A systematic review and meta-analysis of the volume-outcome relationship in the surgical treatment of breast cancer: are breast cancer patients better off with a high volume provider?

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CRD summary
This review found that survival after breast cancer surgery was significantly improved with high volume providers. These conclusions are supported by the data but should be interpreted with some caution due to the possibility of publication bias, lack of details on study quality, small number of included studies (all of which were observational) and differences between studies.

Authors' objectives
To determine the effects of hospital or surgeon volume on clinical outcome of the surgical treatment of breast cancer.

Searching
MEDLINE, EMBASE and the Cochrane Library were searched to February 2010. Full search strategies were reported. Reference lists of relevant studies were screened. The "related articles" function in PubMed was used. No language restrictions were applied, but the review was restricted to studies published in full.

Study selection
Primary studies that assessed the effects of hospital or surgeon volume as an independent variable on post-operative mortality or survival in the surgical treatment of breast cancer were eligible for inclusion. Studies were required to have conducted multivariable analysis to control for the effects of age and gender as a minimum. Studies of single hospitals or surgeons, studies conducted before 1988, or studies in which volume was defined as a distinct number or cut-off volume were excluded.

Included studies were conducted in the USA, UK, Australia, Canada and Taiwan. For hospital volume, thresholds for highest volume ranged from 40 to 195 procedures per year; thresholds for the lowest hospital volume ranged from 10 to 86 procedures per year. For surgeon volume, thresholds for highest volume ranged from 10 to 100 procedures per year; thresholds for the lowest surgeon volume ranged from 4 to 19 procedures per year.

Two reviewers independently screened the search results for inclusion. Disagreements were resolved through discussion or referral to a third reviewer.

Assessment of study quality
Two reviewers independently assessed study quality according to the quality of the data source (administrative or clinical data), study design (prospective or retrospective), and the degree of risk adjustment.

Data extraction
Data were extracted separately for each unit (surgeon or hospital). Data on crude outcomes were noted and adjusted effect sizes, expressed as odds ratios (ORs), hazard ratios (HRs) or relative risks (RRs), together with 95% confidence intervals (CIs) were extracted. Effect sizes were converted so that the lowest volume group was the reference. Only one comparison was extracted for each study; comparisons between the highest and lowest volume groups.

Two reviewers independently extracted data.

Methods of synthesis
Summary estimates were calculated using random-effects models. Statistical heterogeneity was assessed using $I^2$. For meta-analyses that included more than three studies, heterogeneity was investigated using subgroup analysis based on data source (administrative versus clinical), case mix adjustment (adjustment for comorbidity or severity) and study country. Publication bias was assessed using funnel plots and the Egger test.
Results of the review

Twelve observational studies (n=356,102 patients, range 807 to 233,247) were included in the review. Five studies were based on administrative data, six were based on clinical data collected in cancer registries, and one used both types of data.

Two studies assessed in hospital mortality after breast cancer surgery. Mortality was low (0.1 to 0.2%), but was significantly lower in high volume hospitals (OR 0.40, 95% CI 0.22 to 0.74). There was little heterogeneity (I$^2$=12%).

Eight studies examined the effects of hospital volume on survival. Six studies reported results as hazard ratios and reported a significant beneficial effect in favour of high volume hospitals (HR 0.84, 95% CI 0.76 to 0.93), but there was substantial heterogeneity (I$^2$=76%). There was no significant difference between high and low volume hospitals based on the two studies that reported results as relative risks, but there was substantial heterogeneity (I$^2$=96%).

Seven studies assessed the effects of surgeon volume on survival. There was a significant beneficial effect in favour of high volume surgeons based on both hazard ratios (HR 0.82, 95% CI 0.72 to 0.93; four studies) and relative risks (HR 0.85, 95% CI 0.60 to 0.91; three studies). There was evidence of heterogeneity among studies reporting hazard ratios (I$^2$=59%), but studies reporting relative risks were homogeneous.

Sensitivity analysis showed a larger effect size for studies that adjusted for differences in comorbidity for both the studies of hospital (p=0.003) and surgeon volume (p=0.007).

There was some evidence of publication bias for hospital volume (p<0.03) but not for surgeon volume (p=0.41).

Authors' conclusions

Survival after breast cancer surgery was significantly associated with high volume providers after breast cancer treatment.

CRD commentary

The review addressed a focused question and inclusion criteria were defined. An adequate literature search was conducted for published studies, but the restriction of the review to published data raised the possibility of publication bias; this was assessed in the review and some evidence was found. Appropriate steps were taken to minimise bias and errors at all stages of the review process.

Study quality was assessed using some relevant criteria, but a full critical appraisal was not reported. Therefore, the reliability of the included studies was unclear. The meta-analysis was appropriate and clearly reported; it included assessment and investigation of heterogeneity.

The authors’ conclusions are supported by the data but should be interpreted with some caution due to the possibility of publication bias, lack of details on study quality, small number of included studies (all of which were observational) and differences between the studies.

Implications of the review for practice and research

Practice: The authors stated that solid evidence for a specific minimal volume standard cannot be identified from the literature.

Research: The authors stated that further research is needed to identify essential structural or organisational characteristics and high leverage care processes that lead to the better outcomes.

Funding

Dutch Cancer Society.

Bibliographic details

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.