The role of individual and contextual factors in paid employment of workers with a chronic disease
Ots, Patricia

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Chapter 8

General Discussion

The main aim of this thesis was to examine the role of individual and contextual factors in early exit from paid employment among workers with a chronic disease. The individual factors included multimorbidity and unhealthy behaviours and the contextual factors included the work and neighbourhood environment. The specific objectives were: (1) to examine the role of multimorbidity and unhealthy behaviour in early exit from paid employment; (2) to investigate the impact of the psychosocial working environment and neighbourhood health on early exit from paid employment and to assess the moderating role of individual health; and (3) to develop and evaluate a prediction model for early exit from paid employment into unemployment and work disability. This chapter summarizes and reflects on the main findings of this thesis and discusses methodological considerations. Furthermore, recommendations for further research and implications for policy and practice are provided.

Main findings

Multimorbidity and unhealthy behaviours

In chapters 2 and 3, the role of multimorbidity and unhealthy behaviours in early exit from paid employment was examined for workers with five common chronic diseases, including cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD), diabetes mellitus type 2 (T2DM), depression, and rheumatoid arthritis (RA). Results of chapter 2 showed that workers with multimorbidity had a higher risk of exiting paid employment compared to workers without a chronic disease or with only one chronic disease. Regarding the specific combinations of chronic diseases, the risk for exit from paid employment was increased among workers with COPD if they additionally had CVD, depression or RA. Likewise, the risk increased for workers with T2DM if they additionally had CVD or depression. Lastly, an increased risk was observed among workers with depression if they also had T2DM. Results of chapter 3 showed that smoking and low fruit and vegetable intake increased the risk to exit paid employment through unemployment. Furthermore, smoking, low fruit intake and obesity increased the risk of early exit from paid employment into work disability and high alcohol intake was associated with an increased 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 work disability. There was no consistent effect modification by gender nor educational level.

The contextual work and neighbourhood environment
In chapters 4, 5 and 6, the role of the psychosocial working environment and neighbourhood health in early exit from paid employment was examined. Chapter 4 focused on the moderating role of having one or multiple chronic diseases in the association between psychosocial working conditions and early exit from paid employment into unemployment, work disability and early retirement. While psychosocial working conditions were generally associated with unemployment and work disability, little evidence was found for a moderating effect of having a chronic disease. Independent of having a chronic disease, more social support decreased the risk of early exit from paid employment into unemployment, work disability and early retirement. In addition, more meaning of work decreased the risk of unemployment whereas more possibilities for development was associated with a lower risk of work disability. Having a chronic disease only moderated the associations between work pace and unemployment and possibilities for development and unemployment. A higher work pace seemed to increase the risk of unemployment for workers with multimorbidity but not for those without a chronic disease or with one chronic disease. Furthermore, more possibilities for development decreased the risk for unemployment only among those without a chronic disease.

Chapter 5 focused on the interplay between job demands and job resources, including influence at work and possibilities for development, and employment status for workers with and without depression. Employment status was divided into "being employed or not during follow-up" and "the months out of paid employment". Results of this chapter show that job demands had a differential impact for workers with and without depression. Workers with depression were less likely to be employed if they had high job demands during follow-up whereas workers without depression were more likely to be employed if they had high job demands. In addition, the interplay between job demands and job resources differed between workers with and without depression. Workers with depression had more months out of paid employment when reporting high job demands and high job resources compared to workers without depression.

Chapter 6 focused on the impact of neighbourhood health on employment status among the general working population. Neighbourhood health was classified as (1) the proportion of individuals in poor self-reported health and (2) the proportion with a chronic disease. Both indicators of poor neighbourhood health were associated with increased risks of being unemployed or

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work disabled at baseline and with increased risks of becoming unemployed or work disabled during up to 12 years of follow-up, independent of individual health status. Furthermore, for both neighbourhood health indicators, there were some indications of a moderating role of individual health status, but results were modest and inconclusive.

The development and evaluation of a prediction model for unemployment and work disability
Finally, in chapter 7, prediction models for unemployment and work disability were developed and evaluated. In addition, we evaluated whether or not predictors and the discriminative ability of these models differed between five chronic diseases. Generally, the discriminative ability of the models of the development and validation cohort were low for unemployment (c=0.62; c=0.60) and slightly better for work disability (c=0.68; c=0.75). After stratification to the specific chronic diseases, the discriminative ability of models predicting work disability improved for workers with CVD (c=0.81), COPD (c=0.74) and T2DM (c=0.74) in the development cohort. For RA and depression, the discriminative abilities of models were not better than for the general population. The positive predictive value was low while the negative predictive value was high for all models, indicating that the models were better able at predicting who remained employed rather than at predicting who would exit paid employment. The risk factors for early exit from paid employment differed slightly among the specific chronic diseases. For instance, smoking was a risk factor for work disability among workers with CVD but not among workers with other chronic diseases, whereas overweight and obesity were important risk factors for work disability for workers with RA but not for workers with other chronic diseases.

Reflection on main findings

Workers with chronic diseases are known to be at an increased risk of early exit from paid employment into unemployment and work disability. Results from this thesis add to the existing knowledge by showing that not only the disease itself, but also individual factors, such as multimorbidity and unhealthy behaviours, and the work and neighbourhood environment are important factors in early exit from paid employment among workers with chronic diseases. Moreover, differences in risk factors for early exit from paid employment across workers with specific chronic disease were found, and our results highlight that risk factors mainly increase the risk of more involuntary exit routes from paid employment; unemployment and work disability.

Results in chapter 2 and 3 have shown that having specific combinations of chronic diseases and unhealthy behaviours are associated with increased risks of early exit from paid employment among workers who already had a chronic disease. Altogether, this highlights the need to not only focus on the disease itself but also examine workers' health behaviour and the development of other chronic diseases over time, as these may affect daily functioning and subsequently employment outcomes of those living with a chronic disease. The finding that unhealthy behaviours are associated with higher risks of early exit from paid employment indicates that unhealthy behaviours not only affect the aetiology of common chronic diseases, but also impact the working lives of those with a chronic disease. For instance, smoking can for instance exacerbate CVD symptoms (1) and obesity has been shown to worsen RA symptoms (2), which may affect daily functioning. This may explain why increased risks of early exit from paid employment are found specifically for these chronic diseases. This notion is supported by findings from the Health and Retirement Study in the United States. In this study, it was shown that unhealthy behaviours, including physical inactivity, smoking and obesity, were associated with higher levels of physical functioning difficulties among both workers and retirees with chronic diseases (3). Furthermore, research in the Netherlands has shown that workers with a chronic disease who reported work limitations due to their chronic disease were at increased risk of early exit from paid employment (4). Therefore, limitations in daily functioning of workers with chronic diseases may partly explain the increased risk of early exit from paid employment.

Results of this thesis additionally contribute to the existing knowledge on differences between workers with and without chronic diseases with regard to the impact of the psychosocial working environment in early exit from paid employment. Results indicate that risk factors for early exit from paid employment within the psychosocial work environment are largely similar for workers with and without chronic diseases, which corresponds with results from earlier research (5, 6). However, results presented in the prediction model (chapter 7) showed that the impact of some risk factors differed between workers with specific chronic diseases. For instance, influence at work was especially important for workers with COPD and T2DM compared to workers with CVD, depression or RA. This could be due to the fact that especially for workers with T2DM, flexibility with regard to work schedules could be beneficial in managing the challenges associated with glycaemic fluctuations, an important predictor of disease complications (7). This idea is in line with recent findings on differences in work functioning among workers

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with chronic diseases, in which large differences between chronic diseases were observed. In that study, workers with depression had overall low scores on work functioning, whereas workers with RA especially perceived difficulties in meeting physical work demands (8). Furthermore, results presented in chapter 5 show that especially workers with depression may experience psychosocial working conditions in a different way compared to workers without depression. In contrast to workers without depression, workers with depression did not benefit from higher job resources if they experienced high job demands. These results highlight the need for tailored approaches in accommodating workers with chronic diseases at work, and especially those with depression.

The research presented in this thesis additionally contributes to the knowledge on risk factors within the neighbourhood for early exit from paid employment. Our results show that, in addition to the working environment, the neighbourhood environment is associated with early exit from paid employment. These results extend previous cross-sectional findings on the association between neighbourhood health and individual employment status (9). Individuals from neighbourhoods characterized by poor health and a higher prevalence of chronic diseases are not only more likely to be unemployed or work disabled (9), they are also more likely to prematurely exit paid employment into unemployment and work disability. In addition to research on work outcomes, living in a deprived neighbourhood has been associated with a range of negative health effects, including mortality, self-reported health status, and the risk of diseases such as asthma, CVD and cancer (10, 11). The novel findings presented in this thesis show that geographical disparities in health can also affect individual employment outcomes, independent of individual's' own health status. These results indicate that health promotion efforts at the neighbourhood level may not only contribute to individual's health but may also have a broader societal impact. This finding is in line with the concept of "health for all policies" (12), which supports the need to address neighbourhood health to realise effective social and labour market policies. In contrast to the "health *in* all policies" notion, the "health *for* all policies" concept proposes that strengthening health policies offers a win-win situation with mutual benefits for multiple policy areas (i.e. social affairs, internal affairs, foreign affairs, and economic affairs).

Altogether, results presented in this thesis provide insight into the individual and contextual risk factors for early exit from paid employment among

workers with chronic diseases. Our results indicate that these risk factors can be identified at the population level, but prediction models for more involuntary exit routes from paid employment were not to able accurately predict individual risks. This corresponds with findings on prediction models for sick leave (13). Results further show that there are differences between the examined exit routes from paid employment. Risk factors, such as unhealthy behaviour, poor psychosocial working conditions and poor neighbourhood health, were associated with the more involuntary exit routes from paid employment, unemployment and work disability, and to a lesser extent with more voluntary exit routes from paid employment, early retirement and economic inactivity. These findings are in line with earlier research, which also show that poor health is mainly predictive of work disability and unemployment (14-16). Given that health problems are a requirement for disability pension, these findings indicate that the prevention of health deteriorations among workers with chronic diseases may contribute to sustained employment.

Methodological considerations

Several methodological considerations have to be taken into account when interpreting the results of the studies presented in this thesis. Strengths and limitations with regard to the study sample, measures, and analytical procedure are discussed and a reflection on the extent to which our studies support inferences on causality is provided.

Study samples
In this thesis, cohort data from the Lifelines Cohort Study and the Study on Transitions, Employment, Ability and Motivation (STREAM) were used. Lifelines is broadly representative for the population in the north of the Netherlands in terms of socioeconomic characteristics, lifestyle factors, and the prevalence of chronic diseases (17), limiting the risk of selection bias. The large number of adult participants included in Lifelines (N=152,728) enabled subgroup analyses, for instance into groups of workers with a specific chronic disease, which is often not possible in other cohorts due to lower sample sizes. In addition, the STREAM cohort data has been shown to have a low risk of selection bias (18).

Lifelines baseline measures were conducted between 2006 and 2013 and in chapter 4, 5 and 6, data from the second follow-up measurement on the psychosocial working environment were used. These data were collected

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between 2012 and 2016. The difference in timing of the measurements can be considered a limitation, as the length of the follow-up between baseline and the registry data from Statistics Netherlands differed between participants. Therefore, some of the psychosocial work characteristics may have changed over time, both in a positive and negative direction, potentially resulting in either under- or overestimation on some of the presented results. However, altogether, our results on the impact of the psychosocial working environment are in line with results from studies that have examined chronic diseases and psychosocial working conditions at the same time, e.g. for social support (19, 20). In addition, results from the studies using data from Lifelines largely correspond with results from the STREAM cohort, in which there was no time gap between the measurements. Therefore, we assume that the difference in timing of the measurements did not affect our results to a great extent.

All studies in this thesis mainly focused on workers with a chronic disease. Given that not all individuals with a chronic disease are able to work, our sample likely includes the healthier individuals. This selection bias is also referred to as the healthy-worker effect (21). Furthermore, we have focused on five common chronic diseases that were to some extent lifestyle-related (22). However, our results are not generalizable to all workers with chronic diseases, such as workers with cancer and low back pain, which are also common in the Dutch workforce (23). Furthermore, we did not include individuals who were temporarily unemployed, as we examined work status in the months of enrolment in both Lifelines and STREAM.

Measures
In this thesis, a combination of objective and subjective measures was used. For data on paid employment, objective registry data from Statistics Netherlands was utilized. The advantage of using register data for employment status is that there are no missing values due to individuals being lost-to-follow-up. For the classification of chronic diseases, a combination of clinical measures (e.g., electrocardiography for the classification of CVD), medication use administered by trained research nurses, and self-report was used. Altogether, this comprehensive approach limits the risk of information bias and is considered to be more accurate than self-reports only, as it is known from previous research that self-reported information on chronic diseases is not always accurate (24). The measurements of health behaviours and working conditions were based on information from validated questionnaires such as the SQUASH-questionnaire for physical activity and the COPSOQ-II

questionnaire for the working conditions (25, 26). An advantage of using validated questionnaires is that it facilitates the comparability with previous studies. However, there is some risk of information bias as people tend to, for example, overestimate physical activity (27) and uderestimate alcohol consumption (28).

Data on neighbourhood health was available from StatLine and was matched with individual-level Lifelines data and register data from Statistics Netherlands. Data on neighbourhood health was based on Small Area Estimations (29). The SMAP-model (SMall Area estimates for Policymakers) is used by policy makers due to a need for health information at smaller geographical areas as a result of decentralisation in the social domain. Health data at the neighbourhood level was calculated based on extrapolated questionnaire data using specific characteristics of the neighbourhood itself, including age, gender, ethnicity, household composition, marital status, income, housing type, and spatial location using the machine learning technique eXtreme Gradient Boosting (XGBoost). A recent comparison of the XGBoost technique with the earlier "structured additive regression method" showed benefits of the XGBoost approach in terms of accuracy for the calculation of health data at the neighbourhood level in The Netherlands (30). However, as health data on the neighbourhood level are calculated rather than observed, there is some uncertainty around these estimates.

Analytical approach

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In the current thesis, the association with a range of risk factors and early exit from paid employment was examined using competing risk analyses (chapter 3, 4, 6, 7). The advantage of competing risk analyses, compared to examining one exit route at the time, is that they take into account that exit routes may work as communicating vessels, and one exit route may withhold people from exiting through another route (31). For instance, when work disability was the event of interest, unemployment, early retirement and becoming economically inactive were the competing events. Throughout the different chapters, both Fine & Gray analyses and cause-specific Cox regression analyses were used. Since we focused on the first event over time and did not include individuals who returned after a spell of e.g., unemployment, these analyses provide similar estimates.

In chapter 4, employment during two years of follow-up was examined using a zero-inflated Poisson regression model. This model takes into account that most workers remain employed, which is reflected in the excess

amount of zero's, hereby correcting for overdispersion (32). It has been suggested that the zeros in this model (in this case being employed or not) are theoretically different from the count values (in this case the months out of paid employment). This indicates that determinants predicting not being employed may not be the same as determinants associated with the duration of the non-employment episode. Results in chapter 4 do indeed indicate that there is a difference between determinants of "being out of paid employment" and "months out of paid employment". However, more research on employment outcomes using ZIP-regression models is needed to understand these differences.

Inferences on causality

All chapters within this thesis use longitudinal data on employment, our dependent variable, offering an opportunity to make causal inferences. Yet, we have not explicitly tested (reverse) causality in any of the studies. According to the Bradford-Hill criteria, there are nine important criteria when making causal inference claims (33). These include strength, consistency, specificity, temporality, biological gradient, plausibility, coherence, experiment, and analogy. Given that our results have considerable effect sizes, are in line with results from other studies and settings, are to an extent specific, have a temporal pattern (i.e., the independent variable was measured at an earlier point in time than our dependent variable), show a biological gradient (i.e., multiple chronic diseases or unhealthy behaviours have a larger impact on employment), are plausible, and are coherent, our results support causality to some extent.

Implications

Implications for future research

Results of this thesis have contributed to existing knowledge on risk factors for early exit from paid employment, specifically among workers with a chronic disease. This section provides recommendations for future research.

Throughout this thesis, chronic diseases, health behaviours, working conditions and neighbourhood health indicators were measured at baseline, but changes over time were not taken into account. Recent evidence suggests that the onset of a chronic disease is associated with early exit from paid employment (34). In addition, the age at diagnosis and illness duration have been associated with the chances to participate in the labour market (35). Furthermore, previous research suggests that changes in working conditions

such as physical workload or social support can influence early exit from paid employment (36) and that improvements and deteriorations in health behaviour and working conditions can affect health and work ability (37). Future research could examine risk factors for early exit from paid employment by applying life-course epidemiological methods, in which the timing, duration and frequency of exposures to risk factors and the development of chronic diseases are taken into account (38). For instance, de Groot et al. showed that the duration of mental health problems in childhood and adolescence is strongly related with having paid work in young adulthood, highlighting the potential of applying a life-course perspective in research on work and health (39). Doing so, a shift from more static to more dynamic models can be made, that better reflects real-life working life trajectories (40). The cohort and register data used in the studies within this thesis enable such analyses.

As results of this thesis have shown that there are differences in risk factors for early exit from paid employment across workers with specific chronic disease, future research could further elaborate on these disease-specific differences and their underlying mechanisms. For instance, our results indicate that smoking was mainly associated with work disability among workers with CVD whereas obesity was mainly associated with work disability among workers with RA. We hypothesized that this could be due limitations in daily functioning associated with the type and origin of the disease, as is it known that smoking can for instance exacerbate CVD symptoms (1) and obesity can worsen RA symptoms (2). In addition, our results indicate that influence at work was especially important for workers with COPD and T2DM compared to workers with other chronic diseases. We theorized that this can be due to the fact that especially for workers with T2DM, flexibility in work schedules could be beneficial in managing the challenges associated with glycaemic fluctuations. The underlying mechanisms for both the role of unhealthy behaviour and the role of poor psychosocial working conditions and the mediating role of daily functioning in these relationships with early exit from paid employment were not elaborated on in the current thesis due to too low sample sizes. For the examination of these disease-specific differences in the impact of risk factors and their underlying mechanisms, large sample sizes are required. Sufficient sample sizes could be obtained through data harmonization. Although there are challenges associated with data harmonization, such as technical difficulties and high costs, data harmonization also offers many advantages, including enhanced comparability, minimization of bias, and increased robustness of findings (41). An

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example of a recent project is the EU EPHOR project, in which currently 29 cohorts with up to 20 million participants are involved to study the link between occupational exposures and health outcomes (42). Project such as the EU EPHOR project can contribute to knowledge on the relationship between individual and contextual risk factors and employment outcomes, also specifically for vulnerable groups of workers.

Implications for policy and practice

Results of this thesis confirm that for workers with chronic diseases a combination of individual and contextual risk factors may affect early exit from paid employment. To date, most workplace health promotion programs are not effective, especially for those with a lower level of education (43, 44), as these programs mainly focus on the individual worker without taking the work- and living environment into account. Health promotion interventions that also stimulate employers and municipalities to create a healthy environment may be more effective. Such an environment can include for instance, a healthy food culture and opportunities to be physically active (45-47). These are examples of system-level interventions, in which the interplay between the personal system, the health care system, the workplace system and the legislative and insurance system is considered (48, 49). A recent review regarding the impact of system-level interventions for the prevention of work disability indicates that system-level interventions have the potential to be effective in work disability prevention programs (49). To be able to implement system-level interventions within the work context, health promotion programs should be more intertwined with workplace safety programs (50-52). Furthermore, collaboration between key stakeholders that encompasses active involvement and co-production can ensure a more effective implementation of workplace health promotion programs (53). These key stakeholders include the employers, occupational health professionals, and workers themselves. Furthermore, occupational health professionals can aim to collaborate with clinical health professionals. Improved collaboration between occupational and clinical health professionals may contribute to workers' insight into their chronic disease and its consequences with regard to their work ability (54). By increasing collaboration at all levels within the system, the efficiency of current prevention strategies for work disability can be improved.

Furthermore, results of this thesis highlight the need for more tailored approaches in accommodating workers with chronic diseases at work. Our results showed that workers with multimorbidity may benefit from a lower

work pace, workers with COPD and T2DM may benefit from more influence at work, and workers with depression may need other job resources than influence at work and possibilities for development when having high work demands. To be able to make appropriate adjustments in the working environment of workers with chronic diseases, disclosure of the disease towards employers is important (55). Disclosure may bring workers understanding and support and can help the employer in offering adequate work accommodations. Open communication between the employer and employee can further ensure that workers' needs are met (55). Workplace programs that are aimed at facilitating work accommodations and the provision of supervisor support can contribute to the prevention of early exit from paid employment among workers with chronic diseases (56).

Conclusion

The results in this thesis highlight the importance of individual and work and neighbourhood environmental factors in the context of retaining workers with a chronic disease in the workforce. Since predicting individual risks of early exit from paid employment is often inaccurate, risk factors are better examined at the population level rather than the individual level. The findings in this thesis further highlight that risk factors were mainly associated with the more involuntary exit routes from paid employment, i.e., unemployment and work disability. Prevention of early exit from paid employment through action on individual and contextual factors may therefore not only positively impact workers, it may also contribute to the sustainability of the social welfare system.

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