



Review

Scand J Work Environ Health 2014;40(5):441-456

doi:10.5271/sjweh.3431

A reciprocal interplay between psychosocial job stressors and worker well-being? A systematic review of the “reversed” effect

by [Tang K](#)

Scholars in the area of occupational health and epidemiology have increasingly theorized about a reciprocal stressor-strain. A systematic review of the recent literature found “moderate” evidence in support of a reciprocal relationship (ie, bidirectional effects) between psychosocial job stressors and worker well-being. The paper also sets out potential research avenues to advance the state of current knowledge.

Affiliation: Mobility Program Clinical Research Unit, Li Ka Shing Institute of St. Michael’s Hospital, 30 Bond Street, Toronto, Ontario, Canada. ken.tang@mail.utoronto.ca

Refers to the following texts of the Journal: [2003;29\(1\):1-4](#)
[2004;30\(2\):85-128](#) [2005;31\(1\):3-14](#) [2012;38\(4\):299-313](#)
[2013;39\(6\):535-549](#)

The following articles refer to this text: [2014;40\(5\):437-440](#);
[2017;43\(4\):316-325](#)

Key terms: [employee health](#); [job characteristic](#); [job satisfaction](#); [job strain](#); [job stressor](#); [mental health](#); [occupational stress](#); [psychosocial](#); [psychosocial job stressor](#); [reciprocal effect](#); [reciprocal interplay](#); [reversed effect](#); [strain](#); [stress](#); [systematic review](#); [worker](#); [worker well-being](#); [working condition](#)

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/24756578



This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

A reciprocal interplay between psychosocial job stressors and worker well-being? A systematic review of the “reversed” effect

by Kenneth Tang, MSc(PT), MSc^{1,2,3}

Tang K. A reciprocal interplay between psychosocial job stressors and worker well-being? A systematic review of the “reversed” effect. *Scand J Work Environ Health*. 2014;40(5):441–456. doi:10.5271/sjweh.3431

Objectives Work represents an important role in society, and the nature and consequences of job stress have garnered significant research interest. In recent years, considerable effort has been made to elucidate the occupational stressor–strain relationship, or the interplay between unfavorable working conditions (stressor) and worker well-being (strain). In line with Bandura’s notion of “reciprocal determinism”, a reciprocal occupational stressor–strain relationship is now increasingly postulated, where variables exert mutual influences on each other over time. The objective of this study was to determine the extent of empirical support for three specific “reversed” (strain-to-stressor) effects, guided by the Demand–Control–Support Model.

Methods A systematic literature review was conducted (1996–2012 inclusive) through a search of databases. After relevant studies were identified, a methodological quality appraisal was performed based on four key criteria: sample size, measurement, non-spuriousness, and non-response bias. Subsequently, a quantitative synthesis of evidence from high-quality studies was performed by calculating a standardized index of convergence for each reversed effect.

Results Twenty-three qualifying studies were found and evidence from ten high-quality studies ultimately contributed to the synthesis. Moderately strong evidence in support of a positive strain-to-job demands effect was found, but there was no evidence in support of either a strain-to-job control or a strain-to-workplace social support effect.

Conclusions In conjunction with available evidence on the corresponding “normal” (stressor-to-strain) effect, this review gives credence to the possibility of a reciprocal stressor–strain relationship involving job demands and worker well-being.

Key terms employee health; job characteristic; job satisfaction; job strain; mental health; occupational stress; reciprocal effect; strain; stress; working condition.

In recent years, much research attention has been dedicated to understanding the relationship between adverse psychosocial working conditions (ie, stressors) and worker well-being (ie, strain). A number of theoretical models have also emerged, hypothesizing pertinent sources of job stress and their consequences. A prominent example is the Demand–Control–Support (DCS) model (1, 2), which posits that high psychological job demands, low job control, and/or low workplace social support are detrimental to worker well-being (3–5). Accordingly, many studies in the current literature have focused on elucidating various stressor-to-strain effects as postulated by the DCS model (5–7).

In his social cognitive theory, Bandura (8, 9) posits that different variables (eg, behavior, person, or environment) may exert mutual influences on each other through bidirectional feedback loops. In other words, people are thought to be “both products and producers of their environment” and not just passive recipient of environmental influences over the course of lifespan development (8, 10, 11). In line with this notion of “reciprocal determinism”, scholars are increasingly postulating a reciprocal (bidirectional) occupational stressor–strain relationship, where not only job stressors can influence worker well-being (ie, “normal” or stressor-to-strain effect), but conversely, worker well-being can also have influence on the work

¹ Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada.

² Mobility Program Clinical Research Unit, Li Ka Shing Knowledge Institute of St. Michael’s Hospital, Toronto, Ontario, Canada.

³ Institute for Work & Health, Toronto, Ontario, Canada.

Correspondence to: Kenneth Tang, Mobility Program Clinical Research Unit, Li Ka Shing Institute of St. Michael’s Hospital, 30 Bond Street, Toronto, Ontario, Canada. [E-mail: ken.tang@mail.utoronto.ca]

environment (ie, “reversed” or strain-to-stressor effect) (5, 12–16). In the context of the DCS model, this implies job demands, job control, or workplace social support are a consequence of worker well-being.

In general, two main mechanisms have been proposed to explain the reversed effect (ie, a positive association between strain and subsequent level of a stressor). First, the “health selection” hypothesis posits that as healthy workers are likely to retain (or be promoted to) jobs with more favorable work environments (ie, upward selection), unhealthy workers (ie, strained) on the contrary are susceptible to drift off to more negative work environments with unfavorable job characteristics, such as greater job demands, less control, and/or less workplace social support (ie, downward selection, also known as the “drift” hypothesis) (12–14, 17). A number of contributing reasons for downward selection, in particular, have been put forth: (i) job performance may be negatively impacted for strained workers, which makes them susceptible to dismissal or being relegated to more undesirable or stressful work tasks (18); (ii) this also undermines their ability to negotiate favorable changes (within the same job), receive a job promotion, or secure employment with a new organization with favorable characteristics (10, 11, 18); (iii) depressed or emotionally exhausted workers may experience cognitive and/or behavioral withdrawal, which hinders their ability to develop and maintain a positive and collaborative rapport with supervisors and/or co-workers (15, 19, 20); (iv) strained workers may be especially challenged to make the significant investment of time/effort required to seek new jobs with more favorable characteristics; and lastly, (v) employers in desirable workplaces may also be reluctant to hire employees perceived to be unhealthy (18, 21).

The other commonly proposed mechanism is the “perception” hypothesis, which suggests that changes in worker well-being may lead to an altered evaluation of existing job characteristics, even though the work environment itself may be unchanged. The two sides of this effect have been coined the “rosy perception mechanism” and the “gloomy perception mechanism” (22). The former suggests that healthy workers are more likely to re-interpret their jobs positively over time as they are able to maintain engaged in their work, accumulate, and conserve job resources (eg, develop good rapport with co-workers), and ultimately, increase job proficiency (23). On the other hand, the gloomy perception mechanism suggests that strained workers may re-interpret their work environment more negatively over time due to a few reasons: (i) job demands are perceived as more burdensome as a worker’s capacity declines due to increased strain and/or poor health (24) and (ii) individuals with poor affective health (eg, negative moods, depressed) may exhibit a selective (increased) recall of negative information or situations (18, 25, 26),

especially circumstances that are outside their control (eg, lack of job autonomy) (15, 27, 28).

Interestingly, a number of competing influences to the postulated “health selection” and “perception” hypotheses have also been proposed. For example, it is believed that some strained workers may in fact be able to successfully transfer to a new workplace with fewer stressors (eg, lower job demands). This is sometimes referred to as the “refuge effect” (29), which counters the idea of downward selection. On the flip side, some healthy workers may be promoted to more senior positions or new jobs that exceed their capabilities (ie, an unfavorable change in work environment), which counteracts the idea of upward selection. Since work characteristics within the same job can evolve, the development of the gloomy perceptions hypothesis may be counteracted by effective “job crafting” (30) or modifications at work (employee-initiated) to improve fit between job characteristics and his or her own needs, abilities, and preferences (31). For example, some strained workers may be able to negotiate or make arrangements with managers to reduce their workload, and thus alleviate ongoing job stresses. On the other hand, if a manager sees untapped potential in some healthy workers, he may place additional workload on them and consequently dampen the development of rosy perceptions. If these collective (competing) influences are at-play, it is conceivable that the reversed effect may not materialize in the expected manner (ie, weak/no strain-to-stressor relationship).

To explore the notion of reciprocal determinism in the occupational stressor–strain relationship, the primary objective was to conduct a systematic literature review to determine the extent of empirical support for three reversed (strain-to-stressor) effects, guided by the DCS model. Specifically, it was hypothesized that evidence would emerge for: (i) a positive strain-to-job demands effect, (ii) a negative strain-to-job control effect, and (iii) a negative strain-to-workplace social support effect, consistent with the postulated health selection and perception hypotheses. Secondary objectives were to explore the methodological diversity of qualifying studies and provide a broad discussion on gaps in current understanding as well as potential “next step” research avenues.

Methods

Literature search strategy

Three electronic databases (PsycINFO, Medline, and Embase) were searched to identify relevant publications. The search was limited to publications between 1996 and 2012 (inclusive), coinciding with a previous notable

review by Zapf et al (14) where more modern methods to investigate occupational stressor–strain relationships were advocated [eg, cross-lagged structural equation modeling (SEM)] (14). The initial search sought publications under relevant major subject headings (eg, “occupational stress” or “burnout”) and those that featured keywords related to both job stressor (eg, job characteristics, job demands, workload, supervisor support) and strain (eg, well-being, mental health, job satisfaction). Using the operator “AND”, these hits were combined with publications under the subject heading “longitudinal studies” and any additional publications that feature the term reciprocal*, reverse*, or cross-lagged as a keyword. This strategy initially led to 1667 hits (figure 1). After a screening of abstracts, the remaining publications were thoroughly examined for relevance and to identify additional publications from reference lists.

Inclusion and exclusion criteria

To be included, the study had to (i) be a longitudinal observational (ie, non-intervention) study, (ii) have investigated for a longitudinal reversed strain-to-stressor effect, and (iii) feature variables that meet the follow-

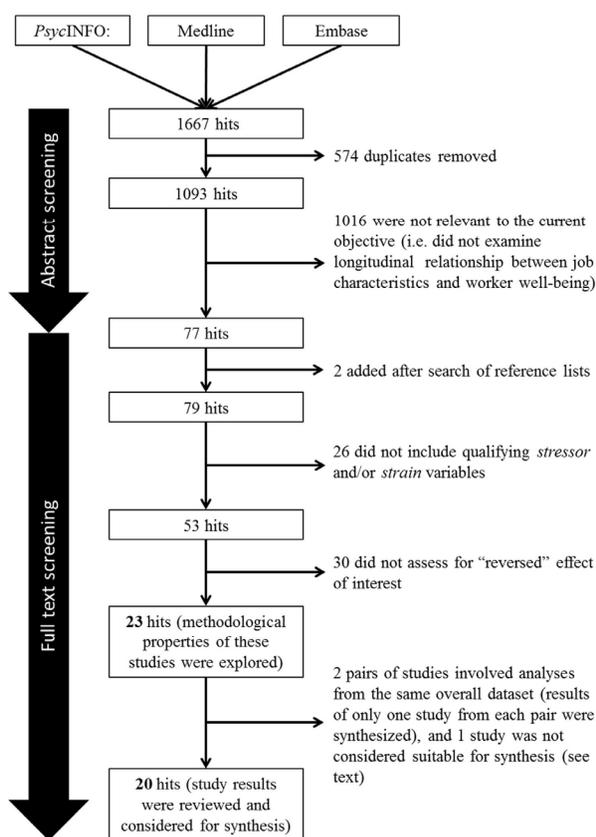


Figure 1. Systematic literature search and selection procedure

ing requirements: (a) to qualify as strain, the variable should provide a direct indication of (impaired) physical, psychological, or general well-being. Examples of strain include psychosomatic symptoms/complaints, depressive mood, psychological distress, burnout (eg, emotional exhaustion, depersonalization), or job satisfaction; (b) to qualify as a stressor, the variable must quantify job demands, job control, workplace social support, or a more specific dimension of these constructs (eg, job autonomy, supervisor support). Studies in a language other than English were excluded. Following this study selection procedure, 23 journal articles met the inclusion/exclusion criteria, and all were explored to gain insights on methodological diversity. Then, a methodological quality appraisal was performed, and relevant findings from studies deemed to be of high-quality were synthesized to address the primary study question.

Appraisal of methodological quality

Based on insights gathered from previous systematic reviews in the field, four methodological features were considered most crucial for affirming the internal validity of any reported strain-to-stressor effects (ie, free from significant biases). To be considered of “high” methodological quality, an effect should be derived from a quantitative analysis that featured: (i) adequate sample size, (ii) appropriate measurement of the stressor/strain variables involved, (iii) considerations for spurious (or alternative) explanations of the observed strain–stressor relationship [ie, the “third variable” issue (14, 32, 33)], and (iv) no evidence of significant non-response bias. Since these were considered fundamentally important methodological features, only studies that met all four of the proposed quality criteria (described below) were deemed to be of high quality.

Sample size. Although its importance is well-recognized in quantitative research, the sample size requirement for statistical modeling currently remains a much-debated topic. In fact, experts have suggested that the required sample size for an SEM may depend on a myriad of factors, including model complexity, estimation method used, distributional characteristics of the observed variables, amount of missing data, reliability of the variables, and expected strength of the relationships among the variables (34, 35). As such, liberal rule-to-thumb guidelines were applied in this review. For SEM, a sample size of $N \geq 200$ was expected based on Kline’s recommendation (35). For multiple regressions, a sample size-to-number of independent variable ratio of 10 was sought (36, 37).

Measurement. Suboptimal measurement can represent a potential source of bias when quantifying relationships between constructs. In the current context, adequate

measurement of the stressor/strain variables is paramount. This can be ascertained in a study by providing indications of the psychometric soundness of the measures employed, and/or by applying analytic strategies that consider measurement error. This criterion was satisfied if the study had incorporated measurement models of stressor/strain variables in a SEM, affirmed the adequacy of the factor structure of these variables (eg, by conducting a factor analysis), or affirmed the internal consistency of these variables at all time-points in accordance to the standard by Nunnally (38) (ie, Cronbach's $\alpha \geq 0.7$).

Non-spuriousness. For non-experimental designs, consideration of alternative explanations is an important aspect of deducing causal inferences between variables of interest (32, 33, 39). As such, it is imperative that a study considers whether an alternative variable(s) might be responsible for (or have artificially inflated) the observed longitudinal stressor–strain association. Notable third variables that have received some attention include personal disposition factors such as neuroticism (40), locus of control (41), and negativity affectivity (42, 43). Moreover, as self-reported measures are predominantly employed in job stress research, common method variance has also been raised as a potential source of bias (44–46). Techniques to explore the influence of measured or unmeasured third variables may include testing a common factor model (ie, both stressor and strain variables are assumed to originate from an underlying higher-order factor) or accounting for potential confounders in the analysis, although much debate currently exists on the need to adjust for personal disposition factors (42). To meet this criterion, it was expected that lagged (strain-to-stressor) effects must have accounted (statistically adjusted) for the same stressor variable at the previous time-point(s). More specifically, SEM were expected to have specified autoregressive paths (or autocorrelations) between measurement waves; for multiple regressions, the initial level of stressor was expected to have been included as an independent variable.

Non-response bias. As subject attrition is common in longitudinal studies, evidence of the absence of selection bias is important to help ascertain the validity of observed effects. To satisfy this criterion, evidence to support no significant differences between responders (ie, stayers) and non-responders (eg, eventual drop-outs) within the study was expected. Indication of non-response bias may involve substantial differences in baseline characteristics (eg, involving $>50\%$ of traits assessed or involving key stressor/strain variables) or significant difference in the magnitude of baseline stressor–strain associations between stayers and eventual dropouts.

Synthesis of evidence

To determine strength of cumulative evidence, a standardized index of convergence (SIC) (47) was calculated for each of the three reversed effects (strain-to-job demands/job control/workplace social support), based on evidence derived only from high-quality studies. This is considered a feasible, quantitative approach to inform the strength of cumulative evidence (based on a comparison of number of significant versus non-significant findings), particularly in situations where a meta-analysis is not ideal due to the heterogeneity of available studies (eg, differences in variables, instruments, analytic approaches) (47). SIC is defined as:

$$\frac{n[\text{positive}] - n[\text{negative}]}{n[\text{total}]}$$

where $n[\text{positive}]$ represents the number of studies reporting a significant positive association, $n[\text{negative}]$ represents the number of studies reporting a significant negative association, and $n[\text{total}]$ represents the total number of studies that examined a given strain-to-stressor effect, including those reporting no significant associations (47). As such, the SIC value provides an indication of the consistency of evidence regarding a particular relationship, which ranges between -1 (all studies reporting a negative association) and $+1$ (all studies reporting a positive association). A value close to 0 would indicate that the cumulative evidence is either inconsistent or that only a small proportion of studies were able to detect a significant association.

For each of the three reversed effects, each study can contribute one (overall) rating to SIC calculations. This rating can be either a "+" to indicate a positive association, "-" to indicate a negative association, or "0" to indicate no statistically significant association based on an alpha level of 0.05. Where a statistical model had been built sequentially (eg, stepwise addition of covariates), only the most advanced (well-adjusted) model was considered. If comparison of alternative SEM specifications were conducted, only the best-fitting ("final") model (as declared by the authors) was considered. If multiple tests/analyses on the same reversed effect were performed within a study (eg, ≥ 2 measurement waves, several closely related qualify in stressor/strain variables were included, conducted subgroup analyses), then a decision tree was applied to derive a single, overall study rating based on results from all relevant tests (48, 49) (figure 2).

The strength of evidence for a specific reversed effect is determined by both the SIC value and the total number of studies examining that very relationship. Table 1 shows the possible outcomes. By this approach, a large number

of relevant studies combined with consistent associations in the same direction (ie, high SIC value) would suggest high strength of evidence (eg, “strong” or “moderately strong”). On the other hand, a low number of relevant studies combined with a lack of (or inconsistent) associations (ie, low SIC value) would suggest weak strength of evidence (eg, “limited” or “inconsistent/no”).

Results

Methodological properties of studies

Among the 23 qualifying studies, considerable variation in methodological properties was found (table 2). In terms of sampling strategy, studies either recruited workers from a specific profession (eg, dentists) or the same work organization (eg, a bank) or utilized data from regional registries (included diverse types of workers). Workers in healthcare settings (eg, clinicians and support staff) were investigated most often (N=10) (50–59). Of the 18 studies originating from Europe (22, 29, 50–52, 54–67), 14 were from The Netherlands. The remaining four were from Australia (68), Canada (53, 69), and Israel (70). Sample size ranged from 52–2255, and study duration ranged from 3 months to as long as 11 years. Sixteen studies featured two measurement waves (50–56, 58–63, 65, 68, 70), four featured three waves (57, 66, 67, 69), two featured four waves (22, 64), and one study featured six measurement waves (29). Of note, eight studies explicitly indicated that job changers (over the course of the study) were excluded from analysis (52, 56, 57, 59, 64, 65, 67, 70).

The 23 qualifying studies also featured varied com-

binations of stressor/strain variables. The range of strain variables included constructs related to psychosomatic complaints, depression, psychological distress, general health, and burnout. Among them, dimensions of burnout (especially emotional exhaustion) were most commonly assessed, using the Maslach Burnout Inventory (71, 72) in most cases. In terms of stressors, most studies employed subscales from the Job Content Questionnaire (73, 74) to quantify job demands and job control, while a few studies employed more specific constructs tailored to their population (eg, patient demands for healthcare professionals). Specific measures chosen to capture workplace social support were highly diverse. All studies relied entirely on self-report measures, except for one which incorporated observer ratings of job control (63).

Design and analytic approaches

In terms of analytic approach, 18 studies applied SEM techniques to evaluate strain-to-stressor effects, often under the context of comparing hypotheses on casual directionality (ie, normal versus reversed versus reciprocal models). Other approaches included a latent growth curve analysis (N=1) and multiple regressions (N=4). Only two studies evaluated a moderator (for a reversed effect of interest), which included gender (67) and social class (69). Psychometric diligence was routinely observed as all included studies made efforts to verify either the internal consistency (N=22) and/or the adequacy of the factor structure (N=7) of the key stressor/strain measures employed. In addition, eight studies incorporated measurement models (using either scale items or subdomains as indicators) in their SEM/growth curve model. Several noteworthy efforts to consider/rule out alternative (or spurious) explanations of the

Test of association #1 = + Test of association #2 = 0	→	Study rating: +	Test of association #1 = + Test of association #2 = + Test of association #3 = + or – or 0	→	Study rating: +
Test of association #1 = – Test of association #2 = 0	→	Study rating: –	Test of association #1 = – Test of association #2 = – Test of association #3 = + or – or 0	→	Study rating: –
Test of association #1 = + Test of association #2 = –	→	Study rating: 0	Test of association #1 = + Test of association #2 = – Test of association #3 = 0	→	Study rating: 0

Figure 2. Decision rule for deriving a single overall study rating when a “reversed” effect of interest is assessed multiple times within a single study (eg, multiple samples, subgroup analyses, ≥ 2 measurement waves, multiple outcomes) and inconsistent associations are observed [+ = positive association; – = negative association; 0 = no association]. Note: where >3 associations are tested within a single study, $\geq 50\%$ of the results in the same direction is needed for the overall study rating to be assigned that same direction (adapted from Nijp HH et al, *Scand J Work Environ Health*. 2012;38(4):299–313, with permission).

Table 1. Assessment of strength of evidence based on the total number of relevant studies and the standardized index of convergence (SIC) value derived from cumulative study findings (adapted from Van Laethem et al, *Scand J Work Environ Health*. 2013; 39(6):535–549, with permission). [0 = inconsistent/no evidence for a positive/negative relationship; -/+ = limited evidence for a positive/negative relationship; --/+ += moderately strong evidence for a positive/negative relationship; ---/+ +++ = strong evidence for a positive/negative relationship; # = insufficient evidence]

N ^a	SIC				
	-1.00–-0.60	-0.59–-0.30	-0.29–0.29	0.30–0.59	0.60–1.00
1–2	#	#	#	#	#
3–5	--	-	0	+	++
≥6	---	--	0	++	+++

^a Number of studies contributing evidence to a specific “reversed” effect.

stressor–strain relationship were found. Four studies incorporated either negative affectivity (52, 58) or neuroticism (66, 70) into their analyses, and one other study assessed (and ruled-out) the fit of a common factor model (29).

Appraisal of methodological quality

Of the 23 qualifying studies, the sample size criterion was met in 18 studies, the measurement criterion was met in 17 studies, the non-spuriousness criterion was met in 22 studies, and the non-response bias criterion was met in 21 studies. Taken together, 12 of 23 studies (52%) met all four methodological quality criteria and were therefore considered to be of high quality (table 3).

Synthesis of evidence

Some additional considerations were needed prior to the review and synthesis of findings from individual studies. During the appraisal process, it was recognized that two pairs of studies analyzed data drawn from the same dataset. This involved two studies by de Lange et al (22, 64) and two studies by Houkes et al (61, 62). To avoid double-counting, it was determined that only one of each pair of studies should be counted. The earlier study by de Lange et al (64) was included, since its design more fully utilized its four-wave data; the other study re-organized the data into a single pre- versus post- analysis (22). Houkes et al (62) was included since it met the sample size criterion, whereas the other study used two smaller samples neither of which met the sample size criterion (61). Furthermore, it was also determined that the results from Garst et al (29) should be excluded for two reasons: (i) only the relationship between initial level of strain and the magnitude of change in stressor over time was assessed (ie, an intercept-slope relationship), which differs from an association between initial and final states which was most typically assessed; (ii)

statistical significance for such intercept-slope relationships was not reported in the publication. Lastly, the study by Melamed et al (70) assessed for both state-to-state and state-to-change associations. Therefore, to be consistent with other included studies, only the analyses examining state-to-state associations were considered for synthesis. Ultimately, this meant that the results from a total of 20 unique qualifying (10 high quality) studies were considered. Of these, 17 (8 high quality) studies contributed evidence to the strain-to-job demands effect (table 4a), 11 (6 high quality) studies contributed evidence to the strain-to-job control effect (table 4b), and 10 (5 high-quality) studies contributed evidence to the strain-to-workplace social support effect (table 4c).

The strain-to-job demands effect

Of the eight high-quality studies that contributed evidence to the strain-to-job demands effect, a “+” rating (ie, supporting a positive association) was assigned to three studies; no studies were assigned a “-” rating (ie, supporting a negative association); and five studies were assigned a “0” rating (ie, no/inconsistent associations) (table 4a). Collectively, these ratings corresponded to an SIC value of +0.38, indicating “moderately strong” evidence for a positive strain-to-job demands effect, consistent with the hypothesized reversed effect (ie, greater initial strain leads to greater future job demands).

The strain-to-job control effect

Of the six high-quality studies that contributed evidence to the strain-to-job control effect, all six were assigned a study rating of “0” (table 4b). This corresponded to an SIC value of 0, indicating no evidence in support of a strain-to-job control effect (in either direction).

The strain-to-workplace social support effect

Of the five high-quality studies that examined a strain-to-workplace social support effect, none were assigned a “+” study rating, one was assigned a “-” study rating, and four were assigned a “0” study rating (table 4c). Collectively, these ratings corresponded to an SIC value of -0.20, indicating no evidence for a strain-to-workplace social support effect (in either direction).

Discussion

This main aim of this study was to conduct a systematic review of evidence on three specific reversed (strain-to-stressor) effects. Emerging attention on this topic should be regarded as a positive development in the field,

Table 2. Overview of studies reviewed. [Analytic method=measurement models specified yes/no; CFA=confirmatory factor analysis; NL=The Netherlands; PCA=principal component analysis; SEM=structural equation modeling; T=time; n/a=not applicable.]

Study	Population	N	Study duration	Number of waves (equal interval?)	Strain (qualified for current review)	Stressor (qualified for current review)	Moderators tested	Analytic method	Tests of measurement	Tests of spuriousness / variables related to work-home conflict	Handling of "job changers" between waves
Leiter & Durup, 1996 (53)	Female hospital workers in Eastern Canada	151	3 months	2	Emotional exhaustion (burnout) ^a	Work overload, supervisor support	None	SEM (no)	Cronbach's α	Work overload at T1, variables related to work-home conflict	Did not explicitly describe
Moyle, 1998 (66)	Managers at head office and retail functions of a major food retail company in UK	148	1 year	3 (yes, 6 mths)	Mental health, job satisfaction	Managerial support, job demands, job control	None	SEM (no)	Cronbach's α	Stressors (auto-correlated), neuroticism	Did not explicitly describe
Bakker et al, 2000 (59)	General practitioners in NL	462	5 years	2	Depersonalization (burnout) ^a	Patient demands	None	SEM (no)	CFA, Cronbach's α	Stressor at T1	"Job changers" excluded from analysis
Garst et al, 2000 (29)	Workers in East Germany (various professions)	202–543	5 years	6 (T1–2: 4 mths, T2–3: 8 mths, T3–5: 12 mths each, T5–6: 24 mths)	Depression, psychosomatic complaints, irritation	Time pressure, social stressors	None	Latent growth curve model (yes)	CFA	Tested and ruled out spurious model	Stressor variables not assessed at follow-up if worker became unemployed
de Jonge et al, 2001 (58)	Healthcare workers from one general hospital and three nursing homes in NL	261	1 year	2	Emotional exhaustion, job satisfaction ^a	Psych job demands, job autonomy, workplace social support	None	SEM (no)	Cronbach's α	Stressors at T1, gender, age, negative affectivity	Did not explicitly describe
Houkes et al, 2003 (61)	Sample 1: employees at large bank; Sample 2: teachers (from NL)	1: 148 2: 190	1 year	2	Emotional exhaustion ^a	Workload, social support	None	SEM (no)	Cronbach's α	Stressors at T1, age, gender	All remained in same work organization
Houkes et al, 2003 (62)	Employees at large bank and teachers in NL	338	1 year	2	Emotional exhaustion ^a	Workload, social support	None	SEM (no)	CFA, Cronbach's α	Stressors at T1, age, gender	All remained in same work organization
de Lange et al, 2004 (64)	Employees in NL (heterogeneous work settings)	668	3 years	4 (yes, 1 year)	Depression, job satisfaction, emotional exhaustion ^{a,b}	Job demands, job control, social support from supervisors ^c	None	SEM (no)	Cronbach's α	Age, gender	"Job changers" excluded from analysis
Demerouti et al, 2004 (67)	Employees of an employment agency in NL	335	12 weeks	3 (yes, 6 weeks)	Exhaustion ^a	Work pressure ^c	Gender	SEM (yes)	Cronbach's α	Stressors (auto-correlated), demographics	"Job changers" excluded from analysis
de Lange et al, 2005 (22)	Employees in NL (heterogeneous work settings)	1588	4 years	4 (data re-organized into single pre- / post for analysis)	Depressive mood ^b	Job demands, supervisor social support ^c	None	SEM (no)	Cronbach's α	Stressors (at previous time-point), age, gender, education	Subgroup analyses differentiated "stayers"/ "job changers"
Grebner et al, 2005 (63)	Workers from 5 occupations (nurses, cooks, sales persons, bank clerks, e-technicians) in Switzerland	52	1 year	2	Psychosomatic complaints, irritated reactions, job satisfaction, exhaustion	Job control	None	Multiple regressions (n/a)	Cronbach's α	Stressors at T1, sex, occupation	Did not explicitly describe
Gelsema et al, 2006 (56)	Registered nurses in an academic hospital in NL	381	3 years	2	Job satisfaction, emotional exhaustion, psychological distress, somatic complaints ^a	Worktime pressure, physical demands, skill discretion, decision authority, social support (supervisor/colleagues) nurse-doctor collaboration	None	Multiple regressions (n/a)	Cronbach's α	Stressors at T1, changes in stressors from T1-T2, age, gender, years of work	"Job changers" excluded from analysis

Continued

Table 2. Continued

Author	Population	N	Study duration	Number of waves (equal interval?)	Strain (qualified for current review)	Stressor (qualified for current review)	Testing	Analytic approach	Verification methods	Tests of spuriousness / variables adjusted	Handling of "job changers" between waves
ter Doest & de Jonge, 2006 (52)	Employees at 2 residential health-care institutions in NL	137	2 years	2	Job satisfaction, emotional exhaustion ^a	Job demands, job autonomy, workplace social support ^c	None	SEM (yes)	CFA, Cronbach's α	Stressors at T1, age, gender, negative affectivity	"Job changers" excluded from analysis
Tummers et al, 2006 (51)	Nurses employed at 6 general hospitals in NL	211	1 year	2	Emotional exhaustion	decision authority	None	SEM (no)	Cronbach's α	Stressors at T1	Did not explicitly describe
Hakanen et al, 2008 (55)	Dentists in Finland	2255	3 years	2	Burnout ^a	Job demands ^c	None	SEM (yes)	CFA, Cronbach's α	Stressor at T1	Did not explicitly describe
Houkes et al, 2008 (54)	General practitioners in NL	261	2 years	2	Burnout domains (emotional exhaustion, depersonalization, personal accomplishment) ^a	Workload, work control, social support from colleagues	Gender (cross-sectional relationships only)	SEM (yes)	CFA, Cronbach's α	Stressors at T1	Did not explicitly describe
van der Heijden et al, 2008 (50)	Nurses in NL	753	1 year	2	General health	Job demands (emotional, quantitative, & physical demands)	None	SEM (yes)	Cronbach's α	Stressors at T1, sociodemographics	Did not explicitly describe
Dalgard et al, 2009 (65)	Norwegian employees	439	11 years	2	Psychological distress	Work demands, work control	None	Multiple regressions (n/a)	PCA, Cronbach's α	Stressors at T1, gender, education	"Job changers" excluded from analysis
Demerouti et al, 2009 (57)	Nurses in general hospitals in NL	258	18 mths	3 (no, T1-2: 1 year, T2-3: 6 mths)	Emotional exhaustion, depersonalization ^a	Job demands (includes workload, patient demands, physical demands)	None	SEM (yes)	Cronbach's α	Stressor at T1, gender, general health at T1	"Job changers" excluded from analysis
Ibrahim et al, 2009 (69)	Workers from Canadian National Population Health Survey	2556	8 years	3 (no, T1-2: 6 years, T2-3: 2 years)	Self-rated health, distress, depression	Work social support	Social class	SEM (no)	Cronbach's α	Stressors (autocorrelated), age, gender, marital status, work status (full-/part-time)	All remained in same social class for all waves
Taris et al, 2010 (60)	Police officers from NL	828	1 year	2	Emotional exhaustion ^a	Job control, job demands ^c	None	SEM (no)	EFA, CFA, Cronbach's α	Stressors at T1, age, gender, education, salary, job experience	All remained in same work organization
Boyd et al, 2011 (68)	Academic employees from 12 universities in Australia	296	3 years	2	Psychological strain (social dysfunction, anxiety/depression, loss of confidence)	Job demands (work pressure and academic workload)	None	SEM (yes)	CFA, Cronbach's α	Stressor at T1, age, tenure	All remained in same work organization
Melamed 2011 (70)	Healthy employees (multi-occupational sample)	986	35 mths (on average)	2	Burnout	Workload, job control, social support ^c	None	Multiple regressions (n/a)	Cronbach's α	Depression, neuroticism, age, gender, education	"Job changers" excluded from analysis

^a Maslach Burnout Inventory.^b Centre for Epidemiological Studies - Depression Scale.^c Job Content Questionnaire.

Table 3. Appraisal of the methodological quality of studies reviewed (X = criterion met)

Author	Year	Criterion #1 (sample size)	Criterion #2 (measurement)	Criterion #3 (non-spuriousness)	Criterion #4 (non-response bias)	High-quality study ^a
Leiter & Durup (53)	1996	.	X	X	.	.
Moyle (66)	1998	.	.	X	X	.
Bakker et al (59)	2000	X	.	X	X	.
Garst et al (29) ^b	2000	X	X	X	X	X
de Jonge et al (58)	2001	X	X	X	X	X
Houkes et al (61) ^b	2003	.	X	X	X	.
Houkes et al (62)	2003	X	X	X	X	X
de Lange et al (64)	2004	X	X	X	X	X
Demerouti et al (67)	2004	X	X	X	X	X
de Lange et al (22) ^b	2005	X	X	X	X	X
Grebner et al (63)	2005	.	X	X	X	.
Gelsema et al (56)	2006	X	X	X	X	X
Tummers et al (51)	2006	X	X	X	X	X
ter Doest & de Jonge (52)	2006	.	X	X	X	.
Hakanen et al (55)	2008	X	X	X	X	X
Houkes et al (54)	2008	X	.	X	X	.
van der Heijden et al (50)	2008	X	.	X	.	.
Dalgard et al (65)	2009	X	X	X	X	X
Demerouti et al (57)	2009	X	.	X	X	.
Ibrahim et al (69)	2009	X	X	X	X	X
Taris et al (60)	2010	X	X	X	X	X
Boyd et al (68)	2011	X	.	X	X	.
Melamed et al (70)	2011	X	X	.	X	.

^a Met all criteria.

^b Excluded from quantitative synthesis of evidence, see text for explanation.

as reversed effects have historically been somewhat overlooked (13, 14). In a previous review by Zapf et al (14), the reversed effect was explored in only 15 of 39 (38%) longitudinal job stress studies (supporting evidence shown in seven studies). Likewise, a more recent systematic review of longitudinal studies on the DCS model found only 2 of 19 (11%) high-quality studies explicitly tested for the reversed effect (5). As a whole, methodological sophistication was evident as 19 of 23 (83%) qualifying studies employed “state-of-the-art” analytic approaches advocated by experts (eg, cross-lagged SEM or latent growth curve model) (13, 14, 33,

75), compared to only 6 of 15 (40%) relevant studies in Zapf et al (14). Based on a synthesis of high-quality evidence, the current review found empirical support for only one of three hypothesized reversed effects. Specifically, there was moderately strong evidence in support of a positive strain-to-job demands effect, but no evidence for either a strain-to-job control or strain-to-workplace social support effect.

Generalizability of results

It is noteworthy that, for each of the three reversed effects examined, there was some inconsistency in the ratings among individual studies (ie, +, -, or 0 were all found). Moreover, it was also apparent that a rating of “0” (no/inconsistent association(s)) was most commonly assigned to the high-quality studies. This underscores the potential complexity of the strain-to-stressor relationship and raises the natural issue of generalizability. As discussed at the outset, there are potential competing forces (eg, refuge effects, job crafting) to both the health selection and perception hypotheses, and current results suggest these influences may indeed be of some relevance. In fact, significant strain-to-stressor associations opposite to the expected direction were found in three of the included studies (29, 66, 70). Furthermore, in a study specifically designed to explore mechanisms, de Lange et al (22) found that, like healthy workers, unhealthy (strained) workers also benefited from a job change in the form of improved job control, offering support to the idea of a refuge effect. If the hypothesized reversed effect is only to be seen in some situations, perhaps a logical next question is under what circumstances are they more/less likely observed? Arguably, this points to the need for additional studies that “go beyond” a sample-level analysis to explore variations in strain-to-stressor effects between subgroups or test potential moderating factors. Only two did so among the studies reviewed, and neither gender (67) nor social class (69) were revealed to be significant moderating factors based on respective multiple-group analyses.

The issue of measurement time-lag

Measurement time-lag stood out as a methodological property that varied widely across individual studies (3 months to 11 years). Could this have played a role in the partial generalizability of results? The ideal time-lag for longitudinal job stress research, unfortunately, has remained a long-standing methodological issue (14, 33, 64, 76, 77), and definitive insights remain elusive to-date. In theory, if the time-lag is too short, meaningful health selection or changes in the perception of the work environment may not have suf-

Table 4a. Synthesis of evidence from individual studies (ordered by time-lag duration). **Strain-to-job demands effect** (17 total studies, 8 high-quality studies). [apriori hypothesis=POSITIVE association; *Italicized effects*=“strain” indicator has opposite orientation, direction of observed association is reversed for purpose of determining overall study rating (“-” actually means “+”)]

Study	Time-lag (months)	High quality	Strain-to-stressor effect (observed association)	Study rating	Standardized index of convergence (SIC)
Demerouti et al (67)	1.5	X	exhaustion → work pressure (+,+) ^b	+	High-quality studies only:
Leiter & Durup (53)	3	.	emotional exhaustion → work overload (+)	+	
Moyle (66)	6	.	<i>mental health</i> → <i>job demands</i> (+)	-	SIC = [3-0] / 8 = +0.38
Demerouti et al (57)	12, 6 ^a	.	emotional exhaustion → job demands (+,0) ^b depersonalization → job demands (+,0) ^b	+	Conclusion: moderately strong evidence of positive association
de Jonge et al (58)	12	X	<i>job satisfaction</i> → <i>job demands</i> (0) emotional exhaustion → job demands (0)	0	
Houkes et al (62)	12	X	emotional exhaustion → workload (0)	0	
de Lange et al (64)	12	X	depression → job demands (0) <i>job satisfaction</i> → <i>job demands</i> (0) emotional exhaustion → job demands (+)	0	
van der Heijden et al (50)	12	.	<i>general health</i> → <i>job demands</i> (-)	+	
Taris et al (60)	12	X	emotional exhaustion → job demands (+)	+	
ter Doest and de Jonge (52)	24	.	<i>job satisfaction</i> → <i>job demands</i> (0) emotional exhaustion → job demands (0)	0	
Houkes et al (54)	24	.	emotional exhaustion → workload (0)	0	
Melamed et al (70)	35	.	burnout → workload (0)	0	
Gelsema et al (56)	36	X	<i>job satisfaction</i> → <i>work time pressure</i> (-) emotional exhaustion → work time pressure (+) somatic complaints → work time pressure (0) psychological distress → work time pressure (0) <i>job satisfaction</i> → <i>physical demands</i> (0) emotional exhaustion → physical demands (0) somatic complaints → physical demands (0) psychological distress → physical demands (0)	0	
Hakenen et al (55)	36	X	burnout → job demands (0) ^c	0	
Boyd et al (68)	36	.	psychological strain → job demands (0)	0	
Bakker et al (59)	60	.	depersonalization → patient demands (+)	+	
Dalgard et al (65)	132	X	psychological distress → work demands (+)	+	

^a Unequal time-lag over adjacent time-intervals (time-lag for sequential intervals specified).

^b Multiple effects assessed in same study (3 measurement waves); the two results correspond to observed associations for T1-T2, T2-T3.

^c Parameters for the effect was not explicitly reported; however, in the study, adding strain-to-stressor paths did not improve fit of autocorrelation model, therefore, such paths were assumed to be non-significant.

Table 4b. Synthesis of evidence from individual studies (ordered by time-lag duration) **Strain-to-job control effect** (11 total studies, 6 high-quality studies). [apriori hypothesis=NEGATIVE association; *Italicized effects*=“strain” indicator has opposite orientation, direction of observed association is reversed for purpose of determining overall study rating (“-” actually means “+”)]

Study	Time-lag (months)	High quality	Strain-to-stressor effect (observed association)	Study rating	Standardized index of convergence
Moyle et al (66)	6	.	<i>job satisfaction</i> → <i>job control</i> (-)	+	High quality studies only:
de Jonge et al (58)	12	X	<i>job satisfaction</i> → <i>job control</i> (0) emotional exhaustion → job control (0)	0	
de Lange et al (64)	12	X	depression → job control (0) <i>job satisfaction</i> → <i>job control</i> (+) emotional exhaustion → job control (0)	0	SIC = [0-0] / 6 = 0
Grebner et al (63)	12	.	psychosomatic complaints → job control (0) irritated reactions → job control (0) <i>job satisfaction</i> → <i>job control</i> (0) exhaustion → job control (0)	0	Conclusion: no evidence of association
Tummers et al (51)	12	X	emotional exhaustion → decision authority (0)	0	
Taris et al (60)	12	X	emotional exhaustion → job control (0)	0	
ter Doest & de Jonge (52)	24	.	<i>job satisfaction</i> → <i>job autonomy</i> (0) emotional exhaustion → job autonomy (0)	0	
Houkes et al (54)	24	.	depersonalization → work control (0) <i>personal accomplishment</i> → <i>work control</i> (+)	-	
Melamed et al (70)	35	.	burnout → job control (0)	0	
Gelsema et al (56)	36	X	<i>job satisfaction</i> → <i>skill discretion</i> (+) emotional exhaustion → skill discretion (0) somatic complaints → skill discretion (-) psychological distress → skill discretion (-) <i>job satisfaction</i> → <i>decision authority</i> (0) emotional exhaustion → decision authority (-) somatic complaints → decision authority (0) psychological distress → decision authority (0)	0	
Dalgard et al (65)	132	X	psychological distress → work control (0)	0	

Table 4c. Synthesis of evidence from individual studies (ordered by time-lag duration). **Strain-to-workplace social support effect** (10 total studies, 5 high-quality studies). [apriori hypothesis=NEGATIVE association; *italicized effects*=“strain” indicator has opposite orientation, direction of observed association is reversed for purpose of determining overall study rating (“-” actually means “+”)]

Study	Time-lag (months)	High quality	Strain-to-stressor effect (observed association)	Study rating	Standardized index of convergence (SIC)
Leiter & Durup (53)	3	.	emotional exhaustion → supervisor support (-)	-	High quality studies only: SIC = [0-1] / 5 = -0.20
Moyle (66)	6	.	<i>job satisfaction</i> → support (-) <i>mental health</i> → support (-)	+	
de Jonge et al (58)	12	X	<i>job satisfaction</i> → workplace social support (0) emotional exhaustion → workplace social support (0)	0	Conclusion: no evidence of association
Houkes et al (62)	12	X	emotional exhaustion → social support (0)	0	
de Lange et al (64)	12	X	depression → supervisor social support (0) <i>job satisfaction</i> → supervisor social support (+) emotional exhaustion → supervisor social support (-)	-	
ter Doest & de Jonge (52)	24	.	<i>job satisfaction</i> → workplace social support (0) emotional exhaustion → workplace social support (0)	0	
Houkes et al (54)	24	.	depersonalization → social support from colleagues (0) <i>personal accomplishment</i> → social support from colleagues (+)	-	
Melamed et al (70)	35	.	burnout → social support (0)	0	
Gelsema et al (56)	36	X	<i>job satisfaction</i> → supervisor social support (+) emotional exhaustion → supervisor social support (0) somatic complaints → supervisor social support (0) psychological distress → supervisor social support (0) <i>job satisfaction</i> → social support from colleagues (0) emotional exhaustion → social support from colleagues (0) somatic complaints → social support from colleagues (0) psychological distress → social support from colleagues (0) <i>job satisfaction</i> → nurse-doctor collaboration (0) emotional exhaustion → nurse-doctor collaboration (0) somatic complaints → nurse-doctor collaboration (0) psychological distress → nurse-doctor collaboration (0)	0	
Ibrahim et al (69)	72, 24 ^a	X	<i>self-rated health</i> → work social support (0,+0,-) ^b distress → work social support (-,0,-) ^b depression → work social support (0,-,0,+) ^b	0	

^a Unequal time-lag over adjacent time-intervals (time-lag for sequential intervals specified).

^b Multiple effects assessed in same study (analyses stratified by social class and 3 measurement waves): the four results correspond to observed associations for T1-2 lower social class; T1-2 higher social class; T2-3 lower social class; T2-3 higher social class.

ficiently unfolded. On the other hand, an excessively long time-lag may provide more opportunities for adaptations that could negate the anticipated reversed effect (14, 78, 79). If true, then perhaps one might expect reversed effects to be more likely seen with less extreme time-lags. Based on a limited number of qualifying studies in the review, however, there did not appear to be any obvious trends between time-lag and study rating. In fact, the expected reversed effects could be seen in four high-quality studies that featured highly distinct time-lags: very short (1.5 months) (67), average (12 months) (60, 64), and extremely long (132 months) (65). To shed further light on this issue in the future, perhaps two research avenues deserve considerations. One approach may involve conducting studies that directly compare strain-to-stressor effects over different time-lags (eg, baseline-to-1st follow-up versus baseline-to-2nd follow-up, etc.). Secondly, as more relevant studies emerge, a formal investigation of the relationship between methodological properties (including time-lag) and study results (eg, effect size) may also be worthwhile.

Disentangling between “health selection” and “perception” mechanisms

Which mechanism(s) is in fact responsible for the reversed effect? Currently, this remains unclear as few studies to-date have explicitly aimed to disentangle the relevance and contributions of the postulated health selection and perception hypotheses. A notable example, however, is de Lange et al (22), which conducted subgroup analyses aimed at discerning the mechanism(s) responsible. In this study, the authors concluded no single dominant mechanism for the reversed effect, as mild support for rosy/gloomy perception and upward health selection mechanisms (but not downward selection) was evident (22). Some insights were gained from the current review. Among the four high-quality studies that demonstrated the expected reversed effect, three had explicitly excluded job changers in their analyses (64, 65, 67), while the other study featured workers (police officers) who had remained at the same organization at follow-up (60). At first glance, this seemingly points to the perception mechanism, although in all these cases, health selection influences cannot be entirely ruled out,

since (real) changes in the work environment is still possible without a formal job transfer (eg, workers given more/less job responsibilities, managerial changes, etc.). In the case of the latter study, the study sample may include workers who had undergone internal job changes (eg, promotions/demotions within the same organization). As such, it is not definitive that the reversed effects in these studies are solely due to perception changes.

Moving forward, further research to help unpack the contributing mechanisms of the reversed effect is certainly worthwhile, although important challenges from a design perspective should be recognized. A key conundrum would appear to be that very different designs may be needed to isolate effects linked to each of the two main postulated mechanisms. Moreover, in most cases, it is likely not possible to anticipate beforehand which mechanisms will be most involved (ie, difficult to know if and when job transfers will occur). Presumably, an examination of health selection may require a focus on workers who have undergone a meaningful change in the work environment and also the specific measurement waves that correspond to the occurrence of such a change. In this case, a relatively short time lag between pre- and post-change may be most desirable to minimize confounding influences (eg, to isolate from perception changes). Yet, in seemingly direct contrast, meaningful changes in the perception of the work environment may be best assessed over longer durations (to ensure changes in perception have fully consummated), but restricting to workers who had not experienced actual changes in the work environment (ie, to isolate from health selection influences). In all likelihood, it is perhaps simply too much to expect a single (and reasonably feasible) design to be able to capture and isolate these mechanisms precisely, particularly if they operate concurrently. As such, improvements in design may need to be explored elsewhere. Far from a panacea, perhaps an aspect of the design that can be more feasibly improved is the measurement of job-related changes between waves, as well as the description of such changes in scientific reports. In the current review, a number of studies appeared to have fallen short in this area (eight did not offer sufficient description of how job changers were handled). Beyond formal job transfers within or outside a work organization, future studies may also consider assessing for other (less drastic but also meaningful) job-related changes. This may include changes in work hours, significant changes in job responsibilities, or even managerial changes – all of which can occur while a worker occupies the same "job" (or job title) over time. At the very least, more comprehensive measurement in this regard should help researchers distinguish between workers who had or had not experienced "real" changes in the work environment (beyond job transfers), thus potentially enabling more definitive conclusions to be

drawn in terms of the contributing mechanism(s).

Propagation of reciprocal stressor–strain effects over time

Do reciprocal stressor–strain effects persist over time? Drawing on the conservation of resources theory (80, 81), scholars are beginning to explore the relevance of gain/loss spirals in the context of the occupational stressor–strain relationship (82–84). Accordingly, this was also revealed to be a key theoretical basis/impetus for many of the studies reviewed. Briefly, the conservation of resources theory posits that psychological stress occurs "when resources (eg, objects, conditions, personal characteristics, and energies – things that people are motivated to acquire or value) are threatened, lost, or when individuals invest resources and do not reap the anticipated level of return" (85, p117). Moreover, it is believed that each loss depletes the available resources for confronting the next threat or loss, making one more vulnerable to additional resource losses. Thus, "initial loss begets future loss" and a loss spiral could ensue (81, p354). Along the same lines, gain spirals have also been theorized (86). If true, cycles of positive or negative influence may be characteristic of occupational stressor–strain relationships. To better understand the relevance and nature of gain/loss spirals, insights on the propagation of the reversed (as well as the normal) effects over multiple time-intervals (ie, more than two measurement waves) are needed. Unfortunately, the current review offered limited insights, as relatively few studies had employed more than two waves, and the available findings were also somewhat conflicting. In Demerouti et al (67), there was remarkable consistency in the magnitude of both normal and reversed effects between adjacent time-intervals (parameter estimates of corresponding relationships were identical between T1-2 and T2-3), suggesting strong persistence of effects over time. Likewise, the four-wave study by de Lange et al (64) found that constraining all corresponding (normal and reversed) effects to be equal across adjacent time-intervals led to the best-fitting model. On the other hand, however, persistence of reversed effects was not seen in Demerouti et al (57), where a significant positive strain-to-job demands effect was observed between T1 and T2, but not between T2 and T3 (no association). Nonetheless, more such studies would be worthwhile to shed further light on the relevance and nature of gain/loss spiral mechanisms in the context of occupational stressor–strain relationships.

Study limitations

Several study limitations should be considered. It should be recognized that reversed effects involving other work-

related stressors/outcomes have also been tested in the literature. For example, the reciprocal relationships involving job insecurity (69, 87), effort–reward imbalance (88), or constructs involved in the work motivational process of the Job Demands–Resources model (eg, work engagement ↔ job resources) have also been previously explored (54, 55, 68). These were considered beyond the scope of the current review. Publication bias is possible in a systematic review focused on the peer-reviewed literature as studies with more novel findings (eg, significant reversed effect) may be more likely published than studies without such findings. That said, it was also apparent that, for each of the three reversed effects of interest, most included studies were ultimately assigned a study rating of “0”, and therefore, this form of bias did not appear to be strongly evident. Lastly, the current review did not involve inter-rater appraisals of the individual studies, which may imply greater risk of rater bias/error. However, appraisals of studies largely involved synthesizing quantitative information directly from publications and every effort has been made to ensure accuracy and consistency in the review process. Also, central to the current review, study ratings were determined by a clear set of decision rules that have been successfully applied in systematic reviews on similar topics (47–49).

Concluding remarks

Based on a systematic review of available evidence, moderately strong evidence in support of one of three reversed effects assessed was found, namely, a positive strain-to-job demands effect. In conjunction with available evidence on the corresponding normal effect, this give credence to the possibility of a reciprocal stressor–strain relationship involving job demands and worker well-being. To advance the state of current knowledge, future research should aim to: (i) shed further light on the generalizability of the expected reversed effect and determine factors influential to the likelihood of this effect; (ii) help disentangle between health selection and perception hypotheses as contributing mechanisms, and (iii) conduct studies with more measurement waves to afford opportunities to explore the influence of measurement time-lag variations, as well as the propagation of reciprocal stressor–strain relationships over time to inform the nature and relevance of gain/loss spiral mechanisms.

Acknowledgments

The author would like to acknowledge Drs. Benjamin C. Amick III, Dorcas E. Beaton, Pierre Côté, Sheilah Hogg-Johnson, and Patrick Loisel for providing general

guidance during the planning stages of this study and feedback on an earlier draft of the paper.

The author is recipient of a Canadian Institutes of Health Research (CIHR) Fellowship. He declares no conflict of interest.

References

1. Johnson JV, Hall EM. Job strain, work place social support, and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population. *Am J Public Health*. 1988;78(10):1336–42. <http://dx.doi.org/10.2105/AJPH.78.10.1336>.
2. Karasek R, Theorell T. *Healthy work: Stress, productivity and the reconstruction of working life*. New York, NY: Basic Books; 1990.
3. Belkic KL, Landsbergis PA, Schnall PL, Baker D. Is job strain a major source of cardiovascular disease risk? *Scand J Work Environ Health*. 2004;30(2):85–128. <http://dx.doi.org/10.5271/sjweh.769>.
4. Van der Doef M, Maes S. The Job Demand-Control(-Support) model and psychological well-being: a review of 20 years of empirical research. *Work Stress*. 1999;13(2):87–114. <http://dx.doi.org/10.1080/026783799296084>.
5. de Lange AH, Taris TW, Kompier MA, Houtman IL, Bongers PM. “The very best of the millennium”: longitudinal research and the demand-control(-support) model. *J Occup Health Psychol*. 2003;8(4):282–305. <http://dx.doi.org/10.1037/1076-8998.8.4.282>.
6. van der Doef MP, Maes S. The job demand-control(-support) model and psychological well-being: A review of 20 years of empirical research. *Work Stress*. 1999;13:87–114. <http://dx.doi.org/10.1080/026783799296084>.
7. de Jonge J, Kompier MAJ. A critical examination of the demand-control-support model from a work psychological perspective. *Int J Stress Manag*. 1997;4:235–58. <http://dx.doi.org/10.1023/B:IJSM.0000008152.85798.90>.
8. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev*. 1977;84(2):191–215. <http://dx.doi.org/10.1037/0033-295X.84.2.191>.
9. Bandura A. The self system in reciprocal determination. *Am Psychol*. 1978;34:344–58. <http://dx.doi.org/10.1037/0003-066X.33.4.344>.
10. Feij JA, Whitely WT, Peiro JM, Taris TW. The development of career-enhancing strategies and content innovation - a longitudinal study of new workers. *J Vocat Behav*. 1995;46(3):231–56. <http://dx.doi.org/10.1006/jvbe.1995.1017>.
11. Jones GR. Socialization tactics, self-efficacy, and newcomers adjustments to organizations. *Acad Manage J*. 1986;29(2):262–79. <http://dx.doi.org/10.2307/256188>.
12. Frese M. Occupational socialization and psychological development - an under-emphasized research perspective in industrial psychology. *J Occup Psychol*. 1982;55(3):209–24. <http://dx.doi.org/10.1111/j.2044-8325.1982.tb00095.x>.

13. Williams LJ, Podsakoff PM. Longitudinal field methods for studying reciprocal relationships in organizational behavior research: toward improved causal analysis. In: Staw BM, Cummings LL, editors. *Research in organizational behavior* (Vol 2). Greenwich, CT: JAI Press; 1989. p. 247–92.
14. Zapf D, Dormann C, Frese M. Longitudinal studies in organizational stress research: a review of the literature with reference to methodological issues. *J Occup Health Psychol.* 1996;1(2):145–69. <http://dx.doi.org/10.1037/1076-8998.1.2.145>.
15. Daniels K, Guppy A. Stressors, locus of control, and social support as consequences of affective psychological well-being. *J Occup Health Psychol.* 1997;2(2):156–74. <http://dx.doi.org/10.1037/1076-8998.2.2.156>.
16. Edwards JR. Cybernetic theory of stress, coping, and well-being: review and extension to work and family. In: Cooper CL, editor. *Theories of organizational stress*. Oxford, UK: Oxford University Press; 1998. p. 122–52.
17. Kohn M, Schooler C. *Work and personality: An inquiry into the impact of social stratification*. Norwood, NJ: Ablex; 1983.
18. Taris TW, Bok IA, Calje DG. On the relation between job characteristics and depression: A longitudinal study. *Int J Stress Manage.* 1998;5(3):157–67. <http://dx.doi.org/10.1023/A:1022988915062>.
19. Firth-Cozens J, Hardy GE. Occupational stress, clinical treatment and changes in job perceptions. *J Occup Organ Psychol.* 1992;65:81–8. <http://dx.doi.org/10.1111/j.2044-8325.1992.tb00486.x>.
20. Schaufeli W, Enzmann D. *The burnout companion to study and practice: A critical analysis*. London, UK: Taylor & Francis; 1998.
21. Taris TW. The mutual effects between job resources and mental health: a prospective study among Dutch youth. *Genet Soc Gen Psychol Monogr.* 1999;125(4):433–50.
22. de Lange AH, Taris TW, Kompier MA, Houtman IL, Bongers PM. Different mechanisms to explain the reversed effects of mental health on work characteristics. *Scand J Work Environ Health.* 2005;31(1):3–14. <http://dx.doi.org/10.5271/sjweh.843>.
23. Fletcher BC. A fit approach to work stress and health. In: Schrabracq MJ, Winnubst JAM, Cooper CL, editors. *The handbook of work & health psychology*. Chichester, UK: John Wiley & Sons Ltd; 2003. p. 549–68.
24. Schaufeli WB, Bakker AB. Job demands, job resources, and their relationship with burnout and engagement: a multi-sample study. *J Organ Behav.* 2004;25(3):293–315. <http://dx.doi.org/10.1002/job.248>.
25. Beck AT. *Cognitive therapy and the emotional disorders*. New York, NY: New American Library; 1976.
26. Mathews A. Biases in processing emotional information. *The Psychologist.* 1993;6:493–9.
27. Firth-Cozens J. Why me? A case study of the process of perceived occupational stress. *Human Relations.* 1992;45:131–41. <http://dx.doi.org/10.1177/001872679204500202>.
28. Miller SM. Why having control reduces stress: If I can stop the roller coaster I don't want to get off. In: Seligman M, Garber J, editors. *Human helplessness: theory and applications*. New York, NY: Academic Press; 1980. p. 71–95.
29. Garst H, Frese M, Molenaar PCM. The temporal factor of change in stressor–strain relationships: a growth curve model on a longitudinal study in East Germany. *J Appl Psychol.* 2000;85(3):417–38. <http://dx.doi.org/10.1037/0021-9010.85.3.417>.
30. Wrzesniewski A, Dutton JE. Crafting a job: Revisioning employees as active crafters of their work. *Acad Manage Rev.* 2001;26:179–201.
31. Berg JM, Dutton JE, Wrzesniewski A. What is job crafting and why does it matter? 2008. Ann Arbor, MI: University of Michigan Ross School of Business. Available from: <http://positiveorgs.bus.umich.edu/wp-content/uploads/What-is-Job-Crafting-and-Why-Does-it-Matter1.pdf>.
32. Bollen KA. *Structural equations with latent variables*. New York, NY: Wiley; 1989.
33. Frese M, Zapf D. Methodological issues in the study of work stress: Objective vs. subjective measurement of work stress and the question of longitudinal studies. In: Cooper CL, Payne R, editors. *Causes, coping and consequences of stress at work*. Chichester, UK: Wiley; 1988. p. 375–411.
34. Muthen LK, Muthen BO. How to use a Monte Carlo study to decide on sample size and determine power. *Struct Equ Modeling.* 2002;9(4):599–620. http://dx.doi.org/10.1207/S15328007SEM0904_8.
35. Kline RB. *Principles and practice of structural equation modeling*. London, UK: The Guilford Press; 2005.
36. Peduzzi P, Concato J, Feinstein AR, Holford TR. Importance of events per independent variable in proportional hazards regression analysis. II. Accuracy and precision of regression estimates. *J Clin Epidemiol.* 1995;48(12):1503–10. [http://dx.doi.org/10.1016/0895-4356\(95\)00048-8](http://dx.doi.org/10.1016/0895-4356(95)00048-8).
37. Concato J, Peduzzi P, Holford TR, Feinstein AR. Importance of events per independent variable in proportional hazards analysis. I. Background, goals, and general strategy. *J Clin Epidemiol.* 1995;48(12):1495–501. [http://dx.doi.org/10.1016/0895-4356\(95\)00510-2](http://dx.doi.org/10.1016/0895-4356(95)00510-2).
38. Nunnally JC. *Psychometric Theory*. 2nd ed. New York: McGraw-Hill; 1978.
39. Judd CM, Jessor R, Donovan JE. Structural equation models and personality research. *J Pers.* 1986;54(1):149–98. <http://dx.doi.org/10.1111/j.1467-6494.1986.tb00392.x>.
40. Cieslak R, Knoll N, Luszczynska A. Reciprocal relations among job demands, job control, and social support are moderated by neuroticism: A cross-lagged analysis. *J Vocat Behav.* 2007;71(1):84–96. <http://dx.doi.org/10.1016/j.jvb.2007.03.001>.
41. Rodriguez I, Bravo MJ, Peiro JM, Schaufeli W. The Demands-Control-Support model, locus of control and job dissatisfaction: a longitudinal study. *Work Stress.* 2001;15(2):97–114. <http://dx.doi.org/10.1080/02678370110066968>.
42. Spector PE, Zapf D, Chen PY, Frese M. Why negative affectivity should not be controlled in job stress research:

- don't throw out the baby with the bath water. *J Organ Behav.* 2000;21(1):79–95. [http://dx.doi.org/10.1002/\(SICI\)1099-1379\(200002\)21:1<79::AID-JOB964>3.0.CO;2-G](http://dx.doi.org/10.1002/(SICI)1099-1379(200002)21:1<79::AID-JOB964>3.0.CO;2-G).
43. Heinisch DA, Jex SM. Negative affectivity and gender as moderators of the relationship between work-related stressors and depressed mood at work. *Work Stress.* 1997;11(1):46–57. <http://dx.doi.org/10.1080/02678379708256821>.
 44. Doty DH, Glick WH. Common methods bias: does common methods variance really bias results? *Organ Res Methods.* 1998;1(4):374–406. <http://dx.doi.org/10.1177/109442819814002>.
 45. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J Appl Psychol.* 2003;88(5):879–903. <http://dx.doi.org/10.1037/0021-9010.88.5.879>.
 46. Lindell MK, Whitney DJ. Accounting for common method variance in cross-sectional research designs. *J Appl Psychol.* 2001;86(1):114–21. <http://dx.doi.org/10.1037/0021-9010.86.1.114>.
 47. Wielenga-Meijer EG, Taris TW, Kompier MA, Wigboldus DH. From task characteristics to learning: A systematic review. *Scand J Psychol.* 2010;51(5):363–75. <http://dx.doi.org/10.1111/j.1467-9450.2009.00768.x>.
 48. Nijp HH, Beckers DG, Geurts SA, Tucker P, Kompier MA. Systematic review on the association between employee worktime control and work-non-work balance, health and well-being, and job-related outcomes. *Scand J Work Environ Health.* 2012;38(4):299–313. <http://dx.doi.org/10.5271/sjweh.3307>.
 49. Van Laethem M, Beckers DG, Kompier MA, Dijksterhuis A, Geurts SA. Psychosocial work characteristics and sleep quality: a systematic review of longitudinal and intervention research. *Scand J Work Environ Health.* 2013;39(6):535–49. <http://dx.doi.org/10.5271/sjweh.3376>.
 50. van der Heijden BIJM, Demerouti E, Bakker AB, Grp NS. Work-home interference among nurses: reciprocal relationships with job demands and health. *J Adv Nurs.* 2008;62(5):572–84. <http://dx.doi.org/10.1111/j.1365-2648.2008.04630.x>.
 51. Tummers GER, Landeweerd JA, Janssen PPM, van Merode GG. Organizational characteristics, work characteristics, and relationships with psychologic work reactions in nursing: a longitudinal study. *Int J Stress Manag.* 2006;13(2):201–27. <http://dx.doi.org/10.1037/1072-5245.13.2.201>.
 52. ter Doest L, de Jonge J. Testing causal models of job characteristics and employee well-being: A replication study using cross-lagged structural equation modelling. *J Occup Organ Psychol.* 2006;79:499–507. <http://dx.doi.org/10.1348/096317905X55271>.
 53. Leiter MP, Durup MJ. Work, home, and in-between: a longitudinal study of spillover. *J Appl Behav Sci.* 1996;32(1):29–47. <http://dx.doi.org/10.1177/0021886396321002>.
 54. Houkes I, Winants YHWM, Twellaar M. Specific determinants of burnout among male and female general practitioners: A cross-lagged panel analysis. *J Occup Organ Psychol.* 2008;81:249–76. <http://dx.doi.org/10.1348/096317907X218197>.
 55. Hakanen JJ, Schaufeli WB, Ahola K. The Job Demands-Resources model: a three-year cross-lagged study of burnout, depression, commitment, and work engagement. *Work Stress.* 2008;22(3):224–41. <http://dx.doi.org/10.1080/02678370802379432>.
 56. Gelsema TI, van der Doef M, Maes S, Janssen M, Akerboom S, Verhoeven C. A longitudinal study of job stress in the nursing profession: causes and consequences. *J Nurs Manag.* 2006;14(4):289–99. <http://dx.doi.org/10.1111/j.1365-2934.2006.00635.x>.
 57. Demerouti E, Le Blanc PM, Bakker AB, Schaufeli W. Present but sick: a three-wave study on job demands, presenteeism and burnout. *Career Dev Int.* 2009;14(1):50–68. <http://dx.doi.org/10.1108/13620430910933574>.
 58. de Jonge J, Dormann C, Janssen PPM, Dollard MF, Landeweerd JA, Nijhuis FJN. Testing reciprocal relationships between job characteristics and psychological well-being: a cross-lagged structural equation model. *J Occup Organ Psychol.* 2001;74:29–46. <http://dx.doi.org/10.1348/096317901167217>.
 59. Bakker AB, Schaufeli WB, Sixma HJ, Bosveld W, Van Dierendonck D. Patient demands, lack of reciprocity, and burnout: A five-year longitudinal study among general practitioners. *J Organ Behav.* 2000;21(4):425–41. [http://dx.doi.org/10.1002/\(SICI\)1099-1379\(200006\)21:4<425::AID-JOB21>3.0.CO;2-#](http://dx.doi.org/10.1002/(SICI)1099-1379(200006)21:4<425::AID-JOB21>3.0.CO;2-#).
 60. Taris TW, Kompier MAJ, Geurts SAE, Houtman ILD, Van den Heuvel FFM. Professional efficacy, exhaustion, and work characteristics among police officers: a longitudinal test of the learning-related predictions of the demand-control model. *J Occup Organ Psychol.* 2010;83:455–74. <http://dx.doi.org/10.1348/096317909X424583>.
 61. Houkes I, Janssen PPM, de Jonge J, Bakker AB. Specific determinants of intrinsic work motivation, emotional exhaustion and turnover intention: A multisample longitudinal study. *J Occup Organ Psychol.* 2003;76:427–50. <http://dx.doi.org/10.1348/096317903322591578>.
 62. Houkes I, Janssen PP, de Jonge J, Bakker AB. Personality, work characteristics, and employee well-being: a longitudinal analysis of additive and moderating effects. *J Occup Health Psychol.* 2003;8(1):20–38. <http://dx.doi.org/10.1037/1076-8998.8.1.20>.
 63. Grebner S, Semmer NK, Elfering A. Working conditions and three types of well-being: a longitudinal study with self-report and rating data. *J Occup Health Psychol.* 2005;10(1):31–43. <http://dx.doi.org/10.1037/1076-8998.10.1.31>.
 64. de Lange AH, Taris TW, Kompier MAJ, Houtman ILD, Bongers PM. The relationships between work characteristics and mental health: examining normal, reversed and reciprocal relationships in a 4-wave study. *Work Stress.* 2004;18(2):149–66. <http://dx.doi.org/10.1080/02678370412331270860>.
 65. Dalgard OS, Sorensen T, Sandanger I, Nygard JF, Svensson E, Reas DL. Job demands, job control, and mental health in an 11-year follow-up study: normal and reversed relationships. *Work Stress.* 2009;23(3):284–96. <http://dx.doi.org/10.1080/02678370903322591578>.

- [org/10.1080/02678370903250953](http://dx.doi.org/10.1080/02678370903250953).
66. Moyle P. Longitudinal influences of managerial support on employee well-being. *Work Stress*. 1998;12(1):29–49. <http://dx.doi.org/10.1080/02678379808256847>.
 67. Demerouti E, Bakker AB, Bulters AJ. The loss spiral of work pressure, work-home interference and exhaustion: Reciprocal relations in a three-wave study. *J Vocat Behav*. 2004;64(1):131–49. [http://dx.doi.org/10.1016/S0001-8791\(03\)00030-7](http://dx.doi.org/10.1016/S0001-8791(03)00030-7).
 68. Boyd CM, Bakker AB, Pignata S, Winefield AH, Gillespie N, Stough C. A longitudinal test of the Job Demands-Resources model among Australian university academics. *Appl Psychol Int Rev*. 2011;60(1):112–40. <http://dx.doi.org/10.1111/j.1464-0597.2010.00429.x>.
 69. Ibrahim S, Smith P, Muntaner C. A multi-group cross-lagged analyses of work stressors and health using Canadian National sample. *Soc Sci Med*. 2009;68(1):49–59. <http://dx.doi.org/10.1016/j.socscimed.2008.10.019>.
 70. Melamed S, Armon G, Shirom A, Shapira I. Exploring the reciprocal causal relationship between job strain and burnout: a longitudinal study of apparently healthy employed persons. *Stress Health*. 2011;27(4):272–81. <http://dx.doi.org/10.1002/smi.1356>.
 71. Maslach C, Jackson SE. The measurement of experienced burnout. *J Occup Behav*. 1981;2(2):99–113. <http://dx.doi.org/10.1002/job.4030020205>.
 72. Maslach C, Jackson SE. *Maslach Burnout Inventory*. Palo Alto, CA: Consulting Psychologists Press; 1986.
 73. Karasek R. *Job content questionnaire and user's guide*. Los Angeles, CA: University of Southern California; 1985.
 74. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol*. 1998;3(4):322–55. <http://dx.doi.org/10.1037/1076-8998.3.4.322>.
 75. Little TD, Preacher KJ, Selig JP, Card NA. New developments in latent variable panel analyses of longitudinal data. *Int J Behav Dev*. 2007;31(4):357–65. <http://dx.doi.org/10.1177/0165025407077757>.
 76. Dormann C, Zapf D. Social stressors at work, irritation, and depressive symptoms: accounting for unmeasured third variables in a multi-wave study. *J Occup Organ Psychol*. 2002;75:33–58. <http://dx.doi.org/10.1348/096317902167630>.
 77. Taris TW, Kompier M. Challenges in longitudinal designs in occupational health psychology. *Scand J Work Environ Health*. 2003;29(1):1–4. <http://dx.doi.org/10.5271/sjweh.697>.
 78. Leventhal H, Tomarken AJ. Life stress research: a social-psychological perspective. In: Kasl SV, Cooper C, editors. *Stress and health: Issues in research methodology*. London, UK: Wiley & Sons; 1987. p. 27–55.
 79. Taris TW. *A primer in longitudinal data analysis*. London, UK: Sage; 2000.
 80. Hobfoll SE. Conservation of resources. A new attempt at conceptualizing stress. *Am Psychol*. 1989;44(3):513–24. <http://dx.doi.org/10.1037/0003-066X.44.3.513>.
 81. Hobfoll SE. The influence of culture, community, and the nested-self in the stress process: advancing Conservation of Resources theory. *Appl Psychol Int Rev*. 2001;50(3):337–70. <http://dx.doi.org/10.1111/1464-0597.00062>.
 82. Salanova M, Schaufeli WB, Xanthopoulou D, Bakker AB. The gain spiral of resources and work engagement: Sustaining a positive worklife. In: Bakker AB, Leiter MP, editors. *Work engagement: A handbook of essential theory and research*. New York: Psychology Press; 2010. p. 118–31.
 83. De Cuyper N, Makikangas A, Kinnunen U, Mauno S, Witte HD. Cross-lagged associations between perceived external employability, job security, and exhaustion: Testing gain and loss spirals according to the conservation of resources theory. *J Organ Behav*. 2012;33(6):770–88. <http://dx.doi.org/10.1002/job.1800>.
 84. Xanthopoulou D, Bakker AB, Demerouti E, Schaufeli WB. Reciprocal relationships between job resources, personal resources, and work engagement. *J Vocat Behav*. 2009;74(3):235–44. <http://dx.doi.org/10.1016/j.jvb.2008.11.003>.
 85. Hobfoll SE, Freedy JR. Conservation of resources: a general stress theory applied to burnout. In: Schaufeli WB, Maslach C, Marek T, editors. *Professional burnout: recent developments in theory and research*. Washington, D.C.: Taylor & Francis; 1993. p. 115–29.
 86. Hobfoll SE, Shirom A. Stress and burnout in the workplace: conservation of resources. In: Golombiewski T, editor. *Handbook of organizational behavior*. New York, NY: Marcel Dekker; 1993.
 87. Hellgren J, Sverke M. Does job insecurity lead to impaired well-being or vice versa? Estimation of cross-lagged effects using latent variable modelling. *J Organ Behav*. 2003;24(2):215–36. <http://dx.doi.org/10.1002/job.184>.
 88. Shimazu A, de Jonge J. Reciprocal relations between effort-reward imbalance at work and adverse health: A three-wave panel survey. *Soc Sci Med*. 2009;68(1):60–8. <http://dx.doi.org/10.1016/j.socscimed.2008.09.055>.

Received for publication: 21 August 2013