

Using linked clinical and hospital morbidity data to assess risk and outcomes of primary lower limb total joint replacement in elderly men

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Submitted in fulfilment of the requirements for the degree of
PhD in medicine

January, 2012

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**"Savour your life. Chew every mouthful thirty times.
If you rush you will miss something remarkable."**

Robert Allen

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Abstract

Background

Osteoarthritis is the most common musculoskeletal disorder affecting elderly Australians and is a leading cause of lower limb total joint replacement (TJR). The incidence of TJR has risen substantially over the past two decades, reflecting the ageing population, and increases in the prevalence of risk factors such as obesity. Primary TJR is considered to be relatively safe with low rates of adverse outcomes, however, there is increasing evidence that elderly, and male patients who undergo the procedure may be at higher risk for postoperative complications and mortality. The retrospective cohort studies presented in this thesis used data, drawn from Health In Men Study (HIMS), that were linked with Western Australia (WA) linked data system to assess risk and outcomes of primary TJR in a large population-based cohort of men. The studies closely examined three issues - obesity, co-morbidities, and smoking - about which there is continuing debate in regard to their association with the risk of undergoing the procedure, and their roles as determinants of outcome of TJR. These risk factors are particularly important because they are amenable to modification.

Objectives

The main objectives of this thesis were:

1. To validate WA hospital morbidity data (HMD) and to assess the performance of HMD-based co-morbidity adjustment methods in predicting mortality among men undergoing elective primary TJR.
2. To assess risk of undergoing elective primary TJR in elderly men.
3. To assess risk of adverse outcomes following elective primary TJR including:
 - in-hospital complications,
 - prolonged length of stay in hospital (LOS),
 - all-cause readmission, and

- short- and long-term mortality.
4. To assess the role of obesity in predicting postoperative complications following TJR.

Methods

The electronic records of 12,203 men from HIMS were linked with WA HMD, Cancer Registry, Mental Health Services System and mortality records. Linkage with hospital morbidity data was done to identify TJR, in-hospital complications, LOS, and readmission in the target population. Significant morbidity was retrieved from HMD in the period 1970-2007. Multivariable analyses including logistic, Cox proportional hazards, and competing risk regressions were undertaken to assess study outcomes.

Main findings

- WA HMD are more likely to identify major co-morbidities and major operations with relatively high sensitivities and positive predictive values than co-morbidities of a less serious nature.
- Co-morbidity as recorded in HMD, irrespective of method used to measure it, independently increased risk of adverse outcomes. Model discrimination of 5-year mortality following TJR improved by 13% when HMD-based Deyo-Charlson index (Deyo-CI) was added to the baseline model that only accounted for age (Harrell's C: 0.69 for baseline model vs. 0.78 for model including age and Deyo-CI).
- A dose-response relationship between both weight and smoking, and risk of TJR was observed. Being overweight independently increased the risk, while smoking lowered it. Engaging in vigorous exercise and having a high socioeconomic status were associated with higher risk of TJR.
- Of the 819 men who had had elective TJR, 331 (40.4%) developed an in-hospital complication of which 155 were major. Age and body mass index independently predicted major complications. Any in-hospital complications significantly increased

risk of short-term mortality. Morbid obesity was independently associated with 5-year mortality following TJR.

- Length of stay in hospital was significantly longer in the overweight or obese and those who had had a total knee replacement [TKR] (compared with total hip replacement [THR]) and these two groups were more likely to be readmitted. All-cause readmission was also significantly high among the socioeconomically disadvantaged patients.
- All-cause 90-day and 1-year readmission following TJR independently increased risk of postoperative 5-year mortality.
- Augmenting HMD with actual weight and height significantly improved the model fit when predicting major in-hospital complications following TJR.

Conclusions

- HMD-based co-morbidity adjustment methods (Deyo-Charlson, Enhanced-Charlson or Elixhauser) significantly improve HMD-based predictive models and are appropriate in epidemiological research.
- Compared to men with normal weight, the obese are at higher risk of undergoing elective TJR and are more likely to develop major complications, stay longer in hospital and be readmitted following the procedure.
- Adding minimal information to routinely collected HMD improves the latter's predictive ability. This study suggests making actual weight and height mandatory variables in any HMD system.

Declaration

I, George Mnatzaganian, certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text of thesis.

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- Mnatzaganian G, Ryan P, Norman PE, Davidson DC, Hiller JE. Smoking, body weight, physical exercise, and risk of lower limb total joint replacement in a population-based cohort of men. *Arthritis & Rheumatism* 2011;63(8):2523-2530.
- Mnatzaganian G, Ryan P, Norman PE, Davidson DC, Hiller JE. Smoking, body weight, physical exercise, and risk of lower limb total joint replacement in a population-based cohort of men: reply to Letter to Editor. *Arthritis & Rheumatism* 2011; DOI 10.1002/art.34324. © 2011, American College of Rheumatology.

- Mnatzaganian G, Ryan P, Norman PE, Davidson DC, Hiller JE. Total joint replacement in men: old age, obesity and in-hospital complications. *ANZ Journal of Surgery* 2012; In press.
- Mnatzaganian G, Ryan P, Norman PE, Davidson DC, Hiller JE. Use of routine hospital morbidity data together with weight and height of patients to predict in-hospital complications following total joint replacement. Under review in the journal *BMC Health Services Research*.
- Mnatzaganian G, Ryan P, Norman PE, Davidson DC, Hiller JE. Length of stay in hospital and all-cause readmission following elective total joint replacement in elderly men. *Orthopedic Research and Reviews* 2012; 4:43-51.

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George Mnatzaganian (PhD Candidate)

Date: _____

Manuscripts Contributing to this Thesis

1. Mnatzaganian G, Ryan P, Norman PE, Hiller JE. Accuracy of hospital morbidity data and the performance of comorbidity scores as predictors of mortality. *Journal of Clinical Epidemiology* 2012;65(1):107-15.
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6. Mnatzaganian G, Ryan P, Norman PE, Davidson DC, Hiller JE. Length of stay in hospital and all-cause readmission following elective total joint replacement in elderly men. *Orthopedic Research and Reviews* 2012; 4:43-51.

Presentations Arising out of this Thesis

- Mnatzaganian G. Obesity and excess long term mortality in men who undergo elective total joint replacement. School of Population Health and Clinical Practice Seminar Series. Adelaide, September 2011.
- Mnatzaganian G. A propensity score that accounts for pre-treatment patient selection bias and predicts major adverse outcomes after total joint replacement in men. School of Population Health and Clinical Practice Seminar Series. Adelaide, October 2010.
- Mnatzaganian G, Ryan P, Norman PE, Davidson DC, Hiller JE. Smoking, body weight, physical exercise and risk of lower limb total joint replacement in a population-based cohort of men. School of Population Health and Clinical Practice HDR Research Symposium. Adelaide, January 2010.
- Mnatzaganian G. Linking datasets from different sources to assess quality of care: Focusing on elective total joint replacements. 2009 State Population Health Conference. Adelaide, October, 2009.
- Mnatzaganian G. Elective total joint replacement in a population-based cohort of Australian men: modifiable risk factors, co-morbidities and outcomes. School of Population Health and Clinical Practice Seminar Series. Adelaide, September 2009.

Acknowledgements

Iron sharpens iron; scholar, the scholar - William Drummond

- ❖ I thank my supervisors, Philip Ryan and Janet Hiller for their guidance and continuous support. Undertaking this PhD under their supervision made this degree one of the most fulfilling experiences of my life. They are gratefully acknowledged.
- ❖ I pay tribute to the late Professor Konrad Jamrozik who made a significant contribution to the initiation and design of much of this thesis. For me, Konrad was more than a supervisor; he was a mentor and a role model. I will ever be so grateful for the guidance I received under his supervision.
- ❖ Special thanks to Professor Paul E Norman and the staff and investigators of the original screening trial and the men who participated in the WA Abdominal Aortic Aneurysm Trial.
- ❖ Special thanks to Mr. David C Davidson for his advice and supervision.
- ❖ Thanks to assistance received from the Data Linkage Unit of the WA Department of Health.
- ❖ Thanks to the University of Adelaide for awarding me a FHS Postgraduate Travelling Fellowship of \$1,700 to participate in the IEA World Congress of Epidemiology conference in Edinburgh, Scotland. August, 2011.
- ❖ Last but not least, I thank my wife Karine and my two sons Emmanuel and Jonathan for their love, support, sacrifice, and for putting up with my absence from home.

Abbreviations

AAA	Abdominal Aortic Aneurysm
BMI	Body Mass Index
CCI	Charlson Co-morbidity Index
CRR	Competing Risk Regression
Deyo-CI	Deyo Charlson co-morbidity Index
HIMS	Health In Men Study
HMD	Hospital Morbidity Data
ICD-9-CM	International Classification of Disease, Version 9, Clinical Modification
ICD-10-AM	International Classification of Disease, Version 10, Australian Modification
LOS	Length Of Stay in Hospital
OA	Osteoarthritis
ROC	Area under the Receiver Operator Curve
SEIFA	Socio-Economic Index For Areas
THR	Total Hip Replacement
TJR	Total Joint Replacement (synonymous with THR or TKR)
TKR	Total Knee Replacement
WALDS	Western Australia Linked Data System