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Effort-reward imbalance at work and risk of type 2 diabetes in a national sample of 50,552 workers in Denmark: A prospective study linking survey and register data☆

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ABSTRACT

Objective: To examine the prospective relation between effort-reward imbalance at work and risk of type 2 diabetes.
Methods: We included 50,552 individuals from a national survey of the working population in Denmark, aged 30–64 years and diabetes-free at baseline. Effort-reward imbalance was defined, in accordance with the literature, as a mismatch between high efforts at work (e.g. high work pace, time pressure), and low rewards received in return (e.g. low recognition, job insecurity) and assessed as a continuous and a categorical variable. Incident type 2 diabetes was identified in national health registers. Using Cox regression we calculated hazard ratios (HR) and 95% confidence intervals (95% CI) for estimating the association between effort-reward imbalance at baseline and risk of onset of type 2 diabetes during follow-up, adjusted for sex, age, socioeconomic status, cohabitation, children at home, migration background, survey year and sample method.
Results: During 136,239 person-years of follow-up (mean = 2.7 years) we identified 347 type 2 diabetes cases (25.5 cases per 10,000 person-years). For each one standard deviation increase of the effort-reward imbalance score at baseline, the fully adjusted risk of type 2 diabetes during follow-up increased by 9% (HR: 1.09, 95% CI: 0.98–1.21). When we used effort-reward imbalance as a dichotomous variable, exposure to effort-reward imbalance was associated with an increased risk of type 2 diabetes with a HR of 1.27 (95% CI: 1.02–1.58).
Conclusion: The results of this nationwide study of the Danish workforce suggest that effort-reward imbalance at work may be a risk factor for type 2 diabetes.

Abbreviations: ANOVA, analysis of variance; ATC, anatomical therapeutic chemical; BMI, body mass index; CI, confidence interval; ERI, effort-reward imbalance; HPA, hypothalamus-pituitary-adrenal; HR, hazard ratio; ICD-10, international classification of diseases and related health problems version 10; NRCWE, National Research Centre for the Working Environment; PCOS, polycystic ovarian syndrome; SES, socioeconomic status; WEHD, Work Environment and Health in Denmark 2012–2020.

☆ The study was conducted at the National Research Centre for the Working Environment, Copenhagen, Denmark.

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1. Introduction

Work-related stress may be associated with risk of developing type 2 diabetes [1,2]. Possible physiological pathways include stress-induced dysregulation of the hypothalamus-pituitary-adrenal (HPA) axis and the central nervous system [3,4], resulting in increased cortisol levels, and subsequent disturbance in blood glucose regulation [5], all of which are associated with risk of insulin resistance and type 2 diabetes [6]. Work stress may also be related to type 2 diabetes via changes in health-related behavior, such as sedentary life style and poor diet, and psycho-physiological changes, such as sleep disturbances and depressive disorders associated with inflammation and cardiometabolic changes [1,7,8].

The model of effort-reward imbalance (ERI) is an established theoretical approach to define and assess stress at the workplace [9]. The model is built on the notion that a lack of reciprocity in terms of the efforts that are put into work and the rewards received in return causes emotional and psycho-physiological stress reactions that subsequently increase the risk of ill-health. The model emerged in the scientific discussions in the 1990s [10] and has been tested mostly in relation to cardiovascular disease and mental health. Recently, two meta-analyses of prospective cohort studies showed that employees with high ERI were at higher risk of coronary heart disease [11] and depressive disorders [12].

Research on ERI and risk of type 2 diabetes is scarce. To our knowledge, only two prospective studies have previously examined the association between ERI and risk of type 2 diabetes [13,14]. Kumari et al. (2004) studied 8067 civil servants (70% men) from 20 London-based departments in the Whitehall II Study and found an association between high ERI and risk of type 2 diabetes among men, but not among women [13]. Mutambudzi et al. (2018) studied 1932 workers in the United States (age > 50 years) from the Health and Retirement Study and reported an association between high ERI and risk of self-reported diabetes [14].

Both the study by Kumari et al. (2004) and Mutambudzi et al. (2018) examined ERI and diabetes in selected occupational groups (civil servants and older workers) and in relatively small study samples. These studies also did not investigate if the individual dimensions of efforts and rewards were associated differently with risk of type 2 diabetes, which may be important to guide future interventions. Further, it has recently been demonstrated that the impact of other psychosocial work factors such as long working hours on type 2 diabetes risk may depend on socioeconomic status (SES) [15], but whether the relation between ERI and type 2 diabetes are modified by SES remains unstudied.

In this article, we investigate the prospective relation between ERI and risk of type 2 diabetes in a national sample of > 50,000 workers in Denmark [16]. We test both ERI and its subcomponents and examine if associations differ with regards to sex, age, SES, and migration background.

2. Methods

2.1. Design and population

The study is a prospective cohort study with register-based follow-up. Before data linkage of the exposure with the outcome, we published a study protocol containing detailed descriptions of the design, methods, data and statistical analyses [16]. Briefly, the study population was participants from the biennial survey 'Work Environment and Health in Denmark 2012-2020 (WEHD)' which is a national sample of the working population in Denmark. Inclusion criteria were a) liable to pay taxes in Denmark, b) employed with monthly working hours of ≥35 and a monthly income of 3000 Danish kroner (≥$530/€400), c) aged 18–64 years and d) registered with an address in Denmark. WEHD consists of 1) a national survey of individuals from the general working population, 2) a supplementary survey (in 2012 and 2016) of individuals from selected workplaces and 3) a cohort, consisting of those individuals who responded in the 2012 wave in the general working population and were invited again in 2014 and 2016. All individuals received a letter with a link to an online questionnaire containing approximately 160 questions about work environment, health and lifestyle. Non-responders were contacted by mail and telephone and received a hard copy of the questionnaire. The overall response rate across all surveys was 53.9%. Compared to respondents of the survey in 2012, among non-respondents there were more men, they were younger, had lower education, they were less cohabiting and there were more with a migration background [17]. To maximize sample size and statistical power we included all unique responders to the surveys in 2012, 2014 and 2016.

We used a unique personal identification number to link participants to nationwide registers [18]. According to Danish legislation, research projects involving surveys with questionnaire and register-based data only, do not need approval from The National Committee on Health Research Ethics. The study was approved by The Danish Data Protection Agency through the joint notification of the National Research Centre for the Working Environment, Copenhagen, Denmark (no. 2015-57-0074). We obtained register-based information from Statistics Denmark (no. 706706) and Sundhedsdatastyrelsen ('The Danish Health Authority', no. FSEID-00003251 and no. FSEID-00003281). All data are stored in a protected server environment hosted by Statistics Denmark.

A complete list of criteria for inclusion and exclusion is available in the study protocol [16]. In short, we excluded participants < 30 years of age because of concerns about misclassification as incident diabetes is more likely to be type 1 than type 2 diabetes in this age-group [19]. We excluded participants with all types of prevalent diabetes at baseline and participants with polycystic ovarian syndrome (PCOS) due to possible overlap with diabetes in drug treatment (n = 2262) assessed by either a hospital diagnosis, previous purchases of relevant prescription medicine or self-report in WEHD. In addition, we excluded participants who were pregnant at baseline because of a risk of developing gestational diabetes (n = 786). We ascertained pregnancy for a period of 280 days before the date of starting register based maternity leave [20]. Finally, we excluded participants with missing data about ERI (n = 1353) and covariates (n = 293), yielding a study sample of 50,552 individuals. See Fig. 1 for a flowchart detailing the exclusion process. There were no considerable differences in baseline characteristics in the population between exclusion stages in the flowchart (see Table A.1, Appendix A, for a comparison of characteristics at each stage in the flowchart).

2.2. Effort-reward imbalance

Effort-reward imbalance describes the mismatch between efforts spent at work and rewards received in terms of financial and career-related rewards, esteem and job security [21]. As WEHD did not include items from the original ERI-questionnaire [21], i.e. the scales on efforts and rewards in WEHD were modified and dissimilar to the original questions, we used proxy measures to construct scales for efforts and rewards. Perceived efforts were measured with a scale consisting of six items, assessing time pressure, high work pace, difficult deadlines, unexpected tasks, being at disposal outside normal working hours and overtime work. Perceived rewards were measured with a scale consisting of five items, assessing promotion of professional development, recognition and appreciation by management, being treated fairly at work, worries about becoming unemployed and worries about being transferred to another job (see Table B.1, Appendix B, for the wording of the effort and reward items).

We calculated sum scale scores for each scale, with high values indicating high efforts and high rewards, respectively. The internal consistency of the effort and reward scales was satisfactory with

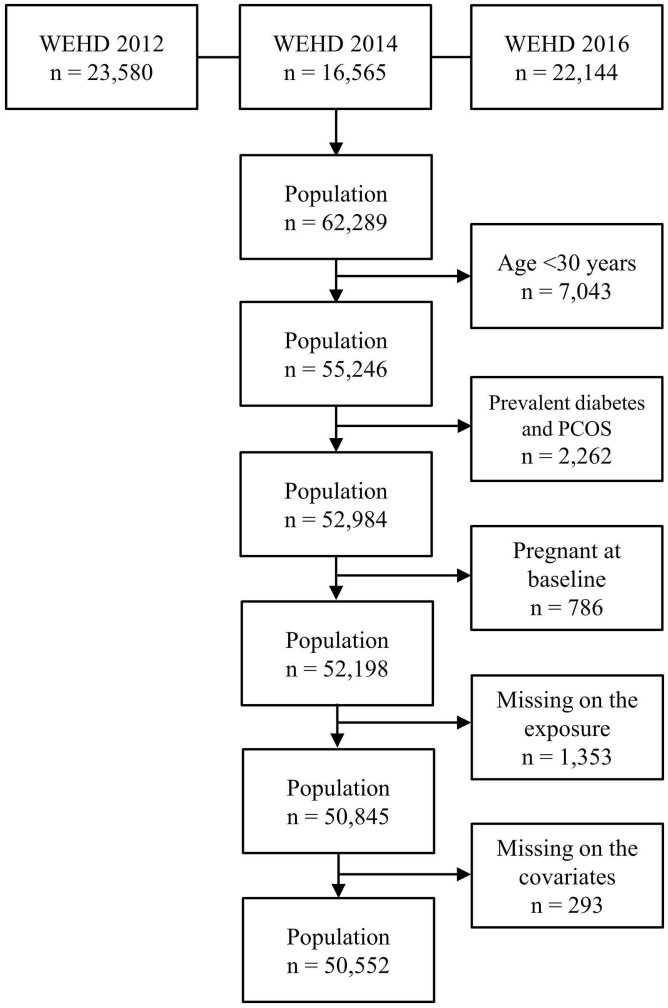

Fig. 1. Flowchart detailing the exclusion of participants in the study.

Cronbach's alpha coefficients of 0.77 and 0.68 for efforts and rewards, respectively. We computed an ERI-ratio by dividing efforts by rewards. As recommended in the literature [21], we used a correction factor ((efforts/rewards)*(5/6)) to take into account the unequal number of items in the effort and reward scale, so that an ERI-ratio of > 1.0 indicates that efforts exceed rewards. For the regression analyses, we standardized ERI, efforts, and rewards scores per one standard deviation (SD) increase (mean = 0, SD = 1) and treated them as continuous measures.

In addition to the continuous ERI-score, we constructed two categorical measures. First, based on the quartiles of their respective scale scores we categorized ERI, efforts and rewards into low, medium-low, medium-high and high. Second, we dichotomized ERI using a cut-off of > 1.0 to indicate exposure to potential health-hazardous ERI, as proposed in the literature [9] (see Appendix B, for more details on the construction of the ERI-measures).

2.3. Type 2 diabetes

We identified incident type 2 diabetes with the International Classification of Diseases version 10 (ICD-10) code E11 (type 2 diabetes mellitus with and without complications, and sub-levels) in the Danish National Patient Register that includes all in- and out-patient hospital admissions, from death certificates in the Danish Register of Causes of Death and by purchases of prescription medicine with at least two redemptions within a two year period with the Anatomical Therapeutic Chemical (ATC) codes A10B (blood glucose lowering drugs, excl. insulins, and sub-levels) or A10AE56 (insulin degludec and liraglutide) in the Danish National Prescription Registry [18]. Participants who had purchased these medications but also appeared with ICD-10 code E10 (type 1 diabetes mellitus, and sub-levels) in the Danish National Patient Register, were not considered as type 2 diabetes cases.

2.4. Confounders

We identified potential confounders based on the literature using the method of Directed Acyclic Graphs [22] as detailed in the study protocol [16]. Using a unique personal identification number we derived information on the confounders from nationwide registers and linked these data to the participants [18].

The confounders in this study were sex, age, SES, cohabitation, young children in the household and migration background. Low versus high SES is associated with a higher risk of type 2 diabetes [23]. The experience of ERI may follow a social pattern, although there are conflicting results on the direction, with one study reporting a higher prevalence of ERI in employees of lower SES [24] whereas another study reported a higher prevalence of ERI among employees of higher SES [25]. In this study we defined SES as highest achieved educational level, divided into three groups *(Low, ≤9 years; Intermediate, 10–12 years; High, ≥13 years*). Cohabitation may be a protective factor for the experience of and coping with ERI [26] and for the development of type 2 diabetes [27]. We defined cohabitation as either living alone or cohabiting. Having young children in the household is a possible stressor that may affect one's perception of demands at work and may also affect the ability to recover [28]. We defined young children in the household as number of children ≤7 years of age in the following categories: *0; ≥1*. Migration background is associated with different predispositions to the development of type 2 diabetes in Denmark [29] and may also be associated with different levels of perceived work stress [30]. We categorized migration background as *'No migration background'* and *'Migration background'*, following the categorization by Statistics Denmark [31].

The relationship between ERI and the risk of developing type 2 diabetes may involve a complex interplay between behavioral factors, psycho-physiological disturbances and adverse health. ERI is associated with physical inactivity [32], unhealthy alcohol consumption, smoking, overweight [33], depression [12], sleep disturbances [28], hypertension and dyslipidemia [7] which in addition may be potential risk factors for the development of type 2 diabetes [34–36]. Therefore, these factors may be potential intermediate variables on the causal pathway from ERI to type 2 diabetes, and hence should not be controlled for. However, they may also affect one's perception of efforts and rewards and therefore be potential confounders. Since we only have baseline measures of these factors, and therefore cannot distinguish between mediation and confounding for these variables, we include these variables not in the main analyses but in supplementary analyses. Detailed descriptions of the covariates have been published in the study protocol [16]. In brief, from WEHD we included self-reported physical activity (categorical in Table 1: *'inactive'; 'low'; 'medium'; 'high'*, continuous in analyses), alcohol consumption (units pr. week) with categories: *'low (women: 0-7; men: 0-14)'; 'medium (women: 8–14; men: 14–21)'; 'high (women: > 14; men: > 21)'*, smoking status (*'never'; 'current/former'*), and BMI categorized into: *'underweight (< 18.5 kg/m^2)'; 'normal weight (18.5-24.9 kg/m^2)'; 'overweight (25-29.9 kg/m^2)'; 'obese (≥30 kg/m^2)'*. Indicators of psycho-physiological disturbances were defined as having an ICD-10 diagnosis for depressive disorders, sleep disturbances, hypertension or dyslipidemia or by at least two purchases of prescription medicine for these conditions within a two year period prior to baseline. We identified depressive disorders with ICD-10 codes F32, F33, F34.1 and F06.3, with ATC-code N06A and by self-reported depressive symptoms in WEHD. We identified sleep disturbances with ATC-codes N05C and N05B and by self-report in WEHD. We defined dyslipidemia by ICD-10 code E78 and ATC-code C10. Hypertension was defined by

Table 1
Baseline characteristics of the study population and relation to effort-reward imbalance (ERI).

Characteristics (missing %)	Total (n = 50,552)		ERI-ratio		High ERI[c]	
	n	(%)[a]	Mean[b]	(SD)	n	(%)[d]
Age (0.0%)						
30–39	9649	(19.1)	0.94	(0.32)	2481	(25.7)
40–49	16,754	(33.1)	0.93	(0.32)	4251	(25.4)
50–59	18,630	(36.9)	0.93	(0.35)	4779	(25.7)
60–64	5519	(10.9)	0.84	(0.32)	894	(16.2)
Sex (0.0%)						
Women	26,378	(52.2)	0.92	(0.34)	6350	(24.1)
Men	24,174	(47.8)	0.93	(0.33)	6055	(25.0)
Migration background (0.0%)						
No migration background	47,675	(94.3)	0.92	(0.33)	11,616	(24.4)
Migration background	2877	(5.7)	0.95	(0.38)	789	(27.4)
Education (0.0%)						
High (≥13 years of education)	22,180	(43.9)	0.93	(0.31)	5400	(24.3)
Intermediate (10–12 years of education)	21,952	(43.4)	0.92	(0.34)	5420	(24.7)
Low (≤9 years of education)	6420	(12.7)	0.91	(0.38)	1585	(24.7)
Cohabitation (0.0%)						
Yes	40,401	(79.9)	0.92	(0.33)	9584	(23.7)
No	10,151	(20.1)	0.95	(0.37)	2821	(27.8)
Young children in the household (0.0%)						
No	40,513	(80.1)	0.92	(0.34)	9874	(24.4)
Yes	10,039	(19.9)	0.93	(0.31)	2531	(25.2)
Physical activity (1.6%)						
Inactive	5272	(10.6)	0.95	(0.38)	1451	(27.5)
Low	14,933	(30.0)	0.93	(0.34)	3707	(24.8)
Medium	24,851	(50.0)	0.92	(0.33)	5929	(23.9)
High	4665	(9.4)	0.92	(0.31)	1093	(23.4)
Alcohol consumption (2.2%)						
Low	32,491	(65.7)	0.92	(0.34)	7898	(24.3)
Medium	10,713	(21.7)	0.92	(0.32)	2539	(23.7)
High	6247	(12.6)	0.94	(0.35)	1661	(26.6)
Smoker (1.0%)						
Never	24,477	(48.9)	0.91	(0.32)	5625	(23.0)
Current/former	25,546	(51.1)	0.93	(0.35)	6625	(25.9)
BMI (1.5%)						
Underweight (< 18.5 kg/m^2)	502	(1.0)	0.94	(0.38)	129	(25.7)
Normal weight (18.5–24.9 kg/m^2)	24,191	(48.6)	0.91	(0.32)	5607	(23.2)
Overweight (25–29.9 kg/m^2)	18,233	(36.6)	0.93	(0.34)	4545	(24.9)
Obese (≥30 kg/m^2)	6872	(13.8)	0.95	(0.37)	1911	(27.8)
Depressive disorders (0.9%)						
No	44,400	(88.6)	0.90	(0.30)	9694	(21.8)
Yes	5686	(11.4)	1.12	(0.49)	2571	(45.2)
Sleep disturbances (0.6%)						
No	42,619	(84.8)	0.90	(0.31)	9346	(21.9)
Yes	7642	(11.4)	1.07	(0.44)	2987	(39.1)
Hypertension (0.0%)						
No	43,460	(86.0)	0.93	(0.33)	10,684	(24.6)
Yes	7092	(14.0)	0.92	(0.35)	1721	(24.3)
Dyslipidemia (0.0%)						
No	47,211	(93.4)	0.93	(0.33)	11,583	(24.5)
Yes	3341	(6.6)	0.92	(0.35)	822	(24.6)
Parental type 2 diabetes (16.6%)						
0	35,421	(84.0)	0.93	(0.33)	8797	(24.8)
≥1	6737	(16.0)	0.94	(0.36)	1755	(26.1)

[a] Column percentage.
[b] P-values from one-way ANOVA tests for differences in characteristics of participants and means of effort-reward imbalance were < 0.001 for most characteristics, except hypertension (p = .026), dyslipidemia (p = .10) and parental type 2 diabetes (p = .012).
[c] 4th quartile of the ERI-ratio.
[d] Row percentage.

ICD-10 codes I10-I13 and I15 and purchases of antihypertensive drugs [16].

2.5. Statistical analyses

Using Cox proportional hazard models with age as the underlying time axis, we calculated hazard ratios (HR) and 95% confidence intervals (95% CI) for the prospective association between ERI and incident type 2 diabetes and assessed the effect of the individual dimensions of efforts and rewards. We also investigated whether the estimate attributable to ERI was explained by an interaction between efforts and rewards (ERI) or by one of these dimensions by analyzing if the interaction between efforts and rewards was associated with a higher risk of developing type 2 diabetes when adjusting for efforts and rewards. Interactions were tested in a Cox model (deviation from multiplicative interaction) and in Aalen's additive regression model (deviation from additive interaction). In the study protocol we planned to analyze categorical measures of ERI, efforts and rewards [16]. To increase statistical power we added analyses of continuous measures of ERI, efforts and rewards.

Participants were followed from the date they filled in the questionnaire until incident type 2 diabetes or censoring due to emigration, death by other causes than diabetes, incident gestational diabetes or PCOS, pregnancy, or at end of follow-up (31 December 2016), whichever came first. We calculated crude estimates, sex- and age-adjusted estimates (model 1) and estimates further adjusted for cohabitation, young children in the household, SES, migration background and for survey and sample method (i.e. whether participants were from the samples of the general working population or the supplementary workplace samples) (model 2).

We assessed the proportional hazards assumption of the Cox model by testing interactions of the covariates with log(time), by visual inspection of log(− log(survival)) curves and by testing and visually inspecting the interactions between Schoenfeld residuals of the covariates with log(time). We found no major violations of the proportional hazards assumption.

In sensitivity analyses we investigated the possibility of misclassifying prevalent cases as incident cases by applying a washout period where we excluded incident cases during the first year of follow-up. In addition, we investigated if an age cut-off point of ≥40 years instead of ≥30 years for inclusion into the study would have an influence on the results. Further, we assessed if the association between ERI and type 2 diabetes depended on type of ascertainment of prevalent and incident diabetes.

We investigated possible effect modification of the association between ERI, efforts and rewards and risk of developing type 2 diabetes by sex, age, SES and migration background in stratified analyses.

We further adjusted model 2 for potential behavioral and psycho-physiological mediators, and parental type 2 diabetes as suggested in previous studies [13,14]. The first model included physical activity, alcohol consumption, smoking, BMI, sleep disturbances, depressive disorders, hypertension and dyslipidemia. In the second model we linked participants to register data of their parents and included parental type 2 diabetes as a covariate (no parent with type 2 diabetes versus one or two parents with type 2 diabetes).

All analyses were carried out using the statistical software R version 3.5.1. All statistical tests were two-sided with a significance level of 5%.

3. Results

3.1. Baseline characteristics

Table 1 shows the characteristics of the study sample at baseline. There were no differences in mean ERI between men (mean = 0.93, SD = 0.33) and women (mean = 0.92, SD = 0.34) or between SES groups. High ERI was more prevalent among those below 60 years of age, among participants with migration background and among those living alone.

3.2. ERI and incident type 2 diabetes

During 136,239 person-years of follow-up (mean = 2.7 years) we identified 347 cases of incident type 2 diabetes (25.5 cases per 10,000 person-years). A one SD higher ERI-score was associated with a 9% increased risk of incident type 2 diabetes in the sex- and age-adjusted analysis (HR: 1.09, 95% CI: 0.98–1.21, Fig. 2, model 1). Adjustment for all confounders did not change the estimate (HR: 1.09, 95% CI: 0.98–1.21, Fig. 2, model 2). Using ERI categorized in quartiles, instead of the continuous ERI, yielded similar results (Table C.1, Appendix C). Using ERI dichotomized into exposure versus no exposure, based on an ERI-ratio > 1.0, yielded a HR of 1.27 (95% CI: 1.02–1.58) (Table D.1, Appendix D).

3.3. ERI components and incident type 2 diabetes

Fig. 2 also shows the association between the ERI components, efforts and rewards, and risk of type 2 diabetes. The HR of incident type 2 diabetes was 1.03 (95% CI: 0.93–1.15) per one SD increase in the effort-score and 0.91 (95% CI: 0.82–1.01) per one SD increase in the reward-score. When using reward-quartiles in the analyses, medium-high rewards, compared to low rewards were associated with a lower risk of type 2 diabetes in the fully-adjusted analysis (HR: 0.70, 95% CI: 0.52–0.93) (Table C.1, Appendix C).

We found no interaction between efforts (continuous, 1 SD increase) and rewards (continuous, 1 SD increase) when tested on a multiplicative scale ($p_{interaction} = 0.84$) or on an additive scale ($p_{interaction} = 0.77$) (results not shown).

3.4. Sensitivity analyses

In the sensitivity analyses we took into account a one year washout period, an alternative age cut-off point, different exclusion criteria at baseline and types of outcome ascertainment. The estimates for the association between ERI, its two components and risk of incident type 2 diabetes in the sensitivity analyses were similar to the estimates in the main analyses (Fig. 2).

3.5. Subgroup analyses

The subgroup analyses are presented in Fig. 3. Overall, there were no large differences between men and women or in relation to migration background. Regarding age and SES groups, the association estimates for ERI, efforts and rewards were more heterogeneous (Fig. 3). High rewards were associated with a lower risk of type 2 diabetes in the group with the highest SES (HR: 0.75, 95% CI: 0.60–0.93), but not in the intermediate or low SES groups.

3.6. Adjustment for behavioral and psycho-physiological mediators and parental type 2 diabetes

When we further adjusted the estimates in the main analyses for potential mediators and parental type 2 diabetes, the estimates for ERI, efforts and rewards remained virtually the same as in the main analyses (Table E.1, Appendix E).

4. Discussion

4.1. Summary of findings

In this prospective study of a national sample of 50,552 workers in Denmark we found a suggestive, albeit not statistical significant association between an increase in ERI-score at baseline and a 9% increased risk of developing type 2 diabetes. When we analyzed ERI as a dichotomized variable, exposure to ERI predicted risk of type 2 diabetes with a hazard ratio of 1.27, which was statistically significant. Analyses of the ERI components suggested that the association between high rewards and a lower risk of type 2 diabetes was more pronounced than the association between high efforts and higher risk of type 2 diabetes.

4.2. Comparison with previous studies on ERI and type 2 diabetes

To our knowledge, this is the first study to investigate the prospective association between ERI, efforts and rewards and type 2 diabetes in a national workforce. Our study is also by far the largest study on ERI and type 2 diabetes to date. Previously, Mutambudzi et al. (2018) reported an association between ERI and self-reported diabetes among 1932 workers, 50 years or older in the United States [14]. Kumari et al. (2004) examined 8067 British civil servants and found an association between ERI and type 2 diabetes among men, but not among women [13]. We did not find such sex differences in our study.

Comparisons of the results from our study with these two previous studies have to be viewed with caution, as we examined a sample from

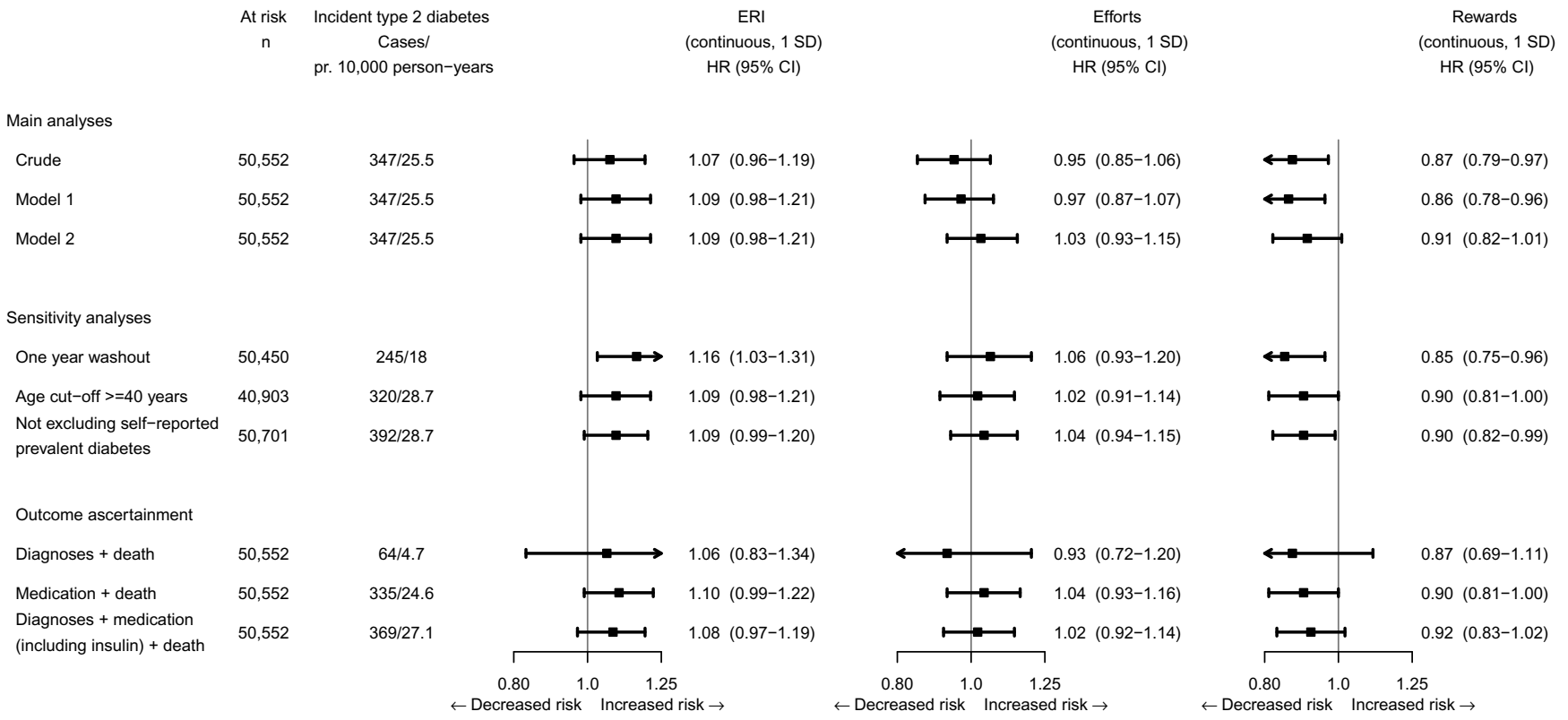

Fig. 2. Main analyses and sensitivity analyses of the relation between effort-reward imbalance (ERI), efforts and rewards and risk of developing type 2 diabetes.
Model 1: Adjusted for sex and age. Model 2: Adjusted for sex, age, cohabitation, young children in the household, SES, migration background, survey year and sample method. Sensitivity analyses: Adjusted for covariates of model 2. At risk: Participants without diabetes at baseline. Incident type 2 diabetes: Participants who developed type 2 diabetes during follow-up.