The Quality of Control Groups in Nonrandomized Studies Published in the *Journal of Hand Surgery*

Shepard P. Johnson, MBBS, Sunitha Malay, MPH, Kevin C. Chung, MD, MS

Purpose To evaluate control group selection in nonrandomized studies published in the *Journal of Hand Surgery American* (JHS).

Methods We reviewed all papers published in JHS in 2013 to identify studies that used nonrandomized control groups. Data collected included type of study design and control group characteristics. We then appraised studies to determine whether authors discussed confounding and selection bias and how they controlled for confounding.

Results Thirty-seven nonrandomized studies were published in JHS in 2013. The source of control was either the same institution as the study group, a different institution, a database, or not provided in the manuscript. Twenty-nine (78%) studies statistically compared key characteristics between control and study group. Confounding was controlled with matching, exclusion criteria, or regression analysis. Twenty-two (59%) papers explicitly discussed the threat of confounding and 18 (49%) identified sources of selection bias.

Conclusions In our review of nonrandomized studies published in JHS, papers had well-defined controls that were similar to the study group, allowing for reasonable comparisons. However, we identified substantial confounding and bias that were not addressed as explicit limitations, which might lead the reader to overestimate the scientific validity of the data.

Clinical relevance Incorporating a brief discussion of control group selection in scientific manuscripts should help readers interpret the study more appropriately. Authors, reviewers, and editors should strive to address this component of clinical importance. *(J Hand Surg Am. 2015;40(1):133–139.*

Key words Confounding, control group, hand surgery, nonrandomized studies, selection bias.

From the Department of Surgery, Saint Joseph Mercy Hospital; the Section of Plastic Surgery, Department of Surgery, University of Michigan Health System; and the Section of Plastic Surgery, University of Michigan Medical School, Ann Arbor, MI.

Received for publication July 8, 2014; accepted in revised form September 15, 2014.

Research reported in this publication was supported by awards from the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health (2R01 AR047328— 06), the National Institute on Aging and National Institute of Arthritis and Musculoskeletal and Skin Diseases (R01 AR062066), and a Midcareer Investigator Award in Patient-Oriented Research (2K24 AR053120-06) to K.C.C. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: Kevin C. Chung, MD, MS, Section of Plastic Surgery, University of Michigan Health System, 2130 Taubman Center, SPC 5340, 1500 E. Medical Center Dr., Ann Arbor, MI 48109; e-mail: kecchung@umich.edu.

0363-5023/15/4001-0024$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2014.09.021

A CONTROL GROUP SHOULD BE a representative sample of the population from which the study group is derived. Thus, it can be similar to the study group but unexposed to a disease, risk factor, or intervention of interest. In nonrandomized studies, selecting comparable groups is necessary to allow appropriate assessment of associations and effectiveness of an intervention.[1–4] Nonrandomized studies are often used in hand surgery research when a randomized controlled trial would be time-consuming or not feasible.[5–7] For example, Clarkson et al[8] compared wrist arthrodesis after resection of a giant cell tumor of the distal radius using a vascularized free fibular transfer versus a nonvascularized structural iliac crest transfer. Given the rarity of disease and specialization of treatment, the authors conducted a retrospective cohort study to compare the effectiveness of these interventions.

In nonrandomized studies, the study design determines the selection of controls. In cohort studies, the control group is determined by practice patterns, physicians' preference, or policy decisions.[9] In the study by Clarkson et al,[8] the method of wrist arthrodesis was determined by regional preference (Vancouver vs Toronto). In contrast, control selection in case-control studies is at the discretion of a researcher.[1,2] Factors that determine whether a participant is placed in the study group or control group of a nonrandomized study may result in comparison groups with unbalanced characteristics.[1,10] If these characteristics have prognostic importance, then selection bias or confounding may occur, affecting the validity of conclusions.[1–3,5–7,9–12] Selection bias refers to systematic differences between baseline characteristics of the comparison groups.[3] For example, Afshar et al[13] performed radial shortening osteotomies in patients with Kienböck disease if they had 2 mm or greater of negative ulnar variance. All other patients were allocated to the control group, who received vascularized bone grafts. This allocation process created comparison groups with slightly differing pathologies. Alternatively, a confounder is an external characteristic that partially or entirely explains an association between an exposure and an outcome of interest.[11,14,15] If confounders are unequally distributed between comparison groups, they distort the effect of the study intervention.[7] Because an ideal control group is unattainable in nonrandomized studies, authors should discuss the limitations of their selected controls.

Our aim was to evaluate the control group selection in nonrandomized studies published in the *Journal of Hand Surgery American* (JHS) in 2013 and to highlight the strengths and weaknesses of various types of controls chosen. We also investigated how often authors adjusted for and discussed the threat of confounding and selection bias. We hypothesized that, in nonrandomized studies in hand surgery, control group selection is appropriate but the discussion of limitations is minimum. Presenting the limitations of a selected control is critical to allow readers to make accurate inferences on the validity of study results. This is an important component of well-written observational research, and peer reviewers and editors share the responsibility of requiring this from their authors.[16]

METHODS

We performed a literature review of all articles published in 2013 in JHS. We included studies using a nonrandomized control group to make conclusions on their primary research hypothesis. Studies using comparison groups to test secondary hypotheses or outcomes were not included. Lack of sufficient demographic details, source or type of controls to review, and primary outcome not involving control groups led us to exclude those studies. Nonrandomized studies included were retrospective cohorts, prospective cohorts, and case-control studies. The types of studies included were therapeutic, prognostic, and diagnostic.

To assess control group selection, we determined the source, type, and number of controls. The source of controls refers to the population from which the controls were selected. The type of control can be concurrent, historical, or an overlap of both. Concurrent controls are enrolled simultaneously with the intervention group and followed for the same study period.[10] Conversely, historical controls are participants treated earlier without the intervention of interest but their outcomes are used to compare with the current subjects.[3] We also recorded the number of studies using healthy (ie, normal or nondiseased) controls, controls that received an alternative intervention, and controls in which subjects were self-controlled (eg, when the contralateral hand of a subject was used as the control group).

Statistical comparison of baseline characteristics between study and control groups can identify unbalanced characteristics, thus indicating poor comparability. We recorded the proportion of studies that statistically compared at least 1 baseline characteristic between the study and the control groups. We then determined the number of included articles that controlled for confounding using matching or exclusion criteria at the design stage and standardization, stratification, matched analysis, or regression analyses in the data analysis stage. Lastly, as a surrogate for assessing the authors' discussion of control group limitations, we assessed whether studies discussed confounding and selection bias. Articles were deemed to have discussed these topics if they provided a possible source of confounding or selection bias, respectively. The authors adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines in the preparation of this manuscript.

RESULTS

A nonrandomized control group was used in 37 of the 236 scientific studies published in 2013 in JHS (Fig. 1). Of the included papers, 19 (51%) were retrospective cohort studies, 5 (14%) were prospective