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ORIGINAL ARTICLE

The joint contribution of diabetes and work disability to premature death during working age: a population-based study in Sweden

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Abstract

Aims: We aimed to examine how newly diagnosed diabetes and work disability jointly predict death during working age. **Methods:** We used prospective population-based register data of 25–59-year-old adults who had lived in Sweden since 2002. All those with onset of diabetes recorded in 2006 were included ($n=14266$). A 2% random sample ($n=78598$) was drawn from the general population, comprising people with no indication of diabetes during 2003–2010. Net days of sickness absence and disability pension in 2005–2006 were examined; the follow-up time for mortality was 2007–2010. Cox regression models were fitted (hazard ratios, HR, 95% confidence interval, CI) adjusting for sociodemographics and time-dependent health conditions. **Results:** Individuals with diabetes and work disability for over 6 months were at a higher risk of premature death (HR=14.2, 95% CI 12.0–16.8) than their counterparts without diabetes and work disability. A high risk was also observed among people without diabetes but equally prolonged work disability (HR=6.4, 95% CI 5.4–7.6). Diabetes was associated with premature death even without work disability (HR=3.5, 95% CI 2.8–4.4). The associations were particularly attenuated after adjustment for health conditions assessed over the follow-up. **Conclusions:** Diabetes and work disability jointly increase the risk of death during working age. Diabetes with long-term work disability is associated with the highest risk of premature death, which highlights the importance of their prevention and early detection.

Key Words: Diabetes, mortality, sick-leave, disability pension, population-based, register data, chronic conditions, time-dependent, socioeconomic, insurance medicine

Introduction

Type 2 diabetes is a growing, notable health and economic challenge [1], and there is strong evidence that it increases the risk of premature death [2–4]. Recent evidence further shows that years lived with disability and disability-adjusted life years because of diabetes are increasing [5]. Moreover, while there is a positive trend towards longer life expectancy globally, diabetes as a cause of death is increasing [6]. These issues highlight the need for timely prevention and the identification of key risk groups.

Work disability (sickness absence and disability pension) has also been shown to predict mortality [7,8]. The risk is increased even after relatively short sickness absence spells (1–30 days) [7]. Moreover, although diagnoses resulting in receipt of a disability pension differ from the most common causes of death, all causes of disability pension have been associated with a higher risk of premature death [8].

Diabetes has a consistent impact on outcomes related to poorer working capacity [9]. Recent studies

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have shown that work disability among people with newly diagnosed diabetes is remarkably higher than that among people without diabetes, even before the onset of the disease [10]. This higher risk of work disability among people with diabetes can be attributed to both mental and somatic comorbid conditions [11]. Despite the strong evidence linking diabetes and work disability to mortality, the joint association between diabetes, work disability and risk of death has not been examined. Given that onset of diabetes has been linked with work disability, we need to examine whether people of working age with newly diagnosed diabetes are also at a higher risk of premature death during the years immediately following the diagnosis, and whether the risk is shaped by the length of work disability. Death during working age is a major health and societal issue [12], but studies linking diabetes with mortality have not specifically considered the risk of premature death during working age.

Our aim was to examine whether work disability more strongly predicts death among working-age people with newly diagnosed diabetes than among people without diabetes using nationwide population-based registers.

Methods

We conducted a prospective population-based cohort study, based on data from the nationwide Insurance Medicine All-Sweden (IMAS) research database [10,13]. The study population was based on all working-age individuals aged 25–59 on 31 December 2005, who had been living in Sweden since 31 December 2002 ($n=4,123,104$). We included all individuals with diabetes diagnosed in 2006, based on IMAS data sources ($n=14,266$, mean age 48.5 years). A 2% random sample was also drawn from the general population in 2006, including people without diabetes ($n=78,598$, mean age 42.1 years).

We used register data obtained from three authorities, as follows: Statistics Sweden, Longitudinal Integration Database for Health Insurance and Labour Market Studies (sociodemographic factors); the National Board of Health and Welfare (International Classification of Diseases (ICD-10) based [14] diagnosis-specific data on hospitalizations or specialized outpatient care from the beginning of 2003 to 2010), the Swedish Prescribed Drug Register (medication purchases from 1 July 2005 to 2010), the Cause of Death register (dates of death); and the National Social Insurance Agency (annual net number of sickness absence and disability pension days with benefits paid by the Social Insurance Agency from the beginning of 2005 to 2006). The follow-up

began on 1 January 2007 and ended at death, emigration or on 31 December 2010, whichever occurred first.

Measures

Newly diagnosed diabetes was based on inpatient or outpatient specialized care in 2006 (ICD-10 codes E10–E14), or prescribed insulin or any other diabetes medication (Anatomical Therapeutic Chemical (ATC)-code A10) [15] purchases during 2006, excluding people with any such specialized care in 2003–2005, or prior medication (medication data are available from 1 July 2005) [10, 11]. The reference population comprised people with no indication of diabetes in any of the included registers during 1 January 2003 to 31 December 2010.

Net days of sickness absence or disability pension in 2005–2006 were divided into four separate groups among both people with and without diabetes: no work disability, less than a month, one to 6 months and over 6 months. The outcome was all-cause mortality over the follow-up of 4 years.

Sociodemographic variables comprised gender, age, educational level, family situation, country of birth and type of living area. Time-dependent chronic health conditions comprised depressive disorders (ATC-code N06 or ICD-10 codes F32–F34), other psychiatric disorders (ATC-code N05 or ICD-10 codes F00–F31 or F35–F99), cardiovascular diseases (ATC-code C01 or ICD-10 codes I20–I25, I46–I49, I60–I69), hypertension (ATC-code C02 or ICD-10 codes I10–I15) and musculoskeletal disorders (ICD-10 codes M00–M99). The timing of these conditions was calculated as either being present already at the beginning of the follow-up in 2007, or incidence in 2008, 2009, or 2010.

Ethics approval

IMAS was approved by the Regional Ethics Review Board, Stockholm, Sweden.

Statistical analyses

We fitted Cox proportional hazard models (hazard ratios, HR, and their 95% confidence intervals, CI). The proportionality of the risk over time is displayed in the survival curve (Figure 1). Model 0 was the unadjusted model. In Model 1, we adjusted for sex and age. Model 2 was adjusted for sex, age, education, family situation, living area and place of birth; and Model 3 was the full model, also including time-dependent health conditions. In addition, we estimated the contribution of covariates to the model

estimates (% reduction in the effect sizes) using the formula $100 \times (\text{Beta}_{\text{Model 0}} - \text{Beta}_{\text{Model 1}}) / (\text{Beta}_{\text{Model 0}})$. Finally, we computed synergy indices to examine whether the joint effects of diabetes and work disability on death were additive or synergistic [16,17]. All analyses were conducted using SAS, version 9.4.

Results

Among people with diabetes, 54% had at least one compensated work disability episode in 2005–2006; among their counterparts without diabetes, the corresponding figure was 27% (Table I). Altogether 1.2% ($n=1112$) of the participants died during the follow-up. Mortality during the follow-up was four-fold among people with diabetes, compared with

Figure 1. Survival by duration of work disability (WD) in 2005–2006 among people with diabetes onset in 2006 ($n=14\,266$) and those without diabetes 2003–2010 ($n=78\,598$, a random 2% population sample), follow-up 2007–2010 of people living in Sweden and aged 25–59 years at baseline (year 0=2007).

people without diabetes. In both groups, mortality increased with increasing work disability, and was at its highest among people with diabetes and work disability lasting over 6 months (6.3%).

Those with diabetes were more likely to be men, older, living with a partner without children, or immigrants, and to have a lower level of education or poorer health than those without diabetes (Table II, all p -values <0.001).

Among people without diabetes, the survival curves for those without work disability and with work disability lasting a month or less were similar, and indicated a low death rate (Figure 1). In addition, most of the individuals without diabetes and with work disability lasting up to 6 months survived over the follow-up, whereas people with diabetes and long-term work disability were at the highest risk of premature death.

Cox regression analyses confirmed that individuals who had diabetes but no indication of work disability were at a higher risk of premature death (crude HR=3.53, 95% CI 2.82–4.42) than their counterparts without diabetes or indication of work disability (Table III). The association notably attenuated (38%) after adjusting for sex and age, whereas additional adjustments for all sociodemographic factors made a negligible contribution (2%) to the association. The association further attenuated (30% compared with the prior model, and 57% compared with the crude model) after full adjustment, including all the covariates and time-dependent health conditions. The risk of death among people with diabetes increased with increasing work disability length. The crude hazard ratio for the risk of death was 4.64 (95% CI 3.20–6.73) for people with work disability lasting less than

Table I. Diabetes, work disability, and number of deaths among adults in Sweden with and without diabetes in 2006. Distribution and prevalence of events over follow-up in 2007–2010 ($n=92,864$).

Work disability in 2005–2006 ^a	Working-age population	
	Distribution (%)	Number of deaths (%)
No diabetes ($n=78,598$)		
No work disability	73.0	263 (0.5%)
Less than a month of work disability	8.1	36 (0.6%)
Work disability 1–6 months	6.4	45 (0.9%)
Work disability 6–24 months	12.5	286 (2.9%)
		630 (0.8%)
Diabetes ($n=14,266$)		
No work disability	46.4	107 (1.6%)
Less than a month of work disability	10.3	31 (2.1%)
Work disability 1–6 months	11.5	57 (3.5%)
Work disability 6–24 months	31.9	287 (6.3%)
		482 (3.4%)
<i>p</i> -value		<0.0001
Total (%)		1112 (1.2%)

^aNet sickness absence and disability pension days.

Table II. Distribution of covariates by diabetes status.

	Diabetes in 2006		No diabetes in 2005–2010	
	Frequency	%	Frequency	%
Sex				
Men	8 295	58.2	39,688	50.5
Women	5971	41.9	38,910	49.5
Age				
25–34 years	1375	9.6	21,638	27.5
35–44 years	2786	19.5	23,931	30.5
45–54 years	5454	38.2	21,831	27.8
55–60 years	4651	32.6	11,198	14.3
Education				
Compulsory school	3888	27.3	11,933	15.2
High school	7200	50.5	38,173	48.6
University	3178	22.3	28,492	36.3
Family situation				
Living with a partner without children	2918	20.5	9813	12.5
Living with a partner with children	4942	34.6	34,993	44.5
Single without children	5231	36.7	27,397	34.9
Single with children	1175	8.2	6395	8.1
Type of living area				
Large city	5188	36.4	29,692	37.8
Medium-sized municipality	4882	34.2	27,559	35.1
Small municipality	4196	29.4	21,347	27.2
Country of birth				
Sweden	10,586	74.2	67,395	85.8
Outside Sweden	3680	25.8	11,203	14.3
Health conditions over follow-up^a				
Depression				
No	10,560	74.0	66,678	84.8
Yes	3706	26.0	11,920	15.2
Other psychiatric disorders				
No	9354	65.6	62,657	79.7
Yes	4912	34.4	15,941	20.3
Cardiovascular diseases				
No	10,221	71.7	67,753	86.2
Yes	4045	28.4	10,845	13.8
Hypertension				
No	10,975	76.9	75,956	96.6
Yes	3291	23.1	2642	3.4
Musculoskeletal disorders				
No	10,918	76.5	66,528	84.6
Yes	3348	23.5	12,070	15.4

^aIndicated on basis of medication purchase or in- or outpatient specialized care.

All $p < 0.0001$ (cross tabulation of covariates by diabetes status).

a month, 7.70 (95% CI 5.79–10.26) for people with work disability lasting from 1 to 6 months, and 14.22 (95% CI 12.03–16.81) for people with work disability lasting more than 6 months. The gradient in the associations persisted throughout the modelling, although

their magnitude strongly attenuated, particularly after full adjustment (49%, 50%, 55%, compared with the crude model).

Among people without diabetes, the risk of death similarly increased with increasing work disability; among people with work disability from 1 to 6 months, the association (crude HR=1.94, 95% CI 1.42–2.67) was particularly attenuated after full adjustment for all sociodemographic factors and health conditions (47%). Among people with work disability of 6 months or more, the risk was substantially higher (crude HR=6.39, 95% CI 5.41–7.56). This association also attenuated most after the full adjustment (53%).

Finally, the synergistic effect (S) of diabetes and work disability on the risk of premature death was found in the crude model (S=1.87, 95% CI 1.55–2.25). The effect remained after adjusting for gender and age (S=1.61, 95% CI 1.32–1.96), and sociodemographic factors (S=1.58, 95% CI 1.28–1.94), but after full adjustment, the effect diluted (S=1.22, 95% CI 0.91–1.65).

Discussion

Main findings

We sought to examine whether newly diagnosed diabetes and work disability jointly contribute to the risk of premature death during working age among a large population-based cohort from Sweden. The main finding was that diabetes strongly predicts premature death, and that the risk is pronounced among people with long-term work disability. The associations remained strong even after considering sociodemographic factors and time-dependent health conditions, although synergistic interaction effects attenuated.

Previous studies

This is the first study to examine the joint associations between diabetes and work disability, and the risk of death during working age. The results showed that the higher risk of death shown among people with diabetes [2, 3] also applies to premature mortality during working age, and that the risk is higher already during the first years after diabetes diagnosis, even among those without work disability.

A recent study reported that the risk of premature death increases among people with over 30 sick-leave days, but attenuates over time, and disappears after a follow-up of 6 years [18]. In our study, the association similarly followed a gradient, but the risks persisted over the entire follow-up of 4 years.

We focused on all-cause disability and all-cause mortality, and one might assume that the risk is

Table III. Joint association of diabetes and work disability in 2005–2006 with subsequent premature death in 2007–2010 among 92,864 adults in Sweden: hazard ratios (HR) and their 95% confidence intervals (CI).

Work disability in 2005–2006	Model 0		Model 1		Model 2		Model 3	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
No diabetes								
No work disability (reference)	1.00		1.00		1.00		1.00	
Less than a month of work disability	1.24	(0.87–1.75)	1.32	(0.93–1.87)	1.29	(0.91–1.83)	1.07	(0.75–1.51)
Work disability 1–6 months	1.94	(1.42–2.67)	2.00	(1.45–2.74)	1.96	(1.42–2.68)	1.42	(1.03–1.95)
Work disability 6–24 months	6.39	(5.41–7.56)	5.10	(4.30–6.06)	4.46	(3.74–5.32)	2.41	(1.99–2.90)
Diabetes								
No work disability	3.53	(2.82–4.42)	2.19	(1.75–2.75)	2.16	(1.72–2.72)	1.71	(1.36–2.16)
Less than a month of work disability	4.64	(3.20–6.73)	3.28	(2.26–4.77)	3.15	(2.17–4.58)	2.18	(1.49–3.18)
Work disability 1–6 months	7.70	(5.79–10.26)	5.08	(3.81–6.78)	4.78	(3.58–6.39)	2.78	(2.06–3.74)
Work disability 6–24 months	14.22	(12.03–16.81)	8.53	(7.17–10.15)	7.68	(6.41–9.20)	3.33	(2.73–4.06)

Model 0, crude model; Model 1, adjusted for sex and age; Model 2, adjusted for sex, age, education, family situation, type of living area and country of birth; Model 3, adjusted for Model 2 variables and time-dependent health conditions 2007–2010 (depression, other psychiatric disorders, hypertension, cardiovascular diseases, musculoskeletal disorders).

shaped by the causes of work disability and death. Given that diabetes and work disability appear to increase the risk of death due to various causes [2,3,7,8], and that the risk of death is low overall during working age, we focused on all-cause mortality, emphasizing the importance of the length of work disability and diabetes in the risk of premature death in midlife and working age. Although the associations were consistent and strong, and the gradient was shown throughout the modelling, the risks could still be higher for specific causes, and then non-existent in the case of, for example, some rarer causes. Our recent studies have reported that diabetes is linked to both mental and somatic causes of work disability [10,11], which supports the decision to focus on all-cause work disability.

As comorbid conditions make a strong contribution to the risk of work disability, particularly in the case of diabetes [10], and are also likely to affect the risk of death, key health conditions were considered as time-dependent variables in this study. As expected, they attenuated the associations among people both with and without diabetes, but even after considering all key sociodemographic and health-related factors, the associations were relatively strong. Synergy index calculations further suggest that diabetes and work disability jointly contribute to the risk of premature death during working age, and that the risk is highest among those with both diabetes and work disability. Health conditions, however, largely account for the synergistic effects. Nonetheless, we also found that people with newly diagnosed diabetes were at a higher mortality risk even without any work disability episodes in the diagnosis year and the year before, when time-dependent health conditions during follow-up had been considered. The reasons for this finding are unknown, but it suggests that people who have diabetes but no work disability might need more adequate care and health monitoring.

Given that about a fifth of all deaths occur during working age in EU countries, our findings highlight not only public health but also the societal relevance of preventive measures, as costs related to each death during working age are substantial [12]. If the risk of developing diabetes could be prevented, this could help reduce the risk of subsequent work disability, comorbidities, and premature death. In countries with a high prevalence of obesity, the group of people with pre-diabetes may also be high [1], highlighting a need for timely prevention and enhanced means to address the challenge, and detect diabetes already at pre-stage. At the same time, novel means to help tackle the risk of work disability and premature death among individuals with and without diabetes diagnosed during working age are warranted. Those with diabetes inevitably more frequently use healthcare services than their counterparts without chronic conditions. We could assume that this would improve opportunities to detect comorbid conditions earlier and to identify risks of work disability, thereby, reducing the risk of premature death during working age.

Methodological considerations

Limitations. First, we only had data on sickness absence days that involved benefits paid by the Social Insurance Agency (sick-leave periods exceeding 14 days in most cases). People with diabetes might have had more short-term sick-leave periods than those without diabetes; if so, the results regarding differences between the groups would be underestimated. Second, although there was no indication of diabetes in the registers before the study began, the diabetes may have been treated with lifestyle intervention only, or may have remained untreated. It is thus possible that some people in the reference population had undiagnosed or untreated diabetes. Since it is possible

to purchase medication for only three months at a time, it is likely that we captured most of those with newly diagnosed diabetes in 2006, and were able to exclude people with prior indication of diabetes. Individuals with only lifestyle-related treatment are likely to be less severe cases who are at a lower risk of work disability and mortality. Data were unavailable from primary health care, which is where most individuals with diabetes are treated. However, our key method to identify diabetes was using prescribed medication purchases. Thus, most of the people treated in primary care are likely to also have been treated with diabetes medication, and were, therefore, included as having diabetes onset in 2006. Moreover, use of oral diabetes medication had strongly increased during a decade prior to 2006 [19]. Specialized health care data were further used to complete the medication data, using additional indications of diabetes. Third, these data do not allow us to distinguish between individuals with type 1 or type 2 diabetes. This is unlikely to bias the examined associations, as there is no particular reason to assume that the joint association between diabetes, work disability and death differed according to diabetes type. In other words, although the prevalence or absolute death rates may vary between the types, if diabetes and work disability are jointly associated with premature death, it is likely that the association is similar for both types. In addition, the majority of newly diagnosed diabetes cases in midlife is likely to be type 2 diabetes, although the age of onset has somewhat decreased [20]. In our cohort of working-aged adults aged 25–59 years at inclusion, we assumed the majority of diabetes incidence to be type 2. Fourth, although register-based data help avoid reporting bias related to survey data, these data only comprise a limited set of covariates. Thus, residual confounding is a potential problem, and we cannot rule out the possibility that we missed some relevant background information. For example, we were unable to control for health behaviours (e.g., smoking, alcohol use, obesity) and poor sleep, which are associated with diabetes, work disability, and mortality [21–25]. Behavioural risk factors, particularly obesity, also increasingly contribute to the global burden of morbidity and mortality, and altogether over 50% of deaths are attributable to such risk factors [26]. Register-data nonetheless comprise key sociodemographic variables such as education, which could partly act as a proxy for smoking and other health behaviours as well as body weight [27–29]. Similarly, we had data on marital status and family situation, living area, and immigration, which alongside education explain health behaviours and obesity. In addition, we were able to cover both somatic and mental disorders. These could be seen as potential consequences of adverse health behaviours, while being

linked to diabetes, work disability, and a higher risk of death. Although we were unable to account for the contribution of working conditions to diabetes, work disability and death, in our sensitivity analyses occupational class was considered a proxy for physical and psychosocial work (data not shown). The associations were similar to those reported, but since education was a clearer, more stable indicator of socioeconomic position in these data, and largely acquired before the inclusion, we retained education in the analyses.

Strengths. Our major strength was the use of nationwide population-based data which have been found to be suitable for large-scale studies [30]. In- and outpatient registers have been shown to have good validity, and their coverage was very high in the years of this study [30]. The registers are complete, with no attrition or bias due to non-response or self-reports. All working-aged individuals living in Sweden could be included and followed until emigration, death or end of follow-up. Another strength was the opportunity to consider health conditions as time-dependent covariates, something that is seldom done in prospective studies. The inclusion of health conditions enabled us to show more robust associations concerning the joint effects between diabetes and work disability on the risk of premature death. We were further able to cover net days of both medically certified sickness absence and disability pension.

Conclusion

Diabetes and work disability jointly associate with subsequent premature death, but diabetes increases the risk of premature death during working age even without work disability. Furthermore, long-term work disability is associated with premature death without diabetes. Diabetes, in combination with long-term work disability, stands out as an indicator of a substantially high risk of premature death, although the causes of death need further examination. Since diabetes and work disability constitute a growing major societal, public health, and individual burden, successful prevention remains a crucial, yet complex challenge, warranting more in-depth scientific knowledge.

Conflict of interest

None declared.

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References

- [1] Dall TM, Zhang Y, Chen YJ, et al. The economic burden of diabetes. *Health Aff* 2010;29:297–303.
- [2] Campbell PT, Newton CC, Patel AV, et al. Diabetes and cause-specific mortality in a prospective cohort of one million U.S. adults. *Diabetes Care* 2012;35:1835–44.
- [3] Emerging Risk Factors Collaboration, Seshasai SRK, Kaptoge S, Thompson A, et al. Diabetes mellitus, fasting glucose, and risk of cause-specific death. *N Engl J Med* 2011;364:829–41.
- [4] Tancredi M, Rosengren A, Svensson AM, et al. Excess mortality among persons with type 2 diabetes. *N Engl J Med* 2015;373:1720–32.
- [5] GBD 2013 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990–2013: quantifying the epidemiological transition. *Lancet* 2015;386:2145–91.
- [6] GBD 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2015;385:117–71.
- [7] Björkenstam E, Weitoft GR, Lindholm C, et al. Associations between number of sick-leave days and future all-cause and cause-specific mortality: A population-based cohort study. *BMC Public Health* 2014;14:733.
- [8] Björkenstam C, Alexanderson K, Björkenstam E, et al. Diagnosis-specific disability pension and risk of all-cause and cause-specific mortality—a cohort study of 4.9 million inhabitants in Sweden. *BMC Public Health* 2014;14:1247.
- [9] Breton MC, Guenette L, Amiche MA, et al. Burden of diabetes on the ability to work: a systematic review. *Diabetes Care* 2013;36:740–9.
- [10] Ervasti J, Virtanen M, Pentti J, et al. Work disability before and after diabetes diagnosis: a nationwide population-based register study in Sweden. *Am J Public Health* 2015;105:e22–9.
- [11] Virtanen M, Ervasti J, Mittendorfer-Rutz E, et al. Trends of diagnosis-specific work disability after newly diagnosed diabetes: A four-year nationwide prospective cohort study. *Diabetes Care* 2015;38:1883–90.
- [12] Oortwijn W, Nelissen E, Adamini S, van den Heuvel S, Geuskens G and Burdof L. Social determinants state of the art reviews – Health of people of working age – Full Report. (2011) Luxembourg: European Commission Directorate General for Health and Consumers. 2011.
- [13] Mittendorfer-Rutz E, Kjeldgård L, Runeson B, et al. Sickness absence due to specific mental diagnoses and all-cause and cause-specific mortality: A cohort study of 4.9 million inhabitants of Sweden. *PLoS One* 2012;7:e45788.
- [14] World Health Organization. *International Statistical Classification of Diseases and Health Related Problems, ICD-10, Volume 1. Second Edition*. 10th ed. Geneva: World Health Organization, 2004.
- [15] WHO Collaborating Centre for Drug Statistics Methodology. *Guidelines for ATC Classification and DDD Assignment, 2013*. Oslo: WHO Collaborating Centre for Drug Statistics Methodology, 2012.
- [16] Andersson T, Alfredsson L, Kallberg H, et al. Calculating measures of biological interaction. *Eur J Epidemiol* 2005;20:575–9.
- [17] Lallukka T, Overland S, Haaramo P, et al. The joint contribution of pain and insomnia to sickness absence and disability retirement: A register-linkage study among Norwegian and Finnish employees. *Eur J Pain* 2014;18:883–92.
- [18] Olsson D, Alexanderson K and Bottai M. Sickness absence and the time-varying excess risk of premature death: a Swedish population-based prospective cohort study. *J Epidemiol Community Health* 2015; 69: 1052–1057.
- [19] Bergmark E and Ericsson Ö. Utvecklingen inom valda områden – Diabetesvård. In: *Hälsö-och sjukvårdsrapport 2009 [Health Care Report 2009]*. Västerås, Sweden: Socialstyrelsen, 2009, pp. 366–73.
- [20] Koopman RJ, Mainous AG, 3rd, Diaz VA, et al. Changes in age at diagnosis of type 2 diabetes mellitus in the United States, 1988 to 2000. *Ann Fam Med* 2005;3:60–3.
- [21] Samitz G, Egger M and Zwahlen M. Domains of physical activity and all-cause mortality: systematic review and dose-response meta-analysis of cohort studies. *Int J Epidemiol* 2011;40:1382–400.
- [22] Robroek SJ, Reeuwijk KG, Hillier FC, et al. The contribution of overweight, obesity, and lack of physical activity to exit from paid employment: a meta-analysis. *Scand J Work Environ Health* 2013;39:233–40.
- [23] Shavelle RM, Paculdo DR, Strauss DJ, et al. Smoking habit and mortality: A meta-analysis. *J Insur Med* 2008;40:170–8.
- [24] Lallukka T, Kaikkonen R, Härkänen T, et al. Sleep and sickness absence: a nationally representative register-based follow-up study. *Sleep* 2014;37:1413–25.
- [25] Lallukka T, Rahkonen O, Lahelma E, et al. Joint associations of smoking and physical activity with disability retirement: a register-linked cohort study. *BMJ Open* 2015;5:e006988.
- [26] GBD 2013 Risk Factors Collaborators, Forouzanfar MH, Alexander L, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2015;386: 2287–323.
- [27] Beenackers MA, Kamphuis CB, Giskes K, et al. Socioeconomic inequalities in occupational, leisure-time, and transport related physical activity among European adults: A systematic review. *Int J Behav Nutr Phys Act* 2012;9:116.
- [28] Ball K and Crawford D. Socioeconomic status and weight change in adults: a review. *Soc.Sci.Med.* 2005;60:1987–2010.
- [29] Lallukka T, Sares-Jäske L, Kronholm E, et al. Sociodemographic and socioeconomic differences in sleep duration and insomnia-related symptoms in Finnish adults. *BMC Public Health* 2012;12:565.
- [30] Ludvigsson JF, Andersson E, Ekblom A, et al. External review and validation of the Swedish national inpatient register. *BMC Public Health* 2011;11:450.