

The ERI Model: Stress and Health

Initiated by Johannes Siegrist, the former Director of this Institute, in 1996, an extensive research program of this Institute has been – and continues to be – concerned with empirical research on associations of stressful work with health-related outcomes. In short, ERI (effort-reward imbalance) represents a theoretical model, rooted in sociological and social psychological research on social exchange, with explicit links to psychobiological stress theory. It aims at explaining adverse health effects of costly transactions in core social roles (paid and unpaid work, educational work, engagement in close social relationships) defined by a lack of reciprocity between efforts spent and rewards received in turn ('high cost/low gain' conditions). If experienced as a violation of the principle of just exchange, these conditions cause negative emotions and sustained stress responses, impairing health in the long run.

Importantly, ERI in terms of a health-adverse psychosocial work environment, measured by a psychometrically validated tool, has received wide interest and application among international researchers in social and occupational epidemiology, psychology, and in biomedical and clinical research. The questionnaire measuring ERI at work is available in a number of languages. It has been implemented in several epidemiologic cohort studies, and it is used as a monitoring tool for workplace health promotion in organizations. As a conceptual extension, ERI has also been operationalized to assess failed reciprocity in household and family work, in educational work, and in close social relationships.

This text starts by a short *section 1* describing the theoretical framework, followed by an extensive *section 2* on measurement, data analysis, and application of the questionnaire in international research. This section is composed by a text (2.1) on the measurement of ERI at work, and by a short description of three further ERI questionnaires (measuring failed reciprocity in household and family work, in close social relationships, and in educational work (2.2) (with links). In addition, a table displaying an overview of major international longitudinal studies measuring ERI at work is provided (2.3).

In *section 3*, some overview information on empirical research evidence on associations of ERI with a variety of health outcomes is given, focusing on systematic reviews and meta-analyses, narrative reviews, and books. In view of a large amount of original papers dealing with this topic, readers are referred to the published literature, using data bases such as PubMed, PsycINFO, Scopus, Web of Science.

The final *section 4* contains essential information on the use of the questionnaires, citation, copyright, and administration. Importantly it presents the questionnaire 'ERI at work' in several available languages (with download links), and it provides references of publications using the ERI at work questionnaire in additional languages/countries.

1. Theoretical framework

1.1 The model's hypotheses

This conceptual approach focuses on a fundamental, evolutionary stable principle of exchange in costly social transactions, the norm of reciprocity (Gouldner 1960). Persons providing an activity that has some utility to other persons expect an equivalent return according to the notion of just exchange. Violations of this principle cause adverse effects, such as strong negative emotions arousing bodily stress responses, thoughts and actions of revenge, or even disruption of social relationships. Contracts have been developed to secure equivalence of return in costly transactions. The work contract is of crucial importance, given the eminent role of continued labour market participation in people's life. In essence, it regulates the exchange between efforts delivered by employees and rewards provided by the employer. The model of effort-reward imbalance at work assumes that contractual promises are often not met in everyday work, such that workers are exposed to high effort without receiving adequate reward in return. Importantly, three basic types of reward are transmitted, salary or wage (financial reward), career promotion or job security (status-related reward), and esteem or recognition (socio-emotional reward). Continued experience of 'high cost/low gain' at work frustrates basic reward expectations, compromising workers' self-esteem and causing sustained psychobiological stress reactions with adverse long-term effects on mental and physical health (Siegrist 1996).

According to the model, distinct extrinsic and intrinsic constraints prevent workers from avoiding this imbalance, thereby increasing their risk of developing a stress-related disorder. Extrinsic constraints include lack of alternative choice in the labour market (e.g. due to poor skill level, advanced age, restricted mobility) and forced competition within one's job (e.g. due to organizational downsizing, restructuring, technological change). In a competitive labour market, unbalanced high effort is often expended as a strategic choice to improve future promotion prospects in occupational trajectories. While the level of effort spent depends on extrinsic demands it is also influenced by the working person's motivation. This model defines one such motivation, a pattern of excessive work-related commitment ('over-commitment') as an intrinsic constraint, maintaining continued experience of effort-reward imbalance at work.

The model is composed of two extrinsic components, effort and reward, and an intrinsic component, 'over-commitment'. The following hypotheses define the links between stressful work and elevated risks of disease. First, each component, high effort, low reward, and high over-commitment, exerts separate effects on the health outcome under study, reflecting a dose-response relationship. Concerning reward, this holds true for each one of its sub-components as well. Second, the effect size on health produced by the combined exposure to high effort and low reward exceeds the effect size of each single component. Third, over-commitment moderates the effect size of effort-reward imbalance on health, with a higher level increasing the risk. A further hypothesis maintains that the effect size on health due to the imbalance between high effort and low reward exceeds the effect size due to the imbalance between low effort and high reward, in accordance with the theory of loss aversion (Kahneman & Tversky 1979; Hobfoll 1989). A graphical representation of the model is depicted in Figure 1.

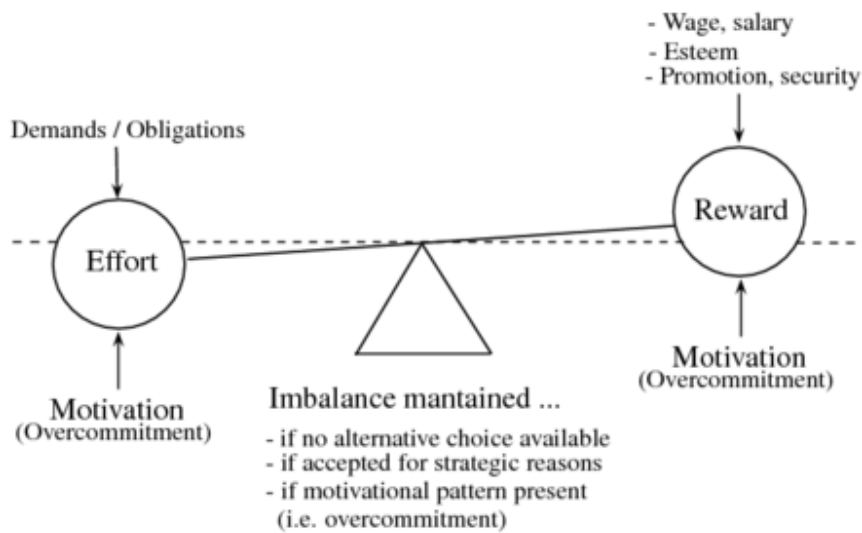


Figure 1: Theoretical model

1.2 Distinct theoretical features of the model

While this theoretical model is rooted in sociological and social psychological research on social exchange and equity (Blau 1964; Adams 1965), its original, distinctive features need to be emphasized. First, the significance of social reciprocity for health is restricted to costly exchange in core social roles, primarily the work role and family roles. With this focus on sociological role theory (Merton 1968), the model analyses links of opportunities and constraints at the macro-and meso-social level (e.g. labour market, work organization) with individual experiences and biological responses. These links are mediated by stress-physiological processes, where the sustained experience of social reward deficiency activates distinct areas in the brain reward circuits that trigger physiological arousal in the organism with adverse long-term consequences for health (McEwen 2007; Schultz 2006; Siegrist 2016).

Second, in addition to a sociological and stress-theoretical extension of basic notions of psychological equity theory, this model also specifies the consequences of inequity. According to Adams (1965), the experience of inequity results either from high cost and low gain, or from low cost and high gain. In either case, adaptive responses are expected, but differential consequences are not predicted by theory. In contrast, in this model, adverse health risks are caused exclusively by ‘high cost/low reward’ conditions, while ‘low cost/high effort’ conditions do not seem to matter for health (for preliminary evidence, Li et al. 2019). Furthermore, psychological equity theory distinguishes between an extrinsic and an intrinsic standard of comparison in evaluating inequity. Whereas the first standard refers to distributive injustice, comparing own gains with respective gains of significant others, the second standard refers to injustice of exchange, weighing the person’s costs of effort against their gains of reward. Whether these two types of reference standards produce different effects, has not been clearly elaborated. For instance, research on organizational justice, a concept with close links to equity theory

(Greenberg & Cohen 1982), postulates adverse effects of distributive justice on health, without distinguishing differences between extrinsic and intrinsic standards (Greenberg 2010). In contrast, the effort-reward imbalance model accords primacy to the intrinsic reference standard, in accordance with the dominant principle of social reciprocity mentioned (see also Fehr & Fischbacher 2003). A further distinction of this model refers to the psychological expectancy value theory (Schönpflug & Batmann 1989). According to this approach, people generally react to high cost/low gain conditions either by leaving the respective context or by reducing their efforts in an attempt to minimize the imbalance. Yet, the model of effort-reward imbalance postulates continued preservation of this imbalance in the range of conditions defined above.

Finally, the effort-reward imbalance model complements the highly influential theoretical concept of stressful work in terms of high demand and low control in two relevant aspects (Karasek & Theorell 1990). First, whereas this latter model represents a ‘black box’ approach focusing on extrinsic components of job tasks (‘psychological demands’, ‘decision latitude’, ‘skill discretion’; in a further conceptual development supplemented by ‘social support at work’), the former model combines extrinsic elements of the work and employment context with intrinsic, personal elements, the motivational pattern of coping with work demands. Strengths and limitations of this extension have been discussed elsewhere (Theorell 2000; Siegrist & Li 2020). The second aspect concerns the differential focus on control versus reward at work. As mentioned, the former notion addresses primarily characteristics of the job task, whereas the latter notion includes aspects of the employment career (promotion prospects, job stability) as well as material and non-material aspects of compensation. Experiences of control and reward may also differ to some extent if emotional and stress-physiological reactions are explored (Theorell 2016). However, it is important to assert that the two models were shown to provide independent predictions of stress-related disease risks of similar strength (Duchaine et al. 2021; Niedhammer et al. 2021). Furthermore, combining both models was shown to increase the effect size of health risks if compared to separate estimates (Juvani et al. 2018).

In conclusion, the effort-reward imbalance model represents an original theoretical contribution to research on health-related effects of adverse psychosocial work environments. While complementing established concepts it is also open to further developments, including an integration into more comprehensive approaches.

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2. Measurement and data analysis

2.1 Measuring effort-reward imbalance (ERI) at work

In principle, different measurement approaches towards assessing ERI are feasible. To some extent, contextual information (e.g. job descriptions, level of salary, career mobility, job loss) can be used. The construction of a Job Exposure Matrix provides an assessment that is unbiased by subjective information, but that has obvious limitations (for an example see Faruque et al. 2022). However, core aspects of the model concern experiences and perceptions of working people. Therefore, self-report data are of core importance. These data can be acquired through several available methods in social and behavioral sciences, such as standardized questionnaires based on psychometrically validated scales, qualitative interviews, or ecological momentary assessments (EMA; see Johnston 2006). Standardized questionnaires are the dominant approach used in ERI research. Moreover, in large scale social epidemiological research economic, parsimonious measures are given preference.

In this tradition, the ERI model has been operationalized as a standardized self-report measure consisting of three psychometric scales: effort, reward, and over-commitment (Siegrist et al. 2004). There are two versions of the ERI questionnaire: the original or long version, which consists of 22 Likert-scaled items (Siegrist et al. 2004), and the short version containing 16 items (Leineweber et al. 2010). The short version of the original questionnaire is more easily applicable in epidemiologic investigations, and it has now been applied in a couple of cohort studies internationally (see below Section 2.3).

Respondents are asked to answer the Likert scaled items that refer to the current (or last) occupation and related typical experiences. Although this information captures the current (or last) situation, longitudinal data demonstrate that in a large majority of respondents ERI assessments remain rather stable over several years (Leineweber et al. 2019).

Construction of Scores

Long version

Effort scale

Effort is measured by five or six items respectively that refer to demanding aspects of the work environment: ERI1-ERI6. The 5-item version excluding physical load (item ERI5) has been found to be psychometrically appropriate in samples characterized predominantly by white collar jobs whereas the 6-item version was appropriate in blue collar samples and occupational groups with manual workers.

All questions refer to the present respectively last occupation, and subjects are asked to indicate how far the items reflect their typical work situation. The rating procedure is defined as follows with higher ratings pointing to higher efforts (see table 1): (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly agree (see Table 2.1).

Table 2.1: 4-point Likert scale answer format in the ERI-Questionnaires.

Strongly disagree	☐ (1)
Disagree	☐ (2)
Agree	☐ (3)
Strongly agree	☐ (4)

It should be noted that for compelling methodological reasons the Likert scale answer format has been changed since many years from the original two-step procedure with five categories to a one-step procedure with four categories (for justification see Montano et al. 2016; Tsutsumi et al. 2008). We therefore recommend to use this latter approach. We are aware that due to this change in answer format the absolute scale scores are no longer strictly comparable between the two scoring formats.

A sum score of the 4-point Likert ratings is computed as the uni-dimensionality of the effort scale has been documented (see below). A total score based on the five items measuring extrinsic effort varies between 5 and 20 (or 6 and 24 with 6 items). The higher the score, the more effort at work is assumed to be experienced by the subject.

Reward scale

Reward is measured by ten 4-point Likert scaled items (items ERI7-ERI16) coded as in table 2.1. We postulate a three-factorial structure of the construct of occupational reward as given in Table 2.2. Therefore, a second-order factor analysis is expected to define a one-dimensional scale. The rating procedure is performed in analogy to the effort scale. Please be aware that the long version of the ERI-Questionnaire (ERI-L version) has now only 16 items. In comparison with the previous version (2007) of the ERI-Questionnaire we have merged the old items ERI7 (“I receive the respect I deserve from my superiors”) and ERI8 (“I receive the respect I deserve from my colleagues”) into the new item ERI7 (“I receive the respect I deserve from my superior or a respective relevant person.”). In this way, the long

version of the ERI-Questionnaire can also be applied to self-employed or small proprietors using the same 4-point Likert scaled items.

After variable recoding procedures (see the coding of the ERI-Questionnaire Long Version in table 2.4 below), lower ratings point to lower rewards. A sum score of these ratings is computed which varies between 10 and 40. The lower the score, the fewer occupational rewards are supposed to be received by the person.

Table 2.2: ERI-Questionnaire. Long version. Construction of scores.
Scales Items Range

Scales	Items	Range
Effort scale	ERI1 to ERI6	6 to 24
Reward scale	ERI7 to ERI16	10 to 40
Overcommitment Scale	OC1 to OC6	6 to 24
Subscales of the reward scale:		
Esteem	ERI7 to ERI9, ERI14	4 to 16
Promotion	ERI10, ERI13, ERI15 and ERI16	4 to 16
Security	ERI11 and ERI12	2 to 8

Additional analyses using scores of the three sub-scales (esteem, promotion, and security) instead of the total reward score provide further meaningful information in theoretical and practical terms (see e.g. Van Vegchel et al. 2002).

Over-commitment scale

Over-commitment is measured by six items (items OC1-OC6) derived from an earlier test containing 29 items (Siegrist et al. 2004). Items range from 1 (low) to 4 (high over-commitment) (see table 2.3).

Table 2.3: 4-point Likert-scaled items for the “over-commitment” dimension.

OC1: I get easily overwhelmed by time pressures at work	
Strongly disagree	☐ (1)
Disagree	☐ (2)
Agree	☐ (3)
Strongly agree	☐ (4)

Note that item OC3 has to be reversed (see table 2.6). The scale score is computed by adding item values. Although the six over-commitment items load usually on a single factor, some studies report a stronger loading of OC1 on the effort factor (e.g., Rantanen et al. 2012).

Table 2.4: ERI Questionnaire. Long version. Item coding

		<i>Strongly disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly agree</i>
ERI1	I have constant time pressure due to a heavy work load.	☐	☐	☐	☐
ERI2	I have many interruptions and disturbances while performing my job.	☐	☐	☐	☐
ERI3	I have a lot of responsibility in my job.	☐	☐	☐	☐
ERI4	I am often pressured to work overtime.	☐	☐	☐	☐
ERI5	My job is physically demanding.	☐	☐	☐	☐
ERI6	Over the past few years, my job has become more and more demanding.	☐	☐	☐	☐
ERI7	I receive the respect I deserve from my superior or a respective relevant person.	☐	☐	☐	☐
ERI8	I experience adequate support in difficult situations.	☐	☐	☐	☐
ERI9	I am treated unfairly at work. Reverse coding	☐	☐	☐	☐
ERI10	My job promotion prospects are poor. Reverse coding	☐	☐	☐	☐
ERI11	I have experienced or I expect to experience an undesirable change in my work situation. Reverse coding	☐	☐	☐	☐
ERI12	My employment security is poor. Reverse coding	☐	☐	☐	☐
ERI13	My current occupational position adequately reflects my education and training.	☐	☐	☐	☐
ERI14	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.	☐	☐	☐	☐
ERI15	Considering all my efforts and achievements, my job promotion prospects are adequate.	☐	☐	☐	☐
ERI16	Considering all my efforts and achievements, my salary / income is adequate.	☐	☐	☐	☐

Short version

Effort scale

Effort is measured by three 4-point Likert-scaled items (ERI 1-3) coded as in tables 2.4 and 2.6. A total score based on the three items measuring effort varies between 3 and 12 (see table 2.5).

Table 2.5: ERI-Questionnaire. Short version. Construction of scores.

Scales	Items	Range
Effort scale	ERI1 to ERI3	3 to 12
Reward scale	ERI4 to ERI10	7 to 28
Overcommitment Scale	OC1 to OC6	6 to 24
Subscales of the reward scale:		
Esteem	ERI4 and ERI8	2 to 8
Promotion	ERI5, ERI9 and ERI10	3 to 12
Security	ERI6 and ERI7	2 to 8

Reward scale

Reward is measured by seven items (ERI4-ERI10). A sum score of these items varies between 7 and 28. The score coding for the reward scale is reproduced in table 2.6. The lower the score, the fewer occupational rewards are supposed to be received by the person.

Over-commitment scale

Because the over-commitment questionnaire was already the result of a previous psychometrically validated reduction capturing the essence of this personal pattern of coping with work, it was included without further change into the short version.

Table 2.6: ERI-Questionnaire. Short version. Item coding.

		Strongly disagree	Disagree	Agree	Strongly agree
ERI1	I have constant time pressure due to a heavy work load.				
ERI2	I have many interruptions and disturbances while performing my job.				
ERI3	Over the past few years, my job has become more and more demanding.				
ERI4	I receive the respect I deserve from my superior or a respective relevant person.				
ERI5	My job promotion prospects are poor. Reverse coding				
ERI6	I have experienced or I expect to experience an undesirable change in my work situation. Reverse coding				
ERI7	My job security is poor. Reverse coding				
ERI8	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.				

ERI9	Considering all my efforts and achievements, my job promotion prospects are adequate.				
ERI10	Considering all my efforts and achievements, my salary / income is adequate.				
OC1	I get easily overwhelmed by time pressures at work.				
OC2	As soon as I get up in the morning I start thinking about work problems.				
OC3	When I get home, I can easily relax and ‘switch off’ work. <i>Reverse coding</i>				
OC4	People close to me say I sacrifice too much for my job.				
OC5	Work rarely lets me go, it is still on my mind when I go to bed.				
OC6	If I postpone something that I was supposed to do today I'll have trouble sleeping at night.				

ER-ratio

The established procedure of data analysis consists in estimating the association of single scales, and eventually their interaction, with outcomes of interest. In this context and in accordance with a core theoretical assumption, it was proposed that the interaction of the effort and reward scales in terms of a ratio may capture the imbalance between efforts and rewards at the individual level (Siegrist et al. 2004). The quantification of imbalance at the individual level provides important additional information with a single indicator. This procedure is comparable to the use of synthetic measures in epidemiological studies (e.g. Body Mass Index, see Rao 2002; Montano et al. 2016 for methodological discussion).

To compute the ER-ratio, the effort score is put in the numerator and the reward score in the denominator:

$$ER = \frac{E}{Rxc}$$

where E is the effort score, R the reward score, and c a correction factor that adjusts for the unequal number of items of the effort and reward scores. For instance, if E contains 5 items and R contains 11 items, c, the correction factor is 5/11=0.454545.

With this formulation, the interpretation of the ER-ratio is facilitated for descriptive purposes. For ER = 1, the person reports one effort for one reward, for ER < 1, there are less efforts for each reward, and for ER > 1, the person reports more efforts for each reward. The ratio can be logarithmically transformed in order to place inverse imbalance of the same magnitude at the same distance from 1.0 (point of no imbalance (Pikhart et al. 2001)).

To interpret results based on the ER-ratio it is important to include as much information as possible (i.e. to use continuous data). Alternatively, distribution-based quartiles or tertiles can be defined (e.g. Niedhammer et al. 2004). Based on evidence from cohort studies, the upper tertile or quartile can be defined as indicating a high-risk condition (e.g. Rugulies et al. 2017).

However, distribution-based scores run the risk of low sensitivity. Therefore, empirically based scores using a reference criterion (e.g. a population defined by incident or prevalent stress-related disease) were proposed, applying receiver-operating characteristics (ROC) analysis (Lehr et al. 2010). This is an established procedure to assess the sensitivity and specificity of cut-off points of scales.

Against this background, the prior use of a simple approach of dichotomizing scores of the scales or the ER-ratio by >1.0 vs. <1.0 seems questionable, not only due to the absence of documented sensitivity and specificity, but also due to imprecise estimates based on substantial information loss (in particular with scales of the short version).

Psychometric information

Scale reliability

Original version: Published data document satisfactory internal consistency in terms of Cronbach's α (usually $\alpha > 0.70$) of the three scales of effort, reward and over-commitment. Test-retest-reliability has been analysed in several studies so far with satisfactory results (e.g. Rantanen et al. 2012; Shimazu et al. 2009; Törnroos et al. 2015). Moreover, multiple assessment of scales has been conducted, using 'Ecological Momentary Assessment' technique documenting a strong correlation between the summary estimate based on the self-administered questionnaire and the momentary estimate based on EMA technique (see Johnston 2006).

Short version:

In a study by Leineweber et. al. (2010) all Cronbach's α coefficients are equal to or higher than 0.80 (effort = 0.80, reward = 0.84, over-commitment = 0.85), indicating a satisfying internal consistency. Item-total correlations varied between 0.55 (0.42 for corrected item-total correlation) and 0.86 (0.78 for corrected item-total correlation) and were all above the threshold of 0.30. In another study (Siegrist et al. 2009) all Cronbach's α coefficients were higher than 0.70, suggesting satisfactory internal consistency (Cronbach's alpha of 0.74 for 'effort', 0.79 for 'reward', and 0.79 for 'over-commitment'). Further, all item-total correlation coefficients were above the threshold of 0.30, indicating considerable consistency of items defining respective scales (see also Li et al. 2012).

Factorial structure

Original version:

Exploratory and confirmatory factor analyses were conducted with satisfactory results. In particular, confirmatory factor analyses based on data from five international samples resulted in a good model fit for the unidimensional 'effort' and 'over-commitment' scales and the three-factorial structure of the 'reward' scale. Goodness of fit was assessed by the GFI- and the AGFI-index, in addition to Chi-square and root-mean square residual (for details see Siegrist et al. 2004). These results were replicated and further validated in several third order confirmatory factor analyses, both for the original and the short version of the scales (see list of methodological publication on ERI scales below, section 4).

Short version:

The ER scales were tested with confirmatory factor analysis (see Figure 2 which represents the second-order model testing the theoretical structure, RMSEA = 95% CI 0.057 - 0.060). This factorial structure was replicated in an important reference study (Leineweber et al. 2010) and in several more recent studies (see list of methodological publications on ERI scales below, section 4).

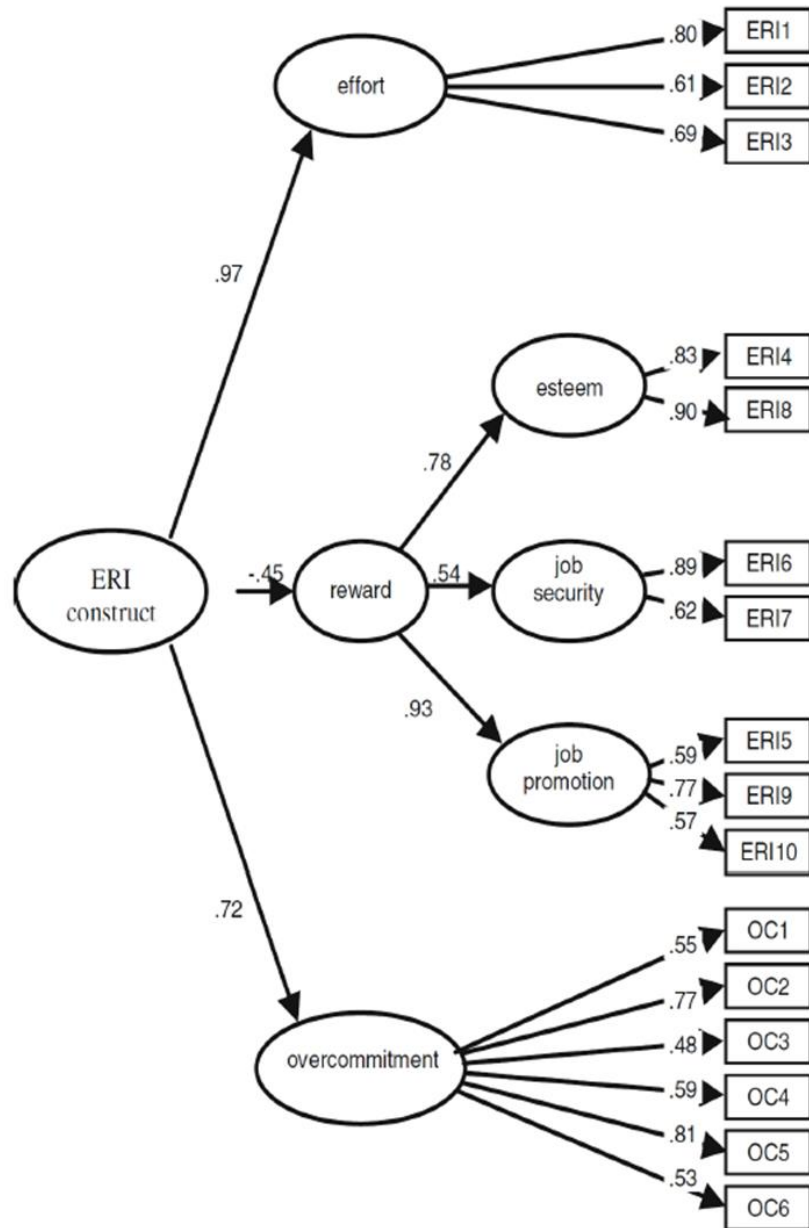


Figure 2: Factorial structure of the effort-reward imbalance model. Source: Siegrist et al. 2009.

Convergent validity

Several studies using the original or short version have documented the independent explanatory power of the ER scales compared to the scales of the demand-control-model (Karasek et al. 1998) despite the fact that the scales ‘demand’ and ‘effort’ show modest to strong correlations (ranging between $r = 0.30$ and $r = 0.60$; (e.g. Calnan et al. 2001; Tsutsumi et al. 2001). Independent explanatory power of the ER scales was also demonstrated in case of the model of organizational injustice (Kivimäki et al. 2007; Juvani et al. 2018) (see also list of methodological publication on ERI scales below, section 4).

Discriminant validity and criterion validity

Significant differences in mean scores of effort, reward and over-commitment according to gender, age, socio-economic status, and other socio-demographic characteristics were observed in a large number of studies using the original or short version. See list of methodological publication on ERI scales below, section 4.

Sensitivity to change over time

Several studies reported sensitivity of the scales to indicate changes of the amount of stressful experience over time. This applies to the original version (e.g. Rantanen et al. 2012; Tsutsumi et al. 2002; Törnroos et al. 2015) and the short version (e.g. Leineweber et al. 2019; see also list of methodological publications on ERI scales below, section 4).

*Link for Download of the English version of the ERI at work questionnaire, see below section 4. **Effort-reward imbalance (ERI) at work questionnaire***

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2.2 Measuring ERI beyond paid work

Household and family work

In the traditional definition of gender roles, unpaid household and family work has been attributed to women, and this trend still prevails in economically advanced societies. The extension of the model's theoretical notions to this type of costly social exchange and its measurement by psychometrically validated scales was accomplished by Stephanie Sperlich, Richard Peter and Siegfried Geyer (2012). Later, a German version (Sperlich & Geyer 2015a) and a Brazilian-Portuguese version of the questionnaire (Vasconellos et al. 2016) were published. Although this measure was exclusively used among women in childcare responsibility, it was tested among fathers attending a family-focused rehabilitation more recently, with satisfying psychometric properties (Sperlich et al. 2016).

The questionnaire is composed by three factors, 'effort' (8 items), 'reward' (11 items), and 'over-commitment' (4 items). Whereas 'effort' and 'over-commitment' were expected to represent a uni-dimensional structure, 'reward' was composed by four dimensions, (1) affection from children; (2) recognition from partner; (3) intrinsic value of family and household work; and (4) societal esteem. The item content of the two uni-dimensional scales follows closely the respective notions related to paid work, while the content of reward items differs markedly, given the relevance of socio-emotional rather than social status-related aspects. In confirmatory factor analysis the theoretical structure of the construct was reproduced, with satisfactory fit indices (Sperlich et al. 2012). In addition to single scale scores, an effort-reward ratio has been proposed to quantify the imbalance between effort and reward at individual level.

Several reports document associations with indicators of poor mental health among women (as

summary, Sperlich & Geyer 2016) and among men (Sperlich et al. 2016). Furthermore, a mediating effect of effort-reward imbalance in household and family work in the association of socioeconomic position (education) with health (somatic complaints) was demonstrated (Sperlich & Geyer 2015b). In summary, there is solid evidence of the value of extending the theoretical model beyond the context of paid work. Future research is expected to apply the construct in prospective investigations and in intervention studies.

*If you use this questionnaire for your own research, please contact [Dr. Stefanie Sperlich](#) and read the text on 'Essential information' below in **section 4**.*

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Close social relationships

Different from the work role, these types of social exchange are mainly realized in private contexts, with less pervasive demands and with a lack of material rewards or social control. Nevertheless, even in relationships defined by affection, appreciation, and altruism, unfair, unbalanced exchange and

recurrent disappointments may occur, resulting in reduced mental health and well-being. With a focus on partnership and parent-child relationships, a short questionnaire was developed to assess these experiences in dyadic exchange. Based on eight Likert-scaled items, it represents a three-factorial structure. The first scale relates to the quality of partnership, the second scale concerns exchange with one's child or children (appreciation, difficulties with educational efforts), and the third one addresses negative life events, such as severe disappointments in intimate relationships.

The three-factorial structure of the questionnaire was confirmed in five different samples in Germany, United Kingdom, and United States of America, including middle-aged and older population groups. Associations of failed social reciprocity with reduced mental health, measured by depressive symptoms and poor self-rated health, were observed. These links were generally stronger in case of partnership quality and intimate exchange than in case of children, and they were more pronounced among women (Knesebeck et al. 2003; Knesebeck et al. 2004; Knesebeck et al. 2009). In the British Whitehall II study, reduced mental health and sleep disturbances were more consistently related to failed reciprocity than other indicators of self-reported health (Chandola et al. 2007).

Whereas these findings were restricted to cross-sectional data, a French study tested the prospective link of failed social reciprocity with reduced mental health. In the Gazel cohort, the two scales of partnership quality and intimate exchange were explored, and higher scores of stressful exchange were associated with an elevated level of poor mental health two years later (Wahrendorf et al. 2010).

In conclusion, despite the obvious differences of stressful experience between work and private life, preliminary knowledge confirms that a balanced exchange between efforts and rewards in cooperative close social relationships matters for mental wellbeing. It should also be mentioned that while the two concepts 'reciprocal social exchange' and 'social support' are closely linked, their notion and their effects are distinct (Chandola et al. 20107).

*If you use this questionnaire for your own research, please see Chandola et al. (2009), 'Appendix A. Appendix' and read the text on 'Essential information' below in **section 4**.*

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Educational work

Educational achievements have a major impact on labor market access and on the quality of jobs in adulthood. Therefore, efforts expended in secondary and tertiary educational settings matter for students' everyday experience. Decisive rewards related to these efforts are often postponed to stages of promotion and graduation, but more imminent rewards concern the appreciation of students' achievements by significant others, specifically teachers and school mates. To assess these experiences, a questionnaire was developed to identify effort, reward, and over-commitment in educational work, specifically in students of secondary education. Again, Likert-scaled items were proposed to assess effort (5 items), reward (11 items), and over-commitment (3 items), mirroring the original conceptual notions. In a first study conducted in a group of 1004 Chinese students in grades 7 through 12, exploratory and confirmatory factor analyses revealed a four-factorial construct, with effort, over-commitment and two reward-related factors (esteem and educational prospects vs. academic performance). Furthermore, effort-reward imbalance at school was related to reduced self-reported health, in particular among female students (Li et al. 2010). Two more investigations in adolescent school settings in China supported these original results, pointing to associations with depressive symptoms (Guo et al. 2014) and suicidal ideation (Shang et al. 2014). A further study conducted in Sweden (Laftman et al. 2015) underlines the transcultural application of this tool. Furthermore, effort-reward imbalance at school was related to fatigue in a study in Japan (Fukuda et al. 2010).

Even more intense learning and training efforts are required from University students, with closer links to future professional performance. Hence, a more specific assessment tool matching this condition is desirable. In fact, in 2017, such a tool was developed and tested in a group of medical students in Germany, with three items measuring effort, six items measuring reward, and five items measuring over-commitment. Findings of confirmatory factor analysis confirmed the three-factorial structure of this approach (Wege et al. 2017). Research exploring criterion validity and replicating the psychometric properties is currently under way.

*If you use this questionnaire for your own research, please see Li et al. (2010), 'Appendix' (for school settings) or Wege et al (2017), '2.2. Measurements' (for University settings) and read the text on 'Essential information' below in **section 4**.*

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Summary

In three domains of recurrent activity performed in a relevant context of social exchange, household and family work, agency related to partnership and children, and educational work in school and University settings, the basic notion of inequity in social exchange has been analyzed, based on scales that mirror the three core factors of the original tool. Overall, this extension of the concept beyond the dominant role of paid work lends support to the idea that inequity in social exchange matters for health and wellbeing even if efforts and rewards are less formalized and less pervasive. Additional evidence of this claim comes from investigations where failed social reciprocity was studied in voluntary work, caring, and informal work. Unfortunately, in these cases the notion was measured by two single items rather than by psychometrically established scales (Wahrendorf et al. 2006). Nevertheless, findings from several cross-sectional and prospective studies demonstrated reduced mental health and poor quality of life among early old age populations who were engaged in these activities without experiencing adequate reward (Wahrendorf et al. 2006; Siegrist and Wahrendorf 2009; McMunn et al. 2009; Zaninotto et al. 2013). Although this knowledge is less robust and less extensive than the one related to the work role, it documents the general significance of a universal element of interpersonal exchange, the norm of social reciprocity (Gouldner 1960).

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2.3 Overview of measures of ERI at work in major longitudinal epidemiologic studies

Table 2.7: ERI-Measures in longitudinal studies

Study (country)	Measure	Publication
<i>France</i>		
CONSTANCES	Original (S) * (3 E, 7 R, 6 OC)	Siegrist et al. (2019)
GAZEL	Original (L) * (5 E, 11 R, 29 OC)	Niedhammer et al. (2000); Siegrist et al. (2004)
Santé, Itineraire Professionnel	SIP Proxy (3 D/E; 1 R)	Niedhammer et al. (2015)
<i>Germany</i>		
Heinz Nixdorf Recall Study	Original (L) (5 E, 11 R, 29 OC)	Dragano et al. (2008)
SOEP	Original (S) * (3 E, 7 R, 6 OC)	Siegrist et al. (2009)
National Cohort Study	Original (S) * (3 E, 7 R, 6 OC)	Reuter et al. (2020)
lidA study of older workers	Original (L) (6 E, 11 R, 6 OC)	Peter et al. (2016)
<i>United Kingdom</i>		
Whitehall II		
Phase 1; 1985-88	Proxy* (5 E, 10 R, 1 OC)	Kuper et al. (2002)
Phase 1: 1985-88	Proxy (10 E/OC, 2 R)	Bosma et al. (1998)

Phase 5 (1997)	Original (6 E, 11 R, 6 OC)	Kuper et al. (2002)
ELSA	Original (2 E, 5 R)	Hintsä et al. (2015), Dragano et al. (2011)
<i>Denmark</i>		
Danish Work Environment Cohort (DWECS)	Proxy (4 E, 7 R)	Rugulies et al. (2009)
<i>Finland</i>		
Finnish Public Sector Study (FPS)	Proxy (1 E, 3 R)	Juvani et al. (2014)
10-Town Study	Proxy (1 E, 3 R)	Kouvonen et al. (2005)
Finnish Hospital Personnel Study	Proxy (1 E, 3 R)	Kivimäki et al. (2007)
Young Finns study	Original* (5 E, 11 R)	Törnroos et al. (2015)
North Finland Birth Cohort Study	Original (3 E, 7 R, 6 OC)	Freni-Sterrantino et al. (2022)
<i>Sweden</i>		
WOLF-Norrland	Original* (6 E, 5 R)	Siegrist et al. (2004); Fahlen et al. (2004)
SLOSH Study	Original (s) * (3 E, 7 R, 6 OC)	Leineweber et al. (2010)
<i>Belgium</i>		
SOMSTRESS	Original (5 E, 11 R, 6 OC)	Godin et al. (2005), Siegrist et al. (2004)
<i>Eastern Europe</i>		
HAPPIE	Original (L) (5 E, 11 R)	Pikhart et al. (2001)
<i>Europe</i>		
SHARE	Original (2 E, 5 R)	Siegrist et al. (2006); Dragano et al. (2011)
IPD-Work consortium	Proxy* (2 E, 5 R)	Siegrist et al. (2014)
<i>Canada</i>		
PROspective Quebec study (PROQ)	Original (4 E/D, 11 R)	Trudel et al. (2018)
Quebec Public Insurance study	Original (4 E/D, 11 R, 6 OC)	Gilbert-Ouimet et al. (2012)
Prospective study post.MI patients	Original* (9 D/E, 9 R, 6 OC)	Aboa-Eboulé et al. (2011)
Alberta prospective study	Original (S) (5 E, 11 R)	Nigatu & Wang (2018)
Longitudinal cohort working population Alberta (LCWPA)	Original (S) (5 E, 11 R)	Wang et al. (2012)
<i>USA</i>		
MIDUS	Proxy measure* (10 E, 7 R)	Li et al. (2021)
Health and Retirement Study (HRS)	Proxy measure (2 E, 5 R)	Mutambudzi et al. (2018)
Intervention studies		

<i>Canada</i>		
Health care professionals intervention	Original (9 D/E, 11R)	Bourbonnais et al. (2011)
White collar intervention	Original (4 D/E, 11 R)	Trudel et al. (2021)
<i>Germany</i>		
Psychiatrists study	Original (L) (5 E, 11 R, 6 OC)	Beschoner et al. (2021)
Abbreviations: D/E = Demand (items from the JCQ tool (Karasek et al. 1998) used as proxies for E = Effort; L = Long version; OC = Over-Commitment; R = Reward; S = Short version		
* Publication includes statistical information on psychometric properties.		

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Siegrist J, Wahrendorf M, Goldberg M, et al. (2019) Is effort-reward imbalance at work associated with different domains of health functioning? Baseline results from the French CONSTANCES study. *International Archives of Occupational and Environmental Health* 92(4), 467–480. <https://doi.org/10.1007/s00420-018-1374-8>

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Niedhammer I, Bertais S, Witt K (2021) Psychosocial work exposures and health outcomes: a meta-review of 72 literature reviews with meta-analysis. *Scandinavian Journal of Work, Environment & Health* 47(7), 489–508. <https://doi.org/10.5271/sjweh.3968>

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Mikkelsen S, Coggon D, Andersen JH, et al. (2021) Are depressive disorders caused by psychosocial stressors at work? *European Journal of Epidemiology* 36, 479–496. <https://doi.org/10.1007/s10654-021-00725-9>

Molen, HF v.d., Nieuwenhuijsen K, Frings-Dresen MHW, de Groene G (2020) Work-related psychosocial risk factors for stress-related mental disorders: an updated systematic review and meta-analysis. *BMJ Open* 10, e034849. <https://doi.org/10.1136/bmjopen-2019-034849>

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Tsutsumi A, Kawakami N (2004) A review of empirical studies on the model of effort-reward imbalance at work: reducing occupational stress by implementing a new theory. *Social Science & Medicine* 59(11), 2335–2359. <https://doi.org/10.1016/j.socscimed.2004.03.030>

4. Effort-reward imbalance (ERI) at work questionnaires

Essential information:

These questionnaires can be freely used for the purposes of conducting research, of monitoring or surveilling working conditions in organizations, and for teaching and educational purposes. They must not be used for any commercial reason (e.g., selling questionnaires for profit) as the main aim is to offer a method of identifying critical working conditions as a basis for preventive, health-promoting actions.

You are not allowed to use single items only or to substantially change the word content of items. Single scales can be used if there are reasons not to apply all scales. The copyright of the questionnaire (long and short version) is with the Institute of Medical Sociology, University Clinic, Heinrich-Heine-University Düsseldorf, Germany. The copyright has to be indicated on all printed (or online) questionnaires.

For all publications using the questionnaires, the appropriate reference or references need(s) to be indicated:

Methods:

ERI at work (long version):

Siegrist J, Starke D, Chandola T et al. (2004) The measurement of effort-reward imbalance at work: European comparisons. *Social Science & Medicine* 58, 1483–1499. [https://doi.org/10.1016/S0277-9536\(03\)00351-4](https://doi.org/10.1016/S0277-9536(03)00351-4)

ERI at work (short version):

Siegrist J, Wege N, Pühlhofer F, Wahrendorf M (2009) A short measure of work stress in the era of globalization: effort-reward imbalance. *International Archives of Occupational and Environmental Health* 82, 1005–1013. <https://doi.org/10.1007/s00420-008-0384-3>

Or:

Leineweber C, Wege N, Westerlund H et al. (2010) How valid is a short measure of effort-reward imbalance at work? A replication study from Sweden. *Occupational & Environmental Medicine* 67(8), 526–531. <http://dx.doi.org/10.1136/oem.2009.050930>

Theoretical background:

Siegrist J (1996) Adverse health effects of high effort-low reward conditions at work. *Journal of Occupational Health Psychology* 1(1), 27–41 (Reference publication)

Siegrist J, Wahrendorf M (eds.) (2016) *Work stress and health in a globalized economy: the model of effort-reward imbalance*. Springer International Publications (Comprehensive review)

For further information or clarification of questions please contact the Secretariat of the Institute of Medical Sociology, Heinrich-Heine-University Düsseldorf (contact details on the Institute's website)

4.1 Downloadable language versions



Brasilian

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance \(long version\) and overcommitment questionnaires](#)

[Overcommitment](#)

References:

de Araújo TM, Siegrist J, Moreno AB et al. (2019) Effort-reward imbalance, over-commitment and depressive episodes at work: evidence from the ELSA-Brasil cohort study. *International Journal of Environmental Research and Public Health* 16(17), 3025. <https://doi.org/10.3390/ijerph16173025>

Griep RH, Rotenberg L, Vasconcellos AGG et al. (2009) The psychometric properties of demand-control and effort-reward imbalance scales among Brazilian nurses. *International Archives of Occupational and Environmental Health* 82, 1163–1172. <https://doi.org/10.1007/s00420-009-0460-3>

Chor D, Werneck GL, Faerstein E et al. (2009) The Brazilian version of the effort-reward imbalance questionnaire to assess job stress. *Cadernos de Saúde Pública* 24(1), 219-224.
<https://doi.org/10.1590/S0102-311X2008000100022>



Czech

[Effort-reward imbalance – Long version](#)

[Overcommitment](#)

Reference:

Pikhart H, Bobak M, Siegrist J et al. (2001) Psychosocial work characteristics and self-rated health in four post-communist countries. *Journal of Epidemiology & Community Health* 55, 624–630.
<http://dx.doi.org/10.1136/jech.55.9.624>



Chinese

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance \(long version\) and overcommitment questionnaires](#)

References:

Li J, Loerbroks A, Shang L et al. (2012) Validation of a short measure of Effort-Reward Imbalance in the workplace: evidence from China. *Journal of Occupational Health* 54(6), 427–433.
<https://dx.doi.org/10.1539/joh.12-0106-BR>

Li J, Yang W, Cheng Y et al. (2005). Effort-reward imbalance at work and job dissatisfaction in Chinese health care workers: a validation study. *International Archives of Occupational and Environmental Health* 78, 198–204. <https://doi.org/10.1007/s00420-004-0581-7>



Danish

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance - Long version](#)

[Overcommitment](#)

Reference:

Weyers S, Peter R, Boggild H et al. (2006) Psychosocial work stress is associated with poor self-rated health in Danish nurses: a test of the effort-reward imbalance model. *Scandinavian Journal of Caring Sciences* 20, 26–34. <https://doi.org/10.1111/j.1471-6712.2006.00376.x>



Dutch

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance - Long version](#)

[Overcommitment](#)

References:

Jonge J de, Linden S v.d., Schaufeli W et al. (2008) Factorial invariance and stability of the effort-reward imbalance scales: a longitudinal analysis of two samples with different time-lags. *International Journal of Behavioral Medicine* 15(1), 62–72. <https://doi.org/10.1007/BF03003075>

Hanson EKS, Schaufeli W, Vrijkotte T et al. (2000). The validity and reliability of the Dutch effort-reward imbalance questionnaire. *Journal of Occupational Health Psychology* 5, 142–155. <https://doi.org/10.1037/1076-8998.5.1.142>



English

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance - Long version](#)

[Overcommitment](#)

References:

Siegrist J, Starke D, Chandola T et al. (2004) The measurement of effort-reward imbalance at work: European comparisons. *Social Science & Medicine* 58, 1483–1499. <https://doi.org/10.1016/S0277->

[9536\(03\)00351-4](#)

Kuper H, Singh-Manoux A, Siegrist J, et al. (2002) When reciprocity fails: effort-reward imbalance in relation to coronary heart disease and health functioning within the Whitehall II study. *Occupational & Environmental Medicine* 59, 777–784. <http://dx.doi.org/10.1136/oem.59.11.777>



German

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance - Long version](#)

[Overcommitment](#)

References:

Reuter M, Dragano N (2020) Qualitätsbericht zur Datenbereinigung. Baseline-Erhebung NAKO Gesundheitsstudie: Modell beruflicher Anerkennung (ERI). [Quality report baseline NAKO health study, module effort-reward imbalance (ERI)]. Düsseldorf: Institut für Medizinische Soziologie, Universitätsklinikum Düsseldorf

Siegrist J (2016) Fragebogen zur Messung beruflicher Gratifikationskrisen (ERI). [Questionnaire for the measurement of effort-reward imbalance (ERI)]. In: Letzel S, Nowak D (eds.), *Handbuch der Arbeitsmedizin* 40: AIII (pp. 3–17). ecomed

Siegrist J, Wege N, Pühlhofer F, Wahrendorf M (2009) A short measure of work stress in the era of globalization: effort-reward imbalance. *International Archives of Occupational and Environmental Health* 82, 1005–1013. <https://doi.org/10.1007/s00420-008-0384-3>

Rödel A, Siegrist J, Hessel A, Brähler E (2004). Fragebogen zur Messung beruflicher Gratifikationskrisen. Psychometrische Testung an einer repräsentativen deutschen Stichprobe [Psychometric test of the questionnaire measuring effort-reward imbalance at work in a representative German sample]. *Zeitschrift für Differentielle und Diagnostische Psychologie* 25(4), 227–238. <https://doi.org/10.1024/0170-1789.25.4.227>



Indonesian

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

Reference:

Widanarko B, Legg S, Stevenson M, Devereux J (2012) Interaction between physical, psychosocial, and organisational work factors for low back symptoms and its consequences amongst Indonesian coal mining workers. *Work* 41, 6112 – 6119. <https://doi.org/10.3233/WOR-2012-1070-6112>



Italian

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance - Long version](#)

[Overcommitment](#)

References:

Magnavita N, Garbarino S, Siegrist J (2012) The use of parsimonious questionnaires in occupational health surveillance: psychometric properties of the short Italian version of the Effort/Reward Imbalance Questionnaire. *The Scientific World Journal* 2012, Article ID 372852. <https://doi.org/10.1100/2012/372852>

Zurlo M, Pes D, Siegrist J (2010) Validity and reliability of the effort-reward imbalance questionnaire in a sample of 673 Italian teachers. *International Archives of Occupational and Environmental Health* 83(6), 665–674. <https://doi.org/10.1007/s00420-010-0512-8>

Magnavita N (2007) Two tools for health surveillance of job stress: the Karasek Job Content Questionnaire and the Siegrist Effort Reward Imbalance Questionnaire. *Giornale Italiano di Medicina del Lavoro ed Ergonomia* 29(3 Suppl), 667–670. [In Italian]



Japanese

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Effort-reward imbalance – Long version](#)

[Overcommitment](#)

References:

Tsutsumi A (2016) Work stress and health: the case of Japan. In Siegrist J, Wahrendorf M (eds.), *Work stress and health in a globalized economy: the model of effort-reward imbalance* (pp. 137-188). Springer International Publications

Kurioka S, Inoue A, Tsutsumi A (2014) Optimum cut-off point of the Japanese short version of the effort-reward imbalance questionnaire. *Journal of Occupational Health* 55(5), 340–348.
<https://doi.org/10.1539/joh.12-0235-OA>

Tsutsumi A, Ishitake T, Peter R et al. (2001) The Japanese version of the effort-reward-imbalance questionnaire: a study in dental technicians. *Work & Stress* 15, 86–96.
<https://doi.org/10.1080/02678370118173>



Russian

[Effort-reward imbalance](#)

[Overcommitment](#)

Reference:

Pikhart H, Bobak M, Siegrist J et al. (2001) Psychosocial work characteristics and self-rated health in four post-communist countries. *Journal of Epidemiology & Community Health* 55, 624–630.
<http://dx.doi.org/10.1136/jech.55.9.624>



Spanish

[Effort-reward imbalance \(short version\) and overcommitment questionnaires](#)

[Overcommitment](#)

References:

Gomez V (2010) Evaluación de estresores psicosociales en el trabajo: propiedades sicométricas de la versión Española del cuestionario ERI (Effort-Reward Imbalance) en trabajadores Colombianos [Assessment of psychosocial stressors at work: psychometric properties of the Spanish version of the ERI (Effort-Reward Imbalance) Questionnaire in Colombian workers]. *Revista de Psicología del Trabajo y de las Organizaciones* 26(2), 147–156. <https://doi.org/10.5093/tr2010v26n2a6>

Fernández-López JA, Fernández-Fidalgo M, Martín-Payo R, Rödel A (2006) Análisis factorial confirmatorio de la versión española del cuestionario "effort-reward imbalance", de medida del estrés laboral [Confirmatory factor analysis of the Spanish version of the effort-reward imbalance questionnaire]. *Atención Primaria* 38, 465–466. <https://doi.org/10.1157/13094809>

Macias Robles MD, Fernandez-Lopez JA, Hernandez-Mejia R et al. (2003). Evaluación del estrés laboral en trabajadores de un hospital público español. Estudio de las propiedades psicométricas de la versión española del modelo «Desequilibrio Esfuerzo-Recompensa» [Measuring psychosocial stress at work in Spanish hospital's personnel. Psychometric properties of the Spanish version of Effort-Reward Imbalance model] *Medicina Clínica* 120(17), 652–657. [https://doi.org/10.1016/S0025-7753\(03\)73799-3](https://doi.org/10.1016/S0025-7753(03)73799-3)

4.2 Publications for language versions from other countries

Belgium

Derycke H, Vlerick P, Burnay M et al. (2011) Impact of the effort–reward imbalance model on intent to leave among Belgian health care workers: a prospective study. *Journal of Occupational and Organizational Psychology* 83(4), 879–893. <https://doi.org/10.1348/096317909X477594>

Godin I, Kittel F, Coppieters Y et al. (2005) A prospective study of cumulative job stress in relation to mental health. *BMC Public Health* 5, 67. <https://doi.org/10.1186/1471-2458-5-6>

Canada

Trudel X, Gilbert-Ouimet M, Milot A et al. (2018) The PROspective Québec (PROQ) Study on Work and Health. *International Journal of Epidemiology* 47(3), 693–693i. <https://doi.org/10.1093/ije/dyy026>

Finland

Törnroos M, Keltikangas-Järvinen L, Hintsala T et al. (2014) Longitudinal measurement invariance of the effort-reward imbalance scales in the Young Finns study. *Occupational and Environmental Medicine* 71, 289–294. <https://doi.org/10.1136/oemed-2013-101947>

Rantanen J, Feldt T, Hyvönen K et al. (2013) Factorial validity of the effort-reward imbalance scale: evidence from multi-sample and three-wave follow-up studies. *International Archives of Occupational and Environmental Health* 86, 645–656. <https://doi.org/10.1007/s00420-012-0798-9>

France

Siegrist J, Wahrendorf M, Goldberg M et al. (2018) Is effort-reward imbalance at work associated with different domains of health functioning? Baseline results from the French CONSTANCES study. *International Archives of Occupational and Environmental Health* 92(4), 467–480 <https://doi.org/10.1007/s00420-018-1374-8>

Niedhammer I, Siegrist J, Landre M et al. (2000) Etude des qualités psychométriques de la version française du modèle du déséquilibre efforts/récompenses. [Psychometric properties of the French version of the Effort-Reward Imbalance model]. *Revue d'Epidémiologie et de Santé Publique* 48(5), 419–437

Greece

Msaouel P, Keramaris N, Apostolopoulos A et al. (2012) The Effort-Reward Imbalance Questionnaire in Greek: translation, validation and psychometric properties in health professionals. *Journal of Occupational Health* 54(2), 119–130. <https://doi.org/10.1539/joh.11-0197-OA>

Hungary

Salavecz G, Chandola T, Pikhart H et al. (2010) Work stress and health in Western European and post-communist countries: an East-West comparison study. *Journal of Epidemiology & Community Health* 64, 57–62. <http://dx.doi.org/10.1136/jech.2008.075978>

Iran

Babamiri M, Siegrist J, Zemestani M (2018) The factorial structure and psychometric properties of the Persian Effort-Reward Imbalance Questionnaire. *Safety and Health at Work* 9(3), 334–338. <https://doi.org/10.1016/j.shaw.2017.10.001>

Yadegarfar G, Alinia T, Hosseini R et al. (2013) Psychometric properties of the Farsi version of effort-reward imbalance questionnaire: a longitudinal study in employees of a synthetic fibre factory in Iran. *International Archives of Occupational and Environmental Health* 86(2), 147–155. <https://doi.org/10.1007/s00420-012-0750-z>

Mongolia

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