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Trajectories of effort-reward imbalance in Swedish workers: Differences in demographic and work-related factors and associations with health

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ABSTRACT
The aim of the study was to identify trajectories of effort-reward imbalance (ERI), to examine these with respect to demographic (age, gender, socio-economic position) and work-related (employment contract, work hours, shift work, sector) factors, and to investigate associations with different health indicators (self-rated health, depressive symptoms, migraine, sickness absence). The study used four waves of data (N = 6702), collected biennially within the Swedish Longitudinal Occupational Survey of Health (SLOSH). Using latent class growth modelling, we identified four trajectories: a stable low imbalance trajectory, which comprised 90% of all participants, and three change trajectories including a decreasing trajectory (4% of the participants), an inverted U-shaped trajectory and an increasing imbalance trajectory, both in 3% of the participants. Results indicate that a sizeable proportion of Swedish employees’ experience imbalance between efforts and rewards at work. The most favourable trajectory comprised relatively more men and was characterised by better work-related characteristics than the less favourable ERI trajectories. All change trajectories were dominated by women and employees in the public sector. Health developments followed ERI trajectories, such that less favourable trajectories associated with impaired health and more favourable trajectories associated with better health. Sickness absence increased among all ERI trajectories, most so for the decreasing and increasing ERI trajectory.

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Effort-reward imbalance; longitudinal; health; Sweden; trajectories; work stress

Introduction
A positive psychosocial work environment is important to protect employees’ health, well-being and work ability until retirement. However, a recent Swedish report on work life quality (Sverke, Falkenberg, Kecklund, Magnusson Hansson, & Lindfors, 2017) shows that work-related stress is still a concern for many and work life quality differs considerably between workers in different industries, and with different backgrounds.
Work-related stress can be conceptualised in different ways; one of the most predominant theories is the effort-reward imbalance (ERI) model developed by Siegrist (1996). This model defines work stress as a perceived lack of reciprocity in terms of what an individual puts into the work and what is gained from it, i.e. the rewards the individual gets in return. Efforts at work are typically understood as psychological and physical demands and work-related rewards as monetary gain, esteem, career opportunities, and job security (Siegrist & Wahrendorf, 2016). Although scholars have shown much interest in the ERI model over the years, only few studies on ERI involve more than two measurement points.

While there is no inherent development potential in ERI, it has been suggested that the ERI level may change over time, for example, due to changes in the organisation (Tsutsumi, Nagami, Morimoto, & Matoba, 2002), but also due to changes in work roles, tasks or benefits. Such changes can be expected to influence an employees’ perception of the ratio between efforts and rewards. However, how ERI levels change over time, and what that means for health, remains largely unknown. Consequently, long-term effects on employees’ health and well-being in relation to how ERI develops over time are still understudied. This is despite an increasing awareness of a need for more longitudinal studies to fully understand the association between work stress and health (Siegrist & Wahrendorf, 2016). In addition, a lack of longitudinal studies on ERI also means that little is known about potential risk groups that experience continuous ERI over a longer time, or for whom imbalance develops gradually over the years. Being able to detect and characterise such groups is an important prerequisite for developing preventive measures. Therefore, the aims of the present study are (i) to identify patterns (trajectories) of ERI over time in the Swedish working population, (ii) to describe these trajectories by means of the workers’ demographic and work-related factors, and (iii) to evaluate how multiple health indicators associate with these trajectories.

Our study, which uses four waves of data covering a time period of six years, contributes to the existing literature in several ways. First, to gain a deeper understanding of the development of ERI we adopted a person-centred perspective to identify employees with different developments in ERI over time. Secondly, our analyses are based on a large sample which is approximately representative of the Swedish working population and covers a wide range of different occupations. Although, there is an increasing number of papers studying ERI in general working populations (Peter, March, & du Prel, 2016; Rugulies et al., 2009), earlier work was often restricted to certain occupational groups such as nurses (Hasselhorn, Tackenberg, Peter, & Next-Study, 2004), managers (Kinnunen, Feldt, & Makikangas, 2008), or health care workers (Derycke et al., 2010). Thus, we add to discussion on generalizability across studies. Third, ERI trajectories are analysed in relation to a set of demographic and work-related factors, which enables us to identify potential risk groups of experiencing ERI over a longer period of time or reporting unfavourable developments over time. Fourth, to extend knowledge on health effects of ERI we analyse ERI trajectories in relation to a set of health indicators (self-rated health, depressive symptoms, migraine, and sickness absence) that previously have been found to associate with ERI in cross-sectional or prospective studies with no more than two measurement points.

The model of ERI has received widespread attention over the years, predominantly in the public health area but also in work and occupational psychology (e.g. Dragano et al., 2017; Rugulies, Aust, & Madsen, 2017). The benefit of the model over other stress theories
is that it encapsulates a more complex balance between what an employee gives and receives in return, thus, putting the focus on the reciprocity and social exchanges at the workplace. An imbalance between efforts and rewards creates negative emotions and negative physiological reactions (Siegrist & Wahrendorf, 2016). However, when perceiving a balance between efforts and rewards, this creates positive emotions and promotes health and well-being. Such a favourable situation with efforts and rewards in balance is known to relate to job satisfaction, health and well-being (van Veghel, de Jonge, Bosma, & Schaufeli, 2005), and should thus be a situation that employees seek and attempt to maintain. In contrast, one expects that employees who frequently experience a lack of reciprocity leave their employment to find better conditions elsewhere (see expectancy-value theory, Schönpflug & Batman, 1989). However, in some life circumstances this might not be possible. For example, if the employee has a low educational level or lives in a remote area, he or she might not see or have other options on the labour market (Fahlén et al., 2009). Furthermore, an employee might accept an imbalance between efforts and rewards in their employment for some time because of strategic reasons, e.g. to improve his or her chances for a permanent employment or a career promotion (Bernhard-Oettel, Sverke, & De Witte, 2005; Siegrist & Wahrendorf, 2016). In addition, particularly in the beginning of a career, an individual may have to invest more efforts to learn all necessary abilities and skills for a certain occupational role. In such a situation, however, a period of relatively high ERI should be followed by decreases in ERI as the individual experiences less efforts (due to increased mastery), can secure a better job or the sought-for career promotion. Yet another possible development is that of a relatively low ERI gradually turning into a more unfavourable balance; that is, efforts start to exceed rewards. Such developments may be due to organisational changes in which job roles are reorganised, or resources and budgets cut (Boyne, Poole, & Jenkins, 1999). Another situation for such unfavourable developments over time may be that an ageing workforce gradually feels that job requirements are more and more difficult to fulfil (Peeters & van Emmerick, 2008; Villioso, Di Pierro, Giordanengo, Pasqua, & Richiardi, 2008).

To conclude, while people generally will try to get and maintain a balance between efforts and rewards, for instance, by increasing rewards or reducing efforts, there may be certain situations in which this is difficult and consequently may spur disadvantageous ERI developments over time.

**Long-term patterns of ERI in a heterogeneous sample**

Despite the large amount of studies conducted on ERI, there are few studies investigating differences in developments in ERI. Also, differences in ERI between different groups have rarely been studied. Thus, it remains unknown how stable or unstable ERI experiences are, if these differ between people, and what the most typical developments look like. One important way to overcome this shortcoming is to study developments over time by way of trajectories (Siegrist & Wahrendorf, 2016). On the one hand, trajectories can be described as growth processes for an entire population, focusing on general trends while ignoring inter-individual differences in the development (Curran, Obeidat, & Losardo, 2010). In this line, one previous study investigated ERI trajectories among pregnant working women and found that both efforts and rewards declined across pregnancy (Meyer, Muntaner, O’Campo, & Warren, 2016). On the other hand, assuming that
employees represent homogenous members of a group in terms of ERI is not only associated with a possible loss of important information but also seems unrealistic, especially when studying large and heterogeneous populations. Thus, in contrast to a variable-centred approach, a person-centred approach does assume heterogeneity. It tries to sort the study population into latent subgroups whose members are similar to each other but different from those in other subgroups and makes it possible to reveal heterogeneity in developmental trajectories. In order to add to the discussion of how ERI develops over time, we use a person-centred approach to reveal latent subgroups of ERI among a large cohort of employees in Sweden.

Today, studies investigating associations between ERI trajectories across a variety of occupations and workers with divergent backgrounds are missing. To the best of our knowledge, only one single paper has investigated diverging trajectory patterns of effort and reward (Feldt et al., 2013); however, while also taking overcommitment (a specific coping pattern characterised by excessive engagement and a desire of being in control, OVC) into account. This study, based on data from 298 Finnish, mostly male, managers, identified five developmental patterns of ERI-OVC characterised by different ERI levels and change patterns. Most common were patterns of stable ERI; only 9% of the population showed changes in ERI-OVC patterns over a time of four years. Further, 47% of the study population were characterised by low ERI and moderate overcommitment. We extend this research by including a study population approximately representative of the Swedish working population. Additionally, while the aforementioned study focused on how ERI trajectories resulted in health differences at the end of the study period, we follow both ERI trajectories and health developments to detect both simultaneous and delayed developments in health.

Based on the reasoning above and previous findings, it is reasonable to expect heterogeneity in experiences of ERI over time. Specifically, based on the results by Feldt et al. (2013), we expect at least one group with a stable ERI pattern. Because we follow participants over a relatively long time, it is reasonable to believe that some will experience changes in ERI, and we therefore expect patterns of changing ERI over time, too. Thus, our first research question reads:

RQ1: Which ERI trajectories can be identified in the sample of Swedish employees in the present study?

**Associations between ERI trajectories and demographic and work-related factors**

The second aim of this paper is to describe these ERI trajectories in terms of demographic and work-related factors. Despite the extensive research on ERI, surprisingly little research has focused on how demographic variables associate with experiences of ERI. Differences regarding demographic factors have widely been neglected or are merely a bi-result of studies. Indeed, the majority of studies treat demographic variables as confounders. However, since the Swedish labour market is gendered both hierarchically and vertically, there are reasons to believe that men are found in positions with better ERI developments than women. Also, age and education may affect ERI, as older workers may have to effort more for the same rewards and those with low education are in more disadvantageous positions. Looking at the existing evidence, however, results have been contradictory. In a large study of German employees, men reported higher effort and slightly higher ERI values than
women (Wege, Li, & Siegrist, 2018). In another study, based on a large European sample of men and women under the age of 65, Siegrist, Wahrendorf, von dem Knesebeck, Jurges, and Borsch-Supan (2007) found that ERI was somewhat more prevalent among younger (<55 years) and those with a lower socioeconomic status. This finding is similar to that reported by Hintsa et al. (2015), who found that younger age and lower occupational class were related to higher ERI. Wahrendorf, Dragano, and Siegrist (2013) observed a gradual increase in the prevalence of ERI with decreasing occupational position. However, findings on ERI in various occupational positions are not consistent and research indicates that the mismatch between high efforts and low rewards is not necessarily more pronounced in lower occupational positions (Siegrist & Wahrendorf, 2016). For example, in a Danish cross-sectional study, Rugulies et al. (2009) found that executives in the public sector, social workers, and managing clerks scored high on ERI, while low ERI scores were found among workers in pre-school and child care, and cleaners.

We also wanted to investigate differences in ERI developments based on work-related factors. As is the case for demographic factors, work-related factors have rarely been studied in relation to ERI. Still, occupational position is closely linked to both physical and psychosocial working conditions; such is shift work, which relates to efforts, more common in lower occupational positions. Other important factors may be type of work contract and main employer (public versus private). For example, temporary as compared to permanent workers may perceive more imbalances between efforts and rewards, especially with respect to job security (a specific reward in the ERI model) (Bernhard-Oettel et al., 2005). Moreover, chances to leave for another employment elsewhere (to re-balance ERI) or to make a career and improve rewards differ when it comes to public versus private employers. Type of employer is also of interest as ERI has been found to be more common in female-dominated occupations (Nyberg, Magnusson Hanson, Leineweber, Hammarstrom, & Theorell, 2018), which are predominantly situated in the public sector. Thus, our second research question reads:

RQ2: How do the observed ERI trajectories relate to workers’ demographic (gender, age, socio-economic position) and work-related (type of work contract, working hours, shift work, main employer) factors?

**Associations of ERI trajectories with health indicators**

The ERI model has resulted in a large amount of studies investigating ERI in relation to health outcomes, such as cardiovascular disease (e.g. Bosma, Peter, Siegrist, & Marmot, 1998; Dragano et al., 2017; Li, Zhang, Loerbroks, Angerer, & Siegrist, 2015), depression (e.g. Rugulies et al., 2017), and self-reported health (e.g. van Vegchel et al., 2005). In addition, studies have also investigated stress indicators, such as musculoskeletal pain (Halonen et al., 2018) and migraine (Mäki et al., 2008). Sickness absence, a behavioural consequence of ill-health, has been found to be associated with ERI by a number of researchers (e.g. Derycke, Vlerick, Van den Ven, Rots, & Clays, 2013; Nielsen, Madsen, Aust, Burr, & Rugulies, 2016; Siegrist & Wahrendorf, 2016). Still, it remains unknown how the above-hypothesised developments in ERI are associated with health developments. On the one hand, it has been suggested that ERI might not influence health over longer periods as people will try to reduce their efforts and/or to maximise their rewards (Schönpflug & Batman, 1989). On the other hand, people might not be able to make required
adaptations, and it is reasonable to expect that long and constant periods of ERI are more strongly associated with poor health than shorter and unstable ERI periods. According to Siegrist (Siegrist, 1996; Siegrist & Wahrendorf, 2016), the recurrent experience of failed reciprocity in effort and reward is expected to negatively affect the health and well-being of working people. This has often been explained by the compromising effects that poor ERI might have on self-esteem and increasing stress responses (Bellingrath & Kudielka, 2016), that over time might result in mental and physical disorders.

While health is a commonly studied outcome of ERI, we still lack knowledge about how diverging temporal patterns of ERI relate to employees’ health. It has been suggested that health-related consequences should be weaker with declining levels of imbalance (Wahrendorf & Chandola, 2016), but empirical evidence is lacking. The scarcity of studies investigating ERI trajectories also implies that it remains unclear whether associations between ERI and health developments depend on the health indicator studied. While some health outcomes might occur close in time, some health reactions might develop over a longer time and first emerge after some time. Thus, our third research questions reads:

RQ3: How do the observed ERI trajectories relate to workers’ health (self-rated health, depressive symptoms, migraine, and sickness absence) over time?

Methods

Study population and design

Data were gathered from the Swedish Longitudinal Occupational Survey of Health (SLOSH) study. SLOSH is a follow-up of the Swedish Work Environment Survey (SWES), which is conducted every second year and representative of the working population aged between 16 and 64 years in Sweden. The SLOSH questionnaires started in 2006 by inviting the stratified random respondents of the SWES 2003. Since the cohort has been extended with additional SWES waves and today SLOSH comprises all SWES 2003–2011 participants (n = 40,877). Respondents of the SWES are invited to participate in SLOSH via postal, self-administered questionnaires every other year. Response rates varied from 65% in 2006 to 51% in 2016. For a detailed description of SLOSH, please see Magnusson Hanson et al. (2018).

The current study is based on data from the 2010 to 2016 data collection (i.e. four waves). The analytic sample consists of participants who answered at baseline (wave 3 (coded as T0), n = 9132) and at least one of the following waves (n = 6702). Out of those 6702 participants, 2683 (40.0%) participants had information on ERI for all four measurement times, 2232 (33.3%) participants had information for baseline and two subsequent waves, and 1787 (26.7%) participants had information on ERI for baseline and one subsequent wave. Ethical approval for SLOSH and the present study was obtained by the Regional Research Ethics Board in Stockholm.

Participants

The mean age at T0 was 48.74 years and varied between 21 and 71 years (SD = 9.43). The majority of study participants were women (n = 3799; 56.7%), white-collar employees (n = 4475; 69.58%), had a permanent employment (n = 5970, 90.65%) and worked full-
time (n = 5355; 80.96%). Just under half of the participants were employed by a private employer (n = 3,017; 45.73%). About one out of five (n = 1139; 17.29%) worked shift work.

**Attrition analyses**

Attrition analyses were performed to test if participants in the final sample (n = 6702) did differ from those who had responded to the questionnaire for those in paid work at baseline but had no follow-up data to be included in the final sample (n = 2430). Participants in the final sample were younger (t(3665) = −14.50, p < .0001), more often women (χ²(1) = 8.52, p < .01), and white-collar workers (χ²(1) = 45.06, p < .0001). They also reported statistical significant higher baseline values in ERI (t(8596) = 3.13, p = .0017) and efforts (t(3576.2) = 6.08, p < .0001). No differences in rewards were found (t(8682) = 0.51, ns).

**Measures**

**ERI**

The Swedish validated short-version of the ERI questionnaire was used, where effort is measured by three items and reward by seven items (Leineweber et al., 2010; Li, Leineweber, Nyberg, & Siegrist, in press). One example item for effort is “I have constant time pressure due to heavy workload.” Reward consists of three components: “esteem,” represented by two items, “job promotion,” represented by three items, and “job security,” represented by two items. An example item for reward is “Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.” Items were answered on a four-point scale (from 1 = agree totally to 4 = do not agree at all). Sum scores of these ratings were calculated with appropriate recoding, such that higher scores reflect higher efforts and higher rewards. Effort scores ranged from 3 to 15 and reward scores from 7 to 35. The Cronbach’s alphas for rewards varied between .76 and .79 and for efforts between .72 and .73. Finally, an effort-reward ratio was calculated according to the formula: e/(r × c), where c is the ratio of the number of items (here: 3/7) (Siegrist et al., 2004). Descriptive information on efforts, rewards, ERI, and health outcomes (number of items, ranges, means, standard deviations, reliabilities) are shown in Table 1.

**Background and work-related factors**

Age, sex, and socio-economic position were chosen to describe potential patterns in ERI trajectories and all obtained from register data linked to questionnaire responses. Age was

| Table 1. The descriptive of the study variables (n = 6702). |
| --- | --- | --- | --- | --- |
| **Variable** | **Number of items (range)** | **Mean (SD)** | **Cronbach’s alpha** |
| **** | **** | **T0** | **T1** | **T2** | **T3** | **T0** | **T1** | **T2** | **T3** |
| Effort | 3 (3–15) | 7.95 (2.12) | 8.07 (2.13) | 8.14 (2.14) | 8.07 (2.16) | .76 | .78 | .78 | .79 |
| Reward | 7 (7–35) | 18.24 (3.62) | 18.07 (3.55) | 18.70 (3.54) | 18.70 (3.51) | .73 | .72 | .72 | .72 |
| ERI ratio | – | 1.08 (0.45) | 1.10 (0.45) | 1.07 (0.43) | 1.06 (0.42) | – | – | – | – |
| Self-rated health | 1 (1–5) | 4.01 (0.78) | 4.017 (0.80) | 3.99 (0.81) | 3.96 (0.82) | – | – | – | – |
| Depressive symptoms | 6 (1–5) | 1.90 (0.85) | 1.77 (0.80) | 1.84 (0.81) | 1.80 (0.82) | .91 | .91 | .90 | .91 |
| Sickness absence | 1 (1–4) | 1.72 (0.85) | 1.70 (0.85) | 1.68 (0.86) | 1.77 (0.89) | – | – | – | – |
| Migraine | 1 (1–4) | 1.26 (0.66) | 1.25 (0.66) | 1.24 (0.65) | 1.24 (0.65) | – | – | – | – |

Note: ERI, effort-reward imbalance.
measured in years. Sex was binary coded into men and women. Socioeconomic position was based on the Swedish socio-economic classification (Statistics Sweden, 1982) and recoded into white-collar and blue-collar workers.

All work-related variables were derived from the questionnaire data. We chose type of employment (permanent/temporary, substitutes and hourly paid/self-employed, farmers, and others), full-time work (yes/no), shift work (yes/no), and type of employer (private/municipality, county council, state) to describe participants’ work-related characteristics in the identified trajectories. All demographic and work-related characteristics were measured at T0.

**Health outcomes**

All health outcomes were based on questionnaire data. **Self-rated health** (Benyamini & Idler, 1999) was measured with one item “How would you rate your general state of health?” answered on a five-point scale reaching from 1 = very good to 5 = very poor and reversed for analyses. Thus, higher values indicate better self-rated health. **Depressive symptoms** were measured with the six items of the Symptom Checklist-core Depression Scale (Magnusson Hanson et al., 2014). An example item is: “How much have you been troubled by feeling blue?” Items were answered on a 5-point Likert scale ranging from “1 = not at all” to “5 = very much.” Higher values indicate more depressive symptoms. Reliabilities were satisfactory at all four measurement points (see Table 1). **Migraine** was assessed by a statement following the question: “Have you or have you had one or more of the following protracted and/or serious illnesses or complaints during the last 2 years?” Responses were given on a four-point scale indicating if one suffered of the illness and how much it influenced life (1 = No, 2 = Yes, but it does not influence my life, 3 = Yes, it influences my life somewhat, 4 = Yes, it influenced my life considerably). Higher values indicate more migraine. **Short-term sickness absence** (Leineweber et al., 2017) was measured by one question “How often have you taken sick leave for a week or less in the past 12 months? Do not count taking care of a sick child.” Responses were given on a four-point response scale with 1 = not at all, 2 = once, 3 = 2–3 times and 4 = four times or more. Higher values indicate more sickness absence.

**Statistical analysis**

We used latent class growth curve analysis (Andruff, Carraro, Thompson, & Gaudreau, 2009; Jung & Wickrama, 2008) to model intra-individual change in ERI over a time period of six years. Latent class growth curve analysis is a very flexible technique for modelling systematic intra- and inter-individual differences in change over time (Nagin, 2005), which allowed us to identify naturally occurring homogeneous latent classes of individuals based on statistical terms. These homogeneous classes differ according to their levels of ERI across measurement points.

Various criteria were used to determine the number of latent classes. The number of trajectories was selected based on the Bayesian Information Criterion (BIC) and the ABIC, where significant decreases indicate better model fit. We also inspected the Vuong-Lo-Mendell-Rubin (VLMR) likelihood ratio test, the Lo-Mendell-Rubin adjusted likelihood ratio test (LMR), and the parametric bootstrapped likelihood ratio test (BLRT), where values >.05, imply that k trajectories are enough compared to k + 1 trajectories (Jung &
Furthermore, we checked entropy values, where values >.90 are preferable. Finally, total count percentages (at least 1% of the participants in a trajectory), percent of total counts and posterior probabilities for the ERI trajectories were inspected (Jung & Wickrama, 2008). Average posterior probabilities of group membership greater than .70 or .80 indicate that individuals with similar patterns of change are grouped together and that individuals with dissimilar patterns of change are discriminated between (Andruﬀ et al., 2009). We assessed replicability using the optseed option. Mplus 7.4 was used for LCGM, which uses full information maximum likelihood to account for missing data.

To describe trajectory patterns in respect to demographic (age, sex, socio-economic position), and work-related factors (type of employment, work hours, shift work, type of employer), we used chi-square and analyses of variance. Finally, associations with health (self-rated health, depressive symptoms, migraine, and sickness absence) were analysed by means of GLM analyses with repeated measures using the proc mixed procedure in SAS 9.4. Because demographic variables inﬂuence health considerably, the analyses relating to health were adjusted for demographic characteristics.

Results

Identifying ERI trajectories

Table 2 reports the ﬁt indices for the unconditional latent class models for ERI. It can be seen that entropy was highest in the two-trajectory solution with the second-highest entropy found for the three-trajectory solution. Posterior probabilities were above or close to .80 in all models. BIC, ABIC, BLRT and VLMR all supported a solution with at least four trajectories. The solution with ﬁve trajectories did converge, but one of the trajectories comprised not more than 0.7% (n = 50) of all individuals. On the basis of the information provided by the ﬁt indices, we chose a four-trajectory solution for subsequent analyses.

The four-trajectory solution is illustrated in Figure 1. The trajectory that comprised the most individuals represented close to 90% (n = 6012) of the participants. At baseline, it was characterised by moderate values of effort (M = 7.74, SD = 2.05) matched by moderate values of reward (M = 18.77, SD = 3.22), resulting in an ERI score of 1.00 ± 0.34. The ERI level was persistent over time and we labelled this the “stable low” ERI trajectory. The next largest trajectory consisted of 4% (n = 264) of all participants. It had the highest baseline value of effort (M = 10.65, SD = 1.41) and the lowest baseline values of reward (M = 10.87, SD = 2.05), revealing a high imbalance (M = 2.34, SD = 0.45). This trajectory was characterised by a decrease in the ERI score over time. We labelled this trajectory as “decreasing” ERI trajectory. The third trajectory represented 3% (n = 227) of all participants. It was characterised by moderate baseline values of effort (M = 8.77, SD = 2.00) matched by moderate values of reward (M = 15.46; SD = 3.50), resulting in a mean ERI of 1.39 (SD = 0.48). As indicated by a statistically signiﬁcant quadratic term, the slope showed an increase in ERI followed by a decrease (intercepts, slopes, and quadratic terms can be obtained from the corresponding author). This pattern was labelled the “inverted U-shaped” trajectory. The last trajectory represented 3% (n = 198) of all participants. It was characterised by a rather high mean value in effort (M = 9.65; SD = 1.67) in combination with a moderate mean value of reward (M = 15.34, SD = 3.30), giving a mean ERI score of 1.54 (SD = 0.45). This trajectory had a pronounced signiﬁcant negative slope
<table>
<thead>
<tr>
<th>No. of trajectories</th>
<th>Tech 14 BLRT $\chi^2$ (df)</th>
<th>BIC</th>
<th>ABIC</th>
<th>VLMR</th>
<th>LMR</th>
<th>Entropy</th>
<th>% of total counts</th>
<th>Posterior probability</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td></td>
<td>18397.945</td>
<td>18356.634</td>
<td>–</td>
<td>–</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1186.429 (4)***</td>
<td>17246.756</td>
<td>17192.734</td>
<td>–9141.706***</td>
<td>1153.692***</td>
<td>.940</td>
<td>[0.05; 0.95]</td>
</tr>
<tr>
<td>3$^a$</td>
<td></td>
<td>977.622 (4)***</td>
<td>16390.528</td>
<td>16333.329</td>
<td>–8604.784***</td>
<td>950.646***</td>
<td>.930</td>
<td>[0.03; 0.92]</td>
</tr>
<tr>
<td>4$^a$</td>
<td></td>
<td>317.155 (4)***</td>
<td>16108.614</td>
<td>16038.703</td>
<td>–8115.973**</td>
<td>308.404**</td>
<td>.894</td>
<td>[0.03; 0.90]</td>
</tr>
<tr>
<td>5$^a$</td>
<td></td>
<td>207.616 (4)***</td>
<td>15936.239</td>
<td>15853.617</td>
<td>–7957.395</td>
<td>201.887</td>
<td>.890</td>
<td>[&lt;0.01; 0.88]</td>
</tr>
</tbody>
</table>

Notes: Values in italics highlight indicate the chosen solution; ABIC, Akaike Bayesian Information Criterion; BIC, Bayesian Information Criterion; BLRT, bootstrapped likelihood ratio test; ERI, effort-reward imbalance; VLMR, Vuong–Lo–Mendell–Rubin; LMR, likelihood ratio.

***p < .001.
**p < .01.*p < .05.
$^a$q variance fixed to zero.
and a positive quadratic term, indicating an accelerating increase in ERI over time. We labelled it the “increasing” ERI trajectory. As seen in Table 3, the ERI ratio showed several significant mean differences across the four trajectories at each measurement time.

**ERI trajectories in relation to demographic and work-related background factors**

The decreasing ERI trajectory showed the highest mean age, while the increasing ERI trajectory displayed the lowest mean age ($F(3,6702) = 3.99, p < .01$). Women were underrepresented in the stable low ERI trajectory ($\chi^2(3) = 60.9, p < .0001$). Socio-economic

Table 3. The four-class solution for the ERI trajectories over a six-year follow-up period with four measurement times ($N = 6702$) (Latent Class Growth Analysis).

<table>
<thead>
<tr>
<th>Variable</th>
<th>T0 M (SE)</th>
<th>T1 M (SE)</th>
<th>T2 M (SE)</th>
<th>T3 M (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stable low ERI</td>
<td>6012 (89.7)</td>
<td>1.00 (0.34)</td>
<td>1.03 (0.36)</td>
<td>1.00 (0.33)</td>
</tr>
<tr>
<td>2. Decreasing ERI</td>
<td>264 (3.9)</td>
<td>2.34 (0.45)</td>
<td>1.54 (0.59)</td>
<td>1.26 (0.48)</td>
</tr>
<tr>
<td>3. Inverted U-shaped ERI</td>
<td>227 (3.4)</td>
<td>1.39 (0.48)</td>
<td>2.22 (0.50)</td>
<td>2.21 (0.53)</td>
</tr>
<tr>
<td>4. Increasing ERI</td>
<td>199 (3.0)</td>
<td>1.54 (0.45)</td>
<td>1.44 (0.42)</td>
<td>1.58 (0.46)</td>
</tr>
<tr>
<td>F-test</td>
<td>1424.01***</td>
<td>706.09***</td>
<td>776.74***</td>
<td>749.39***</td>
</tr>
<tr>
<td>Pairwise comparison</td>
<td>1 $&lt; 2,3,4$</td>
<td>1 $&lt; 2,3,4$</td>
<td>1 $&lt; 2,3,4$</td>
<td>1 $&lt; 2,3,4$</td>
</tr>
<tr>
<td></td>
<td>2 $&gt; 1,3,4$</td>
<td>2 $&lt; 3$</td>
<td>2 $&lt; 3,4$</td>
<td>2 $&lt; 3,4$</td>
</tr>
<tr>
<td></td>
<td>3 $&lt; 2,4$</td>
<td>3 $&gt; 1,2,4$</td>
<td>3 $&gt; 1,2,4$</td>
<td>3 $&lt; 4$</td>
</tr>
</tbody>
</table>

Note: ERI, effort-reward imbalance.

*aTukey comparison.

***$p < .001$.**
position differed statistically significantly between ERI trajectories, with the highest proportion blue-collar workers in the inverted U-shaped and the increasing ERI trajectory ($\chi^2(3) = 14.22$, $p < .01$). Shift workers were overrepresented in the inverted U-shaped and the increasing ERI trajectory ($\chi^2(3) = 33.01$, $p < .001$). The proportion of employees working in the public sector (i.e. municipality, county council, state) was highest in the decreasing ERI trajectory ($\chi^2(3) = 33.84$, $p < .001$). No statistically significant differences between the trajectories were observed with regard to the type of employment and full-time work (Table 4).

**ERI trajectories in relation to health indicators**

Means and mean changes in health outcomes in relation to the four identified ERI trajectories are presented in Table 5 (for visualised presentation see Figure 2). Significant interaction terms between the four ERI trajectories and time were observed for all health outcomes except sickness absence. Specifically, participants classed in the stable low ERI trajectory reported best values for the health indicators self-rated health, depressive symptoms, and migraine at all times. Those in the decreasing ERI trajectory display rather sharp improvements in health between T0 and T1 with an increase in self-rated health and a drop in both depressive symptoms and migraine. Those in the inverted U-shaped trajectory, reported the best health at T0 and T3 and less good health at T1 and T2, both in terms of self-rated health and depressive symptoms. Regarding migraine, those in the inverted U-shaped trajectory seemed to experience an increase in migraine over the years. For those in the increasing ERI trajectory, health generally deteriorated over the years for all health outcomes, with the worst health reported at T3.

Regarding sickness absence, statistically significant main effects were observed for both ERI trajectories and time, while the interaction term was just below the significance level ($p = .052$). Those in the stable low ERI trajectory reported the lowest levels of sickness absence at all times, although an increase of sickness absence over time was observed. Among the three less favourable ERI trajectories, there was an increase in sickness absence over time, but differences between trajectories were small.
Table 5. Changes in self-rated health, depressive symptoms, migraine, and short sickness absence (< one week) according to ERI trajectory, using GLM with repeated measures (controlled for age, sex, and socio-economic position).

<table>
<thead>
<tr>
<th></th>
<th>Stable low ERI (n = 6012)</th>
<th>Decreasing ERI (n = 264)</th>
<th>Inverted U-shaped ERI (n = 227)</th>
<th>Increasing ERI (n = 199)</th>
<th>Trajectory difference</th>
<th>Time effect</th>
<th>Trajectory × time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T0 (M (SE))</td>
<td>T1 (M (SE))</td>
<td>T2 (M (SE))</td>
<td>T3 (M (SE))</td>
<td>T0 (M (SE))</td>
<td>T1 (M (SE))</td>
<td>T2 (M (SE))</td>
</tr>
<tr>
<td>Self-rated health</td>
<td>4.05 (0.01)</td>
<td>4.07 (0.01)</td>
<td>4.03 (0.01)</td>
<td>4.00 (0.01)</td>
<td>3.55 (0.05)</td>
<td>3.73 (0.05)</td>
<td>3.71 (0.05)</td>
</tr>
<tr>
<td>Depression</td>
<td>1.81 (0.01)</td>
<td>1.72 (0.01)</td>
<td>1.80 (0.01)</td>
<td>1.79 (0.01)</td>
<td>2.56 (0.05)</td>
<td>2.10 (0.05)</td>
<td>2.20 (0.05)</td>
</tr>
<tr>
<td>Migraine</td>
<td>1.23 (0.00)</td>
<td>1.24 (0.01)</td>
<td>1.24 (0.01)</td>
<td>1.25 (0.01)</td>
<td>1.37 (0.04)</td>
<td>1.28 (0.04)</td>
<td>1.29 (0.04)</td>
</tr>
<tr>
<td>Sickness absence</td>
<td>1.68 (0.01)</td>
<td>1.68 (0.01)</td>
<td>1.68 (0.01)</td>
<td>1.78 (0.01)</td>
<td>1.96 (0.05)</td>
<td>1.97 (0.06)</td>
<td>1.84 (0.06)</td>
</tr>
</tbody>
</table>

Note: ERI, effort-reward imbalance.
***p < .001.
**p < .01.
*p < .05.
Discussion

In this study, we investigated developmental patterns of ERI over the course of six years. We identified four distinctive ERI trajectories, which differed not only in their start values and developmental patterns, but the workers within each trajectory also varied considerably concerning their demographic and work-related characteristics. Furthermore, we found substantial differences in health between trajectories, where health developments generally matched ERI trajectories.

ERI trajectories in relation to demographic and work-related factors

Most participants (90%) were in the favourable trajectory, which showed a pattern of persistent low ERI over time. While we labelled this trajectory the “stable low ERI” trajectory, it should be considered that the ERI levels are rather at the higher end of the mean ERI levels reported in previous studies (Siegrist, Li, & Montano, 2014). Thus, most of the Swedish employees seem to experience at least some imbalance between efforts and reward, although ERI levels varied quite largely within the class (from around 0.2 to values above 2).

Our findings are congruent with those of other studies showing that ERI is relatively stable over the years (Feldt et al., 2013). In a Finnish study investigating trajectories of ERI in combination with overcommitment, about 71% of the study population were classified as being in a stable low ERI trajectory, although these were sorted into different ERI patterns due to different overcommitment values (Feldt et al., 2013). In line with our expectations, we also identified three trajectories with distinctive ERI developments over time, where both increasing and decreasing ERI were observed. Trajectories...
differed not only in ERI developments but also with regard to demographic and work-related factors.

The low imbalance trajectory was characterised by a relatively higher proportion of men, while the more unfavourable ERI trajectories showed an overrepresentation of women. In this, our findings follow the results from a Finnish study investigating developmental patterns of ERI among managers that found a higher number of women in the unfavourable change pattern characterised by an increasing imbalance between efforts and rewards (Feldt et al., 2013). While we are not aware of any other study investigating ERI trajectories, gender differences in efforts and rewards have been reported in some previous studies (Li, Yang, & Cho, 2006; Peter et al., 1998; Siegrist et al., 2004; Wege et al., 2018), mainly showing lower levels of ERI among women. Siegrist et al. (2004) compared different large epidemiological studies and found lower efforts as well as lower rewards among women in three out of five studies; only in one of those studies did women report higher efforts. Also, Wege et al. (2018) found a more positive ERI ratio among women, which seemed mostly driven by lower efforts. In contrast to these studies, we see less favourable ERI patterns especially among women. This may be explained by the strongly gender-segregated Swedish labour market with women predominantly working in the publicly funded service sector characterised by poorer working conditions (Aronsson, Toivanen, Leineweber, & Nyberg, 2018) with high demands (Cerdas, Härenstam, Johansson, & Nyberg, 2019) and low salaries (also when taking qualification requirements into account) (SOU, 2015). Consequently, the mismatch between qualification requirements of the job and the salary could be one explanation of the higher ERI levels in these trajectories. The possibilities of career development are also lower in many of the female-dominated occupations compared with gender-mixed and male-dominated ones. Also, the working conditions in the female-dominated industries education, health, and social care have been found to develop more negatively compared with other industries on the Swedish labour market particularly since the end of the 1990s (Kamp, Klemsdal, & Gonäs, 2013). With increasingly higher work demands and increasingly poorer job control (Cerdas, et al., under review), many employees in female-dominated occupations may indeed experience an increase in ERI.

ERI trajectories did not only differ by gender, but also by socioeconomic position, where blue-collar and shift workers dominated the more negative trajectories. Similar results were reported by Wahrendorf et al. (2013), who found a gradual increase in ERI prevalence with decreasing social position. Still, a number of other studies revealed either no or even a reversed association between occupational status and ERI (e.g. Chandola, Siegrist, & Marmot, 2005; Wege et al., 2008). While we were not able to identify which specific efforts and rewards, such as time pressure or low career possibilities, contributed to a lower ERI in the more unfavourable ERI trajectories, we found that the more negative ERI trajectories reported as well higher efforts as lower rewards. To allow tailored interventions future research should try to identify the contributing factors.

**ERI trajectories and health developments**

Our study points to considerably higher ill-health and sickness absence among employees with more unfavourable ERI trajectories, also when taking demographic differences into account. This is in line with previous studies of both cross-sectional and longitudinal
design (van Vegchel et al., 2005), which have shown associations between ERI and cardiovascular disease (e.g. Dragano et al., 2017), depression (e.g. Peter et al., 2016; Rugulies et al., 2017), and psychosomatic health symptoms (e.g. Halonen et al., 2018; Mäki et al., 2008). Furthermore, in general, health developments followed ERI trajectories where a decrease in ERI was followed by health improvements and vice versa. Likewise, our findings indicate a close link between ERI and health outcomes. However, the question of causality remains unresolved. The parallel development of ERI and health does not give an indication of what comes first, ERI or poor health. It might very well be that those with poor health evaluate their work environment in terms of ERI differently as compared to persons with good health. While we limited our analyses to simple repeated GLM analyses, two-variable trajectory analyses could provide additional value in describing the close relationship between ERI and health developments.

Interestingly, associations between ERI and health development differed between health indicators. While those in the stable low ERI trajectory reported the best health levels across indicators and time, the differences between the three change trajectories were generally small and non-significant. Still, this might be, at least partly, explained by the rather small group sizes. Interestingly, sickness absence did not decrease even though ERI improved and both those in the increasing and decreasing ERI trajectory showed similar sickness absence rates at T3. Possibly, with better work conditions people dare to take sick leave. Alternatively, they may indeed need time to recover from poor working conditions. Future studies should evaluate in more detail if and in which way different health aspects are related to different ERI trajectory patterns and scrutinise immediate or delayed response patterns in terms of health.

Strengths and limitations

This study contributes to the understanding of the developmental patterns of ERI by applying a person-centred approach, utilising six years of follow-up data gathered among a broad range of employees in Sweden. Still, our study has a number of shortcomings. First, most measures are based on self-reports, which could influence ratings and lead to common method bias. While an objective measure of efforts and rewards is neither available nor preferable (as the subjective experience might be the fact that matters), objective measures of health would have been desirable. That is, we cannot exclude common method bias as both ERI and health were measured by self-reports. However, it has been suggested that common method bias may, in many cases, be trivially small (Conway & Lance, 2010; Meade, Watson, & Kroustalis, 2007). Secondly, it is possible that changes in ERI are a result of measurement variance over time and thus observed changes in ERI might not mirror real changes. However, our own analyses, as well as results reported by Törnroos et al. (2014), indicate measurement invariance over time. Third, health developments were considered only among those who had information on ERI, that is, were in paid work. Consequently, the results may be weaker than they are in reality, as those having most health problems might have been at home due to their ill-health and thus did not report on ERI. Fourth, it might be the case that the ERI measure does not completely capture the rewards experienced by those working in health care and education. It is well known that individuals choosing to work with people as their “work object,” partly
are motivated by other rewards than those related to salary and career development, such as a sense of meaningfulness in the caring and development of other people (Berthelsen, Hjalmers, Pejtersen, & Soderfeldt, 2010). Further research is wanted to cover fully the rewards in human service occupations.

**Conclusion**

To conclude, our results indicate that a large proportion of employees in Sweden experience a rather stable ratio between efforts and rewards at work. The proportion of employees that experience a strong imbalance between efforts and received rewards at work is rather low, about 10%. However, unfavourable ERI trajectories are mainly found among women working in the public sector, which is responsible for health care and education. Occupations in these sectors fight against declining numbers of people who want to work in these occupations and increasing (occupational) turnover rates (Leineweber et al., 2016). ERI trajectories are strongly related to health development and although improvements in ERI were related to improvements in health, these never reached the level of those who reported stable low ERI. Thus, to keep the workforce healthy and engaged, not least in female-dominated industries like education, health and social care, organisations should strive for a balance between efforts and rewards.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

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**Data availability statement**

The data that support the findings of this study are available on request from the corresponding author [Constanze Leineweber]. The data are not publicly available since that would compromise the integrity and privacy of the study participants.

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