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ORIGINAL RESEARCH

Association between Work-Related Rumination, Work Environment and Employee Well-Being: A Meta-Analytic Study of Main and Moderator Effects

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Abstract
Rumination has been proposed to play a significant role as a potential mechanism impairing the recovery process after work. This study examined two main effects: the association between a negative work environment and work-related rumination, and the association between work-related rumination and lack of employee well-being. Moreover, moderator effects of age, seniority and gender were examined. For this purpose, a meta-analysis was conducted. The results of a primary analysis indicated a significant association between rumination and both negative work events and lack of well-being. Meta-regression analysis revealed that the main effects are not moderated by the variables considered. Our findings emphasize the importance of reducing ruminative thinking at both individual and organizational levels.

Keywords Well-being · Work environment · Rumination · Meta-analysis

1 Introduction

The association between job characteristics and employee well-being is a topic that has attracted much interest in the field of organizational psychology (Van De Voorde et al. 2011; Warr and Inceoglu 2018; Zheng et al. 2015). The rumination construct, which has made great advances particularly in the field of clinical psychology, has been incorporated into other fields over the last decade, giving rise to a considerable amount of empirical evidence. The relative novelty of the study of rumination in relation to workers has resulted in a body of research of enormous interest, but also implies a lack of broader works that integrate data disseminated through individual studies.

Current work stress research has shifted its focus from identifying, quantifying and isolating toxic and/or healthy variables in the workplace and their effects on the health and well-being of workers to examining how workers react to stressful situations (Niven

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et al. 2013; Verkuil et al. 2011). Specifically, studies on how workers interact with the work environment focus on the individual cognitive processes that modulate the recovery process after the working day; a key aspect in the new stress management paradigm.

Recovering after the working day is a dynamic process which involves a strategy to intervene in secondary stress. This intervention strategy seeks to alleviate the negative consequences of a worker's interaction with toxic or unhealthy work environments (LaMontagne et al. 2007). Although the recovery process has been traditionally associated with vacation periods or weekends, the focus is currently on recovery processes that the worker can use on a daily basis (Koopman et al. 2016; Lisbona and Salanova 2016).

Actions to promote psychophysiological recovery outside the working day are more necessary in toxic work environments, since the wear and tear on resources is greater than in healthy work settings (Frost 2002; Wilson et al. 2004). However, some actions hinder proper recovery, resulting in the poor health and well-being of workers and problems of sleep or fatigue, while complete recovery is a valid indicator of good health (Zijlstra et al. 2014).

Outside working hours, an employee may disconnect psychologically and engage in more or less active actions that are unrelated to the content that emanates from work (e.g. maintaining social relationships, doing sports, watching TV or reading). Employees may also devote time outside their working hours to think about work-related issues. Thoughts related to work can be of an emotional or pragmatic nature, giving rise to ruminative or problem-solving thinking, respectively.

Ruminative thought processes have been widely investigated in the field of clinical psychology and are currently considered a transdiagnostic factor of depression, anxiety, substance abuse and eating disorders (Nolen-Hoeksema et al. 2008). There are many conceptualizations of ruminative processes, which are understood as the inability to disengage from work after the working day, but all consistently share three traits: (1) they are semi-automatic thought loops imbued in a negative emotional context (Pravettoni et al. 2007); (2) they are ineffective or maladaptive mechanisms for coping with stressful situations (Flaxman et al. 2012); and (3) they are perceived as useful by those who use the mechanism, that is, ruminators have positive beliefs about ruminating (Brosschot et al. 2005).

Research on rumination in the fields of clinical psychology and health psychology has given rise to a large body of work providing empirical evidence of this construct. Olatunji et al. (2013) analysed 179 correlational studies to examine the association between rumination and symptoms of anxiety and depression; Mor and Winquist (2002) studied 226 effect sizes reflecting the relation between self-focused attention and negative affect; Aldao et al. (2010) combined 241 effect sizes to analyse the strength of the relationship between rumination and four psychopathologies (anxiety, depression, eating, and substance-related disorders); Watkins (2008) conducted a systematic review to determine under what conditions repetitive thoughts can be constructive or unconstructive by examining the results of different domains of science; Querstret and Cropley (2013) carried out a systematic review to assess treatments used to reduce rumination and/or worry. To the best of our knowledge, however, this is the first meta-analysis that includes findings related to the inability to disengage from work, that is, rumination in the work setting. Thus, in our analysis we have included data on affective rumination, work-related rumination, work-related concerns, the inability to disengage from work and worry about work issues measured in workers.

Meta-analysis is a quantitative method used to combine the quantitative outcomes (effect sizes) of primary research studies. It is the statistical or data analysis part of a systematic review of a research topic. However, as a statistical technique, meta-analysis can be used to analyse data without a systematic review process (Cooper et al. 2009).

Meta-analysis involves describing the results of each study using a numerical index and then combining these estimates across studies to obtain a summary (Hedges and Pigott 2001).

Our meta-analytic study was guided by two research questions: (1) What is the relationship between both work environment and well-being of an employee and rumination? (2) What factors explain variation in these relationships?

2 Theoretical Background and Hypotheses

2.1 Overall Relationships

In line with the theoretical models of recovery from work stress, the recovery process is not only a result of being physically removed from the negative elements of the work environment, but also involves the replenishment of resources invested during the working day (Hobfoll 1989), the reduction of symptoms of fatigue or tiredness (Meijman and Mulder 1998), an effective self-regulation of the psychophysiological state (Zijlstra et al. 2014) and a psychological detachment from work-related issues (Sonnentag and Fritz 2015).

Employees can optimize their recovery after the workday using various resource mechanisms, such as engaging in non-work-related tasks or activities that involve refocusing their attention, relaxing, the prolonged mental scrutiny of a particular problem or the evaluation of work in order to see how concerns can be resolved or shared during leisure time (Cropley and Millward 2009; Ragsdale and Beehr 2016).

However, certain activities workers engage in outside of work can hamper the recovery process. According to the perseverative cognition hypothesis (Brosschot et al. 2005), the inability to switch off from work prolongs psychophysiological activation at levels similar to those caused by the stressor itself, thus impeding the replenishment of resources, increasing symptoms of strain and preventing the process of psychological detachment from work. These negative effects can be caused by rumination, defined as a cognitive activity in response to a discrepancy or an imbalance in the individual's meta-cognitive system, which is situated at an abstract level and operates on instrumental topics in the absence of immediate environmental demands requiring the thoughts (Martin and Tesser 1996).

Excessive processing of negative information is useless, unhelpful and unconstructive, as it increases the personal importance of events, exacerbates emotional reactivity and impairs problem solving, thus limiting the availability of alternative plans (Watkins et al. 2008). A negative working environment characterized by high demands, exposure to violence and role ambiguity, among other issues, as well as the worker's lack of well-being therefore entails a considerable investment of resources, a greater need for recovery and a multitude of discrepancies, which can lead to a ruminative state once the worker finishes his or her workday (Jalonen et al. 2015; Van Laethem et al. 2015; Zijlstra et al. 2014).

Based on the above theoretical rationale we hypothesized the following:

Hypothesis 1 A toxic work environment will be positively associated with rumination.

Hypothesis 2 The lack of well-being of an employee will be positively associated with rumination.

2.2 Moderator Variables

In order to gain further insight into the dysfunctional process that hinders recovery after the working day, we analyse workers' age, seniority and gender as potential moderator variables in the relationship between recovery processes based on ruminative experiences and toxic work environments on the one hand, and workers' lack of well-being on the other.

The presence of older workers in the labour force has grown in recent years (Shultz et al. 2010) and is a trend that is expected to remain stable in coming decades. For this reason, the moderating effect of the variable age is particularly relevant to the study of the relationships examined here. Some authors have investigated the differential effect of stress components on young adult workers and older workers within the framework of consolidated theories in the field, albeit with varying results. Although the main characteristics of the demand-control theory of work stress (Karasek and Theorell 1990) are associated with similar effects regardless of the worker's age, secondary aspects, such as personal control, seem to play a greater role in older workers (Besen et al. 2015).

Older workers may have a more effective self-regulation strategy when dealing with the recovery process than younger ones. Moreover, years of experience in the same job provides many opportunities to learn how to manage different situations, modify environments or respond differently to stressful situations. However, this is the first study to explore age and seniority as potential moderator variables in the relationship between rumination and work environments.

Thus, the following hypotheses were proposed:

Hypothesis 3 The association between a toxic work environment and the lack of well-being of an employee with rumination will be stronger in younger workers.

Hypothesis 4 The relationship between a toxic work environment and the lack of well-being of an employee and rumination will be stronger in employees with less seniority.

Moreover, outside the field of organizational psychology, the variable gender has been shown to be one of the differentiating variables in the manifestation and use of rumination strategies. In the response styles theory model proposed by Nolen-Hoeksema (1991), gender was used to explain the higher prevalence of depression in women. In relation to rumination, understood as a maladaptive strategy to cope with stress rather than a problem-solving strategy, Folkman and Lazarus (1980) found in a middle-aged community sample that contrary to the cultural stereotype, men do not use problem-focused coping strategies more than women, nor do women use emotion-focused coping strategies more often than men, except in one setting: the workplace.

However, the differences between female and male workers regarding type of strategies and their effects on the recovery process have not been explored in depth in studies on work-related stress. One exception is the work of Rydstedt et al. (2009), who found no differences among workers in the baseline need for recovery after work, although women reported higher scores than men in the rumination construct. Therefore, we propose the following hypothesis:

Hypothesis 5 Gender will moderate relationships involving the work environment and employee well-being and rumination, such that women will generally show higher levels of rumination.

3 Method

In the following subsections, we outline the methodological and analytical approaches used in the meta-analysis, which are closely aligned with the method proposed by Cooper et al. (2009). Specifically, the different stages of meta-analysis are: (1) primary research on a topic and problem formulation; (2) exhaustive literature search for relevant studies according to previously established inclusion and exclusion criteria; (3) extract from each document those pieces of information that will help answer the research questions, which entails the variable coding procedure; (4) data analysis applying statistical procedures for combining results across studies and testing for differences in results between studies; (5) interpretation of results and assessment of the internal validity and robustness of data for which the risk of bias and a set of sensitivity analyses are considered.

3.1 Inclusion and Exclusion Criteria

The sample of primary sources was selected according to the following inclusion criteria: (1) the study must include a quantitative measure of rumination in terms of correlation or the data necessary to calculate rumination; (2) the correlation must be calculated between rumination and some of the variables that may be included in any of the aggregates subject to meta-analytic analysis; and (3) the research participants must be workers.

We have excluded studies on therapeutic interventions (e.g. Querstret et al. 2016), those validating the psychometric values of a test or a questionnaire (e.g. Takagishi et al. 2014), studies using samples of workers with psychological disorders (e.g. Clohessy and Ehlers 1999) and those investigating rumination in relation to remote jobs (e.g. Anderson et al. 2015).

3.2 Literature Search

The literature search was carried out in three phases. The first search was performed in the PsycInfo, PubMed, Web of Science, Proquest Psychology Journals and Scopus bibliographic databases using the keywords ‘work’ and ‘rumination’ simultaneously. The abstracts of 695 articles were analysed.

In the second phase, the search was carried out using a strategy to seek the connections of each article with other articles. This was done two ways: (1) by examining the studies cited in the reference section of each article (a total of 1589 were examined) and (2) by analysing the studies that included the article selected in the first search among their references.

In a third phase, individualized searches were made by authors whose work had been pre-selected on two or more occasions. The journal issues in which two or more pre-selected papers had been published were tracked one by one. Moreover, searches were performed in the previous bibliographic databases, as well as in PsycInfo EBSCOHOST and Medline, using the terms ‘rumination’ and ‘employee’. This brought the search to an end, as no more new, relevant references were found in the literature.

To determine the relevance of each study, we first read the abstract. We then identified the sample composition and examined the measures of the variables, especially the measure of rumination in the methods section. Finally, we examined the results section of each

source, particularly with regard to statistics on the relationship between two variables or those that could be used to calculate Pearson's product-moment value. Of the total 64 relevant papers, 19 formed part of the final sample of our meta-analysis (see Fig. 1).

The most frequent cause of exclusion was that the paper did not contain a measure of the correlation between rumination and any of the variables of interest, either because the research was qualitative in nature (e.g. Cropley and Millward 2009), theoretical (e.g. Zijlstra et al. 2014) or was quantitative but did not express a result in terms of correlation (e.g. Akerstedt et al. 2012). The second most frequent cause for exclusion was that the final measure did not fit the rumination construct, even in cases where it was specified in the

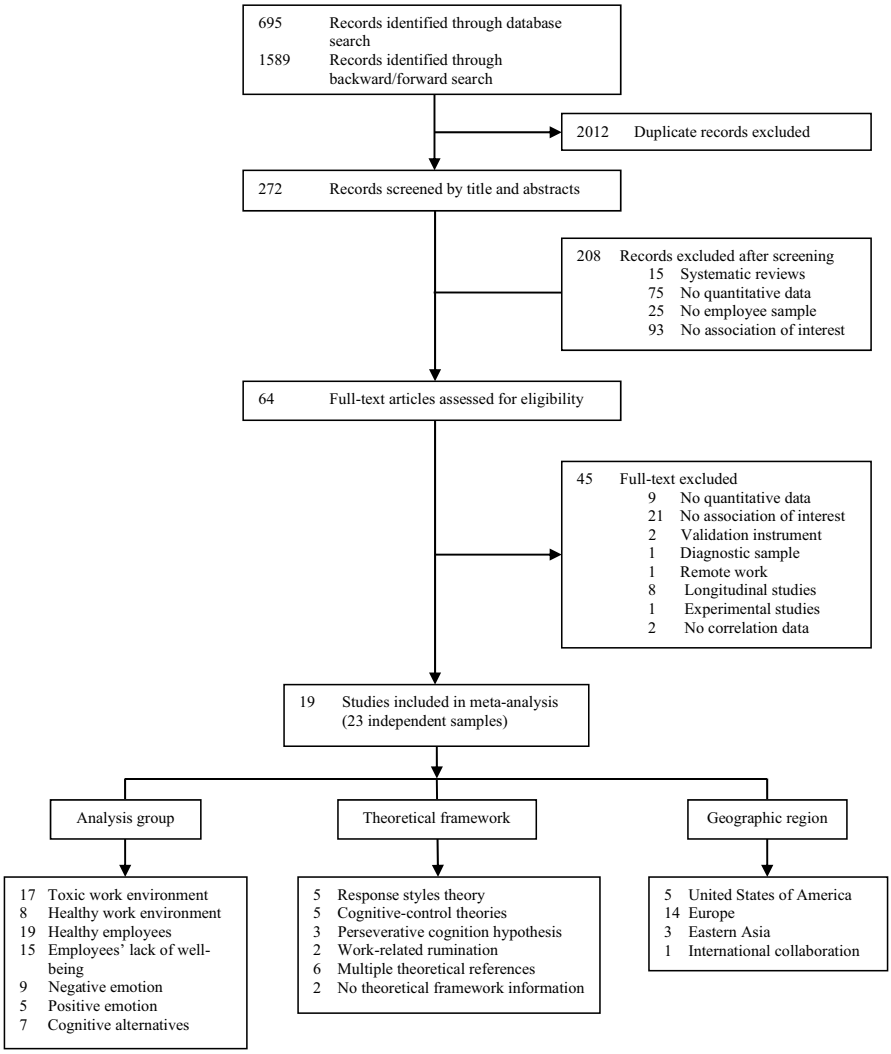

Fig. 1 Flow diagram of the literature search and selection process

introduction of the works, such as 'work-to-family conflict' (Crain 2015); 'overcommitment' (Feuerhahn et al. 2012); 'co-rumination' (Haggard et al. 2011); 'angry' (Meier et al. 2013) and 'spillover' (Wolfram and Gratton 2014).

3.3 Variable Coding Procedure

The moderator variables age, seniority and gender, as well as the effect sizes, were coded on separate sheets by three trained coders familiar with the topic under analysis.

The descriptive variable age was coded by noting the arithmetic mean of the sample of workers. The variable seniority was coded as the arithmetic mean of the number of years employees had an employment relationship with the company. In cases where the primary sources provided data on the years in the company and the average number of years in the same job within the organization, the first was used for codification. The variable gender was coded as the percentage of women in each sample.

To code the results, a single measure of the relation for each study and aggregate was computed. Each variable was included in an aggregate (negative and positive job characteristics, negative and positive employee experiences, negative and positive emotion and cognitive alternatives) by examining the scientific literature for each one. When doubts arose as to how to code the results, the measurement instruments used and the significance of the score obtained for each variable were examined to classify the variable to an aggregate. For example, although the variable sleep in Syrek and Antoni (2014) appears in the table of correlations, what is actually being measured is impaired sleep, so it was coded within the aggregate negative experiences of workers.

For studies using more than one variable from the same construct, the mean effect of the relationship was coded, except when the study showed a global measure and other specific measures of the same variable, in which case only the global measure was coded (e.g. the variable sleep quality in Pereira et al. 2013).

Studies using temporal measures were a subject of discussion among the coders. In the study by Grebner et al. (2005), the value of the second measure of rumination was taken to ensure homogeneity with the rest of the samples, since the first measure shows the effect of the sample at the time the studies concluded. For the study of Vahle-Hinz et al. (2014), the coders opted to code the relationship between rumination and negative mood on Saturday afternoon and not evenings of the workweek, since both measures were taken on the same day. In Wang et al. (2013), the authors established a measure of rumination as a baseline and another measure taken after the effect of a stressful event. In this case, the choice was to code the second measure, since it captures the effect considered in the meta-analysis.

In a single study (Grebner et al. 2005), we found measures of the same variable taken with different instruments (self-reported scores and scores taken by an observer) and chose to codify the self-report measure, since it corresponds with the rest of the samples.

Studies using between- and within-subject measures were coded exclusively on the basis of the between-subject measurements, since most of the remaining studies that were selected employ this level of measurement (e.g. Pereira et al. 2013; Syrek and Antoni 2014; Wang et al. 2013).

The degree of agreement between the coders was high (above 90%). However, three differences were detected when coding the effect sizes, which were solved by means of a careful analysis of each one individually. In addition, all effect sizes were coded twice to correct possible deviations or typographical errors during the process.

3.4 Statistical Analysis

Since there are two popular statistical models for meta-analysis, the fixed-effects model and the random-effects model, a model must be chosen based on the sampling frame in order to contrast the hypotheses with the results of statistical tests.

A fixed-effects model assumes that different studies have different effect sizes and that the effect sizes are fixed quantities, that is, the studies included in the meta-analysis define the entire population of interest (Hedges and Vevea 1998). A random-effects model also assumes that the study effect sizes are different but that they are random, that is, the collected studies represent a random sample from a population of interest (DerSimonian and Laird 1986). In this second case, the variations of the samples with respect to the mean effect not only depend on the sampling error, but also on characteristics that vary from one study to another. Thus, each primary research study we gathered to test the hypotheses use different populations, which is why we consider the random-effects model as the starting point.

The effect size index commonly used is Pearson's correlation coefficient r (Hedges and Olkin 1985). The distribution of the sample correlation coefficient depends on the unknown value of the population correlation and is nonnormal, hence the correlation r must be converted to Fisher's Z scale (Hunter and Schmidt 2004). All analyses were performed using the transformed values. The results, such as the summary effect and its confidence interval, were then converted back to correlation units.

We assume that the selected studies differ from one another in terms of two sources of variability: variability due to sampling error or within-study variability and between-study variability, which is due to the fact that each study estimates its own parametric effect (Hedges and Vevea 1998). Based on the formal approach of the random-effects model, to obtain an estimate of the mean parametric effect ($\bar{r}$), the weighted average of the effect size values estimated for each primary source are calculated as

$$\bar{r} = \frac{\sum_{i=1}^{k} \omega_i r_i}{\sum \omega_i}, \tag{1}$$

where r_i is the empirical correlation of study i, k is the number of primary studies and ω_i is the weighting factor of study i, which is calculated as the inverse of the sum of within-study variance and between-study variance.

Between-study variance (T^2) is the basis of the analysis of heterogeneity and hence of the analysis of the moderating variables. Although up to six different indices have been proposed, to estimate the between-study variance we have opted for the method proposed by DerSimonian and Laird (1986) known as the method of moments (MM) according to which

$$T^2 = \frac{Q - (k-1)}{C}, \tag{2}$$

where C is a weighting factor based on the estimation of the within-study variances and Q can be defined as a weighted sum of the squares of the distances between the observed effect of each study (r_i) and the mean of the correlation ($\bar{r}$). Thus, the Q statistic can be written as

$$Q = \sum_{i=1}^{k} \frac{1}{S_{r_i}^2} \cdot \left(r_i - \bar{r}\right)^2. \tag{3}$$

To assess heterogeneity, we first used Cochran's Q statistic (Higgins and Green 2011) to check to what extent the individual effect sizes vary from the mean effect size. We then used the value obtained from the Q statistic to calculate the variance of the true scores, T^2, and the ratio of the variance of T^2 to the total observed variance, I^2, that is given by

$$I^2 = \frac{T^2}{T^{2+}\sigma^2}. \tag{4}$$

Although the logic is the same as in simple analyses with a single group of studies, in analyses of groups with quantitative moderator variables, the Cochran's Q statistic is used to determine if the mean effect sizes of each group vary from each other or, conversely, the moderator variable has no effect on the relation. Thus, in meta-regression analyses with quantitative moderator variables, the Q statistic is used to test the model and indicates if the predictor variables have a significant effect on the criterion variable. However, in all cases the null hypothesis that tests for significance is always the same: there are no significant differences in scores with respect to the mean of the distribution.

3.5 Assessment of Risk of Bias

The assessment of risk of bias, also known as methodological quality analysis or quality assessment, is an indispensable part of meta-analyses, since data from invalid primary sources can lead to invalid results. The risk of bias systematically affects the estimation of the effect and its direction. Given the nature of the studies included in this paper and the lack of specific quality assessment tools for cross-sectional designs—except those that apply publication criteria to assess quality and thus not the risk of material bias—and following the recommendations of the Cochrane Handbook 5.1.0 (Higgins and Green 2011), we built a domain-based assessment tool. The aim of this tool was to assess the internal validity of the articles separately for different domains that may affect the results in different directions due to the underestimation or overestimation of the correlation effect size.

The tool proposed by the Cochrane Collaboration is specifically designed for systematic reviews of interventions that mainly use Cohen's d as a measure of effect size (Cohen 1977), which equals the standardized difference between treatment and comparison group means. By computing d for each study and averaging, a mean effect size is obtained for the phenomenon under investigation. Thus, we have adapted the principles for assessing the risk of bias in cross-sectional studies that specifically focus on features of the method that may affect Pearson's correlation statistic, which is the statistic of effect size we use here. Each domain is classified as low risk (i.e. the article meets the criteria specified in the item), high risk (i.e. the article does not meet the criteria specified in the item) and unclear risk when the information in the study is not provided in sufficient detail or when detailed information is provided, but the risk of bias that it produces is unknown or when the item is not relevant to the study.

For the assessment, we considered four domains or biases that could affect the size of the effect centered around the relation of the variables. These domains are appropriate for assessing the risk of bias in cross-sectional/epidemiological studies: selection bias, performance bias, detection bias and attrition bias (see Table 1).

Table 1 Criteria for assessing risk of bias

Selection bias: Systematic differences regarding the identification of the characteristics of the participants	
Low risk	The researchers identify participants under any of the following conditions and extract them from the final sample Workers undergoing some type of treatment Workers with reduced working hours
High risk	The researchers identify participants under any of the following conditions, and do not extract them from the final sample Workers undergoing some type of treatment Workers with reduced working hours
Unclear risk	The researchers do not identify participants; there are not enough details or the item is not relevant to the study
Performance bias: Systematic differences on how data are collected	
Low risk	The researchers used a questionnaire to collect the data subject to statistical analysis
High risk	The researchers use a diary to collect the data subject to statistical analysis
Unclear risk	There is no relevant information to assess the risk of performance bias
Detection bias: Systematic differences regarding the measurement instruments	
Low risk	The researchers detail the statistical qualities in at least half plus one of the measurement instruments employed: The reliability is equal to or greater than 0.85 There are three or more items
High risk	The researchers detail the statistical qualities in at least half plus one of the measurement instruments: The reliability is less than 0.85 There are two or one items
Unclear risk	The researchers do not detail the statistical qualities of at least half plus one of the instruments
Attrition bias: Systematic differences on the treatment of missing data	
Low risk	It is specified that there was no missing data or the initial sample of voluntary workers coincides with the size of the final sample
High risk	The missing data are treated statistically by some type of estimation
Unclear risk	There is insufficient information to classify the item as high or low risk

3.6 Sensitivity Analyses

The validity of meta-analytic results is assessed using three approaches: by comparing the results under the two meta-analytic models, identifying outliers and assessing publication bias. These sensitivity analyses determine whether different assumptions made during the research process have a substantial effect on the results (Kepes et al. 2013).

Regarding the first approach (comparison of the results of fixed- and random-effects models), since we have made a theoretical decision about the model selection and opted for the

random-effects model, it is important to contrast that choice with statistical methods (Greenhouse and Iyengar 2009). The homogeneity test is the statistical resource to determine if our previous theoretical assumption regarding the random-effects model for this meta-analysis can be considered appropriate. If the effect sizes are homogeneous across all the studies, then the hypothesis that all studies have a common effect size may be true, and the fixed-effects model may be appropriate. Otherwise, when the hypothesis of homogeneity of effect sizes is rejected, the heterogeneity of the studies is significant. In this case, a fixed-effects model is not sufficient to explain the heterogeneity among the studies and the random-effects model should be applied.

When we use the term outlier we refer to a single data point that is extreme in its value relative to other values of the variable (Arthur et al. 2001). Since the effect of outliers would typically be an increase in the residual variability and a possible shift in the mean correlation effect size, we examined outliers in each meta-analytic distribution using a two-step approach: first we computed the external studentized residual and then used cut-off scores to decide which correlations constitute outliers. Studies with a studentized value greater than 2.00 would be excluded from the meta-analysis (Beal et al. 2002; Viechtbauer and Cheung 2010).

With the aim of lending our results further robustness and cogency, we performed an additional sensitivity analysis to assess the presence of publication bias. Publication biases arise when the dissemination of research findings is influenced by the nature and direction of the results (Higgins and Green 2011). Research results that are not statistically significant ('negative') tend to be under-reported, while statistically significant results ('positive') are more likely to be published, more likely to be published rapidly, more likely to be published in high impact journals and, related to the last point, more likely to be cited by others. Rosenthal (1979) defined this as 'the file drawer problem' and described a scenario where journals are filled with 5% of studies that show significant results while the file drawers are filled with 95% of the studies showing non-significant results.

One of the most common methods proposed to detect the existence of publication bias in a meta-analysis is the funnel plot (Light and Pillemer 1984). A funnel plot is a scatter plot with studies' effect sizes on the horizontal axis and a measure of precision (usually the standard error) on the vertical axis. Results from small studies will scatter widely at the bottom of the graph, with the spread narrowing among larger studies. Funnel plots are supposed to be symmetrical if no publication bias appears. Missing studies suppressed by publication bias in a meta-analysis usually lead to a noticeable asymmetrical funnel plot (Egger et al. 1997).

The quantitative complement of the funnel plot is the trim-and-fill method, which not only indicates the significance of publication bias, but also provides bias-adjusted results (Duval and Tweedie 2000). The basis of this method is to (1) trim (remove) the smaller studies that cause funnel plot asymmetry, (2) use the trimmed funnel plot to estimate the true centre of the funnel, and (3) replace the omitted studies and their missing counterparts around the centre (filling). As well as providing an estimate of the number of missing studies, an adjusted intervention effect is derived by performing a meta-analysis including the filled studies (Higgins and Green 2011).

4 Results

4.1 Selection and Characteristics of the Included Studies

Of the 64 references selected to review the full text, 19 were finally included. The 19 studies have resulted in 23 independent samples. Table 2 shows the descriptive characteristics for each sample finally included in the meta-analysis.

At the descriptive and global level, the mean age of the workers analysed is 37 years (SD = 8.67) out of a total sample of 13,686 workers, of which 53% are women and only 1% is unknown. As regards the distribution of the studies by geographical area, twelve were carried out in Europe, three in the United States of America, three in East Asia and one corresponds to an international collaboration between France and Canada. In terms of occupational categories or occupations, the total sample mainly comprises heterogeneous samples of workers whose occupation is not specified or only specified in a very general way, such as customer service workers, forest service workers, white collar workers or knowledge workers. The rest of the samples include a wide range of occupations and rarely coincide, except in the case of teachers (three samples) and call-centre employees (two samples).

4.2 Risk of Bias

The results of the risk of bias assessment for each of the threats to the validity of the meta-analysis are shown in Fig. 2. The results of the selection bias assessment show an unclear risk, which indicates that the values may be underestimated by including part-time workers or workers undergoing some type of treatment. In spite of this possible effect, it is not of importance given that the mean relations are significant, since the effect is larger than the selection bias of the participants.

Performance bias is based on evidence that data collected using diary surveys overestimate the effects compared to observational techniques or studies that employ questionnaires. In order to determine this, we performed the calculations corresponding to the analysis taking as a moderator variable the type of data collection and built a dummy variable (1 = questionnaire, 2 = diary) for the relationship between rumination and toxic (negative work environment) or unhealthy contexts for the worker (lack of well-being). The results show a differential effect depending on the type of data collection, which affects the relationship between rumination and toxic work environments ($Q = 4.05$, $df = 1$, $p = 0.0441$). However, the mode of data collection does not affect the relationship between rumination and workers' lack of well-being ($Q = 0.05$, $df = 1$, $p = 0.8168$).

Detection bias refers to the reliability of the instruments used to measure the variables, taking into account that measures taken with non-validated instruments or whose reliability is not clearly established could overestimate the measures and hence the statistics of the relationship derived from them. The results of the detection bias assessment show that a large share of the studies are high risk, although more than half present a low risk.

Attrition bias refers to the elimination or withdrawal of participants from the study, which leads to incomplete outcome data. If the values of these withdrawals are estimated based on the rest of the sample, the estimation of the effect can be distorted in any direction. However, we cannot conclude how this type of bias may affect the outcomes, since the treatment of incomplete data is not very clear in the majority of the studies.

Table 2 Overview of the Included Studies

Author(s) (Year)	Country	N	Job	Female (%)	Mean Age (SD)	Seniority
Baranick et al. (2014)	China	737	Customer service employees	77.7	24.7 (2.16)	3
Berset et al. (2011)	Switzerland	100	Various	56.0	32.4 (9)	n.a
Berset et al. (2011)	Switzerland	294	Various	60.2	35.3 (12.2)	n.a
Cropley et al. (2006)	UK	143	Primary and secondary teachers	83.2	38.61 (11.23)	13
Cropley et al. (2012)	UK	268	Various	58.6	36.7 (12.9)	n.a
Cropley et al. (2015)	UK	108	Primary and secondary teachers	71.3	40.8 (10.45)	8.3
Demsky (2015)	USA	699	Forest service employees	49.2	48 (16.67)	16.67
Donahue et al. (2012)	Norway	117	Elite coaches	11.1	39.95 (11.83)	17.5
Donahue et al. (2012)	Canada-France	118	Nurses	91.5	26.85 (2.63)	4.63
Frone (2015)	USA	2831	Various	47.0	41.07 (12.63)	5.9
Grebner et al. (2005)	Switzerland	65	Various	70.8	22 (3.3)	1
Kompier et al. (2012)	Netherlands	5210	Various	48.0	38.9 (1.2)	n.a
Košir et al. (2015)	Slovenia	439	Primary teachers	90.2	49.29 (8.86)	n.a
Luo and Bao (2013)	China	751	Call-center employees	70.4	24.4 (3.45)	2.8
Niven et al. (2013)	UK	78	Social workers	79.5	47.85 (9.72)	12.87
Pereira et al. (2013)	Switzerland	90	Various	63.3	33.79 (12.68)	5
Querstret and Cropley (2012)	UK	719	Various	49.2	42.91 (9.41)	6.99
Rosen and Hochwarter (2014)	USA	150	Various	28.7	40.49 (10.1)	7.39
Rosen and Hochwarter (2014)	USA	161	Accountants	41.0	54.24 (9.91)	13.31
Rosen and Hochwarter (2014)	USA	320	Various	65.0	46.58 (12.25)	11.19
Syrek and Antoni (2014)	Germany	89	Knowledge workers	25.8	30.8 (7.53)	5.2
Vahle-Hinz et al. (2014)	Germany	50	Various	4.0	42.6 (7.32)	5
Wang et al. (2013)	China	149	Call-center employees	n.a	24.43 (2.29)	1.21

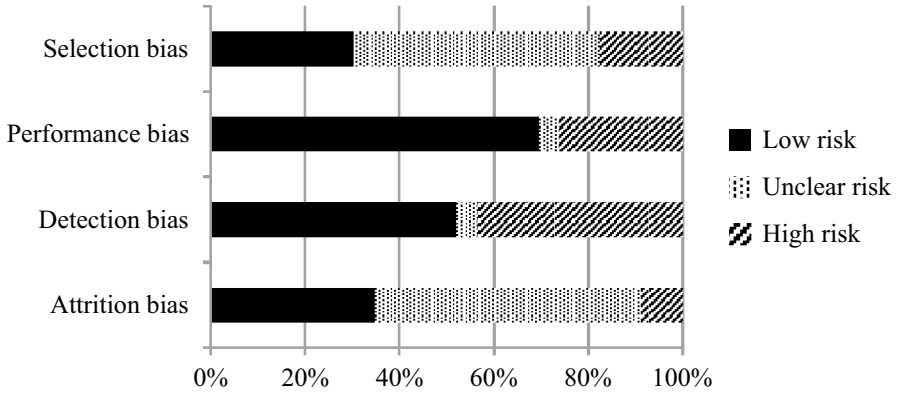

Fig. 2 Results of risk of bias by domain

4.3 Primary Analysis

To calculate the combined estimate, we performed independent meta-analyses for each group of analysis, assuming the random-effects model in all cases. For each group of analysis, Table 3 shows the number of studies included (k), the total number of workers (N), the mean effect of the average size index ($\bar{r}$), the confidence interval, the Q statistic and its significance test (p), the I^2 statistic to determine the percent of unexplained between-study variance and the value of that variance (T^2).

From the results of the confidence intervals obtained at a 95% level, it is observed that none of the calculated $\bar{r}$ includes the value zero, except for the $\bar{r}$ corresponding to the cognitive alternatives aggregate, which suggests that the mean correlations are significant, in support of hypothesis H1 and H2.

To determine if it is appropriate to include third variables in the observed relationships, we have adopted an approach based on several statistical tests following Geyskens et al. (2009). It is necessary to verify if the effect sizes of the studies are homogeneous or if, instead, they present heterogeneity that cannot be explained by the simple random sampling error. Under the hypothesis of homogeneity, the test statistic Q has

Table 3 Meta-analysis results for relationships between rumination and the groups of analysis

Group of analysis	k	N	$\bar{r}$	CI_L	CI_U	Q-value (df)	p	I^2	T^2
Work environment									
Toxic	17	12.234	.302	0.254	0.358	82.206 (16)	.000	80.537	0.007
Healthy	8	10.201	− .125	− 0.168	− 0.082	19.427 (7)	.007	63.967	0.002
Workers									
Discomfort	19	13.236	.343	0.253	0.427	459.247 (18)	.000	96.081	0.043
Well−being	15	8.955	− .195	− 0.265	− 0.123	100.120 (14)	.000	86.017	0.015
Emotio									
Negative	9	5.868	.290	0.173	0.399	138.344 (8)	.000	94.217	0.031
Positive	5	4.213	− .177	− 0.253	− 0.099	15.326 (4)	.004	73.905	0.005
Cognitive alternatives	7	5.811	.022	− 0.135	0.179	182.320 (6)	.000	96.709	0.043

a chi-square distribution with k-1 degrees of freedom. Since $p < 0.05$ in the results, we can reject the homogeneity hypothesis and conclude that the effect sizes are heterogeneous to each other beyond what the simple sampling error can explain. Therefore, it is advisable to perform a moderator analysis.

4.4 Meta-regression Analysis

Meta-regression analysis (MRA) extends on conventional meta-analysis to estimate the extent to which one or more moderators in each study explain heterogeneity in treatment effect. MRA recognizes the specification problem and attempts to estimate its effects by modelling variations in selected econometric specifications. MRA provides a means to analyse, estimate, and discount, when appropriate, the influence of alternative model specifications and specification searches (Stanley and Jarrell 2005).

In this study, workers' age, seniority and gender were included as quantitative variables in the moderator analyses of the relationship between rumination and negative work characteristics on the one hand and rumination and negative personal experiences on the other. Following the recommendations of Borenstein (2009) and Botella and Sánchez-Meca (2015), the results correspond to independent analyses, which take a single predictor for each of the selected variables, thus limiting us to a single predictor for every ten studies.

The results of the moderating effect of age and seniority on the relationship between toxic work environment and lack of well-being and rumination are shown in Table 4.

The variable age of workers has been calculated in a sample of means whose central trend value is 37 years with a standard deviation of nine years and a range of 22–54 years. The question of whether or not effect size is related to age is addressed in the test of the model section (Table 4). The Q-values are 2.57 and 0.19 with one degree of freedom and the p-values are higher than 0.05. The between-study variance (T^2) is estimated at 0.007 and 0.043 at any given point on the regression lines based on age, as compared to T^2 values for the meta-analytic results. This corresponds to a proportion of variance explained of zero. We conclude that effect size is not moderated by age in either the association between rumination and toxic work environment or lack of well-being. Thus, hypothesis H3 is not supported.

The total mean seniority of the sample was 8 years with a standard deviation of 2 years and a range of 1 to 12.87 years in the same organization. We suspected that workers' seniority may be a variable that moderates the relationships under investigation. The Q-values are 1.90 and 0.21 with one degree of freedom and $p > 0.05$, thus indicating that the main effects are not moderated by the variable seniority. Accordingly, T^2 is estimated at 0.008 and 0.045 in the regression models in which seniority is a covariate, as compared to the data in Table 3. This means that seniority cannot explain any heterogeneity. Therefore, hypothesis H4 is not supported.

Regarding the variable gender the test of the model yields Q-values of 0.05 and 0.55 with p-values higher than 0.05. The estimates of T^2 are 0.058 and 0.049, respectively, and therefore the estimate of the proportion of the between-study variance explained by the model is zero. Thus, hypothesis H5 is not supported.

Table 4 Summary of meta-regression results for age, seniority and gender

	Intercept	Coefficient	Standard error	CI_L	CI_U	Z	p	Test of the model		
								Q	df	p
Toxic work environment										
Age	0.5156	− 0.0052	0.0033	− 0.0116	0.0012	− 1.60	.1086	2.57	1	.1860
Seniority	0.3826	− 0.0091	0.0066	− 0.0221	0.0083	− 1.38	.1678	1.90	1	.1674
Gender	0.2987	− 0.0109	0.0503	− 0.1096	0.0877	− 0.22	.8278	0.05	1	.8278
Lack of well-being										
Age	0.4533	− 0.0026	0.0059	− 0.0141	0.0090	− 0.43	.6647	0.19	1	.6647
Seniority	0.4026	− 0.0056	0.0120	− 0.0292	0.0180	− 0.46	.6432	0.21	1	.6432
Gender	0.4092	− 0.0820	0.1107	− 0.2990	0.1351	− 0.74	.4592	0.55	1	.5492

$k = 17$ for the variables age and seniority and $k = 16$ for gender in the toxic work environment analysis; $k = 19$ for age and seniority and $k = 18$ for gender in the lack of well-being analysis

4.5 Sensitivity Analyses

The homogeneity tests for each group of meta-analysis are presented in Table 3. As part of the sensitivity analysis, all distributions showed differences due to primary studies, that is, an amount of between-study variability which is not explained by sampling error. Since the estimated between-study variance (T^2) in all the groups was significantly different from zero, the random-effects model is deemed more valid than considering only one source of variability as a fixed-effect model does.

To detect potential outliers, we computed the studentized residuals for each group of meta-analysis. We found only three potential outliers. Two involved the relationship between the variables rumination and toxic work environment. While the initial mean effect of the average size index ($\bar{r}$) was 0.302, the exclusion of both studies made little difference ($\bar{r} = 0.270$). The third outlier involved the relationship between the variables work-related rumination and healthy work environment. When that study was excluded, we obtained a value of $\bar{r} = -0.131$, which was similar to the initial value (-0.125). As the three outliers did not substantially impact the results, and the values were between the confidence intervals after they were excluded, we retained them.

The visual exploration of the presence of publication bias shows symmetric funnel plots (Fig. 3a–c) while the trim-and-fill method reveals a group of analysis that exhibits publication bias. The discomfort or lack of well-being of employees in relation to work-related rumination shows a corrected mean effect size of $\bar{r} = 0.310$ (versus the estimated $\bar{r} = 0.343$) after eliminating three studies and recalculating the effect on the replaced studies using the trim and fill method in the publication bias analysis. We consider that the data of the two measures, which were estimated and adjusted after the correction, do not vary sufficiently enough to affect the analysis or the discussion of the results since the recalculated and adjusted confidence interval ($CI_L = 0.223$; $CI_U = 0.392$) includes the value of the calculated mean effect without taking into account the publication bias analysis.

5 Discussion

5.1 Summary of Findings

Two of the leading authors who address coping strategies, Folkman and Lazarus (1980), observed that the use of different strategies in a middle-aged community of US residents depended, among other things, on context. Based on the distinction between the work environment and well-being, we aimed to observe the association of the least beneficial coping strategy for managing stressful situations: rumination.

Workers employed in the service sector and/or in jobs that have come to be known as knowledge occupations use the rumination strategy to a greater extent when their work environment is stressful (Gadegaard et al. 2018; Pravettoni et al. 2007). They are exposed to violence and/or do not perceive organizational support, which increases the degree of workplace toxicity. The results point to a very similar mean effect size with regard to the association with workers' lack of well-being. Therefore, there are no differences between the two contexts when observing negative or adverse aspects of the work environment: workers ruminate in negative contexts regardless of whether they are related to the work dimension or the well-being dimension. However, in positive contexts, healthy organizational environments and aspects related to workers' well-being, the association is reversed:

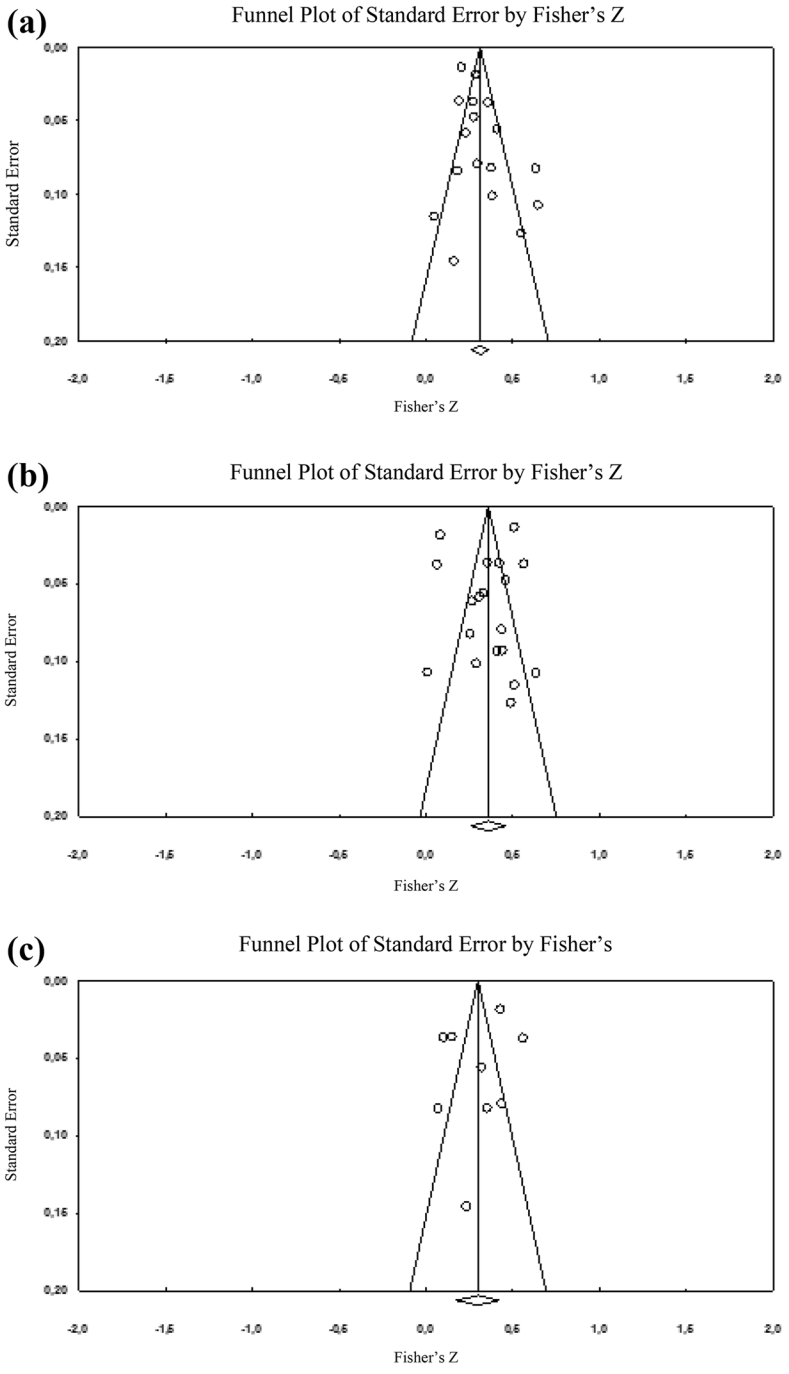

Fig. 3 Publication bias results: **a** toxic work environment; **b** lack of well-being of workers; and **c** negative emotion

employees tend to ruminate less the healthier their working environment and as their job satisfaction and opportunities for recovery increase, such as quality of sleep. This double direction of the network of associations of the rumination strategy also coincides with the results found in relation to negative emotion and positive emotion.

As regards the main associations, only one has not been verified. Specifically, that employees' ruminative thoughts after the working day are independent—in terms of a linear relationship—of other cognitive strategies for coping with stress as alternative mechanisms to rumination. This result may be due to the fact that the composition of the aggregate cognitive alternatives may be too heterogeneous. We included the act of socially sharing events or events perceived as stressful or toxic with colleagues in the workplace or family and friends as a variable of this aggregate. Indeed, sharing stressful events or situations with other people is generally assumed to have a beneficial effect and is considered an emotion-focused coping strategy (Wright et al. 2015). However, our findings question this assumption as its effects are much more ambiguous. In this regard, a novel line of research is being developed around the concept of co-rumination (Haggard et al. 2011).

From a wider perspective, such as that of theories of cognitive control, rumination is a dynamic process encompassed within a broader one that includes concrete thoughts focused on empirical aspects of events and abstract thoughts focused on reappraising emotions associated with everyday events. According to this conceptualization, which is very similar to the reconceptualization of recovery after the working day proposed by Zijlstra et al. (2014), effective self-regulation requires flexible movements through the hierarchy of representations (e.g. ruminative thinking and problem-solving thinking). Nonetheless, the strategies are part of the same system and therefore their effects can be difficult to isolate, especially in cross-sectional designs, which are the great majority of designs that have explored rumination in the work environment.

The association between negative work context and poor well-being with the rumination strategy is consistent and is not affected by worker's age or seniority.

To accurately determine a possible alternative explanation for the lack of statistical significance in all the proposed models, we calculated the correlation matrix of the regression coefficient estimates for all the tested models. The correlation between all moderators and the intercepts is high. This indicates that they are highly confounded, and it is therefore difficult to isolate the unique impact of each.

Nonetheless, the risk of bias is generally low, which adds validity to the results. In fact, the greatest threat has been selection bias, which indicates that many of the samples included in the database are comprised of part-time workers and/or workers undergoing some form of pharmacological treatment or therapy. These two threats result in the underestimation of the strength of the associations under study although the mean values were found to be above this significant bias, with the exception discussed above.

To further examine the robustness of our results, we conducted sensitivity analyses. We found that our results are not biased by extreme outliers and that for the relationships studied, the estimates are quite robust with regard to excluding the potential outliers. Moreover, we found that a potential publication bias is not a serious threat to the validity of the results.

5.2 Theoretical, Practical and Methodological Implications

From a theoretical perspective, a large number of studies have attempted to elucidate the role of rumination as a third variable in the association between negative work

environments and workers' poor health or lack of well-being. The results of our research have shown an intermediate association of a moderate nature in the triad that includes rumination along with the work environment and workers' well-being. This consistent relationship points more to the role of rumination as a mediating variable (Ato et al. 2014) rather than a moderator variable, and can serve as a basis for further research on the role of rumination as a third variable.

Our study suggests several practical implications. From the perspective of employees, it is counterproductive to use an emotion-focused strategy such as ruminative thinking when the work environment is toxic and emotions are negative. Yet this strategy is common in unhealthy work environments precisely where it is the least appropriate because rumination is perceived as being useful and valuable. In line with other studies, it is important to highlight the inefficacy of this type of strategy when the external and internal environment is negative. At both organizational and individual levels, the belief in the beneficial effects of ruminating must therefore be demystified. This generalization has important practical implications as to the power of identifying and controlling these ineffective strategies to manage stress. As regards the implications for organizations, they must be aware of such work-related issues and promote a healthier work environment in which rumination is discouraged with a view to improving the well-being of workers.

The most powerful tools for developing a meta-analytic design are those that synthesize the results of therapeutic interventions with one or more control groups. These types of designs are not, however, so common in other fields, such as organizational psychology where valid, accurate and reliable meta-analyses can be performed. Methodological issues, such as the analysis of the validity of results, lack the tools for application particularly in cross-sectional designs. In this study, we have developed a tool for assessing the risk of domain-based bias rather than opting for quality assessment. Although quality assessment may have some relation to the threat of validity, it is not a direct measure and does not allow for the disaggregated analysis of different threats, whose effect can also occur in different directions. From a methodological point of view, the use of a cross-sectional meta-analysis, as in this study, provides a starting point with important implications.

5.3 Limitations and Directions of Future Research

Although this meta-analysis clarifies the antecedents of rumination in a specific context involving employees' lives (work and well-being) and we have found no threat to the validity of the results either in terms of risk of bias or publication bias, it is not without limitations. First, no causal relationship can be concluded since the analyses are based on cross-sectional data. Second, the findings need to be interpreted with caution given the reliance on self-reported data which capture content better than they capture the underlying process (Olatunji et al. 2013). However, this can also be viewed as an advantage in that it has allowed us to observe differences in the type of self-reported data collection. The results based on questionnaires underestimate the effect of the relationship found between rumination and the personal dimensions of workers, with the strongest relation found in studies using diary surveys.

Future research on this topic should be focused more intensively on potentially moderating variables. In this regard, research should centre on determining which variables explain the observed heterogeneity. In this meta-analysis, it has not been possible to test the effect of type of work performed in any of the proposed associations. First, many of the primary sources use samples of workers belonging to different professional categories without

distinction, which makes it impossible to disaggregate effect sizes. Second, studies using specific occupational samples focus on a very similar set of categories in terms of level of qualification or jobs in which workers must deal with the public. It would be of great interest to analyse the relationship between an adverse work environment and rumination in unqualified or technical jobs, as well as the association between rumination and lack of well-being among workers occupying positions of this type. It would also be interesting to study the moderator effects of other variables, such as education level, socioeconomic status or years in the current job, which were not chosen due to the different ways these variables were coded in the primary research or because there were not a sufficient number of studies reporting data on them.

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