

# NEUROTRAUMA

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# GLOBAL ASPECTS

**Adj. Prof of Neurology and Neurotraumatology  
Head of Turku Brain Injury Centre  
Division of Clinical Neurosciences  
Turku University Hospital & University of Turku  
Finland**

**Email [olli.tenovuo@tyks.fi](mailto:olli.tenovuo@tyks.fi)**

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# Challenges in epidemiological research of TBI

- **Lack of reliable methods to detect, rule out, or classify an acute TBI**
- **Lack of reliable methods to define/detect TBI-related chronic sequels**
- **Poorly known long-term sequels (esp. from childhood TBIs)**
- **Variable and often marked shortcomings in registry-based data of TBI**

# Poorly known long-term sequels...

RESEARCH ARTICLE

## Long-Term Outcomes Associated with Traumatic Brain Injury in Childhood and Adolescence: A Nationwide Swedish Cohort Study of a Wide Range of Medical and Social Outcomes

**Amir Sariaslan<sup>1</sup>, David J. Sharp<sup>2</sup>, Brian M. D’Onofrio<sup>3</sup>, Henrik Larsson<sup>4,5</sup>, Seena Fazel<sup>1\*</sup>**

**1** Department of Psychiatry, University of Oxford, Warneford Hospital, Oxford, United Kingdom,

**2** Computational, Cognitive and Clinical Neuroimaging Laboratory, Imperial College, London, United

Kingdom, **3** Department of Psychological and Brain Sciences, Indiana University, Bloomington, Indiana,

United States of America, **4** Department of Medical Epidemiology and Biostatistics, Karolinska Institutet,

Stockholm, Sweden, **5** School of Medical Sciences, Örebro University, Örebro, Sweden

## What Did the Researchers Do and Find?

- We used national registers in Sweden covering 1.1 million individuals born between 1973–1985
- In the 9.1% who sustained at least one TBI before the age of 25 y, we examined later risk of six medical and social outcomes.
- We compared TBI patients with their unaffected siblings in order to account for the possibility that the risk for these outcomes runs in families.
- We found TBI consistently predicted later risk of premature mortality, psychiatric inpatient admission, psychiatric outpatient visits, disability pension, welfare reciprocity, and low educational attainment in the sibling-comparison analyses, and the effects were stronger for those with greater injury severity, recurrence, and older age at first injury.

**“We found TBI consistently predicted later risk of premature mortality, psychiatric inpatient admission, psychiatric outpatient visits, disability pension, welfare reciprocity, and low educational attainment in the sibling-comparison analyses, and the effects were stronger for those with greater injury severity, recurrence, and older age at first injury.”**

# Unreliable registries

Barker-Collo S, Theadom A, Jones K, Feigin VL, Kahan M. Accuracy of an International Classification of Diseases Code Surveillance System in the Identification of Traumatic Brain Injury. *Neuroepidemiology* 2016;47:46-52.

- **TBI related ICD-codes within the New Zealand health database were examined for all incident cases from a population-based TBI sample (n = 1,369).**
- **Individuals who received a TBI-related ICD-code accounted for 18.6% of the studied population.**
- **“Reported incidence of TBI, when based upon health registration data, is likely to be a significant underestimate.”**

# **Causes of TBI – trends and predictions**

- A clear epidemiologic shift towards older age groups in developed countries**
- In developed countries, falls increasing and surpassed road traffic accidents**
- Rapid increase in many population-rich developing countries: estimate for annual incidence in Africa in 2050 up to 14 million cases**
- Climate change, immigration, increasing nature disasters and armed conflicts may increase the number considerably**
- About 5.5 % have a recurrent TBI within 1 year**

# Global aspects

- **90 % of trauma-related deaths occur in low- and middle-income countries**
- **In traffic, two-wheel vehicle users have the highest risk but in most countries helmet use is close to zero**
- **7% of the world's population (28 countries) have adequate laws that address all of the top five risk factors: speeding, drink-driving, lack of helmet, seat-belt, and child-restraint use<sup>1</sup>**
- **In 2014 there were 33 000 firearm-related deaths in the USA, about ten-fold frequency to Nordic countries (but 20 % of frequency in many South-American countries)**

# More global aspects

- **A recent WHO review of emergency care in 59 LMICs reported that only 28% of facilities had attending or consultant-level physicians available full-time; 18% were staffed by specialty-trained emergency physicians, but in only 4% were these available at all times.<sup>1</sup>**
- **In many African countries, there are 1 neurosurgeon per 9 million inhabitants<sup>1</sup>**
- **International funding for TBI research 75 million € 2012-2018 – for frontotemporal dementia 368 million € 1998-2008 (incidence 0.6 % of TBI)<sup>2</sup>**

<sup>1</sup>Johnson & Griswold. Traumatic brain injury: a global challenge. Lancet Neurology 2017 Nov 6 (Epub ahead of print)

<sup>2</sup>Quaglio et al. Traumatic brain injury: a priority for public health policy. Lancet Neurology 2017 Nov 6 (Epub ahead of print)

# **”Best” estimates of worldwide figures**

## **Incidence**

- **Incidence varies from 100 to 3 000 per 100 000 inhabitants (30-fold...)**
- **Figures based on **hospital admissions** mostly between 100 and 300 per 100 000**
- **The incidence of patients seeking any type of medical care exceeds 600 per 100 000**



**About 10 million hospitalizations and > 50 million TBIs each year (> 27 000 hospitalizations and >135 000 TBIs each day)**

# Aspects on reliability of incidence figures

Nguyen R, Fiest KM, McChesney J, et al. The International Incidence of Traumatic Brain Injury: A Systematic Review and Meta-Analysis. Can J Neurol Sci 2016;43:774-785.

- **The European rate was 147 per 100,000 person-years (pooled data, 95% CI: 33-649)**
  - **The North American rate 632 per 100,000 person-years (pooled data, 95% CI: 511-781)**
  - **The rate in one study from New Zealand 790 per 100,000 person-years (95% CI: 750-833)**
- ➔ Is there a true reason why the incidence would be this different in developed countries?**

# How about pediatric incidence?

Epidemiology of Global Pediatric Traumatic Brain Injury: Qualitative Review

*Michael C. Dewan, Nishit Mummareddy, John C. Wellons III, Christopher M. Bonfield*

- Among reports documenting incidence figures, most reported rates between 47 and 280 per 100,000, with the highest rates from Australia and the **lowest from northern European countries.**
- Using the most conservative incidence estimates of 50 per 100,000 persons, TBI affects more than 3 million children worldwide every year.

➔ Are these figures correct?

# Also different figures available...

Dahl E, von Wendt L, Emanuelson I. A prospective, population-based, follow-up study of mild traumatic brain injury in children. *Injury* 2006;37:402-9.

- **“Yielding an annual incidence of 468/100,000 (95% CI 402-535/100,000). Boys accounted for 57 per cent and fall injuries accounted for 61 per cent of the external causes.”**
- **Annual records from our hospital registry in Turku, Finland give 354 / 100 000 for children 0-15 yrs**

# So how many pediatric TBIs annually?

- **Based on incidence figures from Nordic countries, about 8 million children sustain a TBI every year**
- **The Swedish registry study showed that 9.1% suffer a TBI before the age of 25**
- **There are 3,14 billion people <25 yrs of age**
- **This would give 285 million TBIs worldwide, suffered before the age of 25 → with even frequency almost 12 million TBIs each year**
- **Nordic countries probably do not have the highest TBI-burden in children...**

# **“Best” estimates of worldwide figures**

## **Mortality**

- **Mortality estimate from Europe 15 per 100 000**
- **Mortality much higher in many population-rich countries (usually > two-fold)**
- **Pre-hospital deaths poorly monitored, most occur before reaching hospital**



**Number of TBI-related deaths close to 3 million annually (> 8200 each day)**

# **”Best” estimates of worldwide figures**

## **Prevalence**

- Prevalence of subjects with chronic sequels very poorly known**
- Results vary from 219 to 2356 per 100 000 in different studies**
- An estimate from USA (2 % of population) yields 150 million people worldwide**



**”God only knows” – most probably >> 100 million people suffering from chronic sequels, possibly much more (prevalence of dementia about 40 million)**

# Global aspects

- **The northern Finland birth cohort found that 3.8% of the population had experienced at least 1 hospitalization due to TBI by 35 years of age.<sup>1</sup>**
- **The New Zealand birth cohort found that by 25 years of age 31.6% of the population had experienced at least 1 TBI, requiring medical attention<sup>1</sup>**
- **One in five adults experienced TBIs of sufficient severity to cause LOC; 3% experienced at least one moderate or severe TBI and almost 10% experienced a first TBI with LOC before the age of 15 years.<sup>2</sup>**
- **“there may be a substantially greater burden of injury than concluded from previous prevalence estimates”<sup>2</sup>**

<sup>1</sup>Corrigan JD, Selassie AW, Orman JA. The epidemiology of traumatic brain injury. J Head Trauma Rehabil 2010;25:72-80.

<sup>2</sup>Corrigan JD, Yang J, Singichetti B, Manchester K, Bogner J. Injury Prevention 2017 Epub ahead of print

# Costs of TBI

- **A recent estimate 400 billion \$, or 0.5 % of global annual world product<sup>1</sup>**
- **Probably a severe underestimate, lacking costs e.g. from:**
  - **Long-term sequels (premature aging, increased morbidity, psychiatric disorders)**
  - **Burden for proxies**
  - **Decrease in individual productivity**
  - **Burden for social security, judicial system**
  - **Alienation**
  - **Etc.**

<sup>1</sup>Maas AIR, Menon DK, Adelson PD ym. Traumatic brain injury – integrated approaches to improving clinical care and research. Lancet Neurology 2017 Nov 6 (Epub ahead of print)

# Conclusions

- TBIs are a huge global health burden affecting all age groups and all societies
- **> 135 000 new TBIs (about 35 000 of these for children) and > 8200 deaths daily should alarm us all, including politicians**
- In addition, current figures may be severe underestimates
- **TBIs cost us > 1 billion € every day**
- The influence of TBIs on the aging population is probably much greater than currently realized
- A huge need for reliable epidemiological monitoring!