Mortality and work disability in a cohort of Norwegian couples – the HUNT Study

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Abstract

Background: Poor health is clustered in families, and partners might influence each other. We studied possible consequences of living with a spouse with poor health or unhealthy lifestyle on mortality and work disability.

Methods: 18,943 couples from the HUNT2 Study (1995-97) were linked to national registries and followed until December 2007, identifying deaths and disability pension retirements. Couple's mean exposures were included together with the individual's deviation from the couple mean in discrete time multilevel logistic regression.

Results: There was weak evidence of associations between partner's health and risk of dying. Associations between couples slightly exceeded associations within couples for smoking (OR within 1.57 (95% CI 1.38-1.78) OR between 1.88 (95% CI 1.70-2.08), p-value for difference 0.027) and education (OR within 1.07 (95% CI 0.99-1.15) OR between 1.17 (1.11-1.23), p-value for difference 0.065). Indicators of partner's health, such as self-rated health (OR within 3.17 (95% CI 2.80-3.58) OR between 3.92 (95% CI 3.50-4.40), p-value for difference 0.014), insomnia (OR within 1.39 (95% CI 1.18-1.64) OR between 2.11 (95% CI 1.86-2.53), p-value for difference <0.001) and symptoms of depression (OR within 1.45 (95% CI 1.22-1.71) OR between 1.98 (95% CI 1.69-2.31), p-value for difference 0.009) were, however, associated with risk of work disability. Self-rated health and symptoms displayed stronger associations with work disability among partners than reported somatic diseases.

Conclusions: This study did not indicate strong consequences of living with a spouse with poor health or unhealthy lifestyle on mortality. It did, however, indicate associations of partner's health with work disability.

Key words: social epidemiology, family health, spouses, multilevel analyses

Introduction

Healthy aging and prevention of work disability are increasingly important to maintain viability of social security systems as western populations are aging[1]. Recent studies have suggested that the household or couple that an individual is part of explains a substantial part of the individual's risk of dying[2] as well as work disability[3]. However, research on mortality and disability rarely considers characteristics of the couple, such as partner's health or lifestyle.

Severe disease[4, 5] or death[6] in one spouse have been associated with increased mortality for the other spouse, but there is also evidence of health related assortative mating[7]. Finally, lifestyle patterns like smoking, alcohol intake, obesity and diet, are associated among spouses[7]. While ill health might affect the partner through psychological distress and economic and social consequences[6], one spouse's lifestyle might alter the likelihood of lifestyle changes for the other spouse[8, 9].

The combined exposure of couples can be used to assess possible influence of partner's exposure, similar to a procedure commonly used in the investigation of twins[10]. For instance, a recent Norwegian study suggested that the association between education and self-rated health and mental symptoms could be better explained if considering education as a shared resource of the couple in addition to as an individual characteristic[11]. Furthermore, as spouses tend to share life events, lifestyle and resources, comparing differentially exposed spouses would in itself control for such shared confounders[12]. .

The aim of the present study was to examine associations of own and spouses' health, lifestyle and education with mortality and long-term work disability, respectively. For this purpose, we defined work disability as receiving a disability pension. By considering both the individual exposures and the couple exposures, we were able to estimate associations not

confounded by factors shared by the couple, and to evaluate possible health consequences of living with a partner with poor health or an unhealthy lifestyle.

Methods

Study sample

Data from the second wave of the Nord-Trøndelag Health Study (HUNT2), conducted between 1995 and 1997, were linked to national registries on education, mortality and work retirement (regardless of reason), using the Norwegian 11-digit personal identification number. All inhabitants in Nord-Trøndelag county in Norway, aged 20 or older, were invited to participate in a survey and a clinical examination, and the response rate was about 70%[13]. From 65 600 participants in HUNT2, we identified 18,934 married or cohabitating couples by combining marital status and self-reported information on cohabitation with a household serial number (available from 1992) provided by Statistics Norway. Two individuals within a household were assumed to be a couple if both were either legally married or reporting to live with a cohabitant. Cohabitating couples with an age difference of more than 16 years were excluded to avoid falsely linking parents and children as partners. Married couples with an age difference of more than 16 years were checked manually, revealing one erroneous linkage. Same sex couples were excluded. One participant did not contribute with person-time in mortality analyses because his starting date was missing and arbitrarily set to mid- HUNT, whereas he actually died before this date. 11,827 individuals were retired before start of follow-up, and thus did not contribute with person-time in analyses of work disability. The remaining 26,041, consisting of 11,610 couples in which neither partner is retired and 2821 individuals whose partner is retired, are hereafter referred to as the non-retired subsample.

Work disability, retirement and mortality

Statutory retirement age in Norway during follow-up was 67 years. Full or partial early retirement (contractual pension) was available through tariff-based agreements for most workers of both public and private sector from age 62[14]. Persons whose earning ability is permanently reduced by at least 50% due to disease, injury or defect are entitled to a disability pension. In 2004, a time-limited disability pension, granted up to four years at a time, was introduced in the social security system, aiming at persons whose work ability might later improve[15]. However, this time-limited disability pension primarily worked as a precursor for permanent disability pension[16].

Times of disability pensions, old-age pensions, contractual pensions, emigrations and all-cause deaths were collected from the National Insurance Database. In each case, registries, with negligible errors, cover the entire study population, and outcomes were registered for each individual irrespective of spouse's outcome. Outcomes of interest were death of any cause in mortality analyses and permanent or time-limited disability pensions in work-disability analyses.

Independent variables

We examined a total of 14 independent variables. Self-rated health was measured with the question: "How is your health at the moment?" and dichotomised as poor/very poor versus good/excellent. Self-reported presences of the diagnoses asthma, cardiovascular conditions (angina pectoris, stroke or myocardial infarction), or cancer were all dichotomous. Presence of self-reported somatic symptoms was assessed, including muscle/joint symptoms (pain, stiffness or diagnoses of fibromyalgia), gastrointestinal complaints (dyspepsia, nausea, constipation or diarrhoea) and insomnia (difficulty in falling asleep or waking early often or almost every night). Mental health was assessed with the Hospital Anxiety and Depression Scale (HADS), a well validated measure for symptom severity in the general population [17].

Cut off was set to 8 or more for the depression as well as the anxiety subscale [17]. Metabolic syndrome was defined as presence of three or more of the following criteria: waist circumference >102 cm for men or >88 cm for women, triglycerides >1.7, high density lipoproteins <1.0 for men or <1.3 for women, blood pressure ≥130/85 mmHg or current medication for high blood pressure, and elevated blood glucose[18]. As fasting blood glucose was not available, the criteria were modified to include non-fasting glucose ≥11.1 mmol/L or presence of diabetes. Resting heart rate was recorded as the lowest out of three measurements, and dichotomised as less than 80 or 80 or more beats per minute.

Smoking was registered as present smoking versus not present smoking, and physical activity as high for those who were physically active for more than one hour per week and low for the rest. Information on years of education was provided by the National Education Database and included as a continuous variable, rescaled and inverted to estimate odds ratios per 3 years less education. Smoking and education were used both as independent variables and as covariates in analyses of other independent variables.

Statistical analyses

Models

The risk of mortality and work disability was assessed using discrete time multilevel logistic regression models with individuals clustered in couples[19]. Couple means and individuals' deviation from couple means were calculated for each independent variable and included as independent variables in the regression.

For dichotomous exposures, the couple mean is 0 in concordant non-exposed couples, 0.5 in discordant couples and 1 in concordant exposed couples. Accordingly, the individual's deviation from the couple mean is either -0.5 or +0.5 in discordant couples and 0 in concordant couples. The model is nonetheless also legitimate for dichotomous exposures[20, 21] .

The within couple coefficient quantifies the association between exposure and outcome adjusted for factors shared in couples[22]. Equal within- and between coefficients would suggest that the relationship between exposure and outcome can be fully understood by considering the exposure as an individual attribute. A difference in between and within coefficients would suggest that the exposure of one partner is associated with the outcome of the other partner. Such associations could be caused by spousal influence, i.e. one partner's risk of outcome being causally related to the other partner's exposure, as well as by confounding by factors shared within couples.

Model strategy and selection

Clustering of outcomes in couples was confirmed by estimating the conditional intraclass correlation coefficient (ICC) in models including outcome, age and sex. Then, associations with health indicators were assessed. Each of the 14 independent variables was examined in separate models. We chose to adjust each independent variable for the same covariates. In the first model, we adjusted for age and sex; in the second model we also included smoking and education. Education was only analysed using the first model.

Age in follow-up was split in two year bands, and to optimise the adjustment for age, a spline function for age was constructed with knots at every decade from 30 to 60. This age adjustment was only employed in analyses of work disability, as it caused problems with model convergence in the mortality models. Mortality analyses were therefore adjusted for age and the square of age in two year categories. For the work disability analyses, follow-up started two years after participation in the HUNT2 to avoid reverse causality when adjusting for baseline health. Follow-up ended on December 31, 2007. Participants were followed until death, emigration or end of follow-up in mortality analyses, and until work disability, death, emigration, end of follow-up, old age retirement or contractual pension of 50% or more in work disability analyses, which ever occurred first.

For each exposure, analyses were performed on complete cases. . Analyses were performed using STATA, version 13.

Additional analyses

Results from multilevel analyses were compared to ordinary logistic regression, taking only individual exposures into consideration (web tables 1-2).

Customized adjustment models, including other potential confounders, are presented in web tables 3-4. These include adjusting self rated health and cardiovascular disease for metabolic syndrome, resting heart rate and physical inactivity, adjusting somatic symptoms for mental symptoms and avoiding adjusting mental symptoms for smoking, as smoking might be a consequence of mental illness.

We excluded the first five years of follow-up to see if reverse causality, i.e. deterioration of health over the years before a disability pension, might have affected results (data not shown).

Couples in which one partner was missing on a covariate would be given couple means equal to the exposure of the non-missing partner, which might inflate between couple estimates. Partner's retirement prior to baseline might also be a potential confounder. We therefore also analysed complete couples, i.e. couples were neither partner was missing on covariates nor was censored before start of follow-up (web tables 5-6).

Results

The study sample is described in table 1. Among the 37,868 participants in the couple sample, 4387 died during more than 400,000 person years of follow-up. Among 26,041 participants in

the non-retired subsample, 3513 received a disability pension during more than 210 000 person years of follow-up. Mortality was clustered in couples, with an ICC of 4% (95% confidence interval (CI) 2-7%), suggesting that 4% of the variance in mortality could be attributed to the couple. 15% of an individual's propensity of work disability could be attributed to the couple (ICC 15%, 95% CI 12-19%). Figure 2 and 3 display associations with mortality and work disability, respectively, adjusted for age, sex, smoking and education. A within couple odds ratio (OR) over 1 indicate higher odds of outcome among exposed. Similar ORs within and between couples suggest no association between exposure in the couple and outcome, when holding the individual exposure constant. Larger ORs between than within couples indicate that exposure in the couple is associated with increased odds of the outcome, when holding the individual exposure constant.

Mortality of differentially exposed partners (within estimates)

Partners differentially exposed to somatic symptoms including insomnia did not display substantial differences in the risk of dying (figure 2). We found, however, an association between partner difference in self-rated health and an increased mortality (OR 1.79, 95% confidence interval (CI) 1.62-1.99) which was of similar magnitude to partner differences in being diagnosed with cardiovascular disease.

There were minor differences between population estimates and within couple associations with mortality (see web table 1).

Mortality when comparing couples (between estimates)

Within- and between partner associations with mortality were similar for self-rated health, asthma, cardiovascular disease and cancer (p-values of difference >0.4). Although individual somatic symptoms were not associated with mortality, we found weak associations between symptoms in a couple and mortality (ORs 1.08-1.18). Being part of a smoking or low educated couple was also associated with increased mortality (p-values of difference 0.027

and 0.065). Associations between depressive symptoms and mortality were weaker between couples than within couples (p-value of difference 0.151).

Work disability of differentially exposed partners (within estimates)

As expected, all examined exposures were associated with the individual's own risk of work disability. For instance, compared with a spouse of good self-rated health, poor self-rated health was associated with increased odds of disability (OR 3.17, 95% CI 2.80-3.58). Having musculoskeletal pain also more than doubled the odds of work disability (OR 2.17, 95% CI 1.92-2.45), compared with a spouse without such pain.

The estimated associations with work disability were attenuated for insomnia (OR 1.70, 95% CI 1.53-1.88 vs OR 1.39, 95% CI 1.18-1.64) and education (OR 1.51, 95% CI 1.44-1.58 vs OR 1.28, 95% CI 1.19-1.39), when comparing differentially exposed partners rather than applying population estimates (see web table 2).

Work disability comparing couples (between estimates)

Between couple associations exceeded within couple associations for self-rated health (p-value for difference 0.014), somatic and mental symptoms (p-values for differences <0.001-0.009) and low education (p-value for difference <0.001), when considering risk of work disability. As for somatic diagnoses, metabolic syndrome, smoking and high resting heart rate, there was low statistical evidence of within and between associations being different (p-values 0.12-0.75) .

Additional analyses

Customizing adjustment models for the different independent variables only gave minor changes of estimated associations (see web tables 3 and 4). Excluding the first five years of follow-up somewhat attenuated associations of self rated health and diagnoses with work disability, but without materially affecting the relationship between estimates within couples versus between couples (data not shown). Analysing complete couples rather than complete

cases did not materially change results of mortality analyses. However, it resulted in minor changes in work disability analyses, most noticeably by reducing statistical evidence of within and between estimates being different for somatic and mental symptoms (see web tables 5 and 6).

Discussion

As for mortality, the present study did not indicate strong health consequences of living with a spouse with poor health or an unhealthy lifestyle. Partner's education, smoking and physical activity might still affect mortality, and there was also evidence of weak associations between symptom load of the couple and mortality.

We did, however, find strong associations between living with a spouse with poor health or an unhealthy lifestyle and risk of work disability. These associations were stronger for health symptoms than for somatic disease.

Strengths and limitations

This is a comprehensive study of risk factors of work disability and all cause death. It is also the first study to broadly examine the potential health influence between partners, using death and work disability as outcomes. Interpretation of between-estimates is nonetheless complicated. The method cannot determine which shared factors are of importance, or the relative importance of shared confounding and influence between partners. Furthermore, although shared confounding is accounted for in within-analyses, non-shared confounding and random measurement error can bias results, as in any epidemiologic study[20] Within estimates will be less biased than population estimates if confounders are more shared than the exposure[20]. Considering socioeconomic status as an attribute of the couple rather than an individual attribute thus supports the appropriateness of the model. Influence between partners can decrease the association between exposure and outcome in differentially exposed couples, making the within couple estimate more biased than the population estimate.

The study is based on a large, population-based sample, with a high response rate[13]. Considering the number of variables examined, there is still a possibility of some chance findings on individual risk factors. However, the overall pattern of the results appears to give a consistent image of the association between partner's health and risk of work disability and death. Somatic diagnoses were self-reported, giving potential misclassifications. However, a full medical examination would not have been feasible, given the size of the study.

We did not have information on duration of marriages, which might have modified the observed associations between couples. However, previous studies applying data from HUNT have found no large convergence in health and lifestyle between spouses beyond the first years of marriage[23, 24].

Associations within couples

This study supports previous research on risk factors for work disability[25] and all-cause mortality[26-28]. However, insomnia, in particular difficulties initiating sleep, has previously been linked to mortality[29], whereas our results indicate that this association might be caused by confounding. Whereas weaker associations of symptoms with work disability within couples suggest some degree of overestimation when applying population estimates, weaker associations of smoking with mortality within couples than in populations might be a side-effect of partner influence by passive smoking. .

Attenuated associations of baseline health with work disability when excluding follow-up time was expected both because any reverse causality was removed and because baseline health should be more predictive of outcomes in the near than far future.

Confounding or caregiver's burden?

Spurious associations between exposure of one partner and outcome of the other could appear because of confounding by lifestyle or other factors shared in couples[12]; however, emotional

contagion[7], caregiver's burden[4], and spouses influencing each other's lifestyle[8] could provide causal pathways for associations with mortality[4] as well as work disability[30].

Although couple exposures are more strongly associated with work disability than mortality, some of the same patterns appear. Individual perception of health seems more important to the spouse than potentially severe diagnoses, weighing against caregiver's burden as an important mechanism.

Likely causes of increased between couple associations differ between exposures. Whereas passive smoking can be toxic to the partner, and education might be better seen as a joint exposure of the couple[11], physical activity of one partner is unlikely to have direct consequences for the other partner, other than a chance of affecting frequency or duration of his/her own activity. Associations between symptom load of the couple and mortality likewise suggest presence of shared confounding. Although education was adjusted for, there might be residual confounding from socioeconomic status. An association between one partner's exposure and the other partner's outcome might also appear if ill health manifest as different symptoms or diseases in each partner.

The results from the present study suggest that partner's health and lifestyle might influence work disability stronger than mortality, and that symptoms have stronger effects on work disability among partners than somatic diseases.

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Competing interests: None declared.

Ethical approval: This study was approved by the Regional Committee for Medical and Health Research Ethics, Central Norway (2011/2318).

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Key points:

- We studied risk of death or work disability within and between couples, taking the health and lifestyle of both spouses into consideration.
- Living with a spouses with poor health or an unhealthy lifestyle is strongly associated with work disability, but not with risk of dying.
- Symptom load is more important for work disability in couples than somatic diseases.

Table 1. Descriptive statistics of the couple sample and the non-retired subsample. For each categorical health variable, the number of participants living in couples where both partners are exposed is given, along with the number and percentage of outcomes among these couples. The Norwegian HUNT2 Study, 1995-1997.

	Couple sample			Non-retired subsample		
	Total	Deaths		Total	Disability pensions	
	N	n	%	n	n	%
Categorical variables						
Sex						
Women	18,934	1477	8	13,362	2033	15
Men	18,934	2908	15	12,679	1480	12
Self-rated health						
Good/excellent	27,265	2044	8	21,696	2138	10
Poor/very poor	10,289	2278	22	4157	1343	32
Missing	314	63	20	188	32	17
Both partners poor health	4460	1243	28	1325	486	37
Asthma						
Yes	3493	576	16	2127	391	18
No	34,272	3763	11	23,878	3115	13
Missing	103	46	45	36	7	19
Both partners asthma	366	81	22	199	32	16
Cardiovascular disease						
Yes	2981	1287	43	458	144	32
No	34,828	3057	9	25,570	3366	13
Missing	59	41	69	13	3	23
Both partners have cardiovascular disease	502	258	51	21	8	38
Cancer						
Yes	1422	459	32	534	109	20
No	34,610	3349	10	25,005	3256	13
Missing	1836	577	31	501	148	29
Both partners have cancer	102	39	38	20	6	30
Musculoskeletal pain						
Yes	25,506	2930	11	16,905	2870	17
No	12,276	1450	11	9115	641	7
Missing	86	50	58	21	2	10
Both partners have pain	17,734	2113	12	11,506	2066	18
Gastrointestinal complaint						
Yes	18,690	2100	11	12,523	1964	16
No	17,419	1717	10	12,971	1419	11

Missing	1759	568	32	547	130	24
Both partners have gastrointestinal complaint	9768	1173	12	6381	1066	17
Insomnia						
Yes	4428	695	16	2185	507	23
No	28,507	3055	11	20,466	2453	12
Missing	4933	635	13	3390	553	16
Both partners have insomnia	722	166	23	279	92	33
HADS anxiety score						
≥ 8 /case	5151	488	9	3443	682	20
<8 / non-case	30,659	3111	10	22,133	2722	12
Missing	2058	786	38	465	109	23
Both partners are cases	1106	123	11	731	157	21
HADS depression score						
≥ 8 /case	3760	699	19	1968	451	23
<8 / non-case	32,050	2900	9	23,608	2953	13
Missing	2058	786	38	465	109	23
Both partners are cases	776	153	20	347	97	28
Smoking						
Present	10,105	1196	12	7280	1315	18
Not present	27,495	3106	11	18,651	2183	12
Missing	268	83	31	110	15	14
Both partners are smokers	5074	494	10	3859	718	19
Physically active						
Active	26,118	2198	8	19,348	2345	12
Inactive	8264	1090	13	5745	929	16
Missing	3486	1097	31	948	239	25
Both partners are inactive	2654	382	14	1816	315	17
Metabolic syndrome						
Present	7156	1377	19	3512	739	21
Not present	30,498	2925	10	22,428	2756	12
Missing	223	83	37	101	18	18
Both partners have metabolic syndrome	1878	514	27	685	166	24
Resting heart rate						
80 or above	7489	1079	14	4776	822	17
Less than 80	30,251	3239	11	21,222	2681	13
Missing	128	67	52	43	10	23
Both partners have high heart rate	1550	261	17	906	177	20
Continous variables						
Education						

Years (mean/sd)	11.6 (2.7)	10.1 (2.4)	12.3 (2.6)	11.2 (2.2)
Missing (n)	122	16	87	12
Age				
Years (mean/sd)	51.4(14.6)	70.3(10.6)	44.2 (9.9)	49.6 (7.6)
Total	37,868	4385	26,041	3513

Abbreviations: sd: standard deviation

Figure 1. Flow-chart describing the couple sample and non-retired subsample. The HUNT2 Study, 1995-1997.

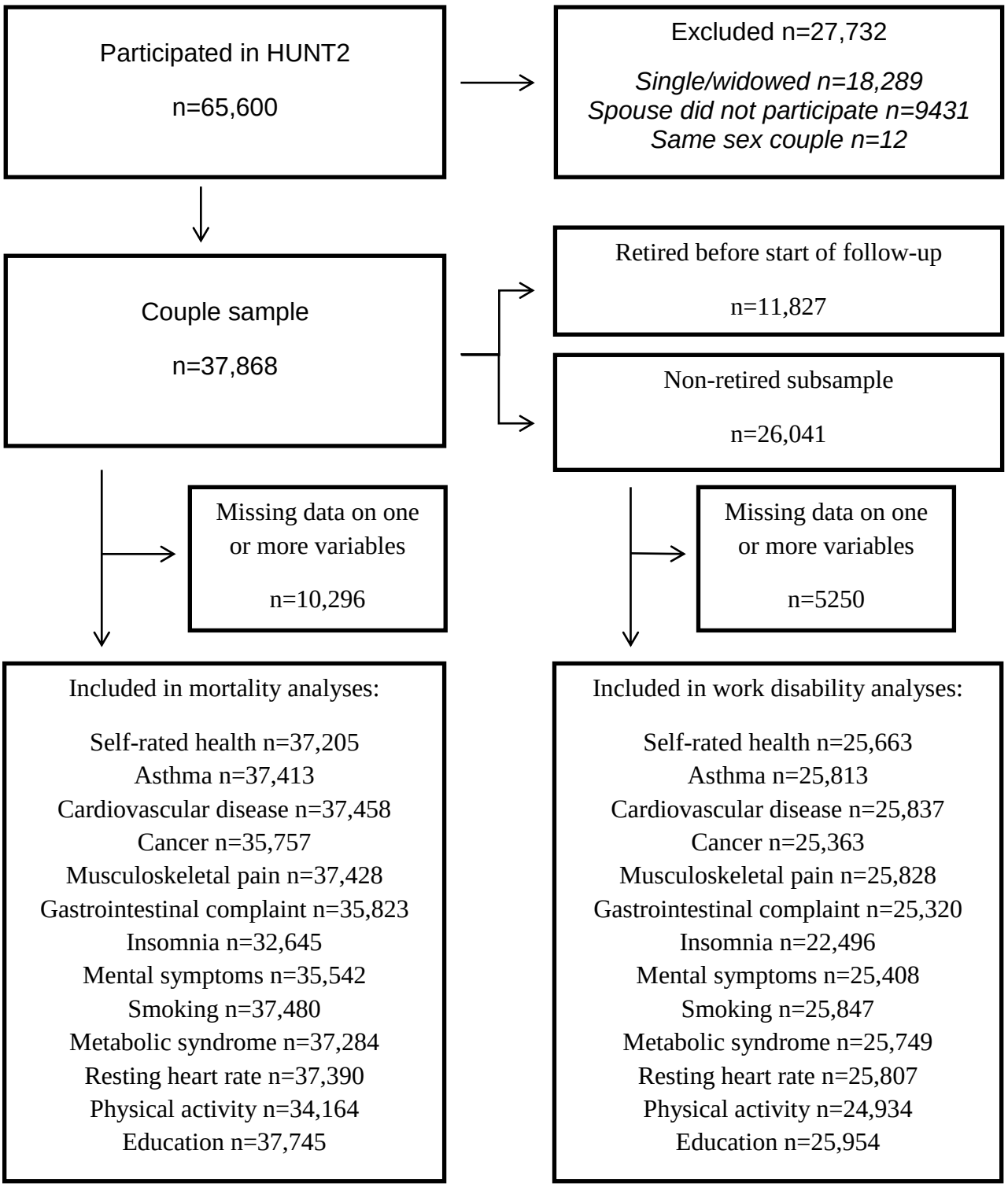


Figure 2 Odds ratios (OR) with 95% confidence intervals for dying. Within couple estimates (squares) compare differentially exposed partners; between couple estimates (circles) compare individuals with different couple means, holding the individual deviation from the couple level constant. Results are adjusted for age, sex, smoking and education. Education is not adjusted for smoking. P-values for within- and between estimates being different. Equal within- and between estimates indicates that exposure can be considered an individual attribute, differences between them indicates excess associations attributable to the couple. The HUNT2 Study, 1995-1997.

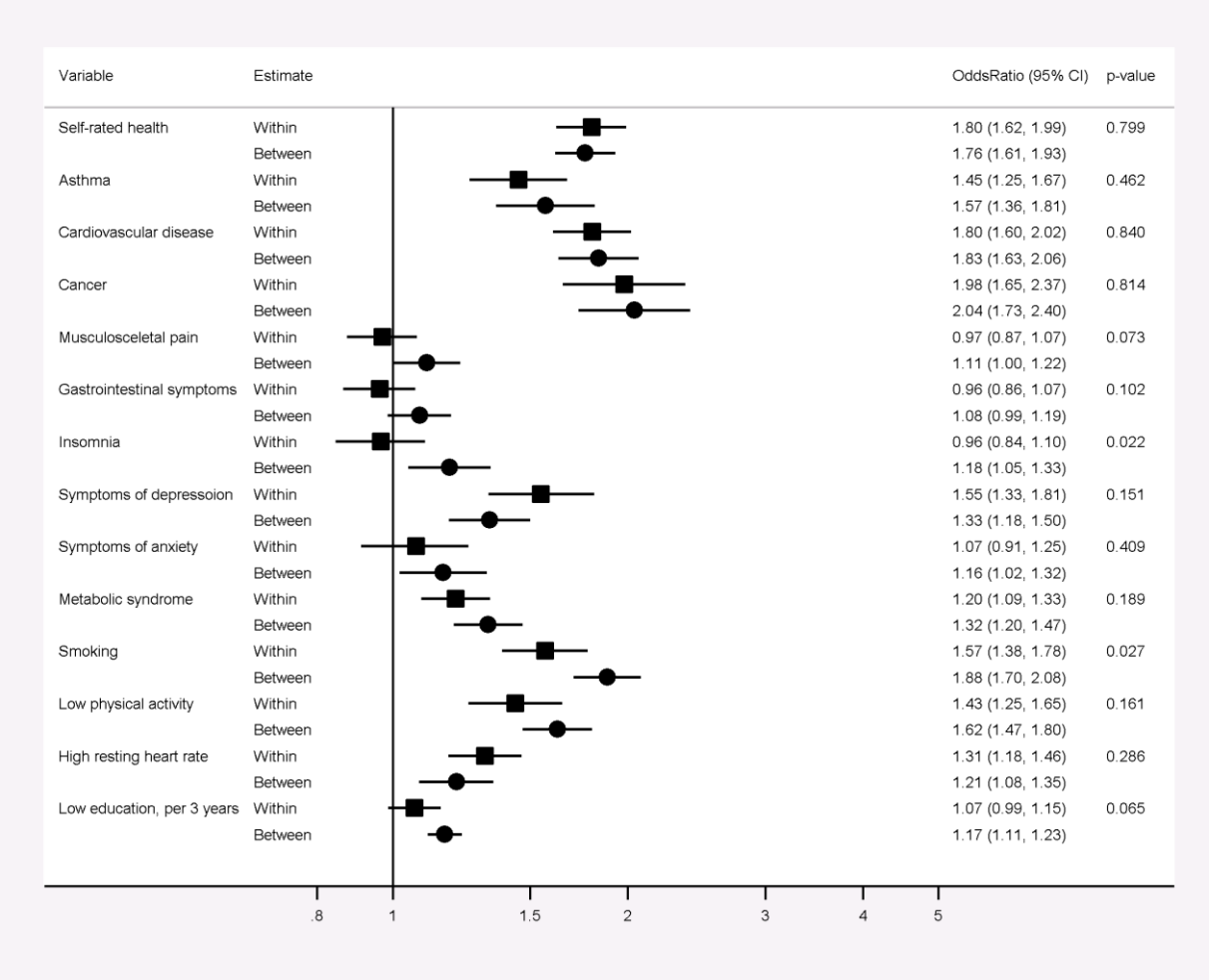
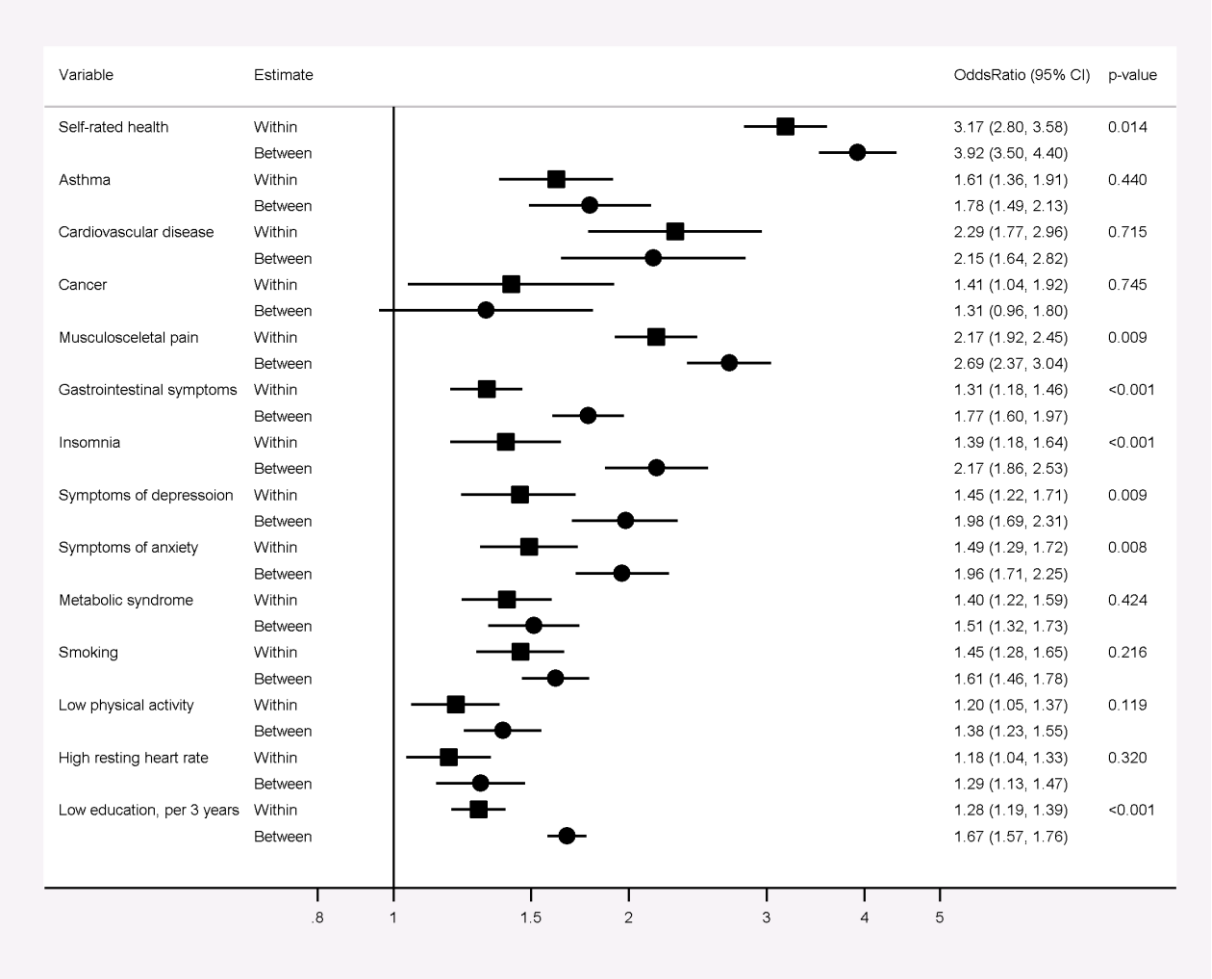


Figure 3 Odds ratios (ORs) with 95% confidence intervals for work disability. Within couple estimates (squares) compare differentially exposed partners; between couple estimates (circles) compare individuals with different couple means, holding the individual deviation from the couple level constant. Results are adjusted for age, sex, smoking and education. Education is not adjusted for smoking. P-values for within- and between estimates being different. Equal within- and between estimates indicates that exposure can be considered an individual attribute, differences between them indicates excess associations attributable to the couple. The HUNT2 Study, 1995-1997.



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