as compared with individuals in high-quality trajectories. Young individuals were over-represented in constant PER. Trajectories of women and men showed similar patterns across individual characteristics (supplementary table S6a-b).

Individuals in low-quality employment trajectories generally had higher incidence of common mental disorders, substance use disorders, and suicide attempt, compared with high-quality employment trajectories, both overall and among women and men respectively (see table 3). The exception was constant SSE, which generally showed a low incidence across all outcomes. Furthermore, the incidence of common mental disorders was overall higher for women compared to men, while it was the reverse for substance use disorders and suicide attempt.

Common mental disorders

The risk of being diagnosed with a common mental disorder was increased among individuals in all low-quality employment trajectories, as compared with individuals in constant SER (fully adjusted HR 1.07-1.62), except for constant SSE (HR 0.95). Mobility within low-quality employment, fluctuating low-quality employment and constant UE showed the largest risk estimates (HR 1.62, 1.49, and 1.42, respectively, although with wide 95% CI). In addition to constant SSE, constant SER/ HI and BO were also associated with reduced risk (HR 0.77 and 0.84, respectively). Men generally had smaller risk estimates compared to women in these trajectories. Additional differences were seen in terms of constant HMJH (increased risk for women, reduced risk for men), mobility between HMJH and low-quality employment, fluctuation in-and-out of low-quality and HMJH (both showed increased risk for women only), and constant SSE (reduced risk for men only). See figure 1 for fully adjusted estimates and table S7a for all estimates. Estimates for depression, anxiety, and stress related disorders separately showed similar patterns (table S8a-c for all, women, and men, respectively).

Substance use disorders

Low-quality employment trajectories were associated with an increased risk of substance use disorders (HR 1.05-2.19), with the exceptions of constant SSE and mobility between HMJH and low-quality employment. The largest risk estimates were found for constant UE (HR 2.19), fluctuating low-quality employment (HR 1.90) and constant low-quality employment (HR 1.56). Reduced risk was seen among individuals in the constant trajectories of high-quality employment (HR 0.92), HMJH (HR 0.84) and SER/HI (HR: 0.80). However, in the sex-specific analyses, these trajectories were associated with reduced risk in men only. Furthermore, reduced risk was found for men in constant SSE and BO (HR 0.90 and 0.90, respectively), while the risk was increased among women in these trajectories (HR 1.19 and 1.27). See figure 1 for adjusted estimates and supplementary table S7b for all estimates. Estimates for alcoholic and non-alcoholic substance use disorders, respectively, showed similar patterns (supplementary table S8a-c).

Suicide attempt

The risk of suicide attempt was increased for individuals in half of the low-quality trajectories, including constant UE (HR 1.76), low-quality (HR 1.30), PER (HR 1.22), fluctuation in-and-out of low-quality and HMJH (HR 1.21), and downwards mobility from high-quality to low-quality (HR 1.08). Reduced risk was seen for individuals in constant SER/HI (HR 0.86), effects which remained for both women and men. However, constant low-quality and fluctuation in-and-out of low-quality and HMJH was only associated with an increased risk among men, and mobility from high-quality to lowquality only among women. See figure 1 for adjusted estimates and table S7c for all estimates.

Discussion

Main findings

This study identified 21 employment trajectories across five years in the Swedish labor market. Ten of these trajectories were considered low-quality, accounting for 21% of the cohort. With the exception of constant SSE, all low-quality employment trajectories increased the risk of diagnosis of common mental disorder and substance use disorder. Half of the low-quality trajectories were associated with an increased risk of suicide attempt. The constant trajectories PER, UE and low-quality employment were risk factors for all three outcomes.

Contrary to our expectations, only women in constant SSE showed an increased risk of substance use disorders, while there was a tendency for reduced risk in the total population and among men in terms of both substance use and common mental disorders. Women also had increased risk of common mental disorders in trajectories characterized by low-quality employment and HMJH, which men did not.

Interpretation

Overall, individuals who experienced low-quality employment trajectories - characterized by patterns of constancy, fluctuation, or mobility - had an increased risk of common mental disorders, substance use disorders and suicide attempt. These findings are in line with the expectations of the study, as well as with previous studies exploring the relationship between employment trajectories and mental health using various measures of employment quality and labor market position (14, 22-25).

In terms of low-quality employment trajectories characterized by fluctuations and mobility, previous Swedish and Swiss studies have found unstable trajectories characterized by multiple transitions to be associated with increased risk of receiving a psychiatric diagnosis (22) and depressive symptoms (24). Further, within low-quality mobility has been found to be associated with an increased risk of psychological distress (10) and downwards mobility with poor mental health (25). Estimates in our study, however, must be interpreted with caution due to the low sample size in some of these trajectories. The harmful effects of these trajectory patterns should therefore be explored in future studies, both quantitative and qualitative, the latter of which could also shed light on potential mechanisms involved.

Apart from constant SSE, constant low-quality trajectories were risk factors for all outcomes. The association between trajectories of constant low-quality positions, characterized by poor labor market attachment (ie, non-standard employment, unemployment, PE) and long-term difficulties, and poor mental health has been shown in a few previous studies (14, 22, 26). Contrary to expectation, only constant SSE among women was associated with an increased risk of substance use disorders, while men in both constant SSE and constant BO showed a decreased risk of substance use disorders and common mental disorders. Previous cross-sectional studies conducted in Europe showed that some types of low-quality self-employment, such as dependent self-employment, increase the likelihood of poor mental well-being (12, 13). Unfortunately, no sexspecific results were provided in these studies, which hinders comparison with our results. Our results could be explained by several reasons. First, self-employed women in our study had lower income than men, which is known to have effects on substance use disorders (27). Second, self-employed women generally report high job demands (ie, long working hours, tight deadlines) (28), which could affect the work-life balance of women more negatively than of men given that women still take on more responsibility for household and childcare (29), and further affect mental health. Indeed, self-employed women and men tend to distribute time in a more gender-traditional manner (30), and self-employed men report better work-life balance and well-being compared with both salaried men and selfemployed women (28). This could partly explain the reduced effects seen among men in SSE and BO in our study. Third, the data available in our study did not allow to differentiate various forms of solo self-employment, which may imply differential mental effects. Another noteworthy finding in our study is that women belonging to trajectories characterized by HMJH (ie, combination of employment with self-employment) generally had an increased risk of common mental disorders, while men had a decreased risk if in constant HMJH or trajectories characterized by HMJH and high-quality employment. A similar reasoning as with self-employed women and men could be applied to these results. Unfortunately, we do not know the employment relations and conditions of the additional jobs, whether they occurred simultaneously or not, or the reasons for taking on additional jobs, which remains to be explored in future studies. Further, this study found that constant SER/HI entailed a reduced risk for all outcomes, results which support previous reports of eg, poorer mental health outcomes of individuals in discontinuous trajectories as compared with stable trajectories (14, 24, 31). Individuals in SER/ HI were characterized by high incomes, stable employment, one job and a high degree of collective bargaining agreement coverage. These results bear important policy health implications, as they point towards that interventions aimed at ensuring and maintaining stable high-quality employment characteristics over time (at least five years) could protect workers from suffering severe common mental disorders in Sweden.

Among possible mechanisms linking low-quality employment trajectories and poor mental health, we note an accumulation of employment, economic and social factors. Factors include employment strain (characterized by the repeated effort of finding employment or a better-quality employment arrangement), job insecurity and other psychosocial exposures in the workplace; income uncertainty and income instability, which may lead to material deprivation as well as have an impact on other social determinants of health (eg, neighborhood quality, lifestyle factors); feelings of precariousness or failure, and social exclusion (5, 24, 32-34). Interestingly, the observed increased risk of mental disorders among individuals following low-quality employment trajectories bear some resemblance with the "deaths of despair" (substance use disorders and suicides caused by poor long-term social and economic outlook) observed during the last decade in the US and the UK (35). Although the constant low-quality trajectories showed clear risk increases in mental disorders, estimates varied across the fluctuating and mobility trajectories. However, the small numbers in some of the trajectories hampers conclusions to be drawn of cross-comparisons of estimates between trajectory patterns. Too little is known about the mechanisms linking specific trajectory patterns and mental disorders, but it is likely that the above-mentioned mechanisms are present (but perhaps to a varying degree) in all these associations.

Strengths and limitations

This study is based on population registers with high validity and low attrition rates (18), allowing for an objective operationalization of a multidimensional construct of PE. Moreover, the study was based on a large and inclusive (unemployed, self-employed, sex-specific analyses) population, and a longitudinal design. Hence, we believe that the results generally can be extrapolated to the working population of Sweden, and potentially also to other Nordic labor markets with similar welfare regime and labor market legislations. Also, as individuals were without a mental disorder diagnosis at the time of inclusion in the study and during the exposure assessment window, reverse causation is unlikely.

We are, however, only capturing the effect of lowquality employment trajectories on severe mental disorders as we do not have information about visits to primary care, leading to a possible underestimation of the risk estimates. Also, we could not capture the effect of low-quality employment trajectories on actual suicides due to the low number of cases. Future studies using a case-control approach may be able to explore actual suicide. In addition, some trajectories were characterized by small numbers, which implies that the results should be interpreted with caution due to uncertainty of the estimates. Further, the cohort included individuals with exposure information (eg, employer) across all years, which might have led to an exclusion of eg, precarious employees in trajectories of employment and nonemployment, leading to an underestimation of effects. Moreover, SWE-ROPE does not as of yet include all items initially described in Kreshpaj et al (4, 16). If all items would have been operationalizable, we may have had a more nuanced employment types and as well as trajectories. This would also have been facilitated by more detailed data as we only had access to data with yearly time-resolution.

Concluding remarks

By considering both a complex range of characteristics of low-quality employment as well as the dynamic nature of individuals' working life course, this study adds to the literature an exploration of several lowquality employment trajectories, some of them largely unexplored in previous studies, and their association with mental health. The results demonstrate that lowquality employment trajectories characterized by constancy, fluctuations and mobility indeed are risk factors for severe common mental disorders, substance use disorders and suicide attempt, while the high-quality trajectory of standard employment relationship with high income showed reduced risk. We also found that there could be differential mental health effects according to sex, the most notable being in constant solo self-employment. In the light of these results - as well as the development of temporary employment on the Swedish labor market and the harmful effects of the ongoing COVID-19 pandemic on vulnerable employees - policy interventions aiming at ensuring and maintaining high-quality employment characteristics over time and protecting employees from ending up in unemployment or in otherwise disadvantageous employment trajectories are essential. Similar studies are needed in Sweden as well as in other contexts. In particular, prospective cohort studies covering pandemic effects and mechanisms involved in the relationship between poor employment quality and mental health are needed.

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Sidebar

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Working life expectancies among individuals with type 1 and type 2 diabetes over a 30- year period

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ABSTRACT (ENGLISH)

Objectives This study aimed to (i) estimate working life expectancies (WLE) and the number of working years lost (WYL) among individuals with type 1 and type 2 diabetes over a 30-year period and (ii) identify educational differences in WLE and WYL. Methods Individuals aged 18-65 years diagnosed with type 1 (N=33 188) or type 2 diabetes (N=81 930) in 2000-2016 and age- and gender-matched controls without diabetes (N=663 656) were identified in Danish national registers. WLE in years were estimated as time in employment from age 35-65 years. We used a life-table approach with multi-state (eg, disability pension, sickness absence, unemployment) Cox proportional hazard modeling. Analyses were performed separately for sex, cohabitation status, educational duration, and type of diabetes. Inverse probability weights accounted for differences between populations. Results People with diabetes had significantly shorter WLE and greater WYL compared to people without diabetes over the 30-year span. At age 35, cohabitant women with lower education and diabetes lost up to 8.0 years [95% confidence interval (CI) 5.0-11.0] and men 7.0 years (95% CI 4.0-8.7). WYL among women with higher education was 4.4 (95% CI 6.6-2.3) and 3.7 years among men (95% CI 1.5-4.5). Compared to people with type 2 diabetes, those with type 1 spend significantly more years in disability pension, but there were no significant differences in the other WYL estimates. Conclusions The WYL among people with diabetes is substantial and characterized by social disparities. The WYL help identify intervention targets at different ages, types of diabetes, sex, educational and cohabitant status.

FULL TEXT

Headnote

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(WYL) among individuals with type 1 and type 2 diabetes over a 30-year period and (ii) identify educational differences in WLE and WYL.

Methods Individuals aged 18-65 years diagnosed with type 1 (N=33 188) or type 2 diabetes (N=81 930) in 2000-2016 and age- and gender-matched controls without diabetes (N=663 656) were identified in Danish national registers. WLE in years were estimated as time in employment from age 35-65 years. We used a life-table approach with multi-state (eg, disability pension, sickness absence, unemployment) Cox proportional hazard modeling. Analyses were performed separately for sex, cohabitation status, educational duration, and type of diabetes. Inverse probability weights accounted for differences between populations.

Results People with diabetes had significantly shorter WLE and greater WYL compared to people without diabetes over the 30-year span. At age 35, cohabitant women with lower education and diabetes lost up to 8.0 years [95% confidence interval (CI) 5.0-11.0] and men 7.0 years (95% CI 4.0-8.7). WYL among women with higher education was 4.4 (95% CI 6.6-2.3) and 3.7 years among men (95% CI 1.5-4.5). Compared to people with type 2 diabetes, those with type 1 spend significantly more years in disability pension, but there were no significant differences in the other WYL estimates.

Conclusions The WYL among people with diabetes is substantial and characterized by social disparities. The WYL help identify intervention targets at different ages, types of diabetes, sex, educational and cohabitant status.

Key terms cohort study; epidemiology; occupational health; work life expectancy; working years lost.

Diabetes mellitus is among the most common noncommunicable diseases in the workforce and one of the leading causes of lifelong disability (1). The future workforce will comprise proportionately more individuals with diabetes than is currently the case (2, 3), and the individual and societal implications of this shift require new prevention and management strategies (4).

Work is an important aspect of quality of life and an important setting for daily diabetes management. Diabetes mellitus affects an individual's ability to work, as indicated by increased risks of short- and long-term sickness absence, unemployment (5-9), and disability pension (10-12). Although adverse work outcomes for people with diabetes are likely to vary across life stages (13), no studies have yet examined diabetes-associated work disability from a life-course perspective.

Similar to life expectancies, working life expectancies (WLE) estimate the number of years populations are expected to work over a defined period of working life, ie, from a specific point in time such as a certain age or when entering the labor force until retirement (14). WLE have been examined in working age populations with mental health issues (15, 16), arthritis (17), poor self-rated health (18), and high physical work demands (19) but has not yet been examined among those with type 1 (T1) or type 2 (T2) diabetes.

Although diabetes-associated work disability is partially explained by disease severity (20), an individual's health and ability to work are shaped by multiple factors throughout the lifespan (21) and cannot be reduced to the way a disease impacts bodily functions (22). Ideally, studies examining work disability in diabetes should consider how individual (eg, age, gender, education, cohabitation status), and societal factors (eg, access to healthcare, employment opportunities) influence the ability to work. However, most studies examining work disability in diabetes apply cross-sectional designs with limited theoretical frameworks, small sample sizes or prospective designs with limited follow-up periods. In the few studies that include T1 diabetes, it is difficult to identify possible differences between diseases and how these risks may change over time (7-9, 23). One study showed that the elevated risk of sickness absence among women with diabetes remained stable, but the risk for men increased over time (hazard ratio: 1.57-1.82) (9). A recent study applying a multi-state design showed no difference between type 1 and 2 diabetes on a wide range of labor market outcomes but a higher risk of unemployment, sickness absence, and disability pension among men than among women (12).

Many countries, including high-income countries, are facing substantial and growing social disparities in diabetes prevalence. Social gradients, as measured by educational or occupational status, influence both the incidence of T2 diabetes and the extent of morbidity that people with T2 diabetes are likely to experience over time (11, 24-26). People with lower education have a markedly higher risk of T2 diabetes compared to those with higher education

(27, 28). These differences are more pronounced among men than women (29). Evidence regarding the incidence of T1 diabetes is conflicting (30), but socioeconomic status also seems to influence morbidity and mortality of T1 diabetes over time (31).

Although cohabitant status may protect people with diabetes from adverse labor market outcomes, it has not yet been investigated. Whereas cohabitant people receive more social support, people living alone are more prone to social isolation, which can have adverse health effects (32). Living alone is associated with higher incidence of T2 diabetes among men and poorer self-management and higher risk of mortality among people with diabetes (33).

Recently, ways of estimating WLE have been tailored to the Danish labor market system, enabling examination of the impact of individual and societal factors on work lifespans at the level of populations (18, 34). Examining WLE in diabetes could both help identify diabetes-associated disability in populations with T1 and T2 diabetes and illuminate occupational health in diabetes from a life-course perspective. Understanding the entire work lifespan of individuals with diabetes can help identify long-term occupational health strategies in diabetes.

The aims of the study were to identify (i): WLE of people with T1 and T2 diabetes, as estimated by the number of years in paid employment from age 35-65 years (the retirement age in Denmark), (ii) the number of working years lost (WYL), as estimated by differences between the number of years in employment of people with T1 and T2 diabetes and those without diabetes, and (iii) social gradients, as measured by educational status, in WLE and WYL among people with T1 and T2 diabetes.

Methods

In a historical cohort study, we linked several Danish national registers to identify all individuals with T1 and T2 diabetes aged 35-65 years in the Danish population. People with T1 or T2 diabetes were matched to control participants without diabetes in the follow-up period from 1 January 2000 to 31 December 2016.

Populations

We identified 3 337 314 people aged 18-64 years from the Danish population during the follow-up period. Individuals with T1 diabetes (N=33 188) and T2 diabetes (N=81 930) were age- and gender-matched to control participants without diabetes randomly selected from the general population in a 1:5 ratio (N=663 656).

We identified people diagnosed with diabetes using diagnostic codes from the International Classification of Diseases, version 10 (ICD-10) (35) in the Danish National Patient Register (36) and Anatomical Therapeutic Chemical (ATC) codes in the Danish National Prescription Register (37). These registers include all Danish citizens who have visited any hospital in Denmark and all prescriptions redeemed at any pharmacy in Denmark.

Given that treatment at hospital-based diabetes clinics is standard in the care of T1 diabetes in Denmark, people with T1 diabetes were likely to be identified via the patient register. However, we applied a conservative approach; people were only identified with T1 diabetes if they were registered by ICD-10 diagnosis code E10 and had >3 redeemed prescriptions with the ATC code for insulin and analogues (A10A) at any time during the follow-up period. Treatment at the general practitioner is the standard care of people with T2 diabetes (unless they have complications or other complicated comorbidities) and they are, therefore, not necessarily registered with the T2 diagnosis in the Danish National Patient Register. Therefore, we identified people with T2 diabetes either by ICD-10 diagnosis code E11 or by >3 redeemed prescriptions with the ATC code for blood glucoselowering drugs, excluding insulin (A10B). Control participants were defined as having no diabetes if they had no recorded ICD-10 codes (E10-14, diabetes mellitus; O24.4, gestational diabetes mellitus) or ATC codes (A10B or A10A). Participants were included in the study on the date of their earliest recorded diagnosis. Somatic and mental chronic comorbidities previously identified as common in occupational populations were also identified from national patient and prescription registers by diagnostic and ATC codes tested in a previous study (9) (cancer; chronic pain; endocrine, hypertension, heart disease, inflammatory bowel disease, kidney disease, liver diseases, neurological, osteoarthritis; paraplegia and hemiplegia, pulmonary, retinopathy, stroke, dementia, substance abuse, and depression and anxiety).

Working life expectancies and working years lost

WLE were defined as the expected time in years a person would remain in work from age 35-65 years (the retirement age in Denmark at the time of the study). WYL were defined as the number of years a person was expected to lose during this period.

Each participant's employment status was identified by the Danish Register-based Evaluation of Marginalization (DREAM) (38). The Danish labor market system is a flexicurity system, characterized by high transition rates between employment and unemployment and easy access to national welfare benefits for Danish residents during temporary (eg, sickness absence, unemployment, maternity leave, education) and permanent periods (disability pension) in which they are unable to work. High levels of income tax finances the welfare system and secures social transfer benefits for all Danish citizen. The right to receive social transfer benefits is secured by law (39).

DREAM covers all residents in Denmark who have received social transfer payments since 1991 and the risk of misclassification is low (40, 41). Payments are recorded on an individual and weekly basis and therefore the DREAM register is well suited for study designs relying on continuous follow-up data. Participants' employment periods were defined as those during which they received no social transfer payments. Their periods without employment were defined by receipt of social transfer payments for unemployment, long-term sickness absence (payments for a minimum of four consecutive weeks), temporary absence from labor market (payments for maternity leave, education, or emigration), disability pension, or death before age 65.

From DREAM, we were able to model 12 recurring transitions between transient states of work, illness, unemployment, or temporary absence and on 8 permanent transitions ('absorbing states') from work, illness, unemployment, or temporary absence to either disability pension or death (figure 1).

In order to assess the risk of misclassification of participants, who could be out of work but were not registered with a social transfer benefit in DREAM, we linked the DREAM register for 2016 with the yearly disposable income ('DISPON') register for 2016 from Statistics Denmark. We used a yearly income of 50 000 DKK as cut-off point of 'not working'.

Additional information on cohabitation and educational status were obtained from national registers at Statistics Denmark. Participants were categorized as cohabitants if partners were registered at the same address or living alone if no partners were registered. Educational status was defined as the longest educational period completed as registered at age 35 and categorized according to the International Standard Classification of Education 2011 (42): (i) long (bachelor's degree or equivalent, master's degree or equivalent, and doctoral degree or equivalent; >14 years); (ii) medium (upper secondary education, post-secondary non-tertiary education and short-cycle tertiary education; 11-14 years); (iii) short (early childhood education, primary or lower secondary education; 0-10 years).

All Danish citizens are assigned a unique personal identification number, administered by the Central Population Register (CPR). We used encrypted CPR, accessed via Statistics Denmark, to link data from national registers of health and labor market statistics. The Danish Protection Agency registered and approved the study, identification number: 2014-54-0804.

Statistical methods

WLE were estimated using state-of-the-art methodology (18) combining a life-table approach, a multi-state design, and the Cox proportional hazard regression model with direct estimation of 95% confidence intervals (CI). WLE estimates were based on 12 recurring transitions between transient states of work, illness, unemployment, or temporary absence and 8 permanent transitions ('absorbing states') from work, illness, unemployment, or temporary absence to either disability pension or death (figure 1). Participants who retired early from causes other than disability pension, such as voluntary early retirement, were censored, as were participants who reached age 65 and those at the end of the follow-up period.

Analyses were performed separately for sex, cohabitation status, educational status, and type of diabetes. We examined between-group differences for people with T1 and T2 diabetes and no diabetes (95% CI). In addition to WLE, we estimated expected years of long-term sickness absence, unemployment, temporary absence from the labor market, disability pension, and death. WYL were estimated as the difference between the expected number of years in the listed states of work (figure 1) for people with diabetes and the control participants without diabetes.

Age was the underlying time variable. The time periods of the participants' different states (eg, work, sickness absence, etc.) were estimated by age, a start-age and an end-age, within a 5-year follow-up period. When summing up all individuals at the ages from 35-65 years, individuals will be registered in the different states (eg, work) within any given small age-interval of 1/365 of a year. The calculation gives the instant transition probability for the particular transition within each of the 5-year age-intervals. Then all the instant transition probabilities for all the possible transitions can be arranged into an instant-transition-matrix within the particular age-interval. By multiplying all the matrixes for each age-interval together, one gets the transition probability for each transition and, in addition, the probability of staying in a particular state. These estimates can all be plotted with age on the x-axis and the transition probability on the y-axis. The area under the curves gives an estimate of the expected time in each state until the age of 65 years, dependent on the starting age (18).

We used inverse probability weights to control for differences between populations in immigrant status and confounding conditions. Retinopathy, hypertension, heart disease and kidney disease (43) inflammatory bowel disease (44), and depression and anxiety (45) are, in relative terms, highly prevalent in diabetes populations. We therefore considered these conditions as complications to, or a consequence of, living with diabetes and, therefore, not confounders. They were not included as inverse probability weights. All analyses were performed with SAS V.9.4 (SAS Institute, Cary, NC, USA).

Results

Population characteristics are shown in Table 1. Most subjects were of Danish origin and living with a partner. Approximately two thirds of individuals with diabetes and half of those in the control group had one or more comorbidities (table 1).

Working life expectancies

Figure 2 is an overview of WLE of cohabitant men and women with T1 and T2 diabetes and the controls, and table 2a shows the estimates of WLE. Supplementary figure S1 (www.sjweh.fi/artide/3972) and table 2b give an overview of the same estimates for participants living alone. The figures highlight the educational differences in WLE.

The gaps in WLE between long and short periods of education were larger among people with diabetes than controls over the 30-year period. For example, WLE for cohabitant women with T1 diabetes, at age 35, with higher education was 21.3 years and 12.2 for lower education (9.1 years difference), whereas the difference for controls were 5.5 years (long 25.7 and short 20.3 education years, table 2a.)

The shortest WLE were observed among individuals living alone (table 2b). For individuals with T1 diabetes, WLE at age 35 ranged from 12.2 (short) to 21.3 (long) education years for women and from 17.2 (short) to 24.2 years (long) education years for men. For individuals with T2 diabetes, WLE at age 35 ranged from 9.6 (short) to 21.3 (long) education years for women and from 9.0 (short) to 17.2 (long) education years for men. Among people living with a partner, women had lower WLE than men (table 2). The lowest expectancies were observed in those with short education years among people living alone.

Working years lost

Individuals with both types of diabetes lost significantly more work years compared with matched controls without diabetes throughout the entire work lifespan (table 3a and 3b). Overall, cohabitating people with short education lost the most work years. Women with T1 diabetes with short education years had work lifespans eight years shorter than controls [8.0 (95% CI 11.0-5.0)], decreasing to a loss of four years with long education years [4.4 (95% CI 6.6-2.3)]. Men with T1 diabetes and short education years lost 6 years of work [6.4 (95% CI 8.7-4.0)], but the loss was only 3 years if they had long education years [3.0 (95% CI 4.5-1.5)]. These educational differences were also observed among women but not men living alone. The educational differences were most pronounced among cohabitant men and women and less pronounced among men living alone. We found no significant differences in WYL between T1 and T2 diabetes.

Number of years in specific labor market transitions

Online supplementary tables S1-5 (www.sjweh.fi/ article/3972) show the number of years people with T1 and T2 diabetes spend in the specific transitions compared with matched controls without diabetes.

Sickness absence. At age 35-55 years, both cohabitant men and men living alone with T1 diabetes and medium education spend significantly more time in sickness absence compared to people without diabetes (table S1). No significant differences were found in the number of years in sickness absence among people with diabetes compared to controls aged 60-65 years. We found no significant differences between the number of years in sickness absences between T1 and T2 diabetes.

Unemployment. With some exceptions, women with T2 diabetes, spend significantly more time in unemployment throughout the work lifespan compared to those without diabetes. These results were most consistent among women, who were living alone or had short or medium periods of education (table S2). Cohabitant men with T2 diabetes and medium education also spend significantly more time in unemployment from age 35- 55 years. No significant differences were found between the diabetes types.

Disability pension. With a few exceptions, at age 35-55 years, people with diabetes spend significantly more time in disability pension compared to people without diabetes (table S3). Men and women who were living alone and with short or medium years of education had the highest number of years with disability pension. At most age intervals, people with T1 diabetes spend significantly more years in disability pension, than people with T2 diabetes. These significant differences were most consistent among people with short or medium years of education.

Temporary absence. No significant differences were found in the WYL for people with diabetes compared to those without diabetes or between diabetes types (table S4).

Death. Regardless of cohabitation status, men with T2 diabetes had significantly more WYL because of death in the age range 35-55 compared to people without diabetes (table S5). With one exception, men who were living alone with T1 diabetes and women with T1 or T2 diabetes living alone, primarily with short education years, had more years lost to death.

Number of people not registered in DREAM with a yearly income of less than 50 000 DK

Of 1 486 541 individuals without any registered social benefits in DREAM in 2016, 1.9% (28 307) had a yearly income of 0-50 000 DKK (data not included). These analyses excluded people who emigrated or died or were outside the age range 18-64 years in 2016.

Discussion

The work life losses among people with T1 and T2 diabetes over a 30-year work lifespan are substantial and characterized by social disparities. Social disparities were observed in WLE among both people with and without diabetes. However, in comparison to people without diabetes the educational disparities in WLE were larger for people with diabetes throughout the work lifespan. People with diabetes with lower education had the shortest WLE and most WYL throughout their work life compared to people without diabetes. For example, at age 35, cohabitant women with T1 diabetes and lower education lost up to 8 years; the equivalent for men was 7 years. The WYL were 4 years among women and 3 years among men with higher education.

Previous studies applying a similar WLE methodology have demonstrated that 55-year-old workers with poor health have an average WYL of up to 1.4 years (18), whereas WYL is 1.1 years for depressive symptoms (15, 16). In comparison, our study showed similar results for people with diabetes. However, the theoretical model applied in this study combined with the most recent WLE methodology showed that social factors such as educational and cohabitant status are important to consider along with health factors. Our study showed that people with diabetes spend significantly more time in sickness absence, unemployment, disability pension and death, but not temporary absence (eg, maternity leave, student). The significant differences in number of years spent in these states for people with diabetes compared to controls varied according to sex, types of diabetes, cohabitant and educational status. For example, at age 35-55 men with T1 diabetes with medium education, spend significantly more time in sickness absence than people without diabetes. Women with T2 diabetes - particularly if they live alone - spend more time in unemployment compared to people without diabetes. Overall, people with diabetes spend more years in disability pension, compared to those without diabetes.

Although this is the first study to examine WLE and WYL among people with diabetes, our results suggest that WLE and WYL was highly influenced by social disparities. In keeping with a previous study examining the labor market consequences of diabetes (12), we found no difference in the number of years lost between people with T1 and T2 diabetes of similar age. However, people with T1 diabetes spend significantly more years in disability pension than those with T2 diabetes. Gender differences in WLE and WYL appeared most prominent among cohabitating men and women, which may reflect a general trend observed in high-income countries that cohabitating women are younger than their spouses and more motivated to retire earlier if their spouse retires (46).

The impact of educational status on work-related outcomes has been demonstrated among people with T2 diabetes (24, 31), but less is known on the topic in relation to T1 diabetes. Our results suggest that educational status affects health- and work-related outcomes of people with both T1 and T2 diabetes. From a lifecourse perspective, our results also suggest that longer periods of education can be protective over the entire work lifespan. We used education as a measure of social inequalities. The impact of short education years on WLE may reflect the poor physical and psychosocial working environment of people with less education as demonstrated in recent studies of WLE (19) and sickness absence (47). Although the impact of social inequalities on WLE should be understood in relation to the other demographic, social and health factors (eg, age, gender, cohabitant status, diabetes types), our results may nevertheless suggest that poor working environment associated with jobs requiring lower or no education may be important intervention targets.

Our study has important limitations. We were not able to identify individuals with T2 diabetes who did not take medication or had not received hospital in- or out-patient care. Consequently, the WLE cannot be generalized to these cases. Although we were able to predict WLE from the entire Danish population, our predictions were based on retrospective data without taking into consideration potential improvements in diabetes outcomes among future generations. The estimates were also based on the highest achieved educational level at age 35 and did not account for changes in educational status after age 35.

The definition of work as time without receipt of social transfer payments may overestimate the results for WLE because this time may also include individuals relying on other economic means, eg, savings. Although the high living expenses in Denmark, combined with high taxes on income and capital, makes self-financed retirement or unemployment before the age of 60 rare, the risk of misclassification cannot be ruled out. However, our analysis suggests that the risk of misclassifying is <2%. Also, we were only able to account for long-term sickness absence and not for shorter spells of sickness absence, which may underestimate the overall impact of diabetes on WLE. When controlling for differences in comorbidities, we excluded conditions that had high prevalence in diabetes populations since we considered them mental or physical consequences of living with diabetes (eg. kidney disease, retinopathy, depression) and not confounders. Including these conditions in the inverse probability weights would be likely to decrease estimates of the impact of diabetes.

The predictive nature of the WLE estimates relies on the assumption of proportionality underlying Cox regression modeling and that future labor market affiliation can be predicted by the current labor market transitions. Those assumptions are valid only if the circumstances, such as economic conditions, of the follow-up period are comparable to both the study period reported here and the Danish system.

The number of years lost throughout the work lifespan for individuals with T1 or T2 diabetes is substantial compared with people without diabetes and also characterized by larger social disparities than people without diabetes. The results highlight the need for new preventive strategies to prevent and manage diabetesassociated disability. Although work is an important aspect of quality of life and an important setting for diabetes management, no occupational health guidelines exists to prevent and manage diabetes-associated work disability. In particular, the results highlight the need to target individuals with short periods of education to alleviate the individual and societal consequences of living with T1 and T2 diabetes. The new approach to examining WYL applied here enables further identification of prevention targets and strategies taking into account specific gender, types of diabetes, educational and cohabitation profiles at different ages throughout the work lifespan.

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Sidebar

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DETAILS

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Psychosocial work exposures and health outcomes: a meta-review of 72 literature reviews with meta-analysis

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ProQuest document link

ABSTRACT (ENGLISH)

Objective This meta-review aimed to present all available quantitative pooled estimates for the associations between psychosocial work exposures and health outcomes using a systematic literature review of literature reviews with meta-analysis. Methods A systematic review of the literature from 2000 to 2020 was conducted using PubMed, Web of Science, Scopus, and PsycINFO databases following the PRISMA guidelines. All literature reviews and Individual-Participant Data (IPD)-Work consortium studies exploring an association between psychosocial work exposures and health outcomes and providing pooled estimates using meta-analysis were included. All types of psychosocial work exposures and health outcomes were studied. The quality of each included review was assessed. Results A total of 72 reviews and IPD-Work consortium studies were included. These mainly focused on job strain as exposure and cardiovascular diseases and mental disorders as outcomes. The associations between psychosocial work factors and cardiovascular diseases and mental disorders were in general significant, and the magnitude of these associations was stronger for mental disorders than for cardiovascular diseases. Based on high-quality reviews, significant associations were found between job/high strain and long working hours as exposures and coronary heart diseases, (ischemic) stroke, and depression as outcomes. A few additional significant associations involved other exposures and health outcomes. Conclusions The included reviews brought convincing findings on the associations of some psychosocial work factors with mental disorders and cardiovascular diseases. More research may be needed to explain these associations, explore other exposures and outcomes, and make progress towards determining the causality of the associations.

FULL TEXT

Headnote

Objective This meta-review aimed to present all available quantitative pooled estimates for the associations between psychosocial work exposures and health outcomes using a systematic literature review of literature reviews with meta-analysis.

Methods A systematic review of the literature from 2000 to 2020 was conducted using PubMed, Web of Science, Scopus, and PsycINFO databases following the PRISMA guidelines. All literature reviews and Individual-Participant Data (IPD)-Work consortium studies exploring an association between psychosocial work exposures and health

outcomes and providing pooled estimates using meta-analysis were included. All types of psychosocial work exposures and health outcomes were studied. The quality of each included review was assessed.

Results A total of 72 reviews and IPD-Work consortium studies were included. These mainly focused on job strain as exposure and cardiovascular diseases and mental disorders as outcomes. The associations between psychosocial work factors and cardiovascular diseases and mental disorders were in general significant, and the magnitude of these associations was stronger for mental disorders than for cardiovascular diseases. Based on high-quality reviews, significant associations were found between job/high strain and long working hours as exposures and coronary heart diseases, (ischemic) stroke, and depression as outcomes. A few additional significant associations involved other exposures and health outcomes.

Conclusions The included reviews brought convincing findings on the associations of some psychosocial work factors with mental disorders and cardiovascular diseases. More research may be needed to explain these associations, explore other exposures and outcomes, and make progress towards determining the causality of the associations.

Key terms pooled estimate; systematic literature review.

Psychosocial work exposures emerged in the area of occupational health epidemiology during the 1990s, the first studies being published in the 1980s (1-5) and some very rare studies in the 1970s (6). Since then, the literature has expanded considerably, making a synthesis of the literature timely. Psychosocial work factors are characterized by a multitude of exposures, which presents problems in summarizing the literature. A number of studies have investigated the factors of the job strain model, one of the first and widely used theoretical model, including decision latitude, psychological demands, job strain (combination of high demands and low latitude), and social support. However, psychosocial work factors embrace a much higher number of aspects, such as long working hours, job insecurity, effortreward imbalance, but also more recently workplace bullying, organizational injustice, and work-family conflict, amongst others. In addition, this is not only the issue of exposure that is complicated but also the issue of outcome, as the diversity of outcomes also adds to complexity in the field.

A large amount of the literature has focused on the associations of psychosocial work exposures with mental disorders and cardiovascular diseases. Various other health outcomes have also been investigated, although less frequently, such as cardiovascular risk factors, behavioral risk factors, and more rarely other diseases. Psychosocial work factors may be expected to be associated with a large number of health outcomes, consequently for this reason too, a synthesis of the literature may also be difficult to achieve.

A substantial number of literature reviews have been published on specific associations between psychosocial work exposures and health outcomes in recent years. Four meta-reviews, based on literature reviews, have been published so far and summarized the evidence for two outcomes, cardiovascular diseases (7) and common mental health problems (8), and two exposures, workplace bullying (9) and long working hours (10). Three of these meta-reviews used a systematic procedure to synthesize information, and only one provided quantitative pooled estimates. Focusing on literature reviews with meta-analysis based on primary studies that have already been selected on the basis of well-defined criteria may be useful in order to summarize the literature in a quantitative way. Indeed, an additional problem may be the heterogeneity of the literature regarding the quality of the studies. In addition, given the inherent problems related to the study of the associations between psychosocial work exposures and health outcomes (such as residual confounding and reporting bias), causal inferences may be difficult to reach and a limited number of primary studies in the literature or pooled in a meta-analysis may not be enough to provide the level of evidence required. Finally, a state-of-the-art providing quantitative pooled estimates may be particularly helpful to other research topics such as those related to the estimation of fractions and costs attributable to psychosocial work exposures.

Our aim was therefore to perform a meta-review (ie, a systematic literature review of literature reviews with meta-analysis) on the associations between psychosocial work exposures and health outcomes and to report all available quantitative pooled estimates for each of these associations. As our aim was to provide a comprehensive review on the etiological effects of psychosocial work exposures, all psychosocial work factors and all health outcomes were included. We further investigated the significance, magnitude, precision, and consistency over time of the associations, and the differences between outcomes to provide more information about the specificity of the effects or on the contrary about the multiple effects of these exposures on health.

Methods

Search strategy

We systematically searched for published systematic literature reviews with meta-analysis using PubMed, Web of Science, Scopus, and PsycINFO databases from 1 January 2000 to 28 September 2020. Keywords were chosen to capture two criteria: firstly, the articles had to be a literature review with meta-analysis, and secondly, the reviews had to explore associations for any psychosocial work exposures. A list of keywords was therefore developed to cover these two criteria (Appendix 1, www.sjweh.fi/article/3968). The comprehensiveness of our search was checked using the reference lists of the included reviews. The meta-review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (www.prisma-statement.org).

Inclusion criteria, eligibility, and selection of reviews

Literature reviews were eligible for inclusion in this meta-review if: (i) keywords (Appendix 1) were present in the titles and/or abstracts, (ii) they were published in English, and (iii) they were published from 1 January 2000 to 28 September 2020. All psychosocial work exposures were included. However, factors related to time schedules, that may have an impact on health outcomes through disruption of circadian rhythms, such as night work or shift work or other atypical work schedules, were not considered. All health outcomes were included as far as they were related to symptoms, disorders, or diseases coded in the International Classification of Diseases, version 10 (ICD-10). Any behavioral disorders due to psychoactive substance use were also included, as well as any behavioral risk factors. However, we excluded outcomes that could not be linked to specific diseases or disorders, such as all-cause mortality, sickness absence, accident/injury, disability, self-reported health, well-being, or quality of life. Furthermore, as the objective was to study the etiological role of psychosocial work exposures, we excluded reviews that explored disease recurrence, chronicity, or exacerbations. In order to extrapolate the results as far as possible to the whole working population, the population had to be a general working population, or at least had to be as varied as possible in terms of occupations and work sectors, thus reviews focusing on one specific occupation or work sector were excluded. The reviews had to include a metaanalysis. We also included the studies of the IPD-Work (individual-participant data meta-analysis in working populations) consortium as these studies were highly relevant because they included large samples from a range of countries and results from meta-analysis even if not always based on a literature review (11). Indeed, this consortium published two types of papers: the first type including unpublished pooled analyses of IPDWork cohorts only (called IPD-Work consortium studies without literature review in our text) and the second type including both literature reviews and unpublished pooled analyses of IPD-Work cohorts (called IPD-Work consortium studies with literature review in our text). Both types were included in our meta-review. For simplicity, we called 'reviews' all publications included in our meta-review. Finally, the reviews had to include a meta-analysis that provided a quantitative pooled estimate for the exposure-outcome association, ie, relative risk (RR), hazard ratio, or odds ratio. If the presentation of the results by the authors led to inverse pooled estimates, then the estimates were reversed (for example, estimate for high support instead of low support). We retained pooled estimates adjusted for gender, age, and socioeconomic status (SES), or if not available the closest minimally adjustment, to make comparison possible as far as possible. If it was possible, adjustment for behavioral risk factors was not retained in the study of cardiovascular diseases, as these behavioral risk factors may be mediators in the studied exposure-outcome associations. The estimates based on one primary study only were not retained. The retained pooled estimates were presented as 'main results' in the data extraction.

Two of the authors (IN and SB) independently conducted the systematic search, screening and selection. In case of inconsistencies, classification mismatches were discussed and resolved by consensus. Figure 1 presents the selection process.

Data extraction

A standardized form was used to collect information about all included reviews and two of the authors (IN and SB) independently extracted data, with any discrepancies resolved by consensus. Extracted data were presented in supplementary table S1.

A number of instruments have been designed to assess the quality of systematic literature reviews, especially those including randomized studies. However, such instruments based on criteria checklists may not be sufficient to draw a conclusion on evidence (12). Indeed, these checklists generally do not collect enough information about the methodological aspects of the nonrandomized and epidemiologic studies. Furthermore, as we included systematic reviews as well as IPD-Work consortium studies without literature review, the use of these checklists would have been irrelevant for these studies. Consequently, inspired by some checklists such as AMSTAR 2 (13), we elaborated a list of critical points including methodological criteria and assessed each review and IPD-Work consortium study. Quality scores were calculated ranging from 0-16 with higher scores indicating higher quality. For IPD-Work consortium studies without literature review, a weighted score was calculated (Appendix 2). The results for quality assessment were presented in supplementary table S2.

The pooled estimates of the main results from the included reviews were presented using figures according to exposure, outcome, publication date, and quality score. Significance, magnitude, and precision of the associations were presented using pooled estimates and their 95% confidence interval (CI). If there was more than one pooled estimate for a given association, the results were studied for consistency according to publication date. In the figures, diseases or disorders were preferred to symptoms (eg, depression versus depressive symptoms), and main exposure dimensions were preferred to sub-dimensions (eg, support versus colleagues/ supervisors support), when both were available. All information may be found in supplementary table S1.

Results

Among the eligible articles for inclusion in the selection process, 72 reviews with meta-analysis were included in our meta-review (14-85) (figure 1). Supplementary table S3 presents the 27 excluded articles after fulltext reading and the reason for exclusion.

Characteristics of the reviews included in the meta-review

Almost all included reviews were published after 2011. Among the 72 reviews, 47 (65%) were literature reviews with meta-analysis, 7 (10%) were IPD-Work consortium studies with literature review, and 18 (25%) were IPD-Work consortium studies without literature review. The reviews included an average of 20 primary studies (range 6-86).

The job strain model exposures were the most frequently studied exposures: job strain or high strain (the difference between these two exposures is related to the reference group: either low demands or high latitude or both for job strain, and low demands and high latitude, also called low strain, for high strain) (37 reviews, 51%), psychological demands and decision latitude (17 reviews each, 24%), and social support (13 reviews, 18%). Long working hours were the second most frequently studied exposure (23 reviews, 32%). Effort-reward imbalance was explored in 12 reviews (17%), and job insecurity or temporary employment in 11 reviews (15%). Workplace bullying or violence were studied in 5 reviews (7%) and organizational injustice in 5 reviews (7%) as well. There were 2 reviews on emotional demands and 2 on worklife imbalance. A number of reviews examined more than one exposure from different concepts or models (14 reviews, 19%).

The most frequently studied outcomes were cardiovascular diseases: coronary heart disease (CHD) (15 reviews, 21%), cardiovascular risk factors (14 reviews, 19%), stroke (5 reviews, 7%), and behavioral risk factors (5 reviews, 7%). Other or unspecified cardiovascular diseases were examined in 5 additional reviews (7%). A large number of reviews explored mental health outcomes: depression-related outcomes (9 reviews, 12.5%), sleep problems (6 reviews, 8%), anxiety or burnout (5 reviews), psychotropic medication use (2 reviews), and suicide-related outcomes (1 review). Unspecified common mental disorders, pregnancy outcomes, and musculoskeletal disorders (MSD) were studied in 5 reviews each. An additional 3 reviews focused on cancer and 1 on digestive diseases.

The quality was low for 22 reviews (score<7), moderate for 30 reviews (score 8-11), and high for 20 reviews (score>12) (supplementary table S2). The mean score was 9.7. The mean score was 8.3 for systematic reviews, 12 for IPD-Work consortium studies with literature review, and 12.7 for IPD-Work consortium studies without literature review. However, for this last group, as the quality score was assessed using 5 criteria instead of 8, the comparison may be difficult with the two other groups. Among the 54 reviews (the 18 IPD-Work consortium studies without literature review excluded), 39 (72%) followed guidelines. Prospective design was the retained study design to select the primary studies, alone (46 reviews, 64%) or combined with case-control studies (9 reviews, 12%). Adjustment for gender, age, and SES was used in 16 reviews (22%), or a close adjustment in 18 additional reviews (25%). Quality was assessed in 37 reviews among 54 (69%). Almost all reviews performed the meta-analysis using adequate statistical methods (63 reviews, 88%). Publication bias was studied in 36 reviews among 54 (67%), and 21 of them did not find this bias whereas 15 found this bias. Heterogeneity was explored in 58 reviews (81%), and 23 of them found low heterogeneity. Among 67 reviews that included both genders, 30 reviews provided no information about gender. Attention was given to gender in 37 reviews (55%), however, gender differences were not always statistically tested, limiting definitive conclusions (9 reviews). A set of 27 reviews (96%) concluded to the absence of gender differences in the exposure-outcome associations, and only one reached the opposite conclusion. When other subgroup differences were tested, the large majority of the reviews did not find differences for age (81%), region/country (79%), and SES (69%). When explored and tested (which was very rare), there were no differences in the associations according to study characteristics such as study quality, study design, adjustment, exposure and outcome measurement, and follow-up length in (almost) all reviews.

Pooled estimates for each exposure-outcome association

Table 1 shows the availability of at least one pooled estimate for all exposure-outcome associations. This table includes 16 exposures and 38 outcomes, making a total of 608 exposure-outcome associations possible. In fact, at least one pooled estimate was available for only 119 exposure-outcome associations (ie, 20%).

Figure 2 presents the results for CHD. There were 15 included reviews (22, 37-39, 43, 44, 46, 49, 65, 68, 72, 73, 75, 81, 82). All were literature reviews except three IPD-Work consortium studies without literature review (22, 37, 43). All the estimates were significant for job/ high strain and CHD, with increasing precision over time. The most conservative estimate (RR=1.17, 95% CI 1.05-1.31) (43), adjusted for gender, age, and SES, had a higher quality. One recent review (68) which investigated CHD mortality (and not CHD) provided a non-significant estimate, with the largest CI (lower precision). Among the five significant estimates for long working hours, three, based on prospective design, provided lower values of similar magnitude (RR=1.12 or 1.13) and had higher precision and higher quality (44, 49, 75). Among the two estimates for effort-reward imbalance, the most recent was significant and had greater precision (RR=1.19, 95% CI 1.04-1.38) and higher quality (22). The estimates for job insecurity (RR=1.32, 95% CI 1.09-1.59, moderate quality) (73) and organizational injustice (RR=1.62, 95% CI 1.24-2.13, low quality) (46) were significant, but displayed lower precision. Thus, the magnitude of the association was similar for job strain, long working hours, and effort-reward imbalance, and a little higher for job insecurity and organizational injustice, though more imprecise.

Figure 3 presents the results for stroke. Five papers (21, 26, 34, 44, 75) provided estimates that were based on literature reviews except one IPD-Work consortium study without literature review (26). For all, prospective design was a selection criterion and quality assessment was high, with one exception. High strain, but not job strain, was associated with overall stroke (RR=1.22, 95% CI 1.01-1.47) (34). The estimates were significant for ischemic stroke but not significant for hemorrhagic stroke. There were three significant estimates for the association of long working hours with overall stroke, the two higher quality estimates providing higher values of similar magnitude (RR of around 1.3) (21, 44).

Three IPD-Work consortium studies without literature review explored other cardiovascular diseases and reported significant associations between job strain and peripheral artery disease (high quality) (30), and long working hours and arterial fibrillation (high quality) (41) and venous thromboembolism (moderate quality) (40). The three RR ranged from 1.4-1.5.

Figure 4 presents the results for diabetes, which was the most frequently studied cardiovascular risk factor in 7 reviews (20, 24, 45, 57, 59, 66, 81), among which 3 were IPD-Work consortium studies without literature review (24, 57, 59). Most of the estimates were nonsignificant, and the three significant associations were reported by the 3 IPD-

Work consortium studies without literature review. For job strain, there were 4 estimates, and only 2, of low or high quality, displayed significant associations with diabetes, the more conservative and more precise RR, of the two estimates, being 1.15, 95% CI 1.06-1.25 (high quality) (57). There was one significant association between job insecurity and diabetes (RR=1.15, 95% CI 1.04-1.28, high quality) (24).

Figure 5 shows the results for obesity. There were 2 literature reviews (42, 85) and 3 IPD-Work consortium studies without literature review (58, 59, 77). Significant associations were observed between job strain and obesity using cross-sectional data but not using prospective data. The associations between long working hours and obesity were significant with all types of design (moderate/high quality), with 4 estimates of similar magnitude ranging from 1.12-1.17 (77, 85).

Figure 6 presents the results for behavioral risk factors. Two IPD-Work consortium studies without literature review (25, 59) and one literature review (81) reported significant associations between job strain (59), high strain (25), long working hours (81) and physical inactivity. The estimate based on prospective design (RR=1.21, 95% CI 1.11-1.32) was more conservative than the estimate based on cross-sectional design for the association between high strain and physical inactivity (high quality) (25). Quality was low for the associations of job strain and long working hours with physical inactivity with significant RR of 1.34 (95% CI 1.26-1.41) (59) and 1.23 (95% CI 1.00-1.52) (81) respectively. Two IPD-Work consortium studies without literature review found a significant association between job strain and smoking using cross-sectional data, but not using prospective data. The association between long working hours and smoking was non-significant. Two reviews (74, 81) and two IPD-Work consortium studies without literature review (32, 59) examined alcohol intake. No association was observed between job strain and alcohol intake except one borderline significant based on cross-sectional design. Two literature reviews (74, 81) studied long working hours in association with alcohol intake, and one (moderate quality) reported two significant associations using either cross-sectional or prospective data with estimates of similar magnitude (RR of around 1.1) (74).

Figure 7 presents the results for depression-related outcomes from nine reviews (36, 51, 61-63, 69, 78, 79, 81) examining depressive symptoms (36, 61, 63, 69, 78, 81), or more rarely, clinical/major depression (51, 62, 79) or hospital-treated clinical depression (51). All estimates were significant except one. All these estimates were derived from literature reviews of prospective primary studies, except one review of low quality (81), including cross-sectional design, that provided a stronger effect size of long working hours on depressive symptoms. The two first estimates (moderate/high quality) for long working hours were consistent in magnitude although the second one (RR=1.14, 95% CI 1.03-1.25) was significant and had greater precision and quality (78). Three estimates provided significant associations between job strain and depression with increasing quality from low to high. The two first estimates were consistent in terms of magnitude (RR ranging from 1.7-1.8) (51, 69). The third estimate was lower probably because the outcome was hospitaltreated clinical depression (51). One estimate displayed a significant association between effort-reward imbalance and depressive symptoms (RR=1.68, 95% CI 1.40-2.01) (moderate quality) (63). There were two significant estimates for the association between job insecurity and depressive symptoms, and the most recent estimate had a higher quality (RR=1.61, 95% CI 1.29-2.00) (61). There was one significant estimate for the association between bullying and depressive symptoms, whose CI was large (RR=2.82, 95% CI 2.21-3.59) (low quality) (69). There was one significant estimate of lower magnitude for the association between physical violence and depression (RR=1.42, 95% CI 1.31-1.54) (moderate quality) (62). Thus, the associations of higher magnitude were found for job strain, effort-reward imbalance, job insecurity, and violence, and still more for bullying.

Figure 8 presents the results for the other mental health outcomes. Two literature reviews, of low or moderate quality, explored the associations between psychosocial work exposures and burnout (15, 62), only one was based on prospective design (15), and both provided estimates that were all significant. The magnitude of the association was larger for psychological demands, organizational injustice, and emotional demands (all RR>2.5). The precision was however low for reward, violence, injustice, and emotional demands. Three reviews reported estimates for anxiety symptoms (61, 62, 81), and two of them showed significant, though imprecise, associations with long working hours (RR=1.31, 95% CI 1.04-1.64, low quality) (81) and job insecurity (RR=1.77, 95% CI 1.18-2.65, high quality) (61). Six reviews provided estimates for sleep problems (low or moderate quality) (50, 52, 55, 62, 81, 84). They were all literature reviews but only two reviews selected prospective primary studies (50, 55). The estimates were significant for almost all exposures. The CI were however very large, except for the job strain model factors and long working hours. The RR ranged from 1.2-1.4 for job strain and long working hours. RR of higher magnitude (>2) were observed for effort-reward imbalance, violence, and work-life imbalance, but these estimates were very imprecise and derived from low quality reviews. One literature review (low quality) (53) provided estimates for suicide-related outcomes. All estimates were significant for suicide ideation and ranged from 1.3-1.9, but the CI were large except for the job strain model factors. The association was borderline significant between low control and suicide (RR=1.23, 95% CI 1.00-1.51). Two reviews (moderate or high quality) explored psychotropic medication use (54, 61), and most of the associations were not significant except for psychological demands, job insecurity, and work-life imbalance (RR ranging from 1.1-1.4).

Figure 9 shows the results for MSD according to the region of pain. There were 5 reviews (14, 27, 47, 48, 76), of low or moderate quality, and all were based on prospective design, except one (76). Job strain model exposures were associated with MSD (all regions), and the two RR for job strain ranged from 1.35 (low quality) to 1.62 (moderate quality). Job strain model exposures were associated with low back pain, the estimates being consistent between the 2 reviews involved (27, 48). Job strain displayed RR ranging between 1.38-1.40. Job insecurity was significantly associated with low back pain in the most recent review (RR=1.43, 95% CI 1.16-1.76) (48). According to three reviews (27, 47, 48), all estimates were significant for the associations between job strain model exposures and neck/shoulder pain, except two estimates. The differences in the estimates between two of these reviews (27, 48) and the third one (47) remained difficult to understand. RR ranging from 1.331.43 were found for job strain. According to two reviews (27, 48), low latitude and high demands were associated with upper extremity pain (27, 48). Low support was significant in one review (27) and not in the other (48). There was no significant association between job strain and upper extremity pain. One review (48) found a significant association of low support with lower extremity pain. Contrarily to our expectations, the associations of job strain with MSD were not always more precise over time when two or more reviews were available. The magnitude of the association was found to be approximately consistent between job strain and MSD (all regions), low back and neck/shoulder pain (RR ranged from 1.3-1.6).

Pregnancy outcomes (figure 10) were explored in 5 reviews (17-19, 60, 71), with quality increasing from low to moderate over time, that displayed significant associations between long working hours and miscarriage (two estimates of similar magnitude, RR ranging between 1.36-1.38), preterm delivery (3 most recent estimates of similar magnitude, RR ranging between 1.21-1.25), small-for-gestational-age (one borderline significant estimate, RR=1.16, 95% CI 1.00-1.36) (19), and low birth weight (RR=1.43, 95% CI 1.11-1.84) (19).

Figure 11 shows the results for cancer. Two IPDWork consortium studies without literature review (28, 29) and one review (83) explored cancer, and all three were based on prospective design and were of moderate quality. All estimates were non-significant, except two associations, significant though imprecise, between job strain and lung cancer (RR=1.32, 95% CI 1.01-1.74) (29), and between long working hours and breast cancer (RR=1.54, 95% CI 1.09-2.18) (28).

Finally, an IPD-Work consortium study without literature review (33), of moderate quality, did not show an association between job strain and Crohn's disease and ulcerative colitis.

Discussion

Summary of the results

This meta-review of 72 reviews showed that the associations were mainly significant between psychosocial work exposures and cardiovascular diseases (CHD and stroke) and mental disorders, particularly depression, based on the highest quality reviews. The magnitude of the associations was a little stronger for mental disorders than for cardiovascular diseases. High-quality reviews reported significant pooled estimates for job/high strain and long working hours in association with the 3 outcomes of CHD, (ischemic) stroke, and depression, as well as for effort-reward imbalance with CHD, and job insecurity with depression. Based on high-quality reviews, a few other significant associations were found between job strain, job insecurity and diabetes, long working hours and obesity, high strain and physical inactivity, and job insecurity and anxiety and psychotropic medication use. Nevertheless, the consistency over time of the associations varied according to the studied exposure-outcome association.

Comparison with the literature

There were four previous meta-reviews (7-10), two on the outcomes of cardiovascular diseases (7) and common mental health problems (8), and two others on the exposures of long working hours (10) and workplace bullying (9). Our results are in line with the findings of these meta-reviews. Fishta et al. (7) reported moderate evidence for the associations between psychosocial work factors (mainly job strain) and cardiovascular outcomes. According to Harvey et al (8), there was moderate evidence for the associations of high job demands, low job control, effort-reward imbalance, low justice, role stress, bullying, and low social support with common mental health problems. Nielsen et al (9) showed that bullying was associated with a large number of health outcomes. However, these meta-reviews did not present and compare the results in terms of pooled estimates, and significance, magnitude, precision, and consistency of the associations. Furthermore, they provided narrative information about the associations with cardiovascular diseases and mental health problems, as broad outcomes, but stated no conclusion about specific outcomes. The exception is the meta-review by Rivera et al focusing on long working hours (10) that used literature reviews with meta-analysis and concluded that stroke was the only outcome with moderate evidence in association with this exposure. Thus, our meta-review underlined that long working hours may have an impact on other health outcomes principally CHD and, to a lesser extent, obesity and depression.

Strengths and limitations of the study

This meta-review had a number of limitations. As a meta-review relies on both the available literature reviews and the primary studies included in each review, it reflects the limitations, including heterogeneity of methods and measurements and sources of bias, of both the included reviews and the primary studies upon which the results of these reviews were based.

This meta-review collected pooled estimates from published literature reviews with meta-analysis. Consequently, the results from reviews without meta-analysis or from published primary studies not included in the reviews were ignored. This approach was probably appropriate for health outcomes such as cardiovascular diseases or mental disorders for which research has accumulated over decades, but may not be for other health outcomes for which reviews with meta-analysis may be missing. As an example, there was one review without meta-analysis for cognitive disorders (86), suggesting some rare uncovered areas in our meta-review. We excluded reviews on all-cause mortality because this outcome was not related to a specific disease or disorder. One systematic literature review with meta-analysis was published on all-cause mortality (68) and was included in our meta-review for CHD mortality. This review showed that low job control only was associated with all-cause mortality. Our meta-review included reviews published until 28 September 2020. Reviews published afterwards include a review by Li et al (87) reporting an association between job strain and diabetes, especially among women, and a review by Mikkelsen et al (88) assessing the evidence for causality whose authors concluded that any of the studied psychosocial work factors was "either likely or unlikely to cause depressive episodes". Publication bias resulting from the non-publication of primary studies or literature reviews with non-significant results may have overestimated the pooled estimates. Publication bias was noted by the authors of the IPD-Work consortium in one study (43). In our meta-review, 58% of the reviews that explored publication bias did not find this bias whereas 42% found this bias.

For a given exposure-outcome association, there may have been overlap in primary studies included in several reviews, preventing us from pooling all the available estimates, but as we had an interest in examining the pooled estimates over time, this issue may not be a problem. Indeed, our meta-review showed that some recent reviews were able to provide more precise pooled estimates than previous ones, which was consistent with a higher statistical power related to a higher number of primary studies. However, some inconsistencies between reviews were also observed in both magnitude and precision of the association over time and might be explained by differences in the choice of selection criteria. For example, the reviews that included all study designs were more likely to provide higher pooled estimates than those based on prospective design alone. In addition, in case of more than one review for a given association, this allowed us to identify the best quality review (which was not always the most recently published review).

It was not always easy to conclude on the comparison of the magnitude of the associations in order to identify the exposures with the highest magnitude of association, as estimates with higher magnitude were also often those with the highest level of imprecision (largest CI).

There may have been heterogeneity and differences in the measurement of exposure and outcome between primary studies and between reviews. Exposure may differ in terms of assessment method, questionnaire, definition, computation, and cut-off scores utilized. Outcomes may also differ in terms of assessment method, which may lead to outcomes different in nature (for example, depression-related outcomes were very different, as they covered a broad continuum from symptoms to clinical disorder). This heterogeneity was not always taken into account in the included reviews. There was also a major lack of information about exposure duration or cumulative exposure, as most primary studies examined exposure measured at one point in time only, leading to potential misclassification and bias towards the null hypothesis in prospective studies. By contrast, reporting bias related to the measurement of both exposure and outcome (especially for the study of mental health outcomes) may have overestimated the associations. The adjustment variables retained in our review were gender, age, and SES, and if not available the closest minimally adjustment possible. This choice was made to make the results as homogeneous and comparable as possible. In addition, including more adjustment variables may not be appropriate as some variables may be mediators in the studied associations and lead to over adjustment. However, there was no major difference in the results between the retained adjustment and additional adjustment when it was available, though not systematically tested in the reviews. Nevertheless, residual confounding bias may still be possible, as all the primary studies were observational.

Our meta-review included strengths that also deserve to be mentioned.

It was based on a well-defined meta-review protocol, following PRISMA guidelines. We searched in various databases and made a check into the reference lists of the included reviews.

We focused on reviews with meta-analysis to be able to provide pooled estimates and draw more solid and quantitative conclusions. We were thus able to provide information on the significance, magnitude, precision, and consistency over time of the pooled estimates. Furthermore, we were also able to present and compare the results according to specific exposures and outcomes. This strategy was in accordance with the previous meta-review by Rivera et al (10) on long working hours in which literature reviews with meta-analysis were included and specific outcomes were studied, and expanded the knowledge provided by the three other meta-reviews that studied very broad outcomes only (7-9). In addition, we summarized the results for all psychosocial work factors and all health outcomes, which has never been done before. The quality of reviews was assessed in our meta-review using various critical points, including methodological criteria.

We extracted a large amount of information from the included reviews. We collected information about gender differences and other subgroup differences. When heterogeneity was studied, moderate or high level of heterogeneity was found in more than half of the reviews. When subgroup differences were tested, there were in general no or few differences between subgroups, which may suggest that differences in study population may not be a major source of heterogeneity. Only few reviews tested differences according to study characteristics and found few differences. However, our meta-review suggested differences related to study design.

Perspectives

Methodological issues, which may appear in some primary studies but may not be translated in reviews to date, may be underlined for future research. The assessment of psychosocial work factors should be enlarged to under- or less studied factors, as the literature tends to focus on a limited number of factors (especially job strain). The assessment of psychosocial work factors relied generally on questionnaires (also called subjective assessment methods), and the use of validated scales or questionnaires when available and respect for use recommendations are highly recommended. The use of alternative objective assessment methods remains rare (job-exposure matrix, expert assessment, etc.) and should be expanded in order to compare these methods and provide information on reporting bias. Theorell and Hasselhorn (89) underlined the importance that the exposure-outcome association be "repeatedly being confirmed" whatever the assessment method used (in accordance with the consistency criterion (12)). More information is needed on exposure duration and doseresponse associations, as well as time lags and reversibility of the effects. The use of diagnostic instruments/ methods for outcome measurement especially for mental health outcomes, but also for other health outcomes, should be more extensive. The study of other health outcomes, that are not cardiovascular and mental health outcomes, should be strengthened. In sum, to further advance the knowledge in this field, high-quality studies are needed and should prioritize: prospective design, study of a larger spectrum of psychosocial work factors, use of objective assessment methods for both exposure and outcome in combination with subjective methods, and study of repeated measures of exposure over time, duration of exposure, dose-response associations, and multiple exposures. More systematic formal testing of subgroup differences in the exposure-outcome associations is suitable, especially between gender, age and SES groups. The impact of study characteristics and methods should also be deepened.

More information is also needed on the mechanisms that may explain the exposure-outcome associations. Firstly, the mechanisms by which psychosocial work factors may impact health outcomes remain poorly understood. For example, robust associations were found for cardiovascular diseases, but the associations for cardiovascular risk factors, including behavioral risk factors, were not as robust as expected. Some rare reviews (9094) were published on physiological indicators, including immune markers, neuroendocrine stress responses, etc., that may contribute to underlying mechanisms. However, the literature remains sparse and inconclusive for psychosocial work exposures. Secondly, there may be strong overlaps between psychosocial work factors, and more research is suitable on the interrelations between these factors, and the underlying causal mechanisms. Harvey et al (8) attempted to construct a more unified model for psychosocial work factors and suggested overlapping concepts. There may also be a need for more research on the determinants of psychosocial work factors, such as economic, social, and political factors at macro-level and company-level organizational factors. More studies and reviews exploring macro- or company-level factors and psychosocial work factors in association with health outcomes may be informative to better understand the interrelations between these factors and elaborate preventive prospects. Finally, our meta-review was not designed to capture reviews of intervention studies focusing on psychosocial or organizational intervention at the workplace. Such reviews remain very rare (95), as well as high-quality intervention studies themselves, but would be particularly useful to provide information on the effectiveness of such intervention on well-defined health outcomes, and to make progress towards causality.

Concluding remarks

Increasing our understanding of the effects of psychosocial work factors on health outcomes is crucial. To this end, it is worth taking advantage of the existing literature, which may not be used fully to date. Given the large corpus of the literature available on the topic of psychosocial work factors and health outcomes, more high-quality literature reviews providing pooled estimates from meta-analysis are an asset. Updates of these reviews with meta-analysis are also needed in order to provide up-to-date pooled estimates. This information may be of upmost importance to define preventive strategies oriented towards the psychosocial work environment. Finally, our present meta-review may also be seen as a reflection of all the results that are still missing and waiting for more research.

Conflict of interest

The authors declare no conflicts of interest.

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Sidebar

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DETAILS

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Aluminum dust exposure and risk of neurodegenerative diseases in a cohort of male miners in Ontario, Canada

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ABSTRACT (ENGLISH)

Objectives We estimated associations between respirable aluminum exposure through McIntyre Powder (MP), a fine-sized aluminum and aluminum compound powder, and neurological disease in a retrospective cohort of mining workers from Ontario, Canada. Outcomes included Alzheimers disease, Alzheimers with other dementias, Parkinsons disease, parkinsonism, and motor neuron disease. Methods The cohort was created by linking a database of mining workers work history to healthcare records. This analysis included 36 826 male miners potentially exposed to MP between 1943 and 1979, followed up for disease diagnosis between 1992 and 2018. Exposure was assessed using two approaches, self-reported and historical records. Neurological diseases were ascertained using physician billing and hospital discharge records. Poisson regression models were used to estimate associations between MP exposure and neurological outcomes using incidence rate ratios (RR) and 95% confidence intervals (95% CI). Results Exposure to self-reported MP was associated with an elevated incidence rate of Parkinsons disease (RR 1.34, 95% CI 1.14-1.57). The rate of Parkinsons disease appeared to increase with the duration of exposure assessed by historical records. Having ever been exposed to MP was positively associated with an elevated rate of Alzheimers with other dementias (RR 1.12, 95% CI 1.06-1.19) but not Alzheimers disease alone. Conclusion This study found that miners who were exposed to MP (respirable aluminum) had elevated rates of Parkinsons disease. The rate of Parkinsons disease appeared to increase with the duration of exposure assessed by historical records.

FULL TEXT

Headnote

Objectives We estimated associations between respirable aluminum exposure through McIntyre Powder (MP), a fine-sized aluminum and aluminum compound powder, and neurological disease in a retrospective cohort of mining workers from Ontario, Canada. Outcomes included Alzheimers disease, Alzheimers with other dementias, Parkinsons disease, parkinsonism, and motor neuron disease.

Methods The cohort was created by linking a database of mining workers work history to healthcare records. This analysis included 36 826 male miners potentially exposed to MP between 1943 and 1979, followed up for disease diagnosis between 1992 and 2018. Exposure was assessed using two approaches, self-reported and historical records. Neurological diseases were ascertained using physician billing and hospital discharge records. Poisson regression models were used to estimate associations between MP exposure and neurological outcomes using incidence rate ratios (RR) and 95% confidence intervals (95% CI).

Results Exposure to self-reported MP was associated with an elevated incidence rate of Parkinsons disease (RR 1.34, 95% CI 1.14-1.57). The rate of Parkinsons disease appeared to increase with the duration of exposure assessed by historical records. Having ever been exposed to MP was positively associated with an elevated rate of Alzheimers with other dementias (RR 1.12, 95% CI 1.06-1.19) but not Alzheimers disease alone.

Conclusion This study found that miners who were exposed to MP (respirable aluminum) had elevated rates of Parkinsons disease. The rate of Parkinsons disease appeared to increase with the duration of exposure assessed by historical records.

Key terms Alzheimers; epidemiology; metal; parkinsonism; Parkinsons disease; workplace exposure.

During the mid-to-late 20th century, a purported prophylaxis against silicosis was administered to workers in underground mines through inhalation of McIntyre Powder (MP), an aluminum powder formulation (1). MP prophylaxis was used at various mine sites in Canada, the United States, Mexico, Chile, Australia, and what is today the Democratic Republic of Congo (1). Silicosis is a lung disease caused by exposure to crystalline silica dust that was common among miners at the time (1).

MP was dispersed into an enclosed environment (often the change area or drys) exposing workers to short-term and fine-sized insoluble aluminum and aluminum compounds at high concentrations (2). MP was comprised primarily of aluminum oxide (~90%) with metallic aluminum (~10%) (3). A recent study characterized MP, assuming it was produced after 1956, and found that its particles were extremely small - within the nanometer range of 5-100 nm (4). However, MP particles can aggregate to form larger sizes after air suspension. Dispersed MP particles in the air were measured in the range of <200 nanometers to >5 micrometers (3, 5). Before shifts, workers had prescribed exposure to MP with a target concentration of 35.6 milligrams per cubic meter (mg/m3) for 10-20 minutes (4). At 15 minutes, this exceeds the threshold limit value for an 8-hour timeweighted average proposed by the American Conference of Governmental Industrial Hygienists (6) and adopted as regulation in many North American jurisdictions. Use of MP was discontinued in the 1970s because of concerns regarding adverse health effects.

The effects of dietary, environmental and occupational exposure to aluminum have been previously examined, primarily focused on Alzheimer's disease. Findings integrated from eight studies showed an increased risk of Alzheimer's disease associated with chronic exposure to aluminum from dietary and occupational sources [odds ratio (OR) 1.71 (95% confidence interval (CI) 1.35-2.18)] (7). However, findings between aluminum exposure and the etiology of Alzheimer's disease remain inconsistent (8), and little evidence has been provided from occupational studies (9-11).

Effects of occupational aluminum exposure on other neurological outcomes have been less studied. Declined cognitive performance has been observed among welders and foundry workers with occupational exposure to aluminum dust and fumes (12-15). Workplace exposure to aluminum was not associated with an increased risk of Parkinson's disease (16). No published studies were identified investigating associations between occupational aluminum exposure and motor neuron disease. There is limited evidence on the risk of neurological disease due to MP exposure specifically. To date, there have only been two published epidemiological studies: one in Canada (17) and the other in Australia (18), both with small numbers of neurological disease cases.

Using a cohort of underground miners in Ontario, Canada, the objective of this study was to estimate incidence rate ratios (RR) of multiple neurodegenerative diseases (1992-2018), including Alzheimer's disease (alone and with other dementias), Parkinson's disease, parkinsonism, and motor neuron disease, among workers exposed to aluminum through MP (1943-1979).

Methods

Study design and population

The study cohort was identified using records from the Mining Master File (MMF). The MMF database of 93 526 Ontario underground miners was collected during mandatory annual medical exams held from 1928 to 1988 and includes work history information spanning 1877-1988. These exams certified miners for medical fitness to work underground.

The study cohort included 36 826 male miners in the MMF who had information on name, date of birth, sex, and work history. Miners were eligible if their age at first employment in mining was 15-65 years, age at the start of disease follow-up (1 January 1992) was <100 years, and they were successfully linked to Ontario's Registered Person's Database (RPDB). The RPDB contains information on Ontario healthcare recipients with unique identification numbers (health insurance numbers) that enable data linkage to the administrative health service databases. The majority of unlinked miners died or were lost to followup (supplementary material www.sjweh.fi/article/3974, figure S1). None of the female mine industry workers linked to RPDB (N=116) were exposed to MP. Women were therefore excluded from further analysis.

Case ascertainment

Miners who were uniquely identified from the RPDB were then linked to Ontario administrative health databases to identify cases of neurological disease. These databases include the Ontario Health Insurance Plan (OHIP) claims database, which contains health service billing information submitted by healthcare providers; the Discharge Abstract Database (DAD), which contains clinical and demographic information related to hospital discharge; and the National Ambulatory Care Reporting System (NACRS), which contains ambulatory care visits from emergency departments, day surgery, outpatient, and community-based clinics under Canada's singlepayer healthcare system (19). Disease diagnoses in the OHIP were coded with a modified version of ICD-9 (International Classification of Disease, 9th revision) and in DAD and NACRS were coded using ICD-9 before 2002 and ICD-10-CA (Canadian modification of ICD10) in 2002 and onwards.

Alzheimer's, Parkinson's, and motor neuron disease cases were ascertained using hospital discharge or ambulatory care data (at least one record with corresponding diagnostic codes; Alzheimer's disease: ICD-9 331.0, ICD-10-CA G30; Parkinson's disease: ICD-9 332.0, ICD-10-CA G20; Motor neuron disease: ICD-9 335.2, ICD-10-CA G12.2). Broader definitions of Alzheimer's with other dementias and parkinsonism were ascertained using physician billing claims (at least two physician claims with diagnostic codes in OHIP within 12 months; Alzheimer's with other dementias: 290, 331; Parkinsonism: 332) in addition to at least one record with corresponding diagnostic codes in hospital discharge or ambulatory care data (Alzheimer's with other dementias: ICD-9 290, 294.1, 331.0, 331.1, 331.82, ICD-10 F00, F01, F02, F03, G30; Parkinsonism: ICD-9 332.0 332.1, ICD-10 G20, G21.0-0.4, G21.8-9, G22, F023) (supplementary table S0). Physician claims data could not be used to isolate Alzheimer's, Parkinson's, and motor neuron disease cases because diagnostic codes include these diseases with related conditions (19).

In previous validation studies that investigated various ascertainment algorithms of these health outcomes using Ontario administrative databases, case definitions for Alzheimer's with other dementias and parkinsonism used in the present study achieved approximately 70% in both positive predictive value and sensitivity (20, 21). Case ascertainment of neurological conditions that only used hospital data also previously showed good positive predictive values. For example, a systematic review reported 56-90% in positive predictive value estimates for Parkinson's disease from seven studies using tal data with datasets collected in United States, Columbia, and European and Nordic countries (22).

Exposure assessment

MP was used in many Ontario mines between 1943 and 1979. Miners' exposure to MP was assessed in this study using two approaches. The first approach used existing self-reported MP exposure information (yes/no) from the MMF database, with data corrected by the research team where available historical records from the McIntyre Research Foundation showed that MP was not administered at a mine in a given year. Miners' self-reported MP information was collected during the annual medical examination (1951-1979) with prior years (1943-1951) backfilled by the database administrators (ie, Workplace Safety &Insurance Board) using an MP usage list containing 39 gold and 9 uranium mines.

The second approach assigned MP exposure (yes/ no) to individuals based on historical records of their working years, mine site, and broad job classification. A comprehensive list of 51 mine sites where MP was administered, including the time period of use, was created using McIntyre Research Foundation records held by the Provincial Archives of Ontario and the historical Mines Accident Prevention Association (MAPAO) dust survey records from the Ontario Ministry of Labor. It was cross-checked with a list reported by the MP Project, a miners' advocacy organization (23).

MP exposure was categorized into exposed or unexposed for each year of work history using both assessment approaches. MP exposure duration was based on the number of work years with recorded exposure and categorized into >0-1, >1-5, >5-10, and >10 years.

Cohort set-up and statistical analysis

Miners enrolled in the MMF between 1928 and 1988 were followed up for neurodegenerative disease between 1992 and 2018 (supplementary figure S2). Follow-up started on 1 January 1992 (based on data availability) and ended on the earliest of: diagnosis date for each neurological disease, death or last administrative date of contact with the Ontario health system, or end of the study period on 31 March 2018. Follow-up was censored at age 100 years to reduce potential immortal persontime bias due to loss of follow-up.

All MP-related analyses were conducted independently using both self-reported MP and MP from historical records. Exposure was estimated both as "ever" MP exposure and as duration of MP exposure for a series of exposure periods (only before 1956, ever after 1956, and only after 1956 (5)). Complete results tables from both approaches are presented in supplementary tables S1.1-S5.3).

Time since last MP exposure was categorized into 12-19, 20-29, 30-39, 40-49, and 50-75 years, and compared to non-MP exposed workers. Its association with neurodegenerative outcomes was estimated to infer the latency interval between last exposure and disease diagnosis. Time window analysis was conducted to infer the 'empirical induction period', referring to the period between exposure and the first detection of disease (24). This analysis considered neurodegenerative cases and person-times only occurring in each of the assigned time windows (12-19, 20-29, 30-39, 40-49, and 50-75 years ago) and examined RR (95% CI) for each disease between ever and never exposure to MP in that time window.

Poisson regression modeling was used to estimate the association between MP exposure and neurodegenerative disease, adjusted for birth year and age throughout the follow-up period to control for potential confounding by differences in age, birth cohort, and calendar year of follow-up between exposed and unexposed groups. The adjustment variables were specified in the model to maximize model fit based on the Akaike Information Criterion (AIC). The p-value for linear trend across durations of MP exposure was also examined using Poisson regression models. The trend analysis for visual inspection of the slope a linear trend in effect estimates across chosen exposure duration categories. Case counts fewer than six were suppressed as per reporting requirements. All analyses were performed using SAS 9.4 (SAS Institute, Cary, NC, USA). The University of Toronto Health Sciences Research Ethics Board approved this study (protocol # 34944).

Results

Miners in the study cohort had a median year of birth in 1938 (IQR 1927-1949), median first hire in 1963 (IQR 1952-1971) and median duration of employment as an underground miner of 11 years (IQR 6-18) (table 1). Throughout the follow-up period for neurodegenerative disease, the median follow-up time for miners was 23 years, and their median age at the end of follow-up was 73 years old. According to self-reports approximately 26% of miners in the study cohort were exposed to MP, while 38% had MP exposure according to historical records (table 2). Over 90% of exposed miners experienced at least some of their exposure during the post-1956 period when MP particles were thought to be smaller (5). Miners with self-reported MP exposure tended to be older than unexposed miners (median year of birth 1932 verus 1941), had an earlier year of hire (median 1955 versus 1966), and were employed longer in duration (13 versus 10 years) (table 1). Age at the end of follow up was older for self-reported MP-exposed miners (median age 77 versus 72 years). Using the historical records exposure assessment approach, characteristics of employment duration, total follow-up years, and age at the end of follow-up appeared more similar between exposed and unexposed miners.

In the study cohort, ever-exposure to MP using the two assessment approaches was associated with 32-34% increased rate of Parkinson's disease [from self-reports: RR 1.34 (95% CI 1.14-1.57); from historical records: RR 1.32 (95% CI 1.13-1.54)] (tables 3 and 4). Elevated rates of parkinsonism were observed among MP exposed workers. However, additional analysis showed that no elevation of parkinsonism - excluding Parkinson's disease cases - was observed, indicating that the elevated rate of parkinsonism among MP-exposed miners was driven by Parkinson's disease cases, although this analysis only captured a small number of cases from the hospital and ambulatory care data (supplementary table S4.4). Exposure to MP was not associated with Alzheimer's disease but was associated with a 12-14% increased rate of Alzheimer's with other dementias [from self-reports: RR 1.12 (95% CI 1.06-1.19); from historical records: RR 1.14 (95% CI 1.08-1.21)]. MP exposure was not associated with motor neuron disease.

By exposure periods, the rate among workers with any post-1956 MP formulation exposure showed a stronger association with Parkinson's disease than exposure only before 1956 (tables 3 and 4). By duration of MP exposure, the rate of Parkinson's disease was the greatest among miners with over ten years of MP exposure according to historical records, but this duration trend was not observed for self-reported MP exposure, although the rate remained elevated for all durations of exposure according to self-reports.

The excess rate of Parkinson's disease and Alzheimer's with other dementias, followed between 1992 and 2018 in the study cohort, continued for several decades since last MP exposure occurred between 1943 and 1979 (tables 3 and 4). The 40% increased rate of Parkinson's disease persisted across several decades after the termination of self-reported MP exposure (table 3). Using historical records for MP assessment, the increased rate of Parkinson's disease reached the highest (50% increased rate) 30-39 years after the exposure ended, then it decreased over time (table 4). In a slightly different pattern, the peak elevated incidence rates of Alzheimer's with other dementias (~20%) was shown in the 12-19year post-exposure period and was lessened afterward.

Elevated incidence rates of Parkinson's disease and Alzheimer's with other dementias were suggested for one or multiple MP exposure time windows (table 5). The most etiologically relevant MP exposure windows were 30-39 years ago for Parkinson's disease. The increased rate of Alzheimer's with other dementias appeared to be in similar magnitudes across several exposure time windows ranging from 12-49 years ago, all of which could be considered etiologically relevant. Discussion

This study examined the association between respiratory exposure to aluminum (MP) and neurodegenerative outcomes in a cohort of Ontario underground miners. Our findings show that miners who were exposed to MP had an approximately 30% increased rate of Parkinson's disease and a 20% increased rate of parkinsonism. However, additional analysis revealed that Parkinson's disease cases drove the observed increased rate of parkinsonism. Miners with exposure to MP also had a slightly >10% increased rate of Alzheimer's with other dementias, but no elevated rate of Alzheimer's alone.

This study of nearly 37 000 miners and >9 500 MP-exposed miners is the first to observe an association between MP and Parkinson's disease. The two previous studies examining MP exposure and neurological disease were based on a small number of cases with low statistical power (17, 18). Rifat and colleagues (17) reported no significant difference in self- or proxy-reported diagnoses in neurological disorders between MP exposed and unexposed underground miners employed between 1955 and 1979 in Ontario. Among 261 exposed workers, there were only one reported diagnosis of probable Alzheimer's dementia and three diagnoses of Parkinson's disease. Among the 346 unexposed miners, only one diagnosis of probable Alzheimer's dementia was reported. However, with adjustment to age, education, immigrant status, employment duration, head injury, blood pressure during the interview, and several interviewer-related factors, this study found an estimated RR of 2.6 for cognitive function impairment among MP exposed miners. Peters and colleagues (18) followed a cohort of 1894 Australian underground gold miners from 1961 to 2009. Compared to miners without MP exposure, their study suggested an elevated risk of Alzheimer's disease mortality among Australian gold miners who were exposed to MP [hazard ratio 2.79 (95% CI 0.88-8.82)], but this elevation was based on 16 Alzheimer's disease deaths. In the present study, MP-exposed miners did not have an elevated incidence rate of Alzheimer's disease, but did have an increased rate of the broader category of Alzheimer's with other dementias.

Among MP-exposed miners in this study, case ascertainment methods based on different data sources may explain the observed elevated rate of Alzheimer's with other dementias but not Alzheimer's disease alone. Case ascertainment for Alzheimer's with other dementias has higher sensitivity due to the utilization of both in-patient and outpatient datasets, whereas case definition for Alzheimer's disease only used in-patient data that may include more severe cases. The elevated rate of Alzheimer's with other dementias may not rule out the possibility of a small excess of less severe Alzheimer's disease. In general, the majority of dementia cases may be Alzheimer's disease. For example, among those aged >65 years in North America, Alzheimer's disease accounted for two-thirds of the prevalent cases of dementia (25). However, in the present study, Alzheimer's with other dementia may not primarily consist of Alzheimer's disease alone since outpatient records can include many non-Alzheimer's cases. For example, one of the outpatient diagnostic codes (OHIP diagnostic code 331) cannot effectively differentiate Alzheimer's disease from other cerebral degenerations. Hence, the elevated rate of Alzheimer's with other dementias among exposed miners cannot be used to infer an association between MP and Alzheimer's disease. However, this elevation may imply that aluminum exposure is associated with a small elevated rate of other types of dementia or cerebral degenerations.

The present study suggests a dose-response relationship between MP exposure duration and Parkinson's disease. The rate of Parkinson's disease appeared to increase with the duration of exposure assessed by historical records. Previously, Rifat and colleagues (17) reported an increased range of cognitive impairment with increased MP exposure duration. Peters and colleagues (18) found a suggestive elevated risk of Alzheimer's disease mortality with years of aluminum dust exposure [hazard ratio 1.11 (95% CI 0.99-1.24), per year of exposure].

Elevated rates of Alzheimer's with other dementias and Parkinson's disease were observed with brief MP exposure for less than one year in the current study. It is possible that aluminum reached the brain as a result of the short-term but high-intensity aluminum exposure, resulting in neurotoxic effects. Respirable MP nanoparticles have a high chance of crossing the blood-air gas exchange barrier and entering the bloodstream to be further translocated to other organs (26). Nanoparticles in the bloodstream could then enter the brain by disrupting junctions of endothelial cells in the blood-brain barrier and change its permeability (27). Aluminum nanoparticles may also translocate to the brain through the olfactory bulb after deposition in the nasal epithelium (28, 29). Ultrafine or nanoparticles that reach the brain may initiate a series of neuro-inflammatory activities (30). Exposure to nanoparticles of metal oxide, such as aluminum oxide, can also lead to adverse effects of cytotoxicity and genotoxicity (31), which could contribute to neuron loss, a pathological hallmark in neurodegenerative disease.

Strengths and limitations

This study of Ontario mining workers is the largest to investigate the association between occupational aluminum exposure and the incidence of neurodegenerative outcomes. This study included approximately 37 000 miners, including >9500 miners with self-reported MP exposure. Of miners from the MMF who were eligible for inclusion for the cohort linkage to neurological disease, we successfully followed up 78% for disease risk. Systematically identifying incident cases from Ontario administrative databases allows for more sensitive identification of cases and statistically precise estimates than case identification using death certificates in previous studies (18, 32), and it reduces recall bias related to cases ascertained from self or proxy reports.

Another significant strength of this study is the utilization of two exposure assessment approaches for MP: self-reports and historical records. The use of historical records may correct for self-reports that are subject to information bias and, in this case, identified a greater number of exposed miners (13 800). In our study, these two approaches generated very consistent results in associations with neurodegenerative outcomes. Lastly, an internal study approach that compared MP-exposed to unexposed miners rather than the general population controlled for bias related to healthy worker effect (33). This study has several limitations. The start of disease follow-up in the present study was in 1992 because of the availability of electronic health records. Exposure to MP ended in 1979, and the MMF enrollment ended in 1988. As a result, we missed disease cases among the cohort that were diagnosed before 1992, which may cause some disease misclassification for both exposed and unexposed miners. Workers with self-reported MP exposure had a closer median total duration of employment than those unexposed workers (13 versus 10 years), but year of first hire tended to occur in earlier years for exposed than unexposed workers (median 1955 versus 1966), indicating that exposed workers likely were employed in earlier calendar periods than the unexposed. Disease follow-up starting in 1992 may have resulted in more missed cases among the exposed miners than those without, leading to differential disease misclassification. Also, this study was not able to trace approximately 51% of miners in the original MMF file (N=93 526) who died (18%) or were lost to follow-up (19%) before the start of disease follow-up in 1992, and those who otherwise failed to link to Ontario's hospital and outpatient records (11%). Almost two-thirds of these miners were historically exposed to MP.

This study was not able to quantify the level of aluminum exposure. The administration of MP was known to vary in practice between mines and periods, based on our review of archival and other historical records. Quantitative exposure information was not available in the MMF, and it was not possible for us to estimate workers' personal MP exposure. We were also not able to adjust for potential mining-related confounders such as exposure to arsenic (34), diesel engine exhaust (32), whole-body vibration (35), or head injury (36). However, we do not expect these other mining-related exposures to be associated with the use of MP in Ontario. We were similarly unable to adjust for non-mining related confounders associated with neurological disease development, such as environmental exposures (37) and other genetic and lifestyle factors.

In identifying cases of neurological disease in this study, the ICD codes at 4 or 5 digits were used in the hospital and ambulatory care databases, allowing for more precise identification of cases. However, physician billing records that contain only the 3-digit code did not allow for the differentiation of Parkinson's disease from parkinsonism, Alzheimer's disease from other forms of dementia, and motor neuron diseases from central nervous system diseases. We could not use additional cases from physician billing data to examine rare outcomes such as ALS among motor neuron disease. From hospital and ambulatory care data, 18 ALS cases were identified, but only one ALS case was observed among MP exposed miners. However, we may infer the relationship between MP and ALS from its null association with motor neuron disease. It has been reported that approximately 70% of motor neuron disease cases are ALS (38). Previously, studies found no significant differences in elemental aluminum concentrations in serum (39), cervical spinal cord cells (40), toenail (41), and hair (42), between ALS patients and controls.

Concluding remarks

This study found that miners who were exposed to MP (respirable aluminum) had elevated rates of Parkinson's disease and the disease category of Alzheimer's with other dementias. The rate of Parkinson's disease appeared to increase with the duration of exposure assessed by historical records and was greater for miners exposed after 1956 when the MP formulation was changed to decrease the particle sizes. Future studies should explore other mining hazards that might contribute to the rate of neurodegenerative disease and health risks that may be associated with aluminum exposure in this population.

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Sidebar

Zeng X, MacLeod J, Berriault C, DeBono NL, Arrandale VH, Harris AM, Demers PA. Aluminum dust exposure and risk of neurodegenerative diseases in a cohort of male miners in Ontario, Canada. Scand J Work Environ Health. 2021;47(7):531539. doi:10.5271/sjweh.3974

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DETAILS

Subject:	Ambulatory care; Silicosis; Mines; Neurological diseases; Health care policy; Epidemiology; Regression analysis; Regression models; Hospitals; Aluminum; Basal ganglia; Disease prevention; Mining; Exposure; Neurodegenerative diseases; Statistical analysis; Aluminum compounds; Medical personnel; Movement disorders; Confidence intervals; Job classification; Occupational exposure; Dementia; Males; Archives &records; Databases; Central nervous system diseases; Miners; Motor neuron diseases; Alzheimer's disease; Health services; Parkinson's disease; Health risks; Motor neurone disease; Health insurance
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Understanding the impact of psychosocial working conditions on workers' health: we have come a long way, but are we there yet?

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ProQuest document link

ABSTRACT (ENGLISH)

Curiously, though, this observation did not inspire research on occupational stressors but rather led to the development of the concept of "type A behavior", a behavioral pattern characterized by feelings of time urgency, competitiveness and hostility that became the dominant psychosocial explanation for risk of coronary heart disease in the late 1970s and early 1980s (4). In Belgium, Kornitzer and colleagues published a paper in 1975 on the risk of coronary heart disease in employees at two banks, and discussed whether the higher occurrence in one of the banks could be related to work organization (6), a hypothesis which they later examined and corroborated (7). A major advance was made in 2012, when the "Individual-Participant Data Meta-Analysis in Working Populations (IPD-Work) Consortium published pooled estimates from 13 European cohort studies with almost 200 000 participants, showing a prospective association between exposure to job strain and risk of coronary heart disease (16). [...]these studies should also be seen as only small pieces of the bigger puzzle.

FULL TEXT

This issue of the journal includes a meta-review, ie, a systematic review of systematic reviews, summarizing the published evidence on the associations between exposure to adverse psychosocial working conditions and risk of developing diseases or disorders during the past 20 years (1). Although the authors allowed inclusion of reviews reporting results from cross-sectional studies, the majority of the included reviews were restricted to prospective cohort studies - the gold standard method in psychosocial occupational epidemiology. We commend the authors for their succinct summary of the current knowledge on the topic, encompassing this multitude of exposures and outcomes in one single paper. The paper finds that there is consistent evidence of associations between certain psychosocial working conditions (job strain, effort-reward imbalance, job insecurity, long working hours) and certain health conditions (cardiovascular diseases and mental disorders, in particular depression). The paper also identifies the lack of studies concerning numerous other working and health conditions, as elegantly depicted in their figure 1, showing the presence or absence of reviews concerning all combinations of the included exposures and outcomes.

The early days of psychosocial occupational epidemiology

Compared to other fields of occupational health, research on psychosocial working conditions and health is a relatively recent discipline (2). One of the first studies on the topic was a paper by Friedman et al, published in 1958, reporting increased cholesterol levels and reduced blood clotting time among tax accountants during a period of putative high occupational stress, the annual April 15th tax filing deadline in the United States (3). Curiously, though, this observation did not inspire research on occupational stressors but rather led to the development of the concept of "type A behavior", a behavioral pattern characterized by feelings of time urgency, competitiveness and hostility that became the dominant psychosocial explanation for risk of coronary heart disease in the late 1970s and early 1980s (4). The concept later largely disappeared from the discussion as findings from earlier epidemiological studies could not be replicated (5). In Belgium, Kornitzer and colleagues published a paper in 1975 on the risk of coronary heart disease in employees at two banks, and discussed whether the higher occurrence in one of the banks could be related to work organization (6), a hypothesis which they later examined and corroborated (7). In the 1960s in Sweden, Gardell, Frankenhaeuser and others pioneered both theoretical concepts and empirical research on the role of work under- and overload, participation and alienation for both workplace democracy and workers' health (8-10). This research inspired, among other things, the development of the demand-control model (job strain model) (11) that was tested in Swedish cohorts from the early 1980s (12, 13). The demand-control model quickly became the dominant approach for understanding the contribution of psychosocial working conditions to risk of cardiovascular disease, but reviews of these studies showed inconsistent results (14, 15). A major advance was made in 2012, when the "Individual-Participant Data Meta-Analysis in Working Populations (IPD-Work) Consortium published pooled estimates from 13 European cohort studies with almost 200 000 participants, showing a prospective association between exposure to job strain and risk of coronary heart disease (16). A key novelty of the IPD approach was to apply harmonized measures of exposures and outcomes in all included cohorts. Subsequent papers from the IPD-Work consortium showed associations between job strain and stroke (17), diabetes (18) and depression (19), between long working hours and coronary heart disease and stroke (20), diabetes (21) and depression (22) and between effort-reward imbalance and coronary heart disease (23).

Whereas research on psychosocial work environment and risk of cardiovascular disease has a long history, dating back to the 1980s, research on psychosocial work environment and mental disorders emerged only towards the end of the 1990s, but then rapidly accelerated. When Stansfeld &Candy published the first systematic review and meta-analysis on psychosocial working conditions and common mental disorders in this journal in 2006, they identified only 11 papers (24). In contrast, a recent review by Mikkelsen et al identified 56 papers on the association between psychosocial working conditions and risk of incident clinical depressive disorders (25).

The past 20 years of research

The meta-review by Niedhammer et al only included reviews with meta-analyses that were published between 2000 and 2020. Given the acceleration of research and the growing number of studies published on the topic, this is a reasonable approach to provide an overview of the current knowledge base. Despite the restriction to the last 20 years, Niedhammer et al identified no less than 72 eligible review studies, a clear indicator of the massive proliferation of studies and the maturation of the research field.

Given this vast number of studies, it is timely to ponder what we have learned. For outcomes such as cardiovascular diseases and depression, the included reviews show rather consistently that employees who report certain psychosocial working conditions, in particular job strain, effort-reward imbalance, job insecurity and long working hours, are at increased risk. But how certain can we be that these associations are causal? First, caution is needed because most of the pooled estimates are modest, usually <2.0 and often <1.5. In the presence of numerous other well-established risk factors, such modest risk estimates make residual confounding a crucial issue. This discussion about causality is not new, and many arguments, such as those related to possible bias due to self-reported data, were raised decades ago (26, 27). Despite the massive research efforts, as evident by the number of studies published, it seems some disputes remain unchanged. For example, the above-mentioned recent review by Mikkelsen et al reported numerous associations between psychosocial working conditions and risk of depressive disorders (25), confirming and extending the results of the meta-review (1). However, due to methodological limitations of the literature, the authors did not feel confident to conclude whether psychosocial working conditions are likely or unlikely to cause depressive disorders.

So what's next?

So how can we move the research field of psychosocial working conditions and health forward? The discussion of causal inference, and how to arrive at it, is not limited to occupational health research. It is a topic of intense debate amongst epidemiologists and philosophers alike, and various approaches exist to establishing causality (28). While some have argued that applying well-defined hypotheses that correspond to potential interventions in combination with certain statistical methods and a counterfactual framework may lead to causal inference (29), others have argued that this approach is overly restrictive and risks limiting the topics that can be researched and the types of evidence that can be considered (30). The latter group proposes that causal claims are arrived at by piecing together bits of evidence from diverse studies, each with their own inherent strengths and weaknesses. Together these studies form a broader picture, like pieces of a puzzle, based on which we can form our judgement. Each study contributes only part of the whole and must be considered in light of the extant knowledge, with a keen eye on ruling out alternative hypotheses.

With this in mind, we propose that the identification of alternative hypotheses - in order to rule them out - may be an important next step. Much criticism of psychosocial work environment research has focused on the role of potential biases related to the self-reported nature of exposure measurements in most studies on psychosocial working conditions and health, and calls have been made for studies measuring exposures objectively (26, 27). While the term objective may certainly also be debated (26), we and other research groups have been making steps to meet this challenge by applying non-self-reported exposure measures (31,32), work unit aggregations (33, 34) or job exposure matrices to measure working conditions (35-37). These measures also have their limita- tions. Job exposure matrices, for example, are vulnerable to non-differential misclassification, issues related to validation, and are unable to measure day-to-day or between-worker variation within the assigned occupational grouping (38). Consequently these studies should also be seen as only small pieces of the bigger puzzle. But within these limits, they may be considered small steps to rule out the alternative hypothesis of confounding due to reporting bias. Other small steps may be fixed-effects analyses examining intra-individual changes and thereby controlling for time-invariant confounders (39) or studies that analyze the association between onset of exposure and subsequent incident health outcomes (40). Alternative hypotheses may also pertain to the possibility of residual confounding due to factors such as personality, genetics, or life events outside the workplace (41-43). Ruling out these alternative hypotheses - and identifying more - could be considered important next steps for the research field.

The issue of causality is not only a technical and somewhat academic discussion. From the viewpoint of those many individuals who believe that they have acquired a health problem due to their psychosocial working conditions, the consequences of this rather academic discussion are very real. More evidence for a causal relationship could result in changes to compensation practices, which would make a tangible difference in the lives of these individuals. At the workplace and societal level, more certainty concerning causality could motivate preventive practices and possibly help prevent the potential adverse health consequences of psychosocial working conditions before they occur - a valuable goal for any public health professional, academic or not.

Conflicts of interest

The two authors are members of the IPD-Work Consortium and have been involved in several of the reviews that were included in the meta-review.

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DETAILS

Subject:	Occupational stress; Diabetes; Competitiveness; Work environment; Working hours; Occupational health; Working conditions; Hypotheses; Epidemiology; Heart diseases; Cardiovascular diseases; Mental disorders; Cardiovascular disease; Consortia; Causality; Mental depression; Heart; Risk; Systematic review; Coronary artery disease; Health risks; Bias
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Workplace environment around physicians' burnout: A qualitative study in French hospitals

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ABSTRACT (ENGLISH)

Objective Burnout among physicians in public hospital has become a major public health issue in most Western countries. Qualitative literature has underlined the importance of interpersonal and group aspects in this context. Yet, no qualitative study has ever explicitly explored workplace direct environments association with physicians burnout. This study aimed to fill this gap. Methods This qualitative study used the five-stage inductive process to analyse the structure of lived experience (IPSE) approach and was conducted in French hospitals. We interviewed 45 participants - 16 with a lived experience of burnout and 29 of their colleagues - 19 women/26 men, (13 radiologists, 12 gastroenterologists, 10 gastrointestinal surgeons and 10 residents) from February 2018 to April 2019. Data analysis followed the IPSE analytic procedure and was conducted in two stages: three individual researchers carried out independent work and the group collectively pooled data. Results Three axes of experience were identified: (i) the loss of meaning, that is being a doctor, no longer has any meaning in the actual context of public hospitals; (ii) the tower of Babel, the impossibility of dialogue with both management and colleagues; and (iii) physicians daily interactions: too many conflicts, too much pressure and not enough recognition. Conclusion Physicians in this study described being exposed to a deleterious atmosphere, experiencing both emotional abuse and structural violence within the workplace. They considered that such an environment could contribute to the development of burnout. Further research is necessary to assess this hypothesis.

FULL TEXT

Headnote

Objective Burnout among physicians in public hospital has become a major public health issue in most Western countries. Qualitative literature has underlined the importance of interpersonal and group aspects in this context. Yet, no qualitative study has ever explicitly explored workplace direct environments association with physicians burnout. This study aimed to fill this gap.

Methods This qualitative study used the five-stage inductive process to analyse the structure of lived experience (IPSE) approach and was conducted in French hospitals. We interviewed 45 participants - 16 with a lived experience of burnout and 29 of their colleagues - 19 women/26 men, (13 radiologists, 12 gastroenterologists, 10 gastrointestinal surgeons and 10 residents) from February 2018 to April 2019. Data analysis followed the IPSE analytic procedure and was conducted in two stages: three individual researchers carried out independent work and the group collectively pooled data.

Results Three axes of experience were identified: (i) the loss of meaning, that is being a doctor, no longer has any meaning in the actual context of public hospitals; (ii) the tower of Babel, the impossibility of dialogue with both management and colleagues; and (iii) physicians daily interactions: too many conflicts, too much pressure and not enough recognition.

Conclusion Physicians in this study described being exposed to a deleterious atmosphere, experiencing both emotional abuse and structural violence within the workplace. They considered that such an environment could contribute to the development of burnout. Further research is necessary to assess this hypothesis.

Key terms doctor; France; mental health; occupational burnout; public hospital; qualitative research; resident; work-related issue.

In recent years, doctors burnout has become a major public health issue in most Western countries (1), having harmful effects on the healthcare system and on physicians and residents themselves (2). Currently, the COVID-19 pandemic has put a considerable strain on healthcare professionals (3). This pandemic has brought new stressors (4) but has mostly heightened existing challenges that physicians have to face that are directly correlated to increase burnout (5). Indeed, experienced physicians and physicians-in-training are exposed to psychological distress and psychiatric disorders (6, 7). Burnout prevalence among them is quite high in many countries, regardless of the specialty (8). In a 2015 US study, 54.4% of a sample of 6880 physicians had experienced at least one symptom of burnout (9).

There are many issues regarding the current burnout research. Many criticisms are raised about methodological errors related to its measurement, especially against the questionnaire used in 90% of the studies (10): the Maslach Burnout Inventory (MBI) (11). This questionnaire is based on only one definition of burnout: a work-related syndrome involving emotional exhaustion, depersonalization, and a reduced sense of personal accomplishment (12). There is also an ongoing debate about burnout as a diagnostic entity (13): is it a validated diagnosis because of some clinical specificities? Do burnout symptoms overlap with those of depression but have specific triggers? With current definitions in excess of 40, burnout is a very complex phenomenon supported by diverse theories (14-17). More recently, an international expert panel reached a consensual definition, without any theoretical underpinnings, that "occupational" burnout is an "exhaustion due to prolonged exposure to work-related problems" (18). This definition has, however, been criticized for not specifying the nature of work. The term "occupational" suggests that burnout can only occur within the context of formal employment (19).

There is an abundant scientific literature on physicians' burnout. The aspects most studied are the outcomes of burnout across regions and specialties (20), the individual and organizational factors that contribute to or protect against it (21), and the efficacy of targeted interventions (22). Qualitative studies of physicians' burnout have developed in recent years. Qualitative methods are especially relevant in this context. They are a tool of choice for focusing on the views of the physicians of how they experience, conceive, and understand burnout in their own field. In 2019, we conducted a systematic review of this literature and identified 33 articles (23). These qualitative studies explored physicians' burnout contributing and protective factors, mostly at individual and organizational levels. Our analysis of this review also showed an intermediate level of these factors, that is the group and interpersonal relationships within the workplace close environment. This group and interpersonal level is an original axis for innovative protection and intervention for battling doctors' burnout, and implies the consideration of burnout as an individual experience taking place within both a group and workplace environment.

Socialization at work has been described as being protective (21). Relational and group dimensions within the workplace have been researched in the fields of social psychology and sociology of work (24).

Yet, to our knowledge, no study has ever explored the experience of physicians' burnout focusing on the group and workplace environment around it.

The aim of this qualitative study was to fill this gap and explore in depth the workplace environment of French hospitals' departments in which one or several physicians' burnout occurred. More precisely, we wanted to investigate to which environment, context and work-related problems physicians are exposed in in such departments.

Method

This exploratory national qualitative study used the inductive process to analyse the structure of lived experience (IPSE) approach (25), a qualitative method specifically developed for clinical medical research to reach concrete proposals. This approach relies on an inductive process exploring in-depth the lived experience of patients, their loved ones and healthcare providers as well as the analysis of the structure of lived experience. Five stages structure the entire research process. The report of this study complies with the COREQ guideline (26). This study was conducted from January 2018 through April 2019 and was approved by the "Comité consultatif de l'Information en matiere de recherche dans le domaine de la santé (CCTIRS, ref 15903)", the "Commission Nationale de l'Informatique et des Libertés (CNIL, ref DR-2016-011) and is registered in ClinicalTrials.gov (NCT02893020). All participants provided informed written consent before inclusion.

Stage 1: Setting up a research group

Our research group included one male gastrointestinal surgeon (OF), two psychiatrists (one woman/one man), both researchers specialized in qualitative methods (ARL, JS), three female psychologists trained in qualitative methods (LB, EM, CS) and a hospital specialist who herself experienced burnout (LV). The group's members were highly diverse, especially in their knowledge, age, and backgrounds. The group worked continuously on reflexivity during open discussions between the researchers.

Stage 2: Ensuring the originality of the study

Two members of the group (JS, ARL) reviewed the qualitative and quantitative literature systematically to confirm the relevance and originality of the study. They verified that no qualitative study had ever explicitly explored the workplace environment in relation to burnout in public hospital. To remain inductive and open to novelty, the other group members had access to this review only after the data analysis had been completed.

Stage 3: Recruitment and sampling, aiming for exemplarity

The research group defined the inclusion and exclusion criteria (table 1), which was intended to attain exemplarity. Recruitment was aimed at participants who have experienced quintessential or archetypal examples of the situation being studied. We also endeavored to include participants who might add something new to what was previously found.

Our position in this research was ecological and not individual. We decided to include both physicians with and without burnout working in the same departments in order to reach an intersubjective description of the lived experience of the shared workplace environment and avoid being confined to the sole perspectives of physicians suffering from burnout.

Radiology, gastroenterology and digestive surgery departments represent three different typical clinical hospital-based activities in terms of both individual practice and group work - inpatient and outpatient work, operating rooms, interventional activity - but have frequent interactions in daily practice and through multidisciplinary meetings. Recruiting physicians within these three types of departments allowed the exploration of various experiences in a homogeneous framework.

Thanks to the networks of the three French professional societies of these specialties, we were able to identify several departments (N=13) in France that had at least one doctor suffering from burnout. To operationalize this criterion, a psychiatrist had to diagnose the burnout within the year preceding in an interview, and the burnout was associated with a related sick leave. In each department, we aimed to interview at least one physician with a lived experience of burnout and at least one of their direct colleagues. In a preliminary interview by telephone or face-to-face, we described the study to participants and verified they met the inclusion criteria. To attain exemplarity, sampling strategy was purposive with maximum variation (27) to select doctors that differed by sex, age, family status, years of experience, rank in their department, and medical practice.

Sample size was not defined in advance but was determined by data saturation according to the principle of "theoretical sufficiency" (28). Inclusion of new participants continued until the analysis of new material no longer yielded new findings; that is, data collection and analysis were complete when the group of research considered that the axes of experience obtained provided a sufficient explanatory framework for the data collected. Saturation is a key criterion for validity in qualitative research as it ensures in-depth study of the phenomenon and suggests that further interviews are unlikely to produce new findings.

Stage 4: Data collection, access to experience

From February 2018 through April 2019, two researchers (LB, CS) conducted the interviews. They met each participant, obtained his/her written consent and collected social/demographic data to facilitate the subsequent research interview. A few days later in the participant's workplace, they conducted semi-structured one-on-one interviews using an open-ended approach, structured by areas to explore topics. These areas (table 2) were collectively determined by the group based on the assessment of two pilot interviews. The interviewers used an interactive conversational style. In an IPSE study, participants are considered the experts on their own experience and researchers must conduct interviews that offer them the opportunity to recount it. The interviews lasted 60-90 minutes. They were recorded and transcribed into anonymized verbatim, including the participants' expressive nuances. These transcripts were then analyzed. Interviewers took field notes after every interview in order to better explore their reflexivity during group meetings.

Stage 5: Data analysis, from the description of the structure of experience to practical implications

The analytic IPSE process presented in figure 1 has been detailed elsewhere (25). It relied on an inductive, phenomenological method based on two stages: three individual researchers carried out independent work and the group collectively pooled data. The individual procedure consisted of three qualitative researchers (JS, LB, CS) independently and simultaneously conducting a systematic descriptive analysis aimed at conveying each participant's experience. This involved for each interview: (i) listening to the recorded interview twice and to reading it three times; (ii) exploring the experience word by word, that is cutting up the entire text into descriptive units; (iii) regrouping the descriptive units into categories. These stages are carried out with the help of QSR NVivo 12 software. During the group process, these three researchers and the other group members - familiarized with the data through listening and reading all the interviews as many times as necessary - met nine times, after the analysis of five interviews, for two-hour meetings in order to conduct (i) the structuring phase, that is to regroup the categories into axes of experience; these axes being constructed such that each can be linked to its subjacent categories, and then to determine the structure of lived experience characterized by the central axes; and (ii) the practical phase, a process of triangulation with the data in the literature to identify the original aspects of the results.

Criteria for rigor in the analyses and patient and public involvement

We used several criteria to ensure the rigor of the analysis and the trustworthiness of the results: triangulation, attention to negative cases, reflexivity within the group process, and feedback from "subjects of the experience" by presenting the research to a group of physicians and residents (N=20) from other medical and surgical departments - dermatology, anatomopathology, internal medicine, reconstructive surgery and psychiatry. They all recognized their own experience in the structure we proposed. This ensured the transferability of our results.

Results

We included 45 physicians and residents working in 13 departments, including 16 who had experienced burnout and 29 of their colleagues. Every potential participant we reached agreed to participate. For 3 departments, two physicians had experienced burnout. Among the colleagues, some reported being under psychotropic medication or seeing a psychotherapist. More than half of them mentioned feeling at risk of developing a burnout and/or having been "almost in burnout", or in what many called "a pre-burnout". The general characteristics of all participants are described in table 3.

The data analysis showed that the structure of experience around workplace environment in this particular situation was common for both the physicians who experienced burnout and their colleagues. All participants reported experiencing a specific atmosphere around burnout in their workplace. We identified three central axes, which will be described in detail below, focusing only on negative aspects of the workplace environment: (i) the loss of meaning, (ii) the impossibility of dialogue; and (iii) physicians' daily interactions: too many conflicts, too much pressure and not enough recognition. The relevant quotations (from the interview transcripts, translated from French into English for the sole purpose of this article) are shown in supplementary material (https://www.sjweh.fi/article/3977) table S1.

The loss of meaning

According to most of the participants, being a doctor, even a good doctor, no longer has any meaning in the current context of public hospitals [quotation 1 (Q1) in supplementary table S1].

Caring is no longer the priority

Most of these specialists considered that their primary function as a physician (treating patients, training residents and students) was being diverted to non-medical tasks (administrative and to make up for the lack of supplies and staff: replacing missing orderlies to move patients on stretchers, substituting in various ways for missing material and the paramedical and medical staff who have not been replaced) (Q2; Q3). Many specified that this primary function was no longer appreciated at all, even sometimes cynically mocked by management or heads of department. The meaning of care was now determined by its cost efficiency and no longer by the quality of care: medical knowledge, time spent with the patient, a relationship of trust, or the doctor's involvement with the patient and the family (Q4; Q5).

No more passion

The most experienced doctors reproached the new generation saying they practice medicine with neither passion nor devotion or commitment as they did. The residents we interviewed reported these criticisms and explained that, given the current constraints in their profession, they do attribute a greater importance to their personal lives (Q6).

No freedom and no vision

Participants complained that they no longer have any freedom or free will in practicing their profession (Q7; Q8). They felt that vision and continuity were absent in the organization of their departments. They recounted an endless succession of orders and counter-orders, that led them in one direction and then backwards to deconstruct what they had just finished building (Q9). Accordingly, each new order and each counter-order was perceived as an accusation that their work did not satisfy management and never would. They experienced these contradictory injunctions as an implicit form of abuse. Many considered the lack of free will and constant dissatisfaction of management as "harmful" or "deleterious" for the physicians. Some perceived it as a potential cause for physician's burnout (Q10).

The "tower of Babel": the impossibility of dialogue

A "dialogue of the deaf" with management. Most doctors insisted that dialogue with hospital management was impossible. They did not think that management understood them or had any idea at all of their profession and its constraints. They perceived clearly that they did not speak the same language or share the same values: while management talked to them about numbers and cutting costs, they were discussing essential care and serious diseases (Q11). They thought that management has never heard their requests or reports related to important problems (lack of beds, lack of time slots, turnover, lack of resources, etc.) or taken them as seriously as the situation required (Q12; Q13). Not being listened to and understood was also experienced as a form of abuse that could "contribute to burnout" on its own.

The impossibility of dialogue with colleagues. The doctors explained they were unable to have conversations with their paramedical colleagues about their difficulties. The other healthcare workers saw them as "privileged", which impeded the expression of any complaints and the possibility of mutual aid, which was evoked as a memory of a long-ago time now gone (Q14).

Even among doctors, the participants reported that it is extremely complicated to have real dialogue, understand each other and resolve conflicts, especially for doctors of different generations and specialties (Q15).

Physicians' daily interactions: too many conflicts, too much pressure and not enough recognition

Finally, all the doctors described daily interactions to lack recognition and be full of conflictual and pressuring interactions among doctors, between doctors and other healthcare workers, between doctors and hospital management, and with patients. Although participants only reported few situations of explicit violence - either physical or verbal - threats of violence and situations close to becoming violent, they mostly used the French term "violence" to describe these daily interactions and made some causal inference between them and physicians' burnout. Most of the time "violence" was used in a figurative sense, which is much more common in French than English, and was associated with other terms such as "harassment", "abuse", "conflicts", "humiliation", "submission", "pressure", and "perniciousness". The physicians reported four distinct situations.

Severe conflicts with management linked to an inability to control one's emotions or recurrent conflicts between people or with management (Q16). Some events seem propitious to the externalization of these conflicts (department meetings, division meetings, orders from colleagues, working conditions (Q17).

Daily horizontal conflicts directly linked to harassment by a supervisor or colleague. Most of the time, the doctors witnessing or experiencing these situations of harassment blamed the hospital system for promoting individualistic, competitive, callous, or even "megalomaniac and pernicious" staff to positions of responsibility (Q18; Q19). Still more serious, some participants considered that medical culture, its hierarchies, its "traditions" and its "omerta" - a term used by several participants referring to an implicit code of silence about conflicts and harassment within hospitals - enable some doctors in high positions to harass other doctors, especially, women and residents. (Q20; Q21).

Female doctors mentioned the pressure they experienced during their pregnancies and maternity leaves; they did not allow themselves to show any signs of fatigue related to their pregnancy. Some reported that they were sometimes ordered to shorten their maternity leave to keep the department running smoothly; they felt guilty toward their colleagues, already understaffed, when using the entire length of their maternity leave. They considered that for women, especially in surgery, becoming pregnant and having children were impediments to professional advancement (Q22). At the same time, young doctors recounted frequent insults and verbal violence ("young slacker") by some of their department heads, comments that humiliated them.

Constant pressure by management and lack of recognition: participants reported that management clearly instructed doctors to "do more with less". They also expressed a lack of recognition, regarding both their status (what some called "doctor-bashing") and their essential role within the hospitals (Q23; Q24). Some doctors even thought of burnout as a method of human resource management: when an individual "cracked", he or she was replaced by a doctor more submissive to the laws of the new administrative management (Q25).

"The patients, they changed": Many doctors noted changes in their relationships with patients, who were described as more "demanding" more "aggressive" and "less grateful" to doctors than in the past (Q26; Q27). Some physicians also talked about being sued or prosecuted and reported threats of violence from patients (Q28).

Discussion

Among the colleagues of physicians with a burnout experience, more than half reported also being in distress. It was not intentional to recruit this proportion of colleagues in distress. However, it is consistent with epidemiologic data, for instance in the study of Shanafelt et al (9) more than half of the sample of 6880 physicians reported at least one symptom of burnout. The current social and economic context of French hospitals - as it is in many European countries - could also explain this proportion of distress among the direct colleagues. Nowadays, in order to avoid closure, hospitals must adopt a profit-making view. A German qualitative study has described how this economic pressure on hospitals could impact medical practice and lead to stressful situations and personal frustration among doctors (29). Moreover, organizational burnout contributors are more likely to be present in these departments in which at least one case of burnout occurred, and this might also be another explaining factor.

The risk of burnout among healthcare workers has been mostly associated with the emotional burden of their work (30) and the lack of human/material resources in hospital departments (31). However, burnout has been described as a changeable concept: its exact meaning varies with its context and the intentions of those using the term (32). In this study, all the participants, both doctors who experienced burnout and those who did not, mentioned environmental factors that have been already described in the literature as burnout contributors (33, 34). There were either organizational - paperwork load, the constant need to do things faster, the hospital chain of command, and the pressure of economics, cost-cutting, and numbers to be achieved (33) - or interpersonal such as discrimination, relationship problems in the team, and lack of recognition (34).

The first original aspect of our results is the common description, in these departments, of a deleterious atmosphere. Physicians, both with and without burnout or even psychological distress, were exposed to this deleterious ambience they characterized by an absence of meaning and recognition of their medical work, the impossibility of dialogue with management and between themselves and negative daily interactions such as pressure, harassment, abuse, conflicts or even violence. The overuse of the French word "violence", in all the narratives and mostly in a figurative sense, raises the question whether we should consider these aspects as part of workplace violence. The association between physicians' psychological distress in general, burnout in particular, and workplace violence has already been shown in several quantitative studies (35, 36). Some studies focused mostly on the violent behaviors by patients toward doctors and have pointed out the increase in workplace violence and its harmful effect on care (37). Others described horizontal violence between doctors (38), the best documented example in our study being bullying of female doctors and residents by other physicians.

The definition of workplace violence is quite restrictive, that is "incidents where staff were abused, threatened or assaulted in circumstances related to their work, involving an explicit or implicit threat to their safety, well-being or health" (39). It does not consider features such as lack of dialogue, meaning or recognition but also pressure, harassment, or constant conflictual interactions. Yet, all these aspects were experienced as insidious abusive acts or mistreatments by the participants of our study. We think that this deleterious ambiance could relate more with both structural violence and emotional abuse, that is forms of violence that are non-physical and sometimes non-intentional. Structural violence occurs when a social institution - here the French public hospital - may harm people by preventing them from meeting their basic needs (40). In our results, these basic needs could be working with meaning, dialogue, and recognition. Structural violence has already been described within the hospital workplace (41), but to our knowledge no research has ever addressed any direct association between structural violence and physicians' burnout. Emotional abuse is characterized by persistent, repetitive patterns of verbal and nonverbal - but nonphysical - behaviors that harm or intend to harm the targeted person (42). This form of abuse has already been reported by physicians who suffer from burnout, especially residents and women (43).

The second original aspect of our results is that participants perceived and/or experienced this deleterious workplace ambience as potentially causing burnout. Further research is necessary to confirm whether this correlation perceived by the participants is a valid hypothesis or not. Given the fact that our results do not distinguish between physicians who experienced burnout and those who did not, they could serve as a relevant support to elaborate a quantitative study to test this hypothesis by screening all the aspects of this deleterious ambience with both groups. Such an approach could help determine which aspects are the most salient and significatively correlated with physicians' burnout, so they could be targeted as a priority. Moreover, since physicians without burnout or even psychological distress also described being exposed to such a deleterious atmosphere, if a correlation is found, it would be particularly relevant to fully describe the coping strategies and protective factors used by those physicians in order to draw concrete preventive implications.

Even if this study was conducted before the COVID19 pandemic, we believe that concrete implications drawn from our results can be already transposed to this context. Concrete actions to help physicians with workrelated psychological distress in this distinctive time, within departments in which burnout occurs, would be to directly intervene in the workplace by: (i) allowing physicians to focus mainly on medical tasks and relieving them of tasks less essential for care; (ii) promoting the essential role physicians play within the healthcare system; (iii) increasing awareness of workplace bullying, harassment and abuse especially targeted at residents and female doctors; and (iv) facilitating dialogue and solidarity among healthcare professionals and between doctors and management.

Study limitations

First, this study took place in France. Caution is needed when transposing our results to other places, especially non-Western countries, because the public hospital context depends strongly on the organization of the medical system as well as on the country's economy. Second, our results were common to all the doctors. Subgroup data analyses did not show any differences between either the specialties, the age or gender of participant. Further qualitative studies should in-depth explore the lived experience of residents and female doctors. Indeed, both appeared to be more exposed to the deleterious environment described in our results.

Third, our sample focuses only on physicians' perspectives. Future studies could explore the perspectives of paramedics and other non-doctors' colleagues about the workplace environment related to physician's burnout in similar or the same departments to identify similarities and differences.

Finally, in the context of recent burnout, participants focused on negative aspects of interpersonal relationships and workplace environment. Data analysis of the interviews revealed that positive aspects were not even a minor theme. No "negative cases", ie, cases that would differ from this structure of lived experience and reporting for instance positive aspects, were found among the 45 participants. This focus on negative aspects might result, we think, from two factors. First, the interview might have been seen as an opportunity to complain. Second, the potential inhibition or reluctance of physicians to speak about positive aspects could also be out of loyalty and solidarity with their colleagues with burnout. A study with similar design within departments free of physician's burnout should be conducted to explore and describe protective factors related to the workplace environment.

Concluding remarks

Physicians in this study, whether they had experienced burnout or not, described being exposed to a deleterious atmosphere, close to both emotional abuse and structural violence within the workplace. They considered that such an atmosphere could contribute to the development of burnout. Further quantitative research using the findings of this study could confirm such correlations and enable the drawing of concrete preventive implications.

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Conflict of interest

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Protection of research participants

The study was approved by the "Comité consultatif de l'Information en matiere de recherche dans le domaine de la santé (CCTIRS, ref 15903)", the "Commission Nationale de l'Informatique et des Libertés (CNIL, ref DR-2016-011) and is registered in ClinicalTrials.gov (NCT02893020). All participants provided informed written consent before inclusion.

Sidebar

Sibeoni J, Bellon-Champel L, Verneuil L, Siaugues C, Revah-Levy A, Farges O. Workplace environment around physicians' burnout: A qualitative study in French hospitals. Scand J Work Environ Health. 2021 ;47(7):521-530. doi:10.5271/sjweh.3977

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Working life, health and well-being of parents: a joint effort to uncover hidden treasures in European birth cohorts

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ABSTRACT (ENGLISH)

Objective Birth cohorts collect valuable and under-utilized information on employment and health of parents before and during pregnancy, at birth, and sometimes after birth. In this discussion paper, we examine how these data could be exploited to study the complex relationships and interactions between parenthood, work, and health among parents themselves. Methods Using a web-based database of birth cohorts, we summarize information on maternal employment and health conditions and other potentially related variables in cohorts spread throughout Europe. This provided information on what data are available and could be used in future studies, and what was missing if specific questions are to be addressed, exploiting the opportunity to explore work-health associations across heterogenous geographical and social contexts. Results We highlight the many potentialities provided by birth cohorts and identify gaps that need to be addressed to adopt a life-course approach and investigate topics specific to the peri-pregnancy period, such as psychosocial aspects. We address the technical difficulties implied by data harmonization and the ethical challenges related to the repurposing of data, and provide scientific, ecological and economic arguments in favor of improving the value of data already available as a result of a serious investment in human and material resources. Conclusions There is a hidden treasure in birth cohorts that deserves to be brought out to study the relationships between employment and health among working parents in a time when the boundaries between work and life are being stretched more than ever before.

FULL TEXT

Headnote

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Objective Birth cohorts collect valuable and under-utilized information on employment and health of parents before and during pregnancy, at birth, and sometimes after birth. In this discussion paper, we examine how these data could be exploited to study the complex relationships and interactions between parenthood, work, and health among parents themselves.

Methods Using a web-based database of birth cohorts, we summarize information on maternal employment and health conditions and other potentially related variables in cohorts spread throughout Europe. This provided information on what data are available and could be used in future studies, and what was missing if specific questions are to be addressed, exploiting the opportunity to explore work-health associations across heterogenous geographical and social contexts.

Results We highlight the many potentialities provided by birth cohorts and identify gaps that need to be addressed to adopt a life-course approach and investigate topics specific to the peri-pregnancy period, such as psychosocial aspects. We address the technical difficulties implied by data harmonization and the ethical challenges related to the repurposing of data, and provide scientific, ecological and economic arguments in favor of improving the value of data already available as a result of a serious investment in human and material resources.

Conclusions There is a hidden treasure in birth cohorts that deserves to be brought out to study the relationships

between employment and health among working parents in a time when the boundaries between work and life are being stretched more than ever before.

Key terms life-course; occupational epidemiology; pooled analysis.

Work represents the primary means of obtaining economic resources essential for material needs and is also central to individual identity and social roles. There are many potential causal pathways between work, health, and well-being. Health affects work ability and work, in turn, can be beneficial for health and well-being but may also carry risks for mental and physical health. The nature, quantity and quality of work, and its social context should be considered in balancing beneficial and harmful effects (1, 2).

Under-employment, long-term unemployment, poor working conditions, and job insecurity negatively affect health, well-being and social cohesion. Younger people and women are a population group particularly vulnerable to adverse working conditions (3). Childbearing typically occurs during early adulthood, which is a period of general good health and well-being. However, pregnancy and first years of childcaring are physically and mentally demanding periods for young mothers and fathers, who often struggle to return to full-time work after parental leave with direct consequences such as delay in their career trajectories and sense of selfrealization. National social security and welfare systems, as well as familial socioeconomic status, may modify the impact of employment and working conditions on the health and well-being of parents. Little research is available on the health consequences of having young children on families while participating in the workforce. Health conditions specific to this time period, such as sleep deprivation and stress, must be considered, as well as their potential long-term health consequences. To examine these type of questions, a large number of variables are needed, including work-related and familylevel constructs and individual determinants of health, particularly lifestyle factors, such as alcohol and tobacco consumption, diet, and physical activity.

Many birth cohorts throughout Europe collect information on employment and health of parents (especially mothers) before and during pregnancy, at birth, and often at one or more follow-up examinations after delivery (www.birthcohorts.net). These records include a wealth of valuable data on working life and health of parents during these time windows, which are typically collected for measuring their potential effects on the health of the children (4-7) (figure 1a), or as confounders in the relation between a risk factor and the health of the children (8, 9) (figure 1b). However, with its inherent longitudinal dimension, the birth cohort setting has greater potential - including the investigation of the direct relationship between work and parents' health (figure 1b) - to address questions related to the causal and intertwined relationships between work and health of parents also in relation to the children's health and other exposures collected at different time points (figure 1c). The conceptual framework is exemplified in figure 1 using the causal diagrams notation, whereby arrows represent possible causal effects and assumptions are encoded by the direction and the absence of arrows (10).

In addition, birth cohorts represent a sizeable resource that would allow researchers to address specific domains difficult to assess in traditional occupational epidemiology studies, such as working life in relation to reproductive life and work-family conflicts.

In this discussion paper, we argue that parental work-related data collected in birth cohorts is a valuable but under-utilized resource that could be exploited more fruitfully in the collaboration between birth cohort research, occupational epidemiology and sociology. Existing birth cohort information as well the collection of new data on less studied aspects could then be used to their full potential to study the complex relationships and interactions between parenthood, work, and health in parents themselves.

For context, we first compare several indicators of welfare systems across countries in Europe. We then provide an overview of available data in existing European birth cohorts. Finally, we provide recommendations on how to overcome the methodological challenges that can arise when repurposing existing data usage.

Working conditions: a cross-national comparison

Many factors can influence the health and well-being of working parents. Working conditions depend on a multitude of factors, often shaped by societal efforts in encouraging childbirth and participation in the workforce. Since World War II, a range of welfare systems have been developed in Europe to cover for childbearing and child care in an effort to promote both increasing birth rates and economic growth. Substantial differences exist between countries. We illustrate these differences through three examples: leave entitlements, childcare possibilities, and public spending towards family benefits.

Leave entitlements. In all European countries, working parents are entitled to a range of different leave types, the most common being maternity, paternity, and parental leaves (11). Maternity leave is intended to protect the health of the mother and new-born child in the period around childbirth. Paternity leave allows the father to spend time with the child and the mother in the period following childbirth. Parental leave is usually equally available to mothers and fathers and can take various shapes and follow different rules of transferability between parents and flexibility (eg, part-time work). It is a measure intended to provide both parents with the opportunity to spend time caring for a young child. Paid leave entitlements have increased in most European countries over the last decades and many countries have recently put leaves in place for fathers. Leave systems often show some level of flexibility, and international comparisons based on rigid criteria can be misleading. Nevertheless, clear between-country differences exist. For example, the length of postnatal leaves paid >75% of the reference income ranges from <14 weeks for the mother and <2 weeks for the father in several countries, such as France and Switzerland, to >50 weeks shareable between parents in Bulgaria and Sweden (11). Within countries, access and benefits provided vary depending on a broad number of factors, such as the number of siblings, employment in the public or private sector, minimum time employed prior to leave, the proportion of the reference salary returned (eg, one can sometimes chose to get a lower allowance but stay on leave a longer time).

Childcare possibilities. Formal childcare is defined as care organized by a private or public structure (eg, centrebased day care, organized family day care, or qualified childminders organizations). Childcare is one of the 20 key principles of the European Pillar of Social Rights, and all European countries offer some type of formal childcare, although with considerable variations in availability and affordability. A survey conducted in 2016 by the European Commission concluded that 39% of children aged <12 years in the European Union (EU) receive formal childcare services, and 68% of the households are satisfied with the access to these services, whether they use them or not (12). The map depicted in figure 2 illustrates the heterogeneity in reported satisfaction with those services in the 27 EU countries, as well as the United Kingdom, Norway, Iceland, and Switzerland. The level of satisfaction ranged from <50->80%. The reasons for not using more of the childcare services differed by country, the most cited being the lack of availability, the cost of the services, and distance from home. These difficulties may create work-family conflicts and are likely to have a large impact on the well-being of parents.

Women's labor market participation and public spending towards family benefits. Work participation among women started increasing at different time points in the mid20th century across Europe and proceeded at different rates in each country. Broad policy configurations that emerged after World War II might have contributed to these differences (13, 14). Figure 3 shows a plot of the proportion of women aged 20-64 years who were employed compared with the public spending on family/ children benefits (as a percentage of country-specific gross domestic product) for 32 European countries in 2017. Again, we observe considerable variation in both indicators, with an apparent positive correlation. While the correlation (Pearson correlation coefficient weighted on the country population sizes: 0.62) may not imply any causal relationship, it does illustrate the heterogeneity that exists within Europe.

The differences observed in welfare systems across countries offer a unique opportunity to explore the association between work-related exposures and health of parents of young children across specific national contexts. However, such analyses can only be done within longitudinal studies that collect a broad range of individual-level variables, in addition to information on national welfare systems.

Uniqueness and specificity of birth cohort data

Life-course studies with prospectively collected data constitute a valuable resource to investigate the role of work on health since they eliminate many biases related to retrospective or cross-sectional study designs and often provide information on numerous confounders at the individual level. Exposures (both occupational and environmental and related to lifestyle and health) experienced around the time of birth of a child could be overlooked by occupational epidemiology studies collecting the whole occupational and medical history of individuals and might be prone to recall biases if collected after years or even decades. The life-course theoretical model applied to epidemiology investigates the interactions between biological and social changes and their influence on health over time, accounting for the timing of multiple exposures and outcomes, and reflecting the impact that early exposure may have on later life. In occupational epidemiology, a life-course approach emphasizes how working life and the social context affect the relationships between work and health (figure 1c). This framework conceptualizes the changing nature of work as a life course experience in which the effect of working life transitions on future health, and conversely, the impact of health status on future working life, depend on place and time. Birth cohort studies represent a potentially important but yet underutilized resource to study the complex interplay between work, parenthood and parents' health and well-being. To date, little is known about the interdependence of work and health among parents. To disentangle these complex relationships and understand their interdependence better, a life-course perspective to work and health within different labor markets and social security contexts is needed (15). Birth cohorts may be the right place to study, for example, transitions in and out of work (eg, maternity or paternity leave) and evaluate the impact of career interruption or the reduction of working hours on health.

During the last decades, many birth cohorts have been established in Europe, including both multi-purpose ones and others specifically designed to investigate selected exposures or outcomes. In recent years, several EU-funded projects (ENRIECO - Environmental Health Risks in European Birth Cohorts; CHICOS - Developing a Child Cohort Research Strategy for Europe; EUCCONET - European Child Cohort Network; BRIDGE Health - Health Bridging Information and Data Generation for Evidence-based Health Policy and Research) have ben carried out to increase collaboration between cohorts and exploit their full potential, and others are currently underway [LifeCycle - Early Life Stressors and Lifecycle Health (16); I4C - The International Childhood Cancer Cohort Consortium (17)]. Recently, the EU Cost-Action OMEGA-NET developed a searchable web-based inventory of European cohorts with data on occupational exposures that partly includes birth cohorts (18, 19). Within the CHICOS project, a web-based database focused on birth cohorts (www. birthcohorts.net) originally established in 2005 within the European programme ChildrenGenoNetwork, was redesigned and updated. The database was developed as a tool to facilitate the exchange of knowledge and collaboration between cohorts and researchers. This website contains detailed information on social and environmental characteristics of children and their parents, parental and child health conditions, and biological samples collected at repeated time points throughout pregnancy and childhood, and is open for registration of cohorts worldwide (20). More recently, and under the umbrella of the LifeCycle project, some of these cohorts have undertaken a thoughtful harmonization of main variables to facilitate cross-cohort studies (16). Existing birth cohorts have mainly been used to study early-life determinants of child health and development, including maternal occupation [eg, refs (21, 22)]; however, they contain valuable information on employment and health of parents which has not been fully exploited.

To illustrate the data available in birth cohort studies, we have summarized information on maternal employment and health conditions and other potentially related variables in European cohorts with at least some occupational information (employment status or job title or occupational exposures) registered in www. birthcohorts.net (table 1 and supplementary table S1, www.sjweh.fi/article/3980). Although some of this information may not be up to date, the table provides an indication of what is available in these cohorts and can potentially be used in future studies. A total of 59 of the 103 European birth cohorts identified in www. birthcohorts.net contained some standard occupationrelated information, such as employment status (N=30, eg, employed, unemployed, inactive, student), job title (N=23, usually classified according to the International Standard Classification of Occupations, 1988 version), and chemical occupational exposures (N=44, eg, pesticides, paints, radiation). Few cohorts have gathered information on heavy lifting (N=25) and working hours (N=11), and very few on work address (N=4), which can be linked with spatial data in a geographical information system (GIS) and provide information on the built and social environments. Using birth cohort data for investigating parental working life does come with drawbacks. Since, with some exceptions [eg, (23)], most cohorts were not set up to study parental working life, little has been collected on psychosocial factors and employment information has often only been collected at one time point, particularly during pregnancy but not afterwards. Consequently, there is poor information on parental occupational trajectories. Additionally, not many cohorts have data on family composition and family functioning, and adverse life events, such as deaths or job loss, which can have a huge impact on the parents' and child's health. Finally, the employment information has mostly been collected from the mother and, less frequently, from the father, opening potential problems such as a different validity of information about mothers and fathers or the legitimate use of data provided by third parties (when mothers have answered about father's variables).

Regarding health conditions and potential determinants (table 2), many cohorts have information on parental, mainly maternal, anthropometric measures (N=54), cardiovascular diseases (N=38), diabetes (N=46), psychological distress or mental health (n=48), respiratory health (N=26), and musculoskeletal diseases (N=27). Despite its relevance and appropriateness in the birth cohorts context, sleep disturbances were collected in a small number of cohorts (N=7). Regarding confounders and other health-related variables, all cohorts have collected information on active smoking (N=59), and many on alcohol consumption (N=55); fewer cohorts had collected data on substance use (N=33) and physical activity (N=42). The timing when these variables were collected varies by study and not all cohorts have repeatedly collected them over time. This is a limitation that will need to be overcome to perform large-scale longitudinal analysis of the effect of work on health. In several countries, however, and under some conditions (such as specific consent, provided by parents at the time of enrolment), cohort data may be linked with registries on education, income, employment, and social transfer payments, as well as registries on medication and health care utilization, including hospitalizations. This option may represent a solution to the lack of repeated collections of information currently limiting the use of birth cohorts that collected parental work and health-related variables at only one time point.

Despite current limitations, collaborative studies using harmonized data from different birth cohorts will move the field on employment and health of working parents forward, allowing the study of the interplay between work participation and the health of the children, mothers and, in many circumstances, fathers. The identification of neglected topics and underdeveloped areas of investigation would be one of the first outputs of a synergy between birth cohort research and occupational epidemiology. As an example, our survey on existing information showed that the study of the effects of sleep deprivation on health and work participation of parents of newborns would be difficult given the small number of birth cohorts that collected information on sleep problems. Social epidemiology applications would also be possible, such as examining the social mobility over time and determining its impact on health, and disentangling social causation and social selection processes.

Technical challenges

General challenges in pooling cohort data, that are not specific to birth cohorts, may vary with each research question and include defining the target population, defining key covariates, and determining an analysis plan (24). Data harmonization is a crucial step before any pooled analyses can be conducted. Variables may have been recorded or measured differently, at various levels of detail, or may measure slightly different aspects of a certain exposure, outcome, as well as covariates (24). The workload of the harmonization step should not be underestimated (25) and a well-defined codebook is essential. The complexity of harmonization varies per variable but needs considerable decision-making steps. Harmonization of key variables may lead to loss of information when going to a less detailed level or to missing fields when choosing a more detailed level (24). The resulting loss of information may, however, be counterbalanced by a larger sample size.

By treating pooled data as if they came from one sample, significant heterogeneity across studies may lead to misleading summary effect estimates. On the other hand, the heterogeneity of study participants in a pooled analysis may result in a better representation of the key target populations than in single studies (24). Further, analyses of comparatively rare occupational exposures and outcomes in individual studies may be statistically underpowered, but power can be increased by pooling data from several birth cohorts.

Many birth cohorts will only have few or no individual level data on occupational exposures. However, when job titles are available or cohorts can be linked to census data with job histories, occupational exposures can be estimated with job-exposure matrices (JEM) (26). A JEM is an efficient method to assess systematically a wide range of exposures in large study populations. Particularly when pooling data, this allows for standardized exposure assessment within and between studies. A general limitation of JEM is the ignorance of heterogeneity within jobs, while exposure may vary between workers, as well as within workers over time. A specific challenge for assessing occupational exposures in relation to adverse birth effects is the timing of the exposure. JEM assign exposures to a certain job, the information of which is typically available by calendar year. Due to this rather crude assessment, typically no distinction in exposure levels relative to the conception, gestation period and birth can be made with a JEM. Birth cohorts could provide valuable complementing information with specific job descriptions and their changes during these relevant windows of exposure.

Ethical challenges

In many (although not all) instances, at the moment of enrolment in a birth cohort, parents consent to provide data about themselves and their child with the specific aim of studying the child health outcomes. Whereas the technical challenges mentioned above affect to some extent all pooled analyses, this implies that using birth cohort data to study parents' health involves the ethical, legal and social implications of repurposing (secondary use) of data, ie, their use beyond that intended at the time of collection, including direct information extraction and possibly linkage with other datasets such as health records.

The notion of 'hidden treasures' mentioned in the title reflects the increasing realization that data are a valuable resource with an extendable range of potential uses. Maximizing the use of existing data and enhancing their interoperability can benefit research, study participants and society as a whole, on the basis of scientific, economic, and ecological arguments. From a scientific point of view, our proposal would allow the investigation of risk factors and outcomes typically understudied in occupational epidemiology (such as work-life conflicts) adopting a life-course approach (15), as detailed above. As far as the economic impact of secondary use of data is concerned, economy of scale and saving of funds emerge as solid reasons for exhausting the value of existing data rather than requiring participants to provide new data or recruiting new participants. In the increasing discussions about the proper prioritization of the research agenda, a main recommendation posits that investment in additional research should always be preceded by systematic assessment of existing evidence (27). Thus, improving the value of data that are already available as a result of a serious investment in both human and material resources seems to be in line with a justified maximization of benefit and an incremental value of data. With regard to a disproportionate effort in recontacting cohort participants to request consent for further use of their data, cost is considered by the GDPR (Recital 26) as an objective factor in the process of "identification, taking into consideration the available technology at the time of the processing and technological developments". Thus, an ecological argument towards the optimal use and statistical power of data that have already been collected could be evoked here: repurposing existing resources implies higher research efficiency, interoperability of data, and reduction of waste by circumventing the collection of new data (28). Capitalizing on and deriving insight from existing data, instead of pursuing additional collection of information, may constitute a long-term resource for occupational epidemiology that would enhance the potential benefit of core resources.

The main ethical challenges related to repurposing of data concern proper access to existing data, processing and sharing through special agreements and approvals from research ethics committees, if and when required. Sharing, in particular, is also related to perceptions about how different research cultures affect the use and interpretation of ambiguous terms such as privacy of individuals, families, or groups, a factor which has to be further explored (29, 30). For example, in relation to the privacy of oneself and one's child, studies reveal that parents show greater reluctance towards sharing child identifiers compared to their own (19). Attitudes also differ with regard to the type of data at stake, ie, biological compared to non-biological data: there seems to be a more liberal approach towards sharing non-biological data. Moreover, people seem to be more willing to share their data with academia than with the private sector (31).

Consent remains a key notion for the collation and processing of personal identifiable data, however the GDPR adopts a balanced approach between protection of personal data and enhancement of a European research area in the public interest. Therefore, for the use of data that were collected from a previous research project, details regarding the initial data collection and the remits of the informed consent are key to evaluating whether a new consent is necessary or not for further use of data. However, even when consent cannot be used as a lawful basis for processing given the high threshold set by the GDPR, the Regulation adopts the concept of compatibility of purpose: according to the general principle of Article 5, "further processing for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes shall, in accordance with Article 89 (1), not be considered to be incompatible with the initial purposes ('purpose limitation')". This presumption of compatibility has to take into account a number of key factors and safeguards, including technical and organizational measures to ensure respect for the principle of data minimization and to protect the subjects' fundamental rights (Article 6 (4), Recital 50 of the GDPR).

An important and favorable characteristic of birth cohorts is that much effort is spent to keep a continuous relationship and contact with the participants in subsequent follow-ups for many years. This may act as a positive factor towards obtaining the necessary consents and integrating existing information with specific questions towards this new area of research, nevertheless, possible methodological and legal ramifications may arise.

Concluding remarks

Birth cohorts have largely contributed to the understanding of the determinants of children's health, including the role of maternal and paternal occupational exposures. We propose to evaluate the relationship between parental peri-pregnancy/perinatal occupation-related conditions and their health around and after the birth of their children. We also recommend to explore the potential interplay between parental occupation, parental health and children's health.

Several previous EU projects have invested enormous efforts and resources in standardizing and harmonizing data of a wide variety of cohorts, created a comprehensive birth cohort inventory and illustrated that (i) data can be shared, combined, pooled and compared; and (ii) different studies may be complementary.

In this discussion paper, we argue that (i) birth cohorts that have collected parental occupational data can and should use them for purposes beyond the study of children's health; (ii) birth cohorts that did not collect parental occupational data could consider starting to collect them; (iii) both should look into the possibility of expanding the data collected to include emerging topics in occupational health, including those specific to families such as work-family balance, as well as more cross-cutting issues (eg, ageing workforce, work trajectories, work as part of the exposome).

Birth cohorts have much potential in studying the relationships between work and health of parents, including the possibility to use this information transgenerationally and investigate their joint effect on the health of children. To further exploit their longitudinal nature to its full extent and address new research and societal issues, further collections of information on work and health trajectories or linkages with existing registries could be envisaged, establishing new contacts with cohort participants and renewing and extending their initial expression of consent.

Future birth cohorts or collection of information in existing ones may also consider including structural information on social protection and career-building to study the potential effects of parenthood on work, health and well-being. For example, partial contributions towards retirement benefits, interrupted careers, lower job quality and fewer skill upgrades may imply health and social disadvantages and even poverty later in life. Special attention could be given to psychosocial work factors, such as work-family balance/interference, as boundaries of work have become weaker. Recent shifts towards parents' smart/telework and children's distance learning determined by the COVID-19 pandemic may have shaken such boundaries even more. Little is known about the unmeasured effects of taking work home, and it is likely that the outsized share of household and childcare responsibilities carried by mothers has escalated (32). With their open gaze on the household, birth cohorts could be the most suitable approach to explore these research questions.

To further utilize the great potential for collaborative analyses, adequate funding - eventually at the EU level - is required and should be applied to boost future research on the intersection of employment and health among working parents.

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Sidebar

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DETAILS

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Jonsson, J., M.Sc, Muntaner, C., PhD., Bodin, T., PhD., Alderling, M., M.Sc, Balogh, R., M.Sc, Burström, B., PhD., . . . Matilla-Santander, N. (2021). Low-quality employment trajectories and risk of common mental disorders, substance use disorders and suicide attempt: A longitudinal study of the swedish workforce. Scandinavian Journal of Work, Environment & Health, 47(7), 509-520. doi:https://doi.org/10.5271/sjweh.3978

Objective High-quality longitudinal evidence exploring the mental health risk associated with low-quality employment trajectories is scarce. We therefore aimed to investigate the risk of being diagnosed with common mental disorders, substance use disorders, or suicide attempt according to low-quality employment trajectories. Methods A longitudinal register-study based on the working population of Sweden (N=2 743 764). Employment trajectories (2005-2009) characterized by employment quality and pattern (constancy, fluctuation, mobility) were created. Hazard ratios (HR) were estimated using Cox proportional hazards regression models for first incidence (2010-2017) diagnosis of common mental disorders, substance use disorders and suicide attempt as dependent on employment trajectories. Results We identified 21 employment trajectories, 10 of which were low quality (21%). With the exception of constant solo self-employment, there was an increased risk of common mental disorders (HR 1.07-1.62) and substance use disorders (HR 1.05-2.19) for all low-quality trajectories. Constant solo self-employment increased the risk for substance use disorders among women, while it reduced the risk of both disorders for men. Half of the low-quality trajectories were associated with a risk increase of suicide attempt (HR 1.08-1.76). Conclusions Low-quality employment trajectories represent risk factors for mental disorders and suicide attempt in Sweden, and there might be differential effects according to sex - especially in terms of self-employment. Policies ensuring and maintaining high-quality employment characteristics over time are imperative. Similar prospective studies are needed, also in other contexts, which cover the effects of the Covid-19 pandemic as well as the mechanisms linking employment trajectories with mental health.

Nexø, M. A., PhD, Pedersen, J., PhD., Cleal, B., PhD., Andersen, I., PhD., & Bjørner, J. B., PhD. (2021). Working life expectancies among individuals with type 1 and type 2 diabetes over a 30- year period. Scandinavian Journal of Work, Environment & Health, 47(7), 540-549. doi:https://doi.org/10.5271/sjweh.3972

Objectives This study aimed to (i) estimate working life expectancies (WLE) and the number of working years lost (WYL) among individuals with type 1 and type 2 diabetes over a 30-year period and (ii) identify educational differences in WLE and WYL. Methods Individuals aged 18-65 years diagnosed with type 1 (N=33 188) or type 2 diabetes (N=81 930) in 2000-2016 and age- and gender-matched controls without diabetes (N=663 656) were identified in Danish national registers. WLE in years were estimated as time in employment from age 35-65 years. We used a life-table approach with multi-state (eg, disability pension, sickness absence, unemployment) Cox proportional hazard modeling. Analyses were performed separately for sex, cohabitation status, educational duration, and type of diabetes. Inverse probability weights accounted for differences between populations. Results People with diabetes had significantly shorter WLE and greater WYL compared to people without diabetes over the 30-year span. At age 35, cohabitant women with lower education and diabetes lost up to 8.0 years 95% confidence interval (CI) 5.0-11.0] and men 7.0 years (95% CI 4.0-8.7). WYL among women with higher education was 4.4 (95% CI 6.6-2.3) and 3.7 years among men (95% CI 1.5-4.5). Compared to people with type 2 diabetes, those with type 1 spend significantly more years in disability pension, but there were no significant differences in the other WYL estimates. Conclusions The WYL among people with diabetes is substantial and characterized by social disparities. The WYL help identify intervention targets at different ages, types of diabetes, sex, educational and cohabitant status.

Niedhammer, I., PhD., Bertrais, S., PhD., & Witt, K., D.Phil. (2021). Psychosocial work exposures and health outcomes: A meta-review of 72 literature reviews with meta-analysis. Scandinavian Journal of Work, Environment & Health, 47(7), 489-508. doi:https://doi.org/10.5271/sjweh.3968

Objective This meta-review aimed to present all available quantitative pooled estimates for the associations between psychosocial work exposures and health outcomes using a systematic literature review of literature reviews with meta-analysis. Methods A systematic review of the literature from 2000 to 2020 was conducted using PubMed, Web of Science, Scopus, and PsycINFO databases following the PRISMA guidelines. All literature reviews and Individual-Participant Data (IPD)-Work consortium studies exploring an association between psychosocial work exposures and health outcomes and providing pooled estimates using meta-analysis were included. All types of psychosocial work exposures and health outcomes were studied. The quality of each included review was assessed. Results A total of 72 reviews and IPD-Work consortium studies were included. These mainly focused on job strain as exposure and cardiovascular diseases and mental disorders as outcomes. The associations between psychosocial work factors and cardiovascular diseases and mental disorders were in general significant, and the magnitude of these associations was stronger for mental disorders than for cardiovascular diseases. Based on high-quality reviews, significant associations were found between job/high strain and long working hours as exposures and coronary heart diseases, (ischemic) stroke, and depression as outcomes. A few additional significant associations involved other exposures and health outcomes. Conclusions The included reviews brought convincing findings on the associations of some psychosocial work factors with mental disorders and cardiovascular diseases. More research may be needed to explain these associations, explore other exposures and outcomes, and make progress towards determining the causality of the associations.

Zeng, X., M.Sc, MacLeod, J., M.P.H., Berriault, C., M.A., DeBono, N. L., PhD., Arrandale, V. H., PhD., Harris, A. M., PhD., & Demers, P. A., PhD. (2021). Aluminum dust exposure and risk of neurodegenerative diseases in a cohort of male miners in ontario, canada. Scandinavian Journal of Work, Environment & Health, 47(7), 531-539. doi:https://doi.org/10.5271/sjweh.3974