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University of East Anglia

Long and Short Term Survival of Total Hip Replacement Cases in United Kingdom

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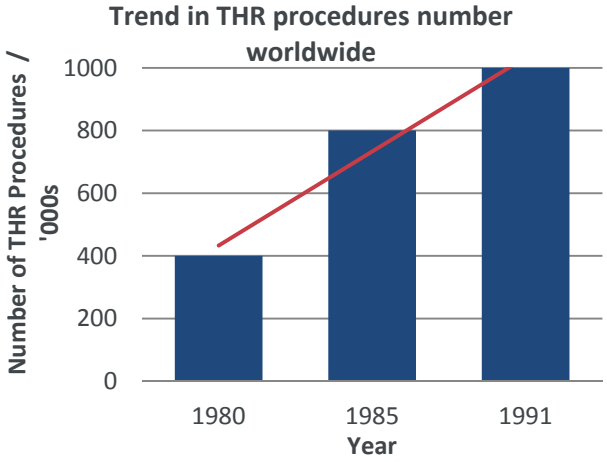
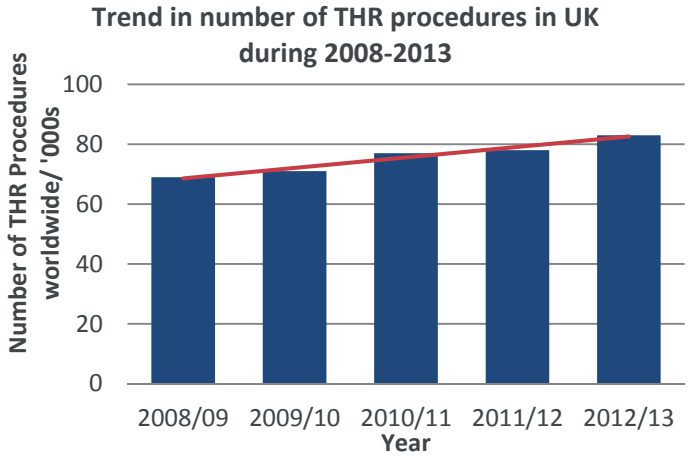
Increasing trends in THR procedures





An increasing number of THR procedures carried out across many countries (Levy, et al., 1985 and Soderman, 2000) while in UK alone, there is a yearly increase of 8% (NJR Report 2013).

Actuarial implications

- Possible increasing number of THR procedures among population of customers buying life assurance, pension and annuity products.
- Does this give rise to mortality/longevity risk and eventually basis risk?
- Impacts of benefits allocation to customers with THR procedures, for example enhanced benefits.

The THIN Study

Purpose

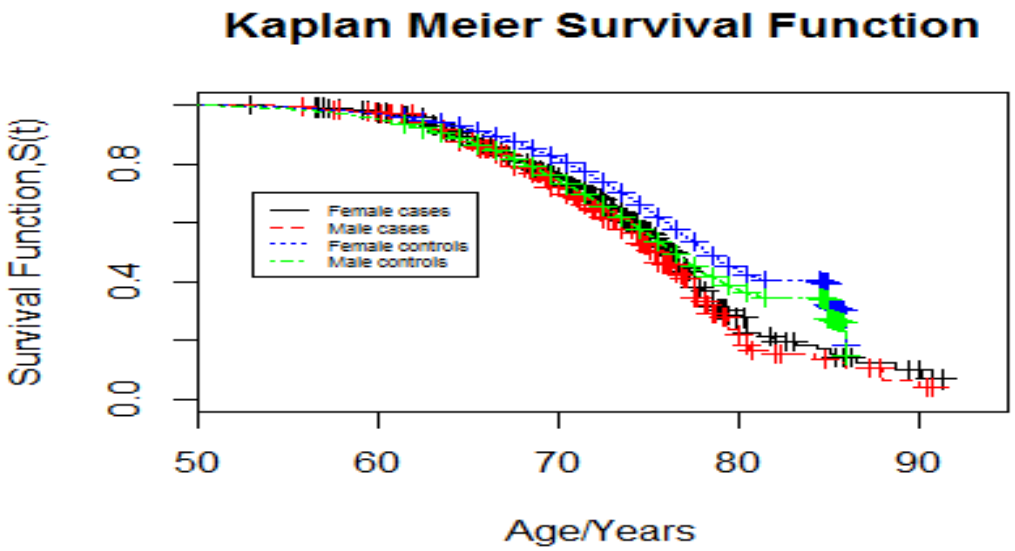
- A retrospective cohort matched study design.
- To study the direct effects of THR procedures on short and long term survival for individuals with different characteristics.

Patients Selection

- Identified 10,155 primary THR cases and 49,559 controls from THIN database.
- Assumed same exposure to death for patients in same GP practice matched by age and sex.
- Demographical, lifestyle, medical and geographical variables were extracted.

Statistical Analysis

Preliminary analysis



- Include deaths in short and long term.
- Cases survive less than controls.
- Female cases survive less than female controls.
- Male cases die earlier than male controls.
- Female cases survive longer than male cases.

The Survival Model – Frailty Cox Model

$$\lambda_{ki}(t) = \boldsymbol{\varepsilon_k}\lambda_0(t)\exp(\beta^T Z_{ki})$$

- Post-THR hazard of death for i^{th} individual from the K^{th} GP Practice.
- $\boldsymbol{\varepsilon_k}$ measures the frailty associated with each GP Practice.

Statistical Analysis

THIN Project – Summary of Results

Short-term v/s Long-term results

- Deaths within 2 years - 968 THR cases died within 2 years of surgery.
- Higher risk of deaths associated at the early post-surgery stages (≤2 years).

Estimation of hazard of death		
Cases vs Controls	THR cases surviving beyond 2 years post-surgery	THR cases dying within 2 years of surgery
Controls	1.00	1.00
Cases	1.08	1.49

Variability of hazard of death post-THR surgery

- Males THR cases have a higher post-THR risk of death than female.
- Being overweight increases hazard of death post-THR in the short term only.
- Post-THR risk of death increases with the deprivation score of the individuals residential area (1.00-1.19) in the short and long term.
- Higher hazard of deaths post-THR surgery (1.08-1.20) in residential areas with high proportion of white individuals(≥40%).

Statistical Analysis

THIN Project – Summary of Results

Variability of hazard of death post-THR surgery

- Being a THR patient and having one of these comorbidities pre-surgery time increases the hazard of death after THR procedures: **high cholesterol (with or without medication), hypertension, osteopenia, osteoporosis and myocardial infarction.**
- Having **Type II diabetes** pre-surgery decreases post-THR risk of death by 2% and 3% in the short and long term.

Conclusion

- Gender, Year of birth, BMI pre-surgery time, Townsend score and proportion of white individuals living in same area of individuals, BP, Cholesterol level and event of MI prior to THR have a **direct impact** on risk of death for **THR cases** after surgery in the **short** and **long** term.

THIN Project – Implications of Results

- The THIN study demonstrated that THR procedures alone increase the risk of death by 49% and 8% in the short and long term respectively – Higher mortality associated with THR customers.
- This is a source of basis risk for actuarial assumptions and a concern for the life assurance, pension and annuities selling industry

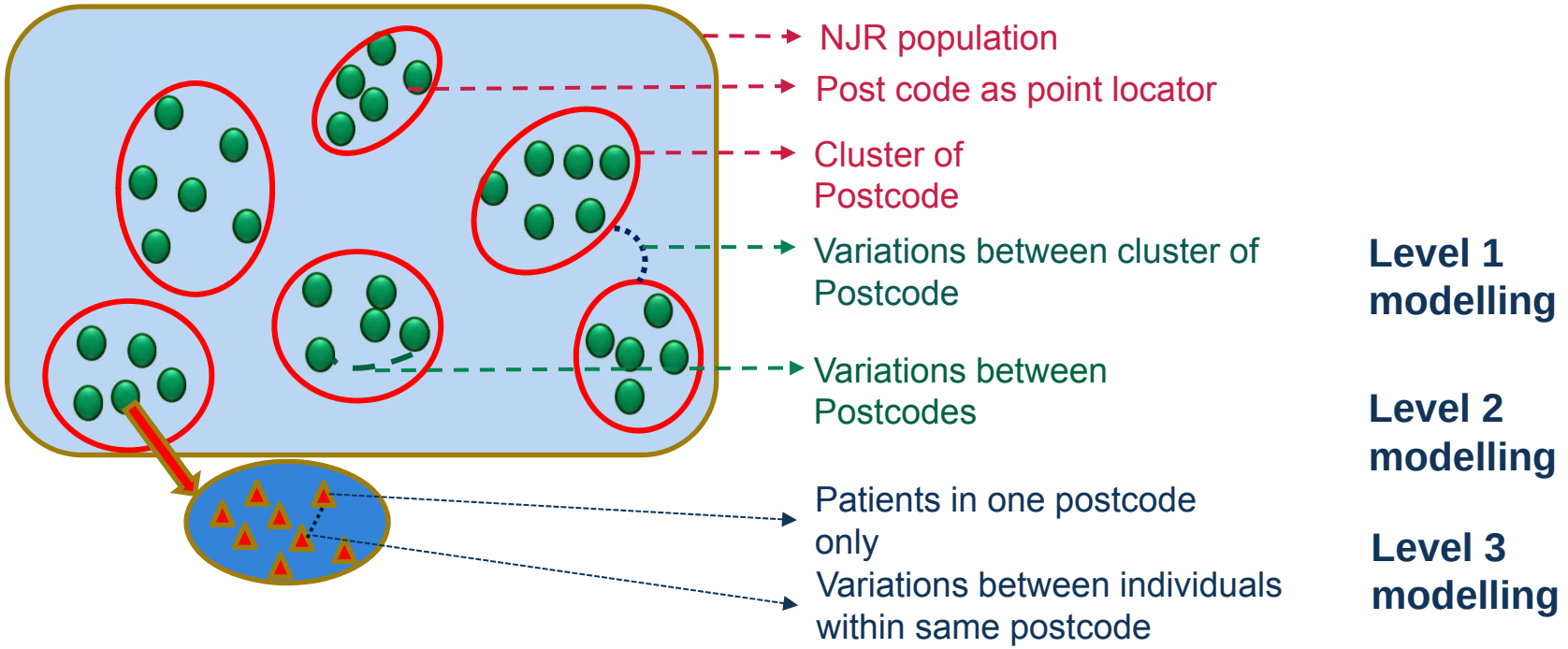
- Higher mortality risk for life assurance.
- Premiums, reserve and benefits calculations need to take account of the 'THR procedures' factor.

- Reduced longevity risk for pension and annuity businesses
- THR customers can be granted additional bonuses besides their basic pension benefits.
- Annuitants can be allowed to receive enhanced annuities.

Further Research

NJR Project – An Overview

- Permit full spatial survival analysis.
- 3 level Survival model - An extension of the shared frailty model used for THIN analysis.



Questions

Comments