Publication Bias & Small-study Effects in Pediatric Dentistry Meta-analyses

Spyridon N. Papageorgiou[a,b,c], Dionysia Dimitraki[d], Trilby Coolidge[e], and Nikolaos Kotsanos[d]

[a]Department of Orthodontics, School of Dentistry, University of Bonn, Bonn, Germany
[b]Department of Oral Technology, School of Dentistry, University of Bonn, Bonn, Germany
[c]Clinical Research Unit 208, University of Bonn, Bonn, Germany
[d]Department of Paediatric Dentistry, School of Dentistry, Aristotle University of Thessaloniki, Thessaloniki, Greece
[e]Department of Oral Health Sciences, School of Dentistry, University of Washington, Seattle, WA, USA

Abstract

Objectives: The aim of this study was to examine the presence and extent of publication bias and small-study effects in meta-analyses (MAs) investigating pediatric dentistry-related subjects.

Methods: Following a literature search, 46 MAs including 882 studies were analyzed qualitatively. Of these, 39 provided enough data to be re-analyzed. Publication bias was assessed with the following methods: contour-enhanced funnel plots, Begg and Mazumdar's rank correlation and Egger's linear regression tests, Rosenthal's failsafe N, and Duval and Tweedie's "trim and fill" procedure.

Results: Only a few MAs adequately assessed the existence and effect of publication bias. Inspection of the funnel plots indicated asymmetry, which was confirmed by Begg–Mazumdar's test in 18% and by Egger's test in 33% of the MAs. According to Rosenthal's criterion, 80% of the MAs were robust, while adjusted effects with unpublished studies differed from little to great from the unadjusted ones. Pooling of the Egger's intercepts indicated that evidence of asymmetry was found in the pediatric dental literature, which was accentuated in dental journals and in diagnostic MAs. Since indications of small-study effects and publication bias in pediatric dentistry were found, the influence of small or missing trials on estimated treatment effects should be routinely assessed in future MAs.

Keywords: Pediatric dentistry, Meta-analytical study, Meta-analysis, Publication bias, File-drawer problem, Funnel plot.

Corresponding author. Department of Orthodontics, School of Dentistry, University of Bonn, 53111 Bonn, Germany. Tel.: +49 (0)228 287 22449; fax: +49 (0)228 287 22588; E-mail: snpapage@gmail.com.

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INTRODUCTION

There are many sources of systematic errors in biomedical research and publication bias is just one type of a group of biases termed reporting bias, which is the selective reporting or suppressing of information.[1] There is quite a lot of evidence that these biases exist, and it may be safely assumed that most systematic reviews will be subject to reporting bias to some extent.[2] Publication bias (also known as the "file-drawer problem") has been identified in many fields of research, including dentistry,[3–5] and can be considered as one of the major drawbacks of meta-analyses (MAs) compromising their validity. Publication bias consists of the fact that studies with non-significant results might be published only after some time or not at all. On the other hand, significant/positive results might have a better chance of being published, are published earlier, or published in journals with higher impact factors. Analysis of research publications in five orthodontic journals indicated that studies with significant results were more likely to be accepted for publication.[3] This trend was also observed for other dental specialties and was independent of the journal's Impact Factor. Scholey[6] reported in his thesis that less than half of the abstracts presented at leading dental conferences proceeded to full publication. Empirical evidence indicates that results showing non-significant differences have greater chances to remain unpublished, and this could be interpreted as a possible indication of publication bias.[7]

It has been frequently noted that small trials tend to report greater treatment benefits than larger trials.[8,9] For example, on the subject of pulpal exposure after one- vs. two-step incomplete caries removal, the trial of Lula et al.[10] including 36 teeth reported a "strong" odds ratio of 0.09 (exposure odds decreased by 91%), while the subsequent trial of Bjørndal et al,[11] published the following year including 292 teeth, reported a considerably "weaker" odds ratio of 0.49 (exposure odds decreased by 51%). Although publication bias is often regarded as the main reason for small-study effects,[7,12] other factors may also exist,[13,14] such as selective outcome reporting, a mathematical artifact due to discordant trial sizes, or random error.[15–17] Such "small-study effects," as they are termed, can result from a combination of lower methodological quality of small trials and reporting biases (including publication bias).[8,18,19] However, if the small trials have implemented more careful patient selection and intervention procedures, their results could reflect the actual clinical heterogeneity.[20]

Systematic reviews and MAs are considered to provide the best quality of evidence, as they increase the power and precision of the included studies, identify heterogeneities across existing studies and might even answer questions that weren't asked in the original studies. The validity of systematic reviews and MAs is associated with their methodological quality and the unbiased dissemination of the results of included trials. As however these qualitative/quantitative reviews rely on published material, publication bias can be logically considered as one of the major drawbacks of meta-analyses compromising their validity. If the sample of identified studies is biased, then the validity of the MA is threatened, no matter how systematic and thorough its methodology is. For example, two recent methodological assessments of MAs in the field of orthodontics[21,22] found that only one third of them formally considered publication bias, although indications of small-study effects exist. Thus, it is important to continue to consider the possibility that publication bias and small-study effects may impact the accurate interpretation of MAs. The aim of this study was to assess these two biases in a set of MAs in pediatric dentistry through analysis of the studies composing each MA and meta-analytic techniques to explore the extent that small-study effects and the potential for publication bias appear to occur in them.

MATERIALS AND METHODS

Selection of MAs and corresponding trials

A comprehensive search (Supplementary Table I) of the literature for dentistry-related MAs was previously conducted for a broad meta-epidemiological study.[23] This database was augmented by manual searches of MEDLINE via PubMed and Google Scholar up to the second week of March 2013 in order to keep it up to date. No restrictions were applied concerning language, publication date or publication status. MAs were eligible for inclusion if they reported data for any group compared with another group (i.e. placebo, sham, control or other group). From that database, we then selected all MAs in the field of pediatric dentistry with 7 or more included trials. Although no firm guidelines exist, and previous research has included MAs with a minimum of 5–10,[20,24,25] a minimum of 7 included studies per MA was deemed as adequate for the assessment of funnel plot asymmetry, due to the small number of eligible MAs. The reports of all trials from the included MAs were obtained and the corresponding original data were re-analyzed. When trial data were not provided by the paper, and retrieval attempts failed, communication with the authors of MAs/trials was attempted.

Data synthesis

All analyses were conducted using both the reported effect size metrics (i.e. odds ratios, risk ratio, mean differences, standardized mean differences, etc.) and fixed-effect (Mantel–Haenszel method) or random-effects model (DerSimonian and Laird method), depending on the original paper. The size and impact of the between-study heterogeneity (inconsistency) were measured with the I^2 statistic and its 95% confidence