DON'T LET THE TRUTH GET IN THE WAY OF A GOOD STORY: AN ILLUSTRATION OF CITATION BIAS IN EPIDEMIOLOGIC RESEARCH

The production of scientific knowledge is susceptible to bias at every stage of the process, from what questions are asked by the investigator, to which method is chosen to gather data, to which analyses are conducted (e.g., “P-hacking,” wherein the method of statistical analysis and the degrees of freedom are manipulated until they yield statistically significant results) (1). Even after completion of a study, authors sometimes choose not to submit their work for publication because they are not satisfied with the results (i.e., the “file drawer” problem) (1), or they encounter difficulties with getting results published because of reviewer or editorial bias (“publication bias”) (2–4).

Although prepublication biases have been well described in epidemiologic textbooks, postpublication biases, such as selective citation, have been less well documented. “Citation bias” occurs when scientists selectively cite papers based upon risk estimates that conform to their preconceived notions (5). When researchers have a bias in favor of “X causing Y,” they are more likely to cite papers that found evidence to support their view. Conversely, when researchers harbor a bias against a hypothesized association, they may selectively cite papers that report null findings.

Here, we use research on job strain and the risk of coronary heart disease to examine factors that influence citations in peer-reviewed literature. In addition to the risk estimate for job strain relative to no job strain in each study, we take into account the impact factor of the publishing journal, which is an indicator of its prestige.

METHODS

We used the most recent meta-analysis of job strain and incident coronary heart disease to identify relevant studies for this analysis (6). According to the total evidence from this meta-analysis (26 studies), employees who experienced job strain had 1.34 (95% confidence interval (CI): 1.18, 1.51) times greater disease risk than did those free of job strain (6). To allow an adequate period of time for citations to accumulate, we focused on papers published at least 10 years ago, which yielded a total of 7 cohort studies (Table 1) (7–13). For each study, we obtained relative risk estimates for the job strain–heart disease association, counted citations in the Scopus (Elsevier, Amsterdam, the Netherlands) and Web-of-Science (Thompson Reuters, New York, New York) databases, and obtained the impact factor of the publishing journal from Web-of-Science Journal Citations 2013. In addition, we obtained an indicator of the scientific quality of each study from a review (14) in which the authors had based their evaluation on 8 criteria (e.g., the characteristics of the study population, validity of the exposure measurement and outcome ascertainment, and comprehensiveness of adjustments for confounding factors). A higher score indicated higher quality (range, 0–12) (14).

We computed the associations of effect size and journal impact factor with the number of citations using general linear models (procedure glm in Stata, version 11.2; StataCorp LP, College Station, Texas). Both analyses were adjusted for

Table 1. Number of Citations, Effect Size, Journal Impact Factor, and Scientific Quality for Cohort Studies on Job Strain and Coronary Heart Disease Published From 1989 to 2004

<table>
<thead>
<tr>
<th>First Author, Year (Reference No.)</th>
<th>No. of Citations a</th>
<th>Relative Risk</th>
<th>95% CI</th>
<th>Journal Impact Factor b</th>
<th>Quality Score c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kivimäki, 2002 (11)</td>
<td>384</td>
<td>2.20</td>
<td>1.16, 4.17</td>
<td>17.215</td>
<td>4</td>
</tr>
<tr>
<td>Johnson, 1989 (8)</td>
<td>255</td>
<td>1.94</td>
<td>1.15, 3.21</td>
<td>3.775</td>
<td>6</td>
</tr>
<tr>
<td>Kuper, 2003 (12)</td>
<td>219</td>
<td>1.57</td>
<td>1.26, 1.96</td>
<td>3.393</td>
<td></td>
</tr>
<tr>
<td>Eaker, 1992 (13)</td>
<td>200</td>
<td>0.94</td>
<td>0.45, 1.44</td>
<td>4.780</td>
<td>8</td>
</tr>
<tr>
<td>Reed, 1989 (7)</td>
<td>125</td>
<td>0.94</td>
<td>0.65, 1.36</td>
<td>4.780</td>
<td>6</td>
</tr>
<tr>
<td>Alterman, 1994 (9)</td>
<td>120</td>
<td>1.48</td>
<td>0.98, 2.24</td>
<td>4.780</td>
<td>8</td>
</tr>
<tr>
<td>Lee, 2002 (10)</td>
<td>79</td>
<td>0.80</td>
<td>0.48, 1.33</td>
<td>6.982</td>
<td>8</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

a Citations as of January 25, 2014.

b Web of Science journal impact factor for 2013.

c Quality score (range, 0–12) was obtained from a previous review (14). The quality score for Kuper et al. (12) is missing because it was not included in that review.
citations in Scopus 

with 16.5 (95% CI: 7.9, 25.0) additional citations in Scopus 

that each 10% increase in reported excess risk was associated 

had the lowest scienti 

authors decided which articles to cite. The most-cited study 

of 8, which was the highest received (9, 10). 

In contrast, the 2 least-cited studies obtained a quality score 

Scopus, per each 1-point increase in impact factor, change in 

estimated, as evidenced by the wide con 

null 

estimates were cited more frequently than those that reported 

paper, job strain was reported to double the disease risk 

in Scopus and 1,305 in Web-of-Science. In the most-cited 

R 

446 

DISCUSSION 

By analyzing the frequency of citation of papers that exam-

ined the relation of job strain with coronary heart disease, we 

showed that higher-quality science in this field did not garner 

more citations. In contrast, studies that reported higher risk 

estimates were cited more frequently than those that reported 

lower risk estimates. Similarly, as described elsewhere (5), 

there was a tendency for articles that were published in the 

more prestigious journals to be cited more often. 

A strength of the present analysis is that we targeted re-

search on a specific topic. This facilitated a straightforward 

comparison between studies. Study quality was determined 

based on a score obtained from an independent review (14); 

unfortunately, this score was missing for one of the target 

papers (12). 

The main limitation of our investigation is the small num-

ber of studies included in the analyses (7–13). Our findings 

should therefore be interpreted in this context; it is unknown 

whether they are generalizable to other areas of epidemiology. 

More general limitations of examining citations as an outcome 

include the fact that citation bias may be bi-directional; for ex-

ample, tobacco industry–funded researchers may be motivated 

to cite studies that found null associations between smoking 

and disease. Further, a citation could be included in a critical 

context or as counterfactual evidence. 

However, our findings are in agreement with those from 

previous studies. In an examination of citations of published 

articles that were originally submitted to an emergency med-

icine specialty meeting, Callaham et al. (2) found that the 

strength of methodology and study design did not predict 

the frequency of citations during a 3.5-year follow-up. Posi-

tive outcome bias was not observed either, but the constituent 

studies were focused on a heterogeneous set of topics (2). 

Jannot et al. (5) retrieved citation counts of specific therapeutic 

intervention studies and found that studies with statistically 

significant findings were cited twice as often as those with 

nonsignificant findings. Similarly, Andrade et al. (15) reported 

that trials that reported favorable outcomes for surgery to alle-

viate chronic nonspecific low back pain tended to be cited 

more often than those that reported less favorable results. 

Selective publication and citation can influence the con-

struction of scientific knowledge and even lead to nonoptimal 

choices for prevention. Researchers as well as journal review-

ers and editors need to pay more attention to these biases. As 

the number of large-scale individual-participant meta-analyses 

and the amount of data sharing increase within the research 

community, epidemiology as a science can become more 

transparent and self-critical.

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REFERENCES 


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