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Work functioning of Dutch workers with a chronic disease in early, mid and late working life: Cross-sectional findings from 38,470 participants in the Lifelines Cohort Study

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ABSTRACT

Insight into the work functioning of workers with chronic diseases may help to improve their sustainable employability. This study examines the work functioning of workers with cardiovascular disease (CVD), diabetes mellitus type 2 (DM2), chronic obstructive pulmonary disease (COPD), rheumatoid arthritis and depression across early, mid, and late working life. This cross-sectional study used data from 38,470 participants of the Dutch Lifelines study. Chronic diseases were classified based on clinical measures, self-reports, and medication. Work functioning was measured with the Work Role Functioning Questionnaire (WRFQ), covering work scheduling and output demands, physical demands, mental and social demands, and flexibility demands. Multivariable linear and logistic regression analyses were used to examine associations between chronic diseases and work functioning (continuous) and low work functioning (dichotomous). Depression was associated with lower work functioning across all subscales and working life stages, with the lowest score in the work scheduling and output demands subscale in late working life (B:-9.51;95%CI:-11.4,-7.65). Rheumatoid arthritis was most strongly associated with lower work functioning in the physical demands subscale, with the lowest score in early working life (B:-9.97;95%CI:-19.0,-0.89). Associations between CVD and DM2 and work functioning were absent in early working life but present in mid and late working life. Associations between COPD and work functioning were absent in mid working life but present in late working life. Occupational health professionals could use the WRFQ to identify workers' perceived difficulties in meeting specific work demands, pointing out directions for interventions to mitigate perceived difficulties and thereby improve sustainable employability.

1. Introduction

In the Netherlands, the number of people working with a chronic disease is steadily increasing (Social and Economic Council, 2016). It is estimated that a third of working age individuals has at least one chronic disease (Fit for Work, 2019). This is partly due to retirement policies requiring people to work until older age. The employment rate among people aged 50–64 years grew by 30% between 2000 and 2018 and older workers now form a much larger share of the total workforce than in the past (OECD, 2019). Furthermore, today's adult generations have a higher prevalence of chronic disease risk factors than their predecessors (Hulsegge et al., 2014) which contributes to chronic disease increases. Despite a large evidence base on e.g. work ability (Leijten et al., 2014), work participation (Boot et al., 2016) and specific exit routes out of work among workers with chronic diseases (Oude Hengel et al., 2019), little is known about how workers with chronic diseases actually perform their work role.

Health-related work functioning (hereafter "work functioning") is a construct providing insight into workers' perceived difficulties in meeting work demands given their physical or psychological health problems (Abma et al., 2013). The work functioning construct covers perceived difficulties across four work demand subscales: work scheduling and output demands, physical demands, mental and social demands, and flexibility demands. Conceptually, work functioning differs from constructs that primarily focus on work demands (Pejtersen et al., 2010), work productivity (Bouwmans et al., 2018), or an overall

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assessment of work ability (Abma et al., 2013; Tuomi et al., 1998). Insight into the work functioning of workers with chronic diseases can provide valuable information for managing work accommodations and prevention of work disability (Abma et al., 2013). Earlier, it was shown that poor health has a negative impact on work functioning of workers with poor self-rated health (Abma et al., 2013), cancer (Dorland et al., 2017; Schallig et al., 2021), mental disorders (Arends et al., 2019; Ubalde-Lopez et al., 2017), carpal tunnel syndrome (Amick 3rd et al., 2004) and obesity (Nigatu et al., 2016). For example, a third of working cancer survivors perceives difficulties in meeting work demands >30% of their working time (Dorland et al., 2017), while workers from the general working population perceive difficulties meeting work demands around 15% of their working time (Abma et al., 2018). As different chronic diseases may cause specific restrictions in basic physical and mental activities (Verbrugge and Jette, 1994), it is important to expand research to other chronic diseases to improve tailored work accommodations and prevention measures.

Among working-age individuals, cardiovascular disease (CVD), diabetes mellitus type 2 (DM2), chronic obstructive pulmonary disease (COPD), rheumatoid arthritis, and depression are responsible for a high disease burden (GBD 2019 Diseases and Injuries Collaborators, 2020), sickness absence (de Vroome et al., 2015), early work exit (Oude Hengel et al., 2019; de Boer et al., 2018; van Zon et al., 2020a; Holman, 2019; Kouwenhoven-Pasmooij et al., 2016) and decreased working life expectancy (Pedersen et al., 2019; Nexo et al., 2021). These diseases differ from each other and from previously examined diseases in terms of affected physiological systems and experienced symptoms. For example, rheumatoid arthritis may limit physical functioning through joint damage, pain and disability (Scott et al., 2010) while depression may limit psychosocial functioning through anhedonia, loss of energy and concentrations problems (Malhi and Mann, 2018). Furthermore, they differ in the risk for sickness absence (de Vroome et al., 2015), early work exit (Oude Hengel et al., 2019; Holman, 2019), and working life expectancy (Pedersen et al., 2019; Nexo et al., 2021). Therefore, we expect that these chronic diseases also affect work functioning differently. Workers with rheumatoid arthritis might especially face problems in meeting physical demands, while workers with depression may be more likely to face problems in meeting mental and social demands. Workers with CVD, DM2, and COPD may mainly face problems in meeting flexibility and work scheduling demands.

The association between chronic diseases and work functioning may vary across stages of the working life. Poor mental health tends to be more common in younger age groups (Whiteford et al., 2015) while poor physical health is more prevalent among older age groups (Barnett et al., 2012). Poor mental health due to depression may particularly affect work functioning in early working life, when workers are less able to compensate for difficulties in meeting work demands with work experience (Barham et al., 2009; Eichhorst et al., 2014). Poor physical health due to physical chronic diseases may especially affect the work functioning of older workers as disease severity generally increases with age (Aletaha and Smolen, 2018; Vestbo et al., 2013). For example, COPD may have caused more physiological damage resulting in more limitations in a 60-year-old worker versus a 40-year-old worker (Aletaha and Smolen, 2018; Vestbo et al., 2013).

This study examines the work functioning of workers with CVD, DM2, COPD, rheumatoid arthritis and depression, and whether workers with these chronic diseases present similar or different patterns among the four work functioning subscales, in early, mid, and late working life.

2. Methods

2.1. Study design and sample

The study sample was derived from the Lifelines Cohort and Biobank Study (Scholtens et al., 2015; Sijtsma et al., 2021). Lifelines is a multidisciplinary prospective population-based cohort study using a unique three-generational design to examine the health and health related-behaviours of 167,729 persons living in the North of The Netherlands. Lifelines 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. Participants were recruited between November 2006 and December 2013 through invitations by their general practitioner, family members, or self-registration. Recruitment and data collection have been described elsewhere (Scholtens et al., 2015; Sijtsma et al., 2021). Lifelines was conducted according to the guidelines in the Declaration of Helsinki and the Medical Ethics Committee of the University Medical Center Groningen approved all procedures involving human subjects (ethics number: 2007/152). Written informed consent was obtained from all participants.

For this study, we included participants in the fourth follow-up wave (2016–2019; n = 63,668) as data on work functioning was collected during this wave. Information from previous waves was used to determine whether participants had a chronic disease, their educational level and occupational group membership, as these concepts were not, or not completely, measured at the fourth follow-up wave (Supplement Fig. 1). Although measurement waves overlap, measurement intervals were the same for all participants, but the calendar timing differed. Participants had to be of working age (i.e., ≥18- < 66 years), working ≥12 h per week as participants then have sufficient experience to complete the WRFQ items, and provided information on at least one of the work functioning subscales. Based on these inclusion criteria, 12,456 participants were excluded due to age-ineligibility, 10,961 due to not working ≥12 h per week, and 765 due to missing information on work functioning. Furthermore, 341 participants had missing data on partner status, 459 on educational level, and 216 on occupational group membership and were excluded from analyses. As the total amount of missing data was 2.6%, we did not impute missing data. The analytic study sample consists of n = 38,470 (60.4%) participants.

2.2. Measures and procedures

2.2.1. Chronic diseases

Data from all waves were used to establish CVD, DM2, COPD, rheumatoid arthritis, or depression at the fourth follow-up wave, as only incident chronic diseases since the previous wave were reported during follow-up waves (Supplement Fig. 1). These chronic diseases were included because they have a high burden in terms of disability-adjusted life years in the Netherlands (National Institute for Public Health and the Environment (RIVM), 2023) and globally (GBD 2019 Diseases and Injuries Collaborators, 2020) in the working age population and represent different bodily systems. Chronic diseases were dichotomized with not having the particular disease as the reference category, which does include workers with other measured, and unmeasured, chronic diseases and is thus not free of diseases. Supplement Table 1 provides an extensive overview regarding the classification of chronic diseases, in line with previous Lifelines studies (Ots et al., 2020; van Zon et al., 2022).

2.2.2. Work functioning

Work functioning was assessed at the fourth follow-up wave with the Work Role Functioning Questionnaire 2.0 (WRFQ). The WRFQ measures perceived difficulties in meeting work demands among workers given their physical or psychological health problems, and has been shown to be reliable and valid in the general working population (Abma et al., 2013). The WRFQ consists of 27 items, divided into four subscales: work scheduling and output demands, physical demands, mental and social demands, and flexibility demands. Items are answered on a five-point scale ranging from 0 = difficult all the time (100%) to 4 = difficult none of the time (0%) or the answer option “does not apply to my job”. Supplement Table 2 shows the 27 items and their responses. In line with the WRFQ manual, scores on “does not apply to my job” were set to missing. Total and subscale scores were summed up separately by

adding all answers and the answers within the subscale, respectively. If 20% or more items were missing, the scale score was set to missing. Total and subscale scores were divided by the number of items and then multiplied by 25 to obtain percentages between 0 and 100, with higher scores indicating better work functioning. The scores are easily interpreted as percentages of time on a scale from 0 to 100. For example, a worker with a 40-h work week and a work functioning score of 80 has difficulties meeting the job demands 20% of the time, i.e., one day of the work week. As the WRFQ scores are somewhat positively skewed to the right, we also dichotomized the total and subscale scores into low work functioning (score < 75) and moderate to high work functioning (score ≥ 75) (Schallig et al., 2021).

2.2.3. Working life stages

Age was measured at the fourth follow-up wave and participants were categorized as being in early working life (aged 18- < 35), mid working life (aged 35- < 50) or late working life (aged ≥ 50) according to previous research (van Zon et al., 2017).

2.2.4. Covariates

Sex, partner status, and working hours were measured at the fourth follow-up wave, educational level was measured at baseline and the third follow-up wave, and occupational group membership was measured at baseline (Supplement Fig. 1). Partner status was dichotomized into having a partner (yes/no). Educational level was categorized into low, medium and high (van Zon et al., 2017). Working hours were categorized into working ≥ 12- < 20 h per week, ≥ 20- < 32 h per week, and ≥ 32 h per week (van Zon et al., 2017). Occupational group membership was coded according to the International Standard Classicisation of Occupations (ISCO-08) by Statistics Netherlands (van Zon et al., 2020b). Subsequently, participants were categorized as high skilled white-collar workers, low skilled white-collar workers, high skilled blue-collar workers, and low skilled blue-collar workers (Runge et al., 2021).

2.3. Statistical analyses

Total and subscale work functioning scores were examined across chronic diseases. Multivariable linear regression analyses were performed to examine the association between chronic diseases and WRFQ scores. Residual plots were examined to assess linearity assumptions; no indication for violation of the linearity assumption was found. Multivariable logistic regression analyses were performed to examine the association between chronic diseases and low work functioning. Analyses were stratified by working life stage and performed for total work functioning and the four subscales for all diseases separately. Models were adjusted for sex, partner status, educational level, working hours, and occupational group membership. We further adjusted for the year work functioning was measured (i.e., 2016–2019) and the time in months between the measurement of work functioning and reporting of a particular chronic disease. To investigate the impact of setting the WRFQ answer category "does not apply to my job" to missing, we performed sensitivity analyses in which we used the best score (i.e. difficult none of the time). In these analyses, we added a covariate indicating whether a score was forced from "does not apply to my job" to "difficult none of the time".

3. Results

3.1. Participant characteristics

The study sample consisted of $n = 38{,}470$ participants. Most participants were between 50 and 65 years old and worked ≥ 32 h per week (Table 1). The most prevalent chronic disease was COPD followed by depression.

Table 1
Participant characteristics by working life stage ($n = 38{,}470$).

	Early working life		Mid working life		Late working life	
	n	Mean (SD) or %	n	Mean (SD) or %	n	Mean (SD) or %
Gender, %	4549		14,834		19,087	
Male		36.0		43.3		46.4
Female		64.0		56.7		53.6
Partner status, %	4549		14,834		19,087	
Partner		72.5		83.5		86.3
No partner		27.5		16.5		13.7
Educational level, %	4549		14,834		19,087	
High		59.4		43.2		33.7
Medium		35.5		41.7		39.4
Low		5.1		15.0		26.9
Occupational group, %	4549		14,834		19,087	
High skilled white collar		46.4		54.0		51.1
Low skilled white collar		37.5		29.7		30.4
High skilled blue collar		7.3		9.9		10.1
Low skilled blue collar		8.7		6.4		8.4
Working hours, %	4549		14,834		19,087	
≥32 h per week		68.5		62.7		60.8
20–32 h per week		26.6		29.9		29.7
12–20 h per week		4.9		7.4		9.5
Chronic diseases, %	4549		14,834		19,087	
Cardiovascular disease		1.2		2.7		6.3
Diabetes mellitus type 2		0.7		2.0		4.5
Chronic obstructive pulmonary disease		N.A.		6.4		17.8
Rheumatoid arthritis		0.9		1.8		3.2
Depression		7.2		6.0		5.9
Work functioning, mean (SD)						
Total work functioning	4461	86.0 (16.4)	14,376	86.9 (16.6)	18,037	86.2 (17.9)
Work scheduling and output demands	4485	83.6 (18.7)	14,460	85.3 (19.1)	18,321	85.0 (20.3)
Physical demands	3683	91.1 (16.9)	11,714	90.0 (17.9)	14,798	87.3 (19.7)
Mental and social demands	4513	85.7 (18.3)	14,526	87.2 (18.2)	18,390	87.1 (19.6)
Flexibility demands	4495	87.1 (18.7)	14,491	87.0 (18.6)	18,293	85.8 (19.8)

3.2. Chronic diseases and work functioning

In general, workers with depression had the lowest work functioning scores across all scales and working life stages (Table 2), and they were the only group with mean scores <3 on several individual items, such as "get easily going at the beginning of the workday" (Supplement table 3). Linear regression analyses showed that depression was negatively associated with work functioning scores across all scales and working life stages, with most perceived difficulties in the work scheduling and output demands subscale in late working life (Table 3). Logistic regression analyses showed that depression was also associated with low work functioning across all scales, except the physical demands subscale in early working life (Figs. 1 a-e).

In early working life, rheumatoid arthritis was negatively associated with work functioning scores on the total scale, the work scheduling and output demands subscale and the physical demands subscale, and with

Table 2
Mean (SD) work functioning scores by chronic disease and working life stage.

	No chronic disease	Cardiovascular Disease	Diabetes mellitus type 2	Chronic obstructive Pulmonary disease	Rheumatoid Arthritis	Depression
	Mean (SD), (n)	Mean (SD), (n)	Mean (SD), (n)	Mean (SD), (n)	Mean (SD), (n)	Mean (SD), (n)
Early working life						
Total work functioning	86.6 (16.1), (4039)	86.0 (16.2), (52)	87.4 (10.9), (32)	Not applicable	80.6 (16.0), (42)	78.0 (18.8), (315)
Work scheduling and output demands	84.3 (18.4), (4054)	83.6 (18.5), (53)	85.2 (13.2), (33)	Not applicable	79.4 (19.5), (42)	75.6 (20.5), (323)
Physical demands	91.5 (16.6), (3330)	93.9 (12.5), (45)	90.2 (15.4), (25)	Not applicable	78.4 (23.1), (37)	86.6 (20.1), (262)
Mental and social demands	86.5 (17.8), (4077)	85.1 (17.4), (53)	87.1 (10.9), (32)	Not applicable	81.7 (18.7), (42)	76.3 (21.3), (328)
Flexibility demands	87.9 (18.2), (4064)	86.2 (18.2), (53)	88.5 (15.9), (32)	Not applicable	83.2 (20.0), (42)	78.3 (22.5), (323)
Mid working life						
Total work functioning	87.6 (16.2), (11,924)	84.6 (18.0), (389)	83.6 (20.3), (278)	86.3 (16.5), (924)	86.4 (16.0), (251)	78.9 (19.5), (866)
Work scheduling and output demands	85.9 (18.7), (11,987)	83.0 (20.3), (395)	81.5 (23.8), (277)	84.8 (19.1), (934)	85.8 (18.0), (250)	76.9 (21.7), (874)
Physical demands	90.8 (17.2), (9702)	86.9 (20.8), (311)	85.5 (21.9), (231)	88.9 (18.2), (771)	84.4 (19.7), (212)	82.4 (22.9), (713)
Mental and social demands	87.8 (17.7), (12,042)	84.9 (19.4), (400)	84.3 (22.2), (283)	86.6 (18.8), (930)	87.5 (18.6), (257)	78.9 (21.5), (873)
Flexibility demands	87.7 (18.0), (12,022)	85.4 (20.1), (393)	84.3 (22.5), (280)	86.0 (19.2), (924)	87.6 (18.4), (257)	79.0 (23.1), (870)
Late working life						
Total work functioning	87.1 (17.3), (12,314)	84.0 (19.7), (1137)	83.0 (21.6), (809)	85.7 (18.0), (3190)	82.4 (19.4), (568)	77.7 (20.3), (1061)
Work scheduling and output demands	86.0 (19.5), (12,501)	82.5 (22.4), (1147)	80.8 (25.5), (817)	84.6 (20.4), (3249)	81.7 (21.9), (573)	76.1 (23.2), (1092)
Physical demands	88.5 (18.9), (10,035)	84.9 (21.2), (938)	83.3 (22.8), (686)	86.3 (20.1), (2664)	78.5 (23.5), (466)	79.0 (23.9), (903)
Mental and social demands	87.8 (19.0), (12,541)	85.1 (21.8), (1163)	84.6 (23.4), (817)	86.9 (20.0), (3265)	84.4 (22.3), (577)	78.8 (22.2), (1090)
Flexibility demands	86.6 (19.1), (12,488)	83.7 (22.3), (1147)	83.5 (23.4), (816)	85.3 (20.3), (3246)	83.8 (22.0), (580)	78.0 (22.7), (1072)

Table 3
Associations between chronic diseases and work functioning (total scale and subscales) by working life stage*.

	Total work Functioning	Work scheduling And output demands	Physical Demands	Mental and Social demands	Flexibility Demands
	Unstandardized beta (95% CI)	Unstandardized beta (95% CI)	Unstandardized beta (95% CI)	Unstandardized beta (95% CI)	Unstandardized beta (95% CI)
Early working life					
Cardiovascular disease	1.40 (−3.79, 6.58)	0.83 (−4.99, 6.64)	5.26 (−0.33, 10.9)	0.54 (−5.14, 6.23)	0.02 (−5.79, 5.84)
Diabetes mellitus type 2	5.05 (−5.38, 15.5)	6.07 (−5.79, 17.9)	−3.00 (−14.7, 8.66)	3.23 (−8.37, 14.8)	10.2 (−1.66, 22.1)
Chronic obstructive pulmonary disease	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Rheumatoid arthritis	−8.33 (−16.2, −0.44)	−9.60 (−18.6, −0.63)	−9.97 (−19.0, −0.89)	−6.40 (−15.2, 2.39)	−8.16 (−17.1, 0.82)
Depression	−7.86 (−10.6, −5.14)	−8.35 (−11.4, −5.27)	−3.53 (−6.60, −0.45)	−8.21 (−11.2, −5.24)	−8.77 (−11.8, −5.72)
Mid working life					
Cardiovascular disease	−2.96 (−5.05, −0.87)	−3.48 (−5.85, −1.10)	−3.23 (−5.78, −0.69)	−3.24 (−5.49, −0.98)	−2.08 (−4.40, 0.24)
Diabetes mellitus type 2	−4.36 (−7.65, −1.08)	−5.21 (−8.95, −1.46)	−6.96 (−10.8, −3.16)	−4.08 (−7.63, −0.53)	−3.90 (−7.57, −0.23)
Chronic obstructive pulmonary disease	−1.09 (−3.01, 0.82)	−1.42 (−3.60, 0.75)	−0.49 (−2.70, 1.73)	−0.93 (−3.01, 1.15)	−1.88 (−4.02, 0.25)
Rheumatoid arthritis	2.03 (−1.82, 5.89)	1.53 (−2.87, 5.93)	−3.06 (−7.43, 1.31)	3.63 (−0.54, 7.79)	2.87 (−1.33, 7.07)
Depression	−8.01 (−9.72, −6.30)	−8.40 (−10.3, −6.46)	−6.77 (−8.78, −4.76)	−8.66 (−10.5, −6.80)	−8.53 (−10.4, −6.63)
Late working life					
Cardiovascular disease	−1.62 (−3.02, −0.23)	−1.67 (−3.25, −0.08)	−2.21 (−3.89, −0.53)	−1.61 (−3.12, −0.10)	−1.91 (−3.46, −0.37)
Diabetes mellitus type 2	−3.67 (−6.01, −1.33)	−4.77 (−7.43, −2.11)	−4.11 (−6.89, −1.34)	−3.61 (−6.15, −1.07)	−4.14 (−6.71, −1.57)
Chronic obstructive pulmonary disease	−1.93 (−3.43, −0.42)	−1.67 (−3.36, 0.02)	−3.28 (−5.06, −1.50)	−1.49 (−3.12, 0.14)	−1.87 (−3.52, −0.22)
Rheumatoid arthritis	−2.33 (−5.01, 0.35)	−1.09 (−4.11, 1.92)	−7.95 (−11.2, −4.67)	−1.01 (−3.94, 1.91)	−0.60 (−3.57, 2.38)
Depression	−8.97 (−10.6, −7.32)	−9.51 (−11.4, −7.65)	−8.57 (−10.6, −6.60)	−8.79 (−10.6, −7.00)	−8.44 (−10.3, −6.61)

* Analyses were adjusted for sex, partner status, educational level, working hours, occupational group membership, the year work functioning was measured, and time between the measurement of work functioning and the reporting of a particular chronic disease.

low work functioning on all scales except the work scheduling and output demands subscale. Rheumatoid arthritis was not associated with work functioning in mid working life. In late working life, rheumatoid arthritis was negatively associated with work functioning scores in the physical demands subscale. Rheumatoid arthritis was also associated with low work functioning in the physical demands subscale in late working life. The item on "lifting, carrying, or moving objects weighing more than 10 pounds" was scored as most problematic by workers with rheumatoid arthritis.

CVD was not associated with work functioning in early working life, but negative associations with work functioning scores were observed across all scales in mid and late working life, except for the flexibility demands subscale in mid working life. Furthermore, CVD was associated with low work functioning on the total scale, the work scheduling and output demands subscale and the mental and social demands subscale in mid working life. In late working life, however, CVD was only associated

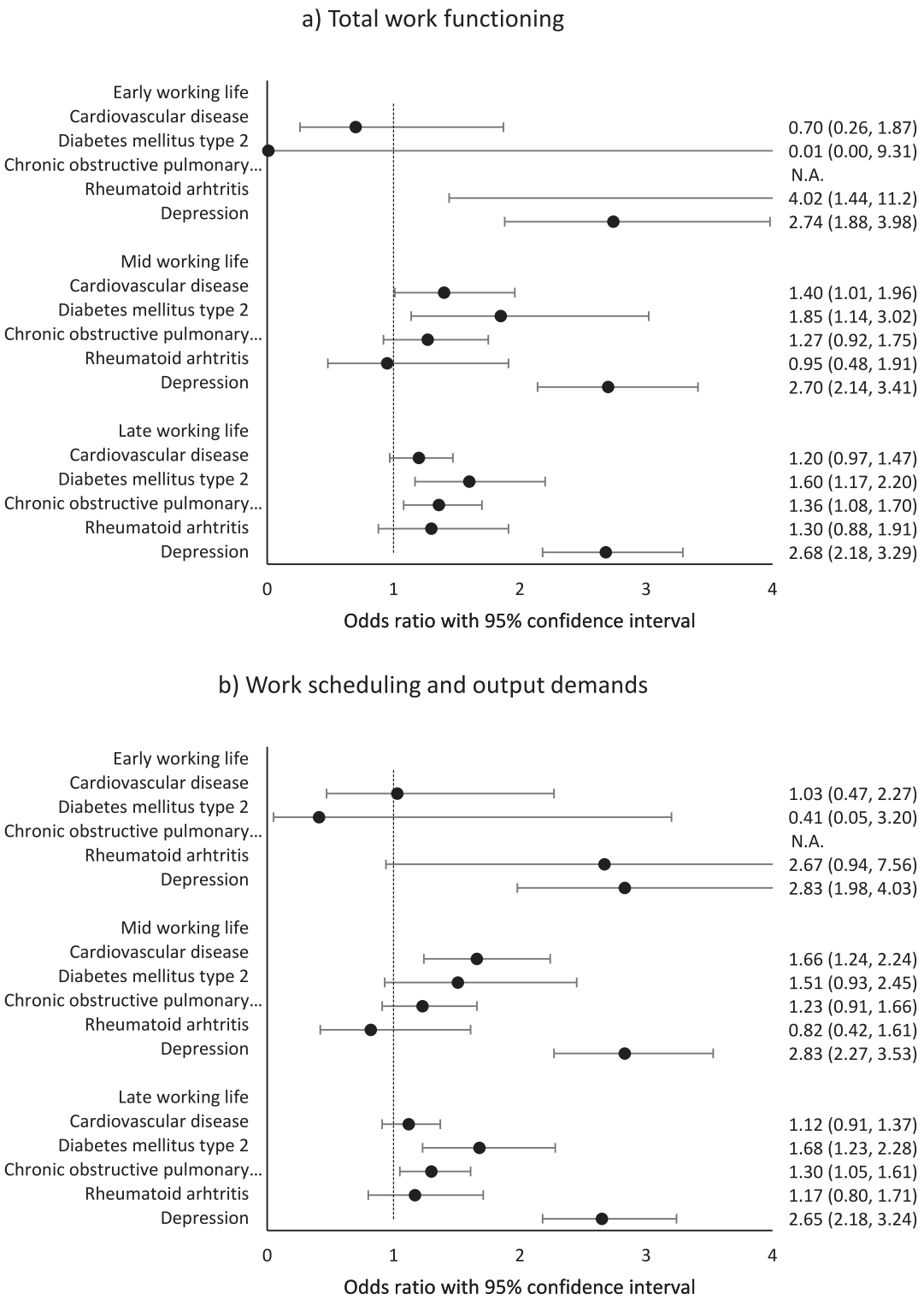
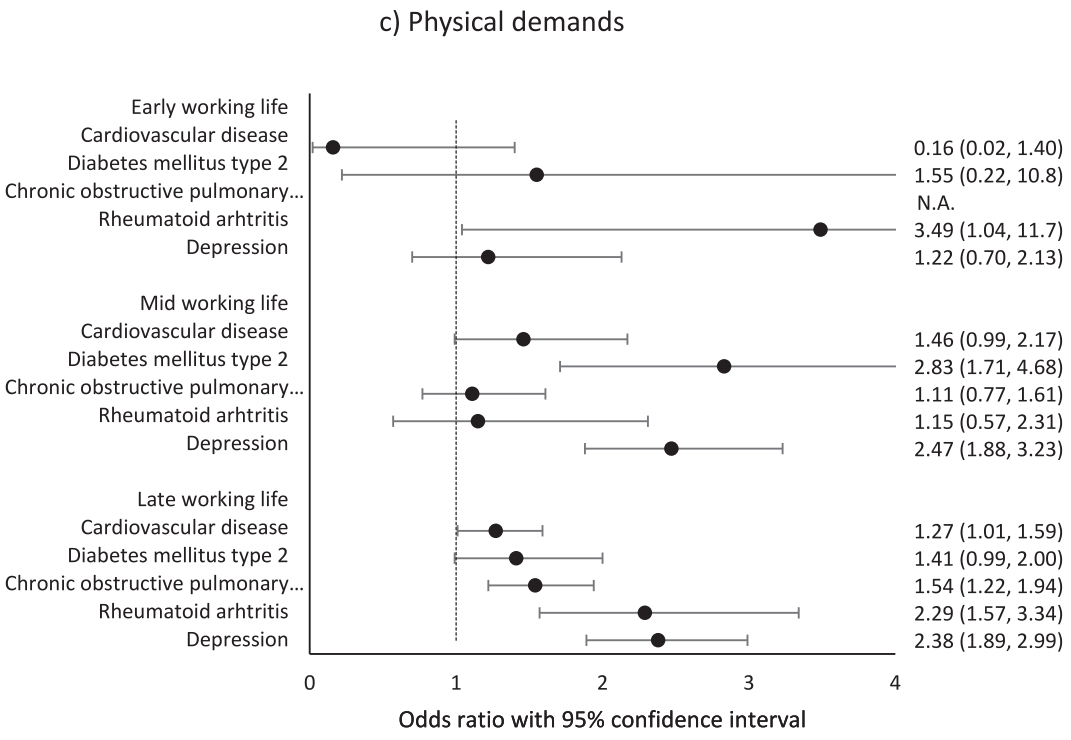


Fig. 1. a-e. Association between chronic diseases and low work functioning (total scale and subscales) by working life stage*.
* Analyses were adjusted for sex, partner status, educational level, working hours, occupational group membership, the year work functioning was measured, and time between the measurement of work functioning and the reporting of a particular chronic disease.

with low work functioning on the physical demands subscale. Similarly, DM2 was negatively associated with work functioning scores across all scales in mid and late working life. DM2 was associated with low work functioning on the total scale, the physical demands and flexibility demands subscales in mid working life and with all scales in late working life, except for the physical demands subscale. Finally, only in late working life, COPD was negatively associated with work functioning scores on the total scale, the physical demands and the flexibility demands subscales and with low work functioning on all scales.



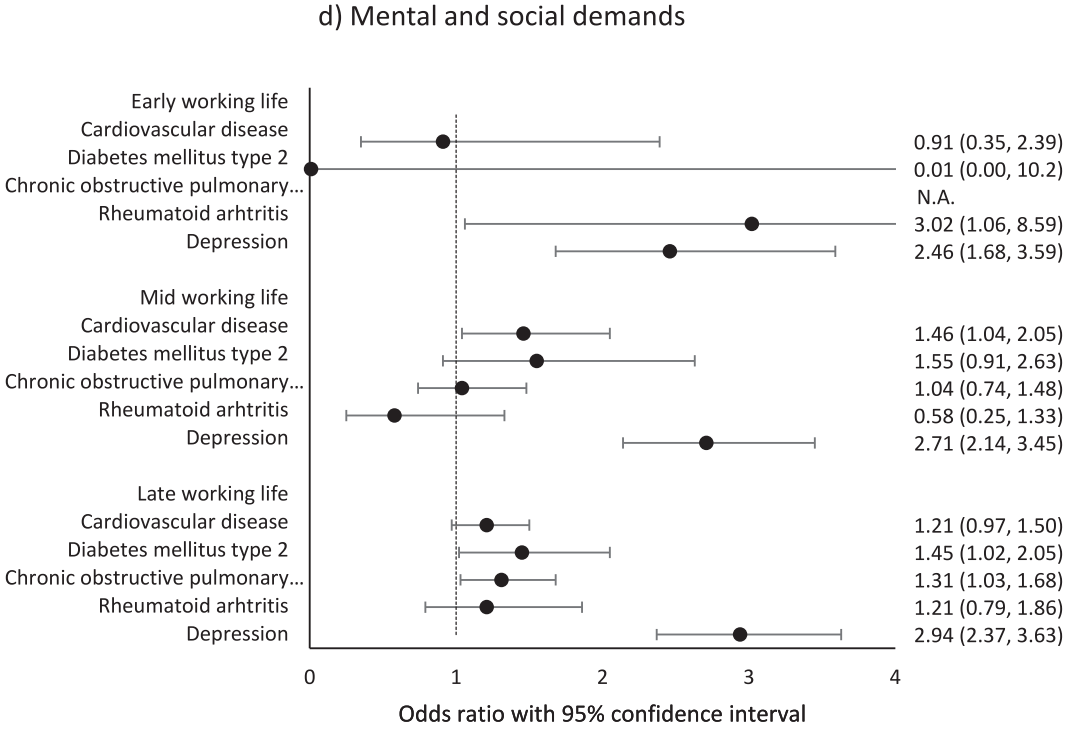


Fig. 1. (*continued*).

3.3. Sensitivity analyses

When the answer category "does not apply to my job" was set to "difficult none of the time", results were similar for the linear regression analyses (supplement table 4), and with a few exceptions, for the logistic regression analyses (supplement fig. 2).

4. Discussion

In this study among 38,470 Dutch workers, associations between CVD and DM2 and work functioning were absent in early working life but present in mid and late working life. Depression was negatively associated with work functioning regardless of working life stage, while COPD was only associated with work functioning in late working life. Subscale specific work functioning problems were most noticeably

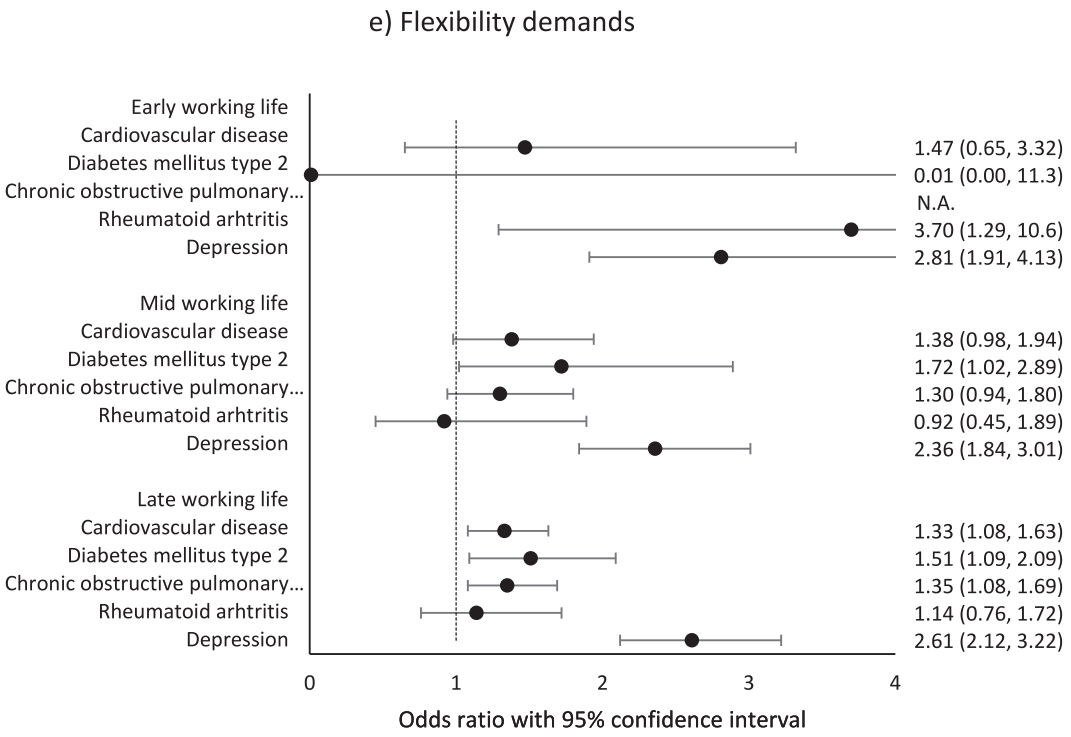


Fig. 1. (*continued*).

observed for meeting physical demands among workers with rheumatoid arthritis in early and late working life, respectively.

We found that chronic diseases are negatively associated with work functioning scores in the general population, which is in line with previous studies in specific patient populations (Abma et al., 2013; Dorland et al., 2017; Schallig et al., 2021; Arends et al., 2019; Ubalde-Lopez et al., 2017; Amick 3rd et al., 2004; Nigatu et al., 2016). Work functioning scores across the chronic diseases in this study were somewhat higher than that of working cancer survivors and workers with mental disorders (Abma et al., 2018). This may be explained by working cancer survivors and workers with mental disorders being recruited into the respective studies just after they returned to work after a period of sickness absence. Associations between CVD and DM2 and lower work functioning scores were found in mid and late working life, but not in early working life. This may be explained by a generally increasing severity of chronic diseases with age (Aletaha and Smolen, 2018; Vestbo et al., 2013), thereby causing more limitations in basic physical and mental activities (Verbrugge and Jette, 1994). Yet, longitudinal studies including age of disease onset are needed to verify this possible explanation. Another explanation is that the prevalence of CVD and DM2 was low in early working life, causing power issues. Associations between depression and work functioning were found across all working life stages. An explanation for the similar effect size across working life stages may be that people with depression, classified through the MINI and recorded medication, all exceed a certain symptom level threshold that may affect work functioning, irrespective of age.

COPD was not associated with lower work functioning scores in mid working life. This finding contradicts studies showing that respiratory diseases are related to a substantially increased risk for, a different and more distal outcome, work disability (Oude Hengel et al., 2019; Holman, 2019). An explanation may be that our measurement of COPD, partly through spirometry, might have captured participants with mild COPD. Another explanation may be that early-stage COPD may not yet influence work functioning, which is in line with the low number of additional sickness absence days due to respiratory diseases in the Netherlands (de Vroome et al., 2015), while people with moderate or severe COPD may not be participating in work anymore.

When strictly looking at statistical significance, there were discrepancies in results when using work functioning as a continuous or dichotomized outcome. Yet, results point in the same direction. Most significant associations with work functioning as a continuous outcome were almost significant with work functioning as a dichotomized outcome, especially in mid and late working life. As dichotomizing data leads to loss of information and some statistical power, using work functioning as a continuous outcome may be preferred. Although most chronic diseases were associated with lower work functioning scores on the four subscales, the subscales do not seem to capture specific experienced difficulties across chronic diseases. Possible explanations are that the WRFQ is not designed to capture disease specific difficulties in meeting work demands, and that workers have already adapted their work tasks to be able to stay at work and no longer experience difficulties with meeting these work demands. Longitudinal research is needed to unravel these possible adaptations over time. Furthermore, a substantial number of workers indicated that the items in the physical demands scale did not apply to them. As these items were set to missing, analyses regarding the physical demands subscale were performed in a smaller sample of workers. Yet, sensitivity analyses in which participants were given the highest score when they indicated that a certain item was “not applicable to their job” showed similar results.

Study strengths include the valid and reliable measurement of work functioning through the WRFQ (Abma et al., 2013) and the classification of chronic diseases through a combination of self-reports, clinical measures and medication use (Ots et al., 2020). These comprehensive measurements limit the risk of information bias on the predictor and outcome variables. A limitation is the cross-sectional nature of the study, which limits statements about temporality. However, while it seems likely that chronic diseases affect work functioning, it may be less likely that limited work functioning causes chronic diseases. Lower work functioning scores may be indicative for an underlying physical or psychological problem but will in itself probably not cause a chronic disease. Longitudinal studies are needed to corroborate our findings, and to disentangle the respective role of individual characteristics, the broader work environment, and work functioning. Furthermore, as incident depression and rheumatoid arthritis were not measured during

the last measurement wave, we may have missed new cases of these diseases. It is also important to note that the reference group for a particular association contained workers without the disease under study but included workers with other diseases. Presented associations may therefore underestimate the true associations as the reference group is not free of diseases. Finally, while depression is often chronic either in terms of recurrent or persistent depression, it is not by definition a chronic disease (Monroe, 2012). We may thus have misclassified participants as having depression while they may have recovered.

Study results offer some leads for future research and practice. Although studies have shown the importance of health behaviours (Ots et al., 2020), working conditions (Schram et al., 2020), and employer policies (Dettmann and Hasselhorn, 2021) to prevent involuntary work exit among workers with chronic diseases, it may be more beneficial to focus on workers' perceived difficulties in meeting work demands. According to the disablement process (Verbrugge and Jette, 1994), chronic diseases may cause dysfunctions and structural abnormalities in specific body systems, that may cause difficulties in meeting work demands, which in turn may result in work exit. Future studies need to disentangle these mechanisms and pathways. In addition, other diseases like osteoarthritis, low back pain but also communicable diseases and injuries may affect work functioning. Studies should further broaden the scope of diseases and their impact on work functioning. In addition, studies should investigate the role of disease severity. For example, depressive symptoms may already affect work functioning in the absence of a formal depression diagnosis. Finally, by selecting workers who worked at least 12 h per week, we may have excluded a particularly vulnerable subgroup of workers that is still able to work less hours. Although the WRFQ is not designed to examine the work functioning of those working <12 h, future research may examine how this particular subgroup of workers functions when being at work. For practice, occupational health professionals may use the WRFQ to explore workers' perceived difficulties in meeting specific work demands. This may provide levers for actions to mitigate perceived difficulties and thereby improving the sustainable employability of workers within the context of a specific working life stage for a particular disease. For example, difficulties with lifting, carrying, or moving objects among workers with rheumatoid arthritis could be addressed by using aiding devices.

In conclusion, associations between CVD and DM2 and lower work functioning were absent in early working life but present in mid and late working life. Associations between depression and lower work functioning scores were present and similar across working life stages, while COPD was only associated with lower work functioning scores in late working life. Occupational health professionals may use the WRFQ to identify workers' perceived difficulties in meeting work demands so these can be addressed through targeted work accommodations.

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Author contributions

Sander KR van Zon: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing - original draft. Benjamin C Amick III: Conceptualization, Methodology, Writing - review & editing. Femke I Abma: Conceptualization, Methodology, Writing - review & editing. Corné Roelen: Conceptualization, Methodology, Writing - review & editing. Ute Bültmann: Conceptualization, Methodology, Supervision, Writing - review & editing.

Declaration of Competing Interest

The authors report no potential conflicts of interest.

Data availability

The authors do not have permission to share data.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2023.107549.

References

Abma, F.I., van der Klink, J.J., Bultmann, U., 2013. The work role functioning questionnaire 2.0 (Dutch version): examination of its reliability, validity and responsiveness in the general working population. J. Occup. Rehabil. 23, 135–147.
Abma, F.I., Bultmann, U., Amick Iii, B.C., Arends, I., Dorland, H.F., Flach, P.A., et al., 2018. The work role functioning questionnaire v2.0 showed consistent factor structure across six working samples. J. Occup. Rehabil. 28, 465–474.
Aletaha, D., Smolen, J.S., 2018. Diagnosis and Management of Rheumatoid Arthritis: a review. JAMA 320, 1360–1372.
Amick 3rd, B.C., Habeck, R.V., Ossmann, J., Fossel, A.H., Keller, R., Katz, J.N., 2004. Predictors of successful work role functioning after carpal tunnel release surgery. J. Occup. Environ. Med. 46, 490–500.
Arends, I., Almansa, J., Stansfeld, S.A., Amick, B.C., van der Klink, J.J.L., Bultmann, U., 2019. One-year trajectories of mental health and work outcomes post return to work in patients with common mental disorders. J. Affect. Disord. 257, 263–270. Oct 1.
Barham, C., Walling, A., Clancy, G., Hicks, S., Conn, S., 2009. Young people and the labour market. Econom. & Labour Market Rev. 3, 17–29.
Barnett, K., Mercer, S.W., Norbury, M., Watt, G., Wyke, S., Guthrie, B., 2012. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet 380, 37–43.
Boot, C.R.L., de Kruif, Anja, Th, C.M., Shaw, W.S., van der Beek, Allard J., Deeg, D.J., Abma, T., 2016. Factors important for work participation among older workers with depression, cardiovascular disease, and osteoarthritis: a mixed method study. J. Occup. Rehabil. 26, 160–172.
Bouwmans, C., Hakkaart-van Roijen, L.H., Koopmanschap, M., Krol, M., Severens, H., Brouwer, W., 2018. Productivity Costs Quesionnaire Vragenlijst. Institute for Medical Technology Assessment. Erasmus University Rotterdam.
de Boer, A.G.E.M., Geuskens, G.A., Bultmann, U., Boot, C.R.L., Wind, H., Koppes, L.L.J., et al., 2018. Employment status transitions in employees with and without chronic disease in the Netherlands. Int. J. Public Health 63, 713–722.
de Vroome, E.M., Uegaki, K., van der Ploeg, C.P., Treutlein, D.B., Steenbeek, R., de Weerd, M., et al., 2015. Burden of sickness absence due to chronic disease in the Dutch workforce from 2007 to 2011. J. Occup. Rehabil. 25, 675–684.
Dettmann, M.M., Hasselhorn, H.M., 2021. Helpfulness of workplace accommodations in maintaining health and work ability in older employees with poor health in Germany. J. Occup. Environ. Med. 63, e1–e6.
Dorland, H.F., Abma, F.I., Roelen, C.A.M., Stewart, R.E., Amick, B.C., Ranchor, A.V., et al., 2017. Work functioning trajectories in cancer patients: results from the longitudinal work life after Cancer (WOLICA) study. Int. J. Cancer 141, 1751–1762.
Eichhorst, W., Boeri, T., De Coen, A., Galasso, V., Kendzia, M., Steiber, N., 2014. How to combine the entry of young people in the labour market with the retention of older workers? IZA J. Eur. Labor. Stud. 3, 19.
Fit for Work, 2019. Werkbehoud bij Chronische Aandoeningen, Wat Levert Het op? (Job Retention in Chronic Conditions, What are the Benefits?). Available at: https://www.fitforworknederland.nl/wp-content/uploads/2019/04/FitforWork_ImpactGraphic_2019.pdf.
GBD 2019 Diseases and Injuries Collaborators, 2020. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet 396, 1204–1222.
Holman, D., 2019. Chronic conditions as predictors of later life disability employment exit: a gendered analysis. Occup. Environ. Med. 76, 441–447.
Hulsegge, G., Picavet, H.S., Blokstra, A., Nooyens, A.C., Spijkerman, A.M., van der Schouw, Y.T., et al., 2014. Today's adult generations are less healthy than their predecessors: generation shifts in metabolic risk factors: the Doetinchem cohort study. Eur. J. Prev. Cardiol. 21, 1134–1144.
Kouwenhoven-Pasmooij, T.A., Burdorf, A., Roos-Hesselink, J.W., Hunink, M.G., Robroek, S.J., 2016. Cardiovascular disease, diabetes and early exit from paid employment in Europe; the impact of work-related factors. Int. J. Cardiol. 215, 332–337.

Leijten, F.R., van den Heuvel, S.G., Ybema, J.F., van der Beek, A.J., Robroek, S.J., Burdorf, A., 2014. The influence of chronic health problems on work ability and productivity at work: a longitudinal study among older employees. Scand. J. Work Environ. Health 40, 473–482.

Malhi, G.S., Mann, J.J., 2018. Depression. Lancet 392, 2299–2312.

Monroe, S.M.H.K., 2012. Is depression a chronic mental illness? Psychol. Med. 42, 899–902.

National Institute for Public Health and the Environment (RIVM), 2023. Rankings – Disorders by Disease Burden (in DALYs). Available at: https://www.vzinfo.nl/ranglijsten/aandoeningen-op-basis-van-ziektelast-in-dalys/leeftijd.

Nexo, M.A., Pedersen, J., Cleal, B., Andersen, I., Bjorner, J.B., 2021. Working life expectancies among individuals with type 1 and type 2 diabetes over a 30-year period. Scand. J. Work Environ. Health 47, 540–549.

Nigatu, Y.T., van de Ven, H.A., van der Klink, J.J., Brouwer, S., Reijneveld, S.A., Bultmann, U., 2016. Overweight, obesity and work functioning: the role of working-time arrangements. Appl. Ergon. 52, 128–134.

OECD, 2019. Pensions at a Glance 2019: OECD and G20 Indicators. OECD Publishing, Paris.

Ots, P., van Zon, S.K.R., Schram, J.L.D., Burdorf, A., Robroek, S.J.W., Oude Hengel, K.M., et al., 2020. The influence of unhealthy behaviours on early exit from paid employment among workers with a chronic disease: a prospective study using the Lifelines cohort. Prev. Med. 139, 106228.

Oude Hengel, K., Robroek, S.J.W., Eekhout, I., van der Beek, A.J., Burdorf, A., 2019. Educational inequalities in the impact of chronic diseases on exit from paid employment among older workers: a 7-year prospective study in the Netherlands. Occup. Environ. Med. 76, 718–725.

Pedersen, J., Thorsen, S.V., Andersen, M.F., Hanvold, T.N., Schlunssen, V., Bultmann, U., 2019. Impact of depressive symptoms on worklife expectancy: a longitudinal study on Danish employees. Occup. Environ. Med. 76, 838–844.

Pejtersen, J.H., Kristensen, T.S., Borg, V., Bjorner, J.B., 2010. The second version of the Copenhagen psychosocial questionnaire. Scand J. Public Health 38 (3 Suppl), 8–24.

Runge, K., van Zon, S.K.R., Bultmann, U., Henkens, K., 2021. Metabolic syndrome incidence in an aging workforce: occupational differences and the role of health behaviors. SSM Popul. Health 15, 100881.

Schallig, M.M.T., Bultmann, U., Ranchor, A.V., van Zon, S.K.R., 2021. Does social support at home moderate the association between social support at work and work functioning among cancer patients? J. Cancer Surviv. https://doi.org/10.1007/s11764-021-01132-5.

Scholtens, S., Smidt, N., Swertz, M.A., Bakker, S.J., Dotinga, A., Vonk, J.M., et al., 2015. Cohort profile: LifeLines, a three-generation cohort study and biobank. Int. J. Epidemiol. 44, 1172–1180.

Schram, J.L.D., Robroek, S.J.W., Ots, P., Brouwer, S., Burdorf, A., van Zon, S.K.R., et al., 2020. Influence of changing working conditions on exit from paid employment among workers with a chronic disease. Occup. Environ. Med. 77, 628–633.

Scott, D.L., Wolfe, F., Huizinga, T.W., 2010. Rheumatoid arthritis. Lancet 376, 1094–1108.

Sijtsma, A., Rienks, J., Navis, G., Rosmalen, J.G.M., Dotinga, A., 2021. Cohort Profile Update: Lifelines, a three-generation cohort study and biobank. Int. J. Epidemiol. 51, e295–e302.

Social and Economic Council, 2016. Werk: Van Belang Voor Iedereen. Een Advies Over Werken Met een Chronische Ziekte (Advice on Working with a Chronic Illness). Social and Economic Council, The Hague.

Tuomi, K., Ilmarinen, J., Jahkola, A., Katajarinne, L., Tulkki, A., 1998. Work Ability Index, 2nd ed. Finnish Institute of Occupational Health, Helsinki.

Ubalde-Lopez, M., Arends, I., Almansa, J., Delclos, G.L., Gimeno, D., Bultmann, U., 2017. Beyond return to work: the effect of multimorbidity on work functioning trajectories after sick leave due to common mental disorders. J. Occup. Rehabil. 27, 210–217.

van Zon, S.K.R., Reijneveld, S.A., Mendes de Leon, C.F., Bultmann, U., 2017. The impact of low education and poor health on unemployment varies by work life stage. Int. J. Public Health 62, 997–1006.

van Zon, S.K.R., Reijneveld, S.A., Galaurchi, A., Mendes de Leon, C.F., Almansa, J., Bultmann, U., 2020a. Multimorbidity and the transition out of full-time paid employment: a longitudinal analysis of the health and retirement study. J. Gerontol. B Psychol. Sci. Soc. Sci. 75, 705–715.

van Zon, S.K., Amick III, B.C., de Jong, T., Brouwer, S.B., U., 2020b. The occupational distribution of metabolic syndrome prevalence and incidence differs by sex and is not explained by health behavior: results from 75,000 Dutch workers from 40 occupational groups. BMJ Open Diabetes Res. Care 8, e001436.

van Zon, S.K.R., Ots, P., Robroek, S.J.W., Burdorf, A., Oude Hengel, K.M., Brouwer, S., 2022. Do chronic diseases moderate the association between psychosocial working conditions and work exit? Longitudinal results from 55 950 Dutch workers. J. Epidemiol. Community Health. https://doi.org/10.1136/jech-2021-21843 jech-2021-218432.

Verbrugge, L.M., Jette, A.M., 1994. The disablement process. Soc. Sci. Med. 38, 1–14.

Vestbo, J., Hurd, S.S., Agusti, A.G., Jones, P.W., Vogelmeier, C., Anzueto, A., et al., 2013. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am. J. Respir. Crit. Care Med. 187, 347–365.

Whiteford, H.A., Ferrari, A.J., Degenhardt, L., Feigin, V., Vos, T., 2015. The global burden of mental, neurological and substance use disorders: an analysis from the global burden of disease study 2010. PLoS One 10, e0116820.