The influence of unhealthy behaviours on early exit from paid employment among workers with a chronic disease: A prospective study using the Lifelines cohort

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ABSTRACT

Objectives: This study examined the risk of unhealthy behaviours and the additive effects of multiple unhealthy behaviours on exit from paid employment among workers with a chronic disease and investigated effect modification by gender and educational level.

Methods: Data from the Lifelines cohort, collected between 2006 and 2013, were enriched with registry data from Statistics Netherlands with up to 11 years follow-up. Workers with a chronic disease were selected (*n* = 11,467). The influence of unhealthy behaviours (physical inactivity, smoking, unhealthy diet, high alcohol intake, and obesity) on exit from paid employment (unemployment, disability benefits, early retirement, and economic inactivity) was examined using competing risk models. To examine effect modification by gender and educational level, interaction terms were added.

Results: Smoking and low fruit intake increased the risk to exit paid employment through unemployment and disability benefits. Low vegetable intake increased the risk of unemployment, obesity the risk of receiving disability benefits, and high alcohol intake the risk of early retirement. Physical inactivity was not associated with any exit from paid employment. Having multiple unhealthy behaviours increased the risk of both unemployment and of receiving disability. No consistent effect modification for gender or educational level was found.

Conclusions: Unhealthy behaviours increased the risk to exit paid employment through unemployment and disability benefits among workers with a chronic disease, and this risk increased when having multiple unhealthy behaviours. Health promotion to support workers with chronic diseases to make healthier choices may help to extend their working life.

1. Introduction

In Europe, almost 30% of individuals within the working-age population have a chronic disease (Corral et al., 2014). Having a chronic disease can impact an individuals' social participation. Work is an important domain of social participation and an important social determinant of health (Wilkinson and Marmot, 2003). Being employed contributes to an individual's physical and mental health, while unemployment, on the other hand, is related to poor health outcomes like a poor self-perceived health status, depressive symptoms and an increased mortality risk (Bambra and Eikemo, 2009; Paul and Moser, 2009). Workers with a chronic disease experience reduced work functioning, productivity loss, and health-driven exit from paid employment (Alavinia and Burdorf, 2008; Corral et al., 2014; van Zon et al., 2019; Zhang et al., 2016). In particular, individuals with a chronic disease are at an increased risk to exit paid employment due to unemployment, disability benefits, and early retirement (Alavinia and Burdorf, 2008; Oude Hengel et al., 2019). As policies in industrialized countries stimulate workers in poor health to remain at work and employers to offer inclusive workplaces, knowledge on what is important in keeping

individuals with a chronic disease in paid employment has become essential (Sigg and De-Luigi, 2007). Although some studies have focused on predictors of early exit from employment among individuals with a chronic disease, most of them focussed on work-related factors, e.g. job demands (Boot et al., 2014; de Boer et al., 2018; Fleischmann et al., 2018). Research into the role of unhealthy behaviours in early exit from paid employment among workers with a chronic disease is still limited.

Unhealthy behaviours have not only been shown to affect the etiology of chronic diseases, but may also affect daily functioning (including work) of those living with a chronic disease. Meta-analyses have shown overweight and obesity to be associated with disability benefits (Neovius et al., 2008; Robroek et al., 2013; Shiri et al., 2020) and physical inactivity with both unemployment and disability benefits (Robroek et al., 2013). To be able to cope with the consequences of having a chronic disease, improving health behaviours may play an important role. For instance, among individuals with diabetes, an improved lifestyle, characterized by physical activity and weight loss, was associated with improved disease control (American Diabetes Association, 2007). Given that unhealthy behaviours are to a large extent modifiable, in contrast to other factors associated with employment such as the economic cycle or fixed aspects of the work itself, it is important to examine whether unhealthy behaviour influences the risk of exiting paid employment early. This knowledge could specifically benefit the high-risk group of workers with a chronic disease, as they can exert some control over their behaviour and adjust it to optimize their functioning, workability, and chance of sustained employment (Kushner and Sorensen, 2013; van den Berg et al., 2017).

Up to date, only a few studies investigating the effects of unhealthy behaviour on disability benefits were conducted among workers with chronic diseases. For example, Ervasti et al. (2016) performed a study on workers with pre-existing chronic conditions such as cardiometabolic disease and Claessen et al. (2010) investigated reasons for receiving disability benefits, e.g. due to respiratory diseases. In both studies, obesity was found to be a strong predictor of work disability. Other studies focusing on different exit routes were not conducted among workers with a chronic disease at the start of the study, and only adjusted for being in poor health (Robroek et al., 2013) or having a chronic disease (Feigl et al., 2019; Hagger-Johnson et al., 2017; van den Berg et al., 2010). Furthermore, these studies only focussed on some unhealthy behaviours (Feigl et al., 2019; van den Berg et al., 2010) and did not examine the extent to which multiple unhealthy behaviours jointly affect early exit from paid employment. It is known that unhealthy behaviours often occur together, e.g. an individual who is physically inactive may be more likely to also have insufficient fruit and vegetable intake (Del Duca et al., 2012). This co-occurrence of unhealthy behaviours has been studied in relation to disability benefits, but results are inconclusive, as one study did find an increased risk of receiving disability benefits (Helgadottir et al., 2019), while another study did not confirm this association (Ropponen and Svedberg, 2014). The risk of multiple unhealthy behaviours on other exit routes from paid employed (i.e. unemployment, early retirement, and economic inactivity) has not been investigated yet. Unemployment and disability benefits are generally considered involuntary routes, in contrast to early retirement and economic inactivity. As predictors for these different exit routes have been shown to differ, e.g. obesity has mostly been associated with exit into disability benefits but not with other exit routes (Robroek et al., 2013), it is necessary to distinguish between these exit routes. Besides, studies have often used self-reported data on exit routes from paid employment instead of registry data (Hagger-Johnson et al., 2017; Robroek et al., 2013; van den Berg et al., 2010).

Previous studies indicate that gender and educational level may modify the relationship between unhealthy behaviour and early exit from employment. For instance, obesity had a negative impact on employment status among women but not among men (Feigl et al., 2019). For educational level, no studies have yet investigated to what extent differences exists in the effect of unhealthy behaviour on exit from employment across different educational groups. However, it is known that workers with a low educational level are at a higher risk to exit paid employment compared to workers with a high educational level (Robroek et al., 2015; van Zon et al., 2019). Moreover, differences in exit from employment across educational groups have been shown to be mediated by various factors, including unhealthy behaviours, which is more common among lower educated workers (Robroek et al., 2015).

Against this background, the current study examined (1) the risk of unhealthy behaviours on early exit from paid employment among workers with a chronic disease, (2) the additive effects of multiple unhealthy behaviours on early exit from paid employment among these workers, and (3) effect modification by gender and educational level.

2. Methods

2.1. Design & procedure

The current study was embedded within the Lifelines Cohort Study (Scholtens et al., 2015). Lifelines is a multi-disciplinary prospective population-based cohort study examining in a unique three-generation design the health and health-related behaviours of 167,729 persons living in the North of the Netherlands. It employs a broad range of investigative procedures in assessing the biomedical, socio-demographic, behavioural, physical and psychological factors which contribute to the health and disease of the general population, with a special focus on multi-morbidity and complex genetics. Data collection started in November 2006 and participants were recruited through their general practitioners, through family members, or by self-registering. The data collection in Lifelines was conducted according to the guidelines of the Declaration of Helsinki, and all procedures were approved by the Medical Ethics Committee of the University Medical Center Groningen (2007/152).

2.2. Participants

Participants in the current study included 11,467 workers, ≥18 and < 65 years old, who had at least one of the following chronic diseases: cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD), depression, rheumatoid arthritis (RA), or type 2 diabetes mellitus (T2DM). These conditions were selected as they are highly prevalent and disabling lifestyle-related chronic diseases among individuals within the working-age (Friedman et al., 2004). Fig. 1 shows the flow chart for inclusion in the analyses.

2.3. Measures

2.3.1. Chronic diseases

At baseline, the chronic diseases (CVD, COPD, depression, RA, and T2DM) were classified based on previous studies by Meems et al. (2015) and van Zon et al. (2018) according to a combination of clinical measures, self-report, and medication use (see Appendix A). Medication use was recorded by trained research nurses and coded based on the Anatomical Therapeutic Chemical (ATC) Classification System (World Health Organization, 2017; World Health Organization, 2019). Multi-morbidity was defined as having at least two of the five included chronic diseases.

2.3.2. Exit routes from paid employment

Exit routes from paid employment were measured by using data on the gross wages and social benefit pensions from the Dutch tax register, which was available through data linkage with Statistics Netherlands (Bakker et al., 2014). Data on these income characteristics were available on monthly basis from the time of enrollment in Lifelines to December 2017. Employment status was divided into five mutually exclusive categories: paid employment, disability benefits,
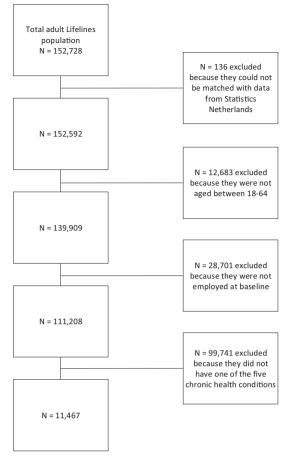
Fig. 1. Flow chart of participant inclusion.

unemployment benefits, early retirement, and economic inactivity. To be categorized as receiving disability benefits, at least half of the individual's income had to be from disability benefits. For unemployment benefits, an individual needed to have lost their job and receive unemployment or social security benefits. Early retired individuals had not reached the Dutch statutory retirement age yet, but received a company pension as their main source of income. Economically inactive persons did not have personal income or benefits, for instance because they choose to be a homemaker or to retire early without benefits. An individual needed to be in a specific exit pathway for at least three months to be included as an actual event. When a participant had multiple events over time, only the first event was considered.

2.3.3. Unhealthy behaviours

Physical activity was assessed based on one question from the "Short QUestionnaire to ASsess Health enhancing physical activity" (SQUASH): 'On average how many days per week do you cycle, do odd jobs, garden, or exercise for a total of at least half an hour?' (Wendel-Vos et al., 2003). Participants were classified as insufficiently active when they were active less than five days per week at least half an hour per day (based on WHO guidelines of 150 min of physical activity per week (World Health Organization, 2010)). Participants were classified as smokers if they reported current smoking or smoking in the past month, and as non-smokers if they did not. Dietary intake, including fruit and vegetable intake, was based on self-report. Participants were asked how often they ate fruit and vegetables in the past month and intake was classified as insufficient if participants indicated to eat fruit or vegetables on less than four days (Klijs et al., 2016). Alcohol intake was based on self-report and classified as high if participants indicated to drink alcohol at least four days a week. Obesity was based on Body Mass Index (BMI), calculated as weight (kg)/height (m)^2, based on

anthropometric measurements at the Lifelines research centers. Participants were obese if their BMI $\geq$ 30 kg/m^2. Multiple unhealthy behaviours was defined as the sum of the number of unhealthy behaviours and categorized into six categories ranging from zero (no unhealthy behaviour) to five or more unhealthy behaviours.

2.3.4. Covariates

Age, gender, marital status, and educational level were self-reported. Marital status was coded into 'in a relationship' or 'other'. Educational level was based on participants' highest level of completed education and options were merged into (1) low (no education; primary education; lower or preparatory secondary vocational education; junior general secondary education), (2) intermediate (secondary vocational education or work-based learning; senior general secondary education, pre-university secondary education), and (3) high (higher vocational education; university education).

2.4. Statistical analyses

Missing data ranged from < 0.1% for BMI to 9.1% for physical activity. Data were imputed on individual characteristics and unhealthy behaviours using multiple imputation by chained equations. In total, 20 datasets were imputed using information on age, type of chronic disease, multimorbidity, and exit route from employment as auxiliary variables. Percentages and means with corresponding standard deviations were used to describe study characteristics of individuals who exited paid employment through different exit routes and for those who remained at work.

The influence of unhealthy behaviours on early exit from paid employment was investigated using Fine & Gray proportional subdistribution hazards survival analysis (Fine and Gray, 1999). By controlling for competing risks, the model takes into account that one exit route impedes the occurrence of alternative pathways from paid employment. Subdistribution hazard ratios (SHRs) and corresponding 95% confidence intervals (CIs) were presented for the unhealthy behaviours. All analyses were adjusted for age, marital status, and multimorbidity. Additionally, analyses were adjusted for gender and educational level, and the included chronic diseases (Appendix 3). Individuals were censored if they reached the retirement age of 65 years or in case of missing data on employment. Analyses on early retirement were restricted to workers of 50 years and older. The influence of multiple unhealthy behaviours on exit from paid employment was examined using the sum score of unhealthy behaviours. All models were tested for effect modification of gender and educational level by adding interaction terms with (multiple) unhealthy behaviours to the adjusted model, which were considered statistically significant if $p \leq 0.01$. Analyses were conducted using STATA version 15 (Stata Corp, College Station, TX, USA).

3. Results

In total, 11,467 individuals with a chronic disease were employed at baseline. The mean age was 47.1 (SD 8.4), and the majority was female (55.2%) and had a partner (86.5%). Of the participating workers, 37.9% of had a low educational level, 39.7% an intermediate level, and 22.4% a high educational level. Low physical activity was the most prevalent unhealthy behaviour, followed by low fruit intake. For those having multiple unhealthy behaviours, the majority had a low physical activity level in combination with one or more of the other unhealthy behaviours (Appendix B). Phi coefficients between the investigated unhealthy behaviours were low (all $\leq$ 0.20). In total, 29.0% of the workers left paid employment early, mostly through unemployment (14.6%) (Table 1). The median time at risk before leaving paid employment through unemployment, disability benefits, early retirement, and economic inactivity was 27 (interquartile range (IQR): 12–45), 26 (IQR: 13–48), 28 (IQR: 13–48), and 25 (IQR: 10–44) months,

Table 1

Study characteristics of individuals with a chronic disease who are employed at baseline (n = 11,467).

	Paid employment (n = 8141)	Unemployment (n = 1671)	Disability benefits (n = 563)	Early retirement (n = 449)	Economic inactivity (n = 626)
Age in years (M, SD)	46.9 (7.8)	45.1 (8.8)	45.7 (9.3)	59.0 (3.0)	47.6 (10.0)
Gender (% male)	46.7	43.9	41.0	53.9	19.6
Marital status (% in a relationship)	87.2	81.1	82.8	89.7	93.2
Educational level (%)					
Low	35.9	40.9	47.5	38.5	46.6
Intermediate	40.3	41.4	37.7	27.3	37.1
High	23.8	17.7	14.8	34.2	16.3
Multimorbidity					
No (0)	92.1	91.7	80.8	90.6	90.6
Yes (≥1)	8.0	8.3	19.2	9.4	9.4
Unhealthy behaviours (%)					
Low physical activity	55.4	58.5	55.9	51.4	54.6
Smoking	27.8	36.1	35.0	15.9	30.4
Low fruit intake	40.0	46.1	49.0	24.8	38.1
Low vegetable intake	27.8	33.0	30.7	20.3	20.8
High alcohol intake	22.7	20.2	18.5	38.7	20.5
Obesity	25.4	25.9	34.8	25.2	23.3
Multiple unhealthy behaviours (n, %)					
0 unhealthy behaviour	11.7	9.6	7.7	13.6	15.0
1 unhealthy behaviour	26.3	22.1	21.5	30.5	27.3
2 unhealthy behaviours	29.4	27.4	30.3	31.0	26.4
3 unhealthy behaviours	20.8	24.7	24.3	17.4	20.2
4 unhealthy behaviours	9.3	13.3	12.8	5.5	9.9
≥5 unhealthy behaviours	2.6	2.8	3.3	1.9	1.2

Notes: Missing values marital status 1.2%, educational level 2.1%, physical activity 9.1%, smoking 4.2%, fruit intake 4.0%, vegetable intake 4.0%, alcohol intake 4.0%, obesity < 0.1%.

respectively.

Table 2 presents the risk of unhealthy behaviours on the different exit routes from paid employment. Smoking (SHR: 1.24, 95%CI: 1.12; 1.38), low fruit intake (SHR: 1.12, 95%CI 1.01; 1.24) and low vegetable intake (SHR: 1.22, 95%CI: 1.10; 1.37) increased the risk to exit paid employment early through unemployment. Smoking (SHR: 1.22, 95%CI: 1.01; 1.48), low fruit intake (SHR: 1.26, 95%CI: 1.06; 1.51), and obesity (SHR: 1.45, 95%CI: 1.22; 1.74) increased the risk to exit paid employment into disability benefits. High alcohol intake increased the risk of early retirement (SHR: 1.29, 95%CI: 1.05; 1.58). Low vegetable intake decreased the risk to become economically inactive (SHR: 0.72, 95%CI: 0.59; 0.87) and to retire early (SHR: 0.68, 95%CI: 0.53; 0.86). Physical activity was not associated with any exit route from paid employment.

Workers with three (SHR: 1.38, 95%CI: 1.14; 1.67) or four (SHR: 1.58, 95%CI: 1.27; 1.96) unhealthy behaviours had a higher risk to exit paid employment through unemployment (Table 3). Having two or more unhealthy behaviours increased the risk of disability benefits (SHRs ranging from 1.53, 95%CI: 1.06; 2.21 for two to 1.97, 95%CI: 1.12; 3.48 for five or more unhealthy behaviours, respectively). Workers with two or more unhealthy behaviours had a lower risk to

become economically inactive; this was statistically significant for two (SHR: 0.75, 95%CI: 0.58; 0.97) and five or more unhealthy behaviours (SHR: 0.39, 95%CI: 0.20; 0.85). No significant associations were found between multiple unhealthy behaviours and early retirement.

Besides one exception, no effect modification by gender and educational was found. The only interaction effect was found for gender between unhealthy behaviours and early retirement. However, after stratification, the risk of early retirement was only significantly higher for women having three unhealthy behaviours.

4. Discussion

Unhealthy behaviours increased the risk of early exit from paid employment among workers with a chronic disease, especially through the involuntary exit routes unemployment and disability benefits. Specifically, smoking and low fruit intake increased the risk to exit paid employment through unemployment and disability benefits. Additionally, low vegetable intake increased the risk to exit paid employment through unemployment, while obesity increased the risk to exit paid employment through disability benefits. High alcohol intake increased the risk of early retirement. With an increase in the number of

Table 2

The influence of unhealthy behaviours on exit routes from paid employment among individuals with a chronic disease (n = 11,467).[a]

	Unemployment		Disability benefits		Early retirement		Economic inactivity	
	SHR	95% CI	SHR	95% CI	SHR	95% CI	SHR	95% CI
Low physical activity	1.07	0.96; 1.18	0.96	0.80; 1.14	0.99	0.81; 1.21	0.99	0.84; 1.17
Smoking	1.24	1.12; 1.38	1.22	1.01; 1.48	0.84	0.64; 1.10	1.16	0.97; 1.38
Low fruit intake	1.12	1.01; 1.24	1.26	1.06; 1.51	0.81	0.65; 1.02	0.95	0.80; 1.13
Low vegetable intake	1.22	1.10; 1.37	1.08	0.89; 1.31	0.68	0.53; 0.86	0.72	0.59; 0.87
High alcohol intake	0.94	0.83; 1.06	0.87	0.70; 1.10	1.29	1.05; 1.58	0.82	0.67; 1.00
Obesity	1.04	0.93; 1.17	1.45	1.22 1.74	1.04	0.83; 1.30	0.87	0.72; 1.05
Age	0.98	0.97; 0.99	0.98	0.97; 0.99	1.40	1.36; 1.44	1.01	1.00; 1.02
Marital status (=in a relationship)	0.73	0.64; 0.83	0.80	0.64; 0.99	0.90	0.66; 1.23	2.04	1.51; 2.77
Multimorbidity	1.03	0.86; 1.23	2.61	2.11; 3.22	0.70	0.50; 0.97	1.08	0.83; 1.42

Notes: SHR = subdistribution hazard ratio.

[a] Model adjusted for age, marital status, and multimorbidity.

Table 3
The influence of multiple unhealthy behaviours[a] on exit routes from employment among individuals with a chronic disease (n = 11,467).

	Unemployment		Disability benefits		Early retirement		Economic inactivity	
	SHR	95% CI	SHR	95% CI	SHR	95% CI	SHR	95% CI
1 unhealthy behaviour	1.03	0.85; 1.25	1.23	0.84; 1.79	1.02	0.74; 1.41	0.84	0.65; 1.10
2 unhealthy behaviours	1.15	0.95; 1.39	1.53	1.06; 2.21	0.93	0.68; 1.28	0.75	0.58; 0.97
3 unhealthy behaviours	1.38	1.14; 1.67	1.68	1.17; 2.42	0.80	0.56; 1.13	0.77	0.59; 1.02
4 unhealthy behaviours	1.58	1.27; 1.96	1.70	1.12; 2.58	0.71	0.44; 1.15	0.80	0.57; 1.11
≥5 unhealthy behaviours	1.35	0.97; 1.88	1.97	1.12; 3.48	0.88	0.41; 1.88	0.39	0.20; 0.85
Age	0.98	0.97; 0.98	0.98	0.97; 0.99	1.40	1.36; 1.44	1.01	1.00; 1.02
Marital status (= in a relationship)	0.71	0.63; 0.81	0.79	0.63; 0.99	0.93	0.68; 1.27	2.05	1.51; 2.78
Multimorbidity	1.03	0.86; 1.23	2.78	2.24; 3.43	0.69	0.50; 0.95	1.09	0.83; 1.42

Notes: SHR = subdistribution hazard ratio.
[a] Model adjusted for age, marital status, and multimorbidity.

unhealthy behaviours, the risk to exit paid employment through unemployment and, more profoundly, disability benefits increased gradually, indicating additive effects. In general, no indications were found for effect modification by gender or educational level.

To our knowledge, this study is unique regarding its specific focus on the role of unhealthy behaviours on the risk of early exit from paid employment among individuals with a chronic disease, while we already know that these workers are at an increased risk to exit paid employment (Oude Hengel et al., 2019; Scharn et al., 2019; van Zon et al., 2019). Overall, this study shows that, for workers who already have a chronic disease, unhealthy behaviour increases the risk of early exit from paid employment. This complements earlier research, in which it was shown that employment likelihood was negatively affected by obesity for women with a chronic disease (Feigl et al., 2019). The current study is in line with previous studies among a general working population, specifically regarding the increased risk of exit from paid employment into disability benefits for smoking (Helgadottir et al., 2019; Lallukka et al., 2015; Ropponen and Svedberg, 2014) and obesity (Hagger-Johnson et al., 2017; Neovius et al., 2008; Robroek et al., 2013). Results on dietary intake are also in line with a study of showing an increased risk of early exit from paid employment, although this was found only for women in case of multiple observations (Hagger-Johnson et al., 2017). Regarding high alcohol intake, previous studies among a general working population also showed an increased risk to exit paid employment into early retirement (Alavinia and Burdorf, 2008; Robroek et al., 2013). The current study did not find any association between physical inactivity and one of the exit routes which contradicts previous findings among a general working population (Robroek et al., 2013). This might be explained by the fact that the duration and intensity of the activity was not taken into account. The risk to exit paid employment early through disability benefits and unemployment gradually increased with multiple unhealthy behaviours, indicating additive effects. This is in line with earlier research among general working population on exit into disability benefits (Helgadottir et al., 2019). Together, these results indicate that it is important to identify workers with multiple unhealthy behaviours and to target multiple unhealthy behaviours simultaneously. Future research could investigate whether these effects are disease-generic or disease-specific.

There were no consistent findings for effect modification by gender and educational level. Previous studies, in which the impact of having chronic diseases on work exit was examined, also found mixed and inconsistent results (Oude Hengel et al., 2019; van Zon et al., 2019). This indicates that, although there is a main effect of gender and educational level (Robroek et al., 2015) on exit from paid employment, no clear moderating effect exists on the risk of unhealthy behaviours on exit from paid employment.

The current study provides new insight into the role of unhealthy behaviours among a specific group of workers known to be at an increased risk of early exit from paid employment. Results of the current study indicate that unhealthy behaviours increase the risk of

involuntary exit from paid employment, and that this risk gradually increased for having multiple unhealthy behaviours. The investigated health behaviours are well-established factors in the promotion and maintenance of good health. For those in poorer health due to the presence of a chronic disease, unhealthy behaviour may worsen disease severity and prognosis, which could negatively affect daily functioning and work ability below the level needed to remain employed (Kushner and Sorensen, 2013; van den Berg et al., 2017). As workers with a chronic disease are at an increased risk of early exit from the labour market already, adequate chronic disease management, with a focus on promoting or maintaining a healthy lifestyle, could therefore help to prevent exit from work.

Findings are important for employees, as they may adapt their health behaviours to extend their working life. In addition, it may provide employers the grounds for providing tailored health promoting activities, especially to support workers with a chronic disease who are at an increased risk of early labour market exit. As employment is an important aspect of social participation, preventive efforts of both workers and their employer could possibly contribute to keeping these individuals active within society. This fits with the extended Chronic Care Model, which recognizes that improving health behaviours should be a communal effort of different actors, as health behaviours are likely influenced by 'social, economic, and cultural factors inherent in the environment where people live, learn, work and play' (Barr et al., 2003).

4.1. Strengths and limitations

The large representative population sample (Scholtens et al., 2015), comprehensive classification of different chronic diseases based on clinical measures, and the use of objective registry data on early exit from paid employment with an 11 year follow-up period are strengths of the current study. Furthermore, the selection of chronic diseases common among individuals within the working-age population is considered an important strength (Friedman et al., 2004), as results are expected to be generalizable to a large group of workers with a chronic disease. By selecting an adequate sample which represents our population of interest, the risk of selection bias is likely to be low.

A limitation is the use of single items for unhealthy behaviours instead of more extensive measurement, e.g. validated questionnaires for physical activity, which could have given a more precise estimate of the risk. In addition, by using dichotomized, detailed information on health behaviours was lost. However, by using cut-offs based on international guidelines and previous research, usefulness for public health professionals is increased as they can more easily distinguish healthy from unhealthy individuals and assess their risk of early exit. A second limitation is the use of a sum score to measure multiple unhealthy behaviours. By doing so, different behaviours were treated as equally important in a single ordinal dimension while, in reality, some health behaviours may cancel out each other's effects (Lallukka et al., 2015).

Although the additive scoring of unhealthy behaviours has received some criticism, this approach has been adopted by studies investigating the negative effects of multiple unhealthy behaviours on health and disability benefits (Helgadottir et al., 2019; Khaw et al., 2008). Additionally, previous research has also shown that the interaction of health behaviours on the risk of receiving disability benefits is rather complex (Ropponen and Svedberg, 2014). Thirdly, obesity itself may not be seen as an unhealthy behaviour, but rather as a marker of other unhealthy behaviours, such as physical inactivity and poor diet. As the relationship between obesity and early exit is evident among the general working population, it is important to elucidate whether this holds among workers with a chronic disease. Furthermore, there was no strong association with the other health behaviours. Lastly, results of the current study are not necessarily generalizable to other countries, as benefit schemes largely differ between different welfare states (Reeuwijk et al., 2017).

5. Conclusion

The current study shows that unhealthy behaviours increase the risk of becoming unemployed and of receiving disability benefits. Having multiple unhealthy behaviours gradually increased the risk of unemployment and receiving disability benefits. No consistent evidence was found for effect modification by gender or educational level.

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CRediT authorship contribution statement

Patricia Ots: Conceptualization, Writing - original draft, Methodology, Software, Formal analysis. **Sander K.R. van Zon**: Conceptualization, Writing - review & editing, Methodology, Funding acquisition, Supervision. **Jolinda L.D. Schram**: Writing - review & editing, Methodology. **Alex Burdorf**: Writing - review & editing, Funding acquisition, Methodology. **Suzan J.W. Robroek**: Writing - review & editing, Funding acquisition, Methodology. **Karen M. Oude Hengel**: Writing - review & editing, Funding acquisition, Methodology. **Sandra Brouwer**: Conceptualization, Writing - review & editing, Methodology, Funding acquisition, Supervision.

Data availability statement

Data are stored at Statistics Netherlands. Data are available upon reasonable request, following the guidelines of the Statistics Netherlands.

Declaration of competing interest

None declared.

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