The association between comorbidity and length of hospital stay and costs in total hip arthroplasty patients: a systematic review

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ABSTRACT

We performed a systematic review on the relationship between comorbidity and length of hospital stay (LOS) and hospital costs (HC). Electronic databases were systematically searched for relevant studies, conducting methodological quality assessment and best-evidence synthesis: 317 articles were identified, 10 of which fit the inclusion criteria; nine studies determined the relationship between comorbidity and LOS, with eight reporting a positive correlation; five studies were considered to be of high quality, four of which found a positive correlation; two studies analyzed the relationship between comorbidity and HC and reported significantly higher HC for patients with comorbidities, and were considered to be of high quality. In conclusion, there is limited evidence that patient comorbidity has a positive correlation with LOS and HC.

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Total hip arthroplasty (THA) is a safe and cost-effective procedure for patients with osteoarthritis of the hip [1]. The prevalence of osteoarthritis of the hip is rising due to an ageing Western society [2,3]. In addition, there is an increase of patients with obesity, which is also a predisposing factor for osteoarthritis of the hip [4–6]. Both an ageing society and the obesity epidemic cause the number of operative interventions to be on the rise [7,8].

There is a vast variety in the characteristics of candidates for THA. Some patients are relatively young and healthy, whereas others can be considered as complex cases, being old and suffering from several comorbid diseases. Due to an ageing society the number of elderly patients and patients with comorbid diseases is on the rise. Increasingly complex patients with multiple comorbidities are found to be eligible for THA and receive an operative intervention [2,9]. To that end, preoperative work-up and perioperative procedures are ever more adjusted to fit the needs of the individual patient. Additional attempts can be made to improve ward occupation and scheduling of personnel. The financial compensation for THA is approximately equal for each patient, regardless of age, gender or medical history [10,11]. This is the case for most European countries, including the Netherlands. The current Dutch financial compensation system does not distinguish patient complexity, hence although a distinction is made between primary diagnosis (e.g. osteoarthrosis, avascular necrosis, fracture) and primary or revision THA, hospitals receive the same amount of compensation for every THA patient, comorbid or not.

Our hypothesis is that complex THA patients with multiple comorbidities have longer length of hospital stay (LOS), require more diagnoses and therapies, and therefore consume more hospital costs than healthy patients. Insight into these variables could be used to adjust the planning and staffing on the orthopedic wards, and to estimate hospital budgets for THA patients. So far, however, the extent to which there is scientific evidence supporting this hypothesis is not known. To that end, the objective of this study is to conduct a systematic review of the available literature on the relationship between comorbidity and LOS and hospital costs.

Methods

Studies were searched that reported patient comorbidity and length of hospital stay and/or hospital costs during admission, and which concerned adult patients undergoing primary total hip arthroplasty (THA). We followed the PRISMA statement for conducting and reporting systematic reviews [12].

Search Strategy and Data Resources

We conducted a systematic search of publications listed in MEDLINE, EMBASE, and the Cochrane Library between 1 January 1997 and 1 July 2013. We used keywords targeting total hip arthroplasty, comorbidity and comorbidity indices, comorbid diseases, and length of stay and/or costs. The detailed search strategy is presented in Table 1. This search strategy was applied to titles and abstracts, with language restrictions (English and Dutch). The search strategy was formulated and executed by an experienced medical librarian. We also searched for additional articles by viewing cited references of included articles.

Table 1
Search Strategy.

("Arthroplasty, Replacement, Hip"[Mesh] OR "total hip arthroplasty"[tiab] OR "total hip replacement"[tiab] OR "hip prosthesis implantation"[tiab]) AND (("Organ Transplantation"[Mesh]) OR (("Immunosuppressive Agents"[Mesh]) OR "Arthritis, Rheumatoid"[Mesh] OR "rheumatic disease"[tiab] OR "rheumatic diseases"[tiab] OR "rheumatic disorder"[tiab]) OR (("Mental Disorders"[Mesh] OR anxiety[tiab] OR depression[tiab]) NOT ("Delirium"[Mesh])) OR (("Stomach Diseases"[Mesh]) OR "Esophageal Diseases"[Mesh] OR "stomach dis*"[tiab]) OR ((("Cardiovascular Diseases"[Mesh]) OR ("Diabetes Mellitus"[Mesh]) OR ("Pulmonary Disease, Chronic Obstructive"[Mesh]) OR ("heart disease*"[tiab] OR diabetes[tiab] OR "obstructive lung disease*"[tiab])) NOT ("Embolism and Thrombosis"[Mesh])) OR ((("Comorbidity"[Mesh] OR comorbid*[tiab] OR co-morbid*[tiab] OR "Charlson comorbidity index"[tiab] OR ASA-score[tiab] OR ASA-index[tiab])) OR ("index of co-existent disease"))) AND (("Economics"[Mesh] OR "economics"[Subheading]) OR (("Length of Stay"[Mesh]) OR "Patient Discharge"[Mesh] OR ("length of stay" OR "hospital stay" OR "patient stay" OR discharge OR (stay[tiab] AND hospital[tiab]))))))

Inclusion Criteria and Procedure

Two inclusion criteria were used: 1) the article describes the relationship between comorbidity and length of stay and or costs; and 2) the article describes a separate analysis for total hip arthroplasty patients. Articles were excluded when the study group solely contained revision hip arthroplasty and hip fractures. No exclusion was made on study design and demographic patient data.

After conducting the search as described above, two authors (MO and MS) independently selected eligible articles based on title and abstract. Full-text versions were obtained for all selected articles and these were assessed by the same two review authors (MO and MS) for inclusion. Any disagreement between the two review authors was resolved by consensus, and in case of deadlock by judgment of a third author (IAS).

Methodological Quality Assessment

Study quality was independently evaluated by two authors (MO and MS) using 14 criteria based on a previously published scoring instrument [13], with adjustments in terminology to evaluate studies on the association between comorbidity and length of stay and/or costs in THA patients (see Table 2). This scoring instrument contains criteria about the study population, assessment of comorbidity, assessment of costs/length of stay, and analysis and data presentation. An article scored 1 point when a given criterion was met, otherwise it scored '0'. A '0' was also scored when no information was given in the article about

Table 2
Quality Rating of the Selected Studies.

	Criteria
	Study population
1	Sufficient description of characteristics of study groups.
2	The study population is selected at uniform point.
3	There is a clear description of selection of study subjects.
4	Cases and controls were drawn from the same study population.
5	The study cohort equals or is larger than 200 subjects.
6	The participation rate equals or is larger than 80% for study groups.
	Assessment of comorbidity
7	Comorbidity was measured identically for cases and controls.
8	Comorbidity was measured prior to outcome.
	Assessment of costs or length of hospital stay
9	Costs or length of hospital stay were measured identically for cases and controls.
10	A prospective study design was used.
	Analysis and data presentation
11	A distribution of comorbidity is given.
12	Sufficient information on association sizes was given.
13	Appropriate analysis techniques were used.
14	Results were adjusted for age and gender.

Adapted from Yusuf et al. 2010 [11].

the criterion. Differences in assessment were resolved by consensus, and in case of deadlock by judgment of a third author (IAS).

Maximum score obtainable was 14. Studies were regarded to be of high quality when the sum score was 8 or higher, regardless of study type [14]. Studies with a score between 5 and 7 were regarded to be of medium quality, and scores of 4 or lower identified low-quality studies.

Data Analysis

Given the heterogeneity of the included studies and the different statistical tests used, it was not possible to perform a meta-analysis on the data, therefore the results are summarized using a 'best-evidence synthesis' as presented in Table 3. This synthesis makes it possible to rate the evidence of observational studies according to five levels: no evidence, conflicting, limited, moderate or strong evidence [13–15]. A $P < 0.05$ was considered to be statistically significant.

Results

Article Selection

The initial literature search provided 317 articles. Subsequent reading of the titles and abstracts led to exclusion of 295 articles, then excluding 12 for various reasons, as reported in Fig. 1. Overall, 10 studies met the inclusion criteria and were identified as appropriate for this systematic review.

Description of Studies

The 10 included articles only comprised cross-sectional studies. Nine studies used length of hospital stay as primary outcome measure. Two studies included costs as outcome measure [16,17]. Table 4 presents the characteristics of the included studies. Seven studies were published between 2009 and 2011 [16–22]. Studies with large sample sizes were published throughout the review period, with Amitage [19] publishing a study of 238,999 patients in 2010 and Styron [22] a study of 40,333 patients in 2011.

Methodological Quality

A total of six studies were considered to be of high quality [16,17,20–23], and four studies were categorized to be of medium quality [18,19,24,25].

Demographics

Women represented between 2.6% (veteran study) and 62% of the patients; three articles did not provide these data. A total of five articles did not mention age nor provided mean age of the total population studied. In the other articles mean age varied between 64 and 74 years. Five studies were conducted in North America [20–24], two studies in

Table 3
Best-Evidence Synthesis [11–13].

Strong evidence	Generally consistent findings in multiple high quality cohort studies.
Moderate evidence	Generally consistent findings in one high quality cohort study and ≥2 high quality case–control studies, or in ≥3 high quality case–control studies.
Limited evidence	(Generally consistent) findings in a single cohort study, or in maximum two case–control studies, or in multiple cross-sectional studies.
Conflicting evidence	Less than 75% of the studies reported consistent findings.
Insufficient evidence	Less than two low quality studies available.
No evidence	Provided when no studies could be found.