Summary of the doctoral thesis for Jonviea Chamberlain

This doctoral thesis aims to contribute to the global evidence on spinal cord injuries and local, Switzerland-specific evidence of traumatic spinal cord injuries. The following paragraphs provide an overall summary on the content, objectives and results of the doctoral thesis submitted to the University of Luzern by Jonviea D. Chamberlain.

Epidemiology is commonly defined as the study of disease distribution in populations and the determinants of health-related events in order to control health problems [1]. Epidemiology not only helps to define high-risk groups for prevention purposes, but can also generate causal hypotheses to answer ‘why’ a certain sub-population is at higher risk. The quantification of health conditions in populations with epidemiological indicators, such as incidence (the number of new cases in a population) or standardized mortality ratios (SMR; a ratio comparing the mortality rate in a study population to that of the general population, standardized by age and sex) is essential in epidemiological research, as they provide comparative indicators that may inform interventions for prevention, health policy, and resource management.

Injury epidemiology, a focus within the broader sphere of epidemiology, as evidenced in the name focuses on health events or states resulting from an acute exposure to mechanical, thermal, electrical, chemical or radiant energy [2-4]. In Switzerland, nearly one million non-occupational injuries occurred in 2012, causing a monetary burden of over 11 billion dollars, or roughly 2% of the Swiss gross domestic product [5]. Within this realm are traumatic spinal cord injuries (TSCIs), a potentially life-altering event that can result in the loss of function, reduced quality of life, increased risk of morbidity and mortality, as well as an increased burden on monetary resources. Therefore, understanding the cascade of events following SCI contributing towards an individual’s risk of SCI and resulting adverse outcomes is imperative for informing effective interventions along the prevention spectrum.
Extant literature has demonstrated large variation in the incidence and prevalence of spinal cord injuries globally, stressing the importance of country-specific estimates. For example, available data on the incidence rates of traumatic SCIs range between 11.4 to 61.4 per million population, with estimates of prevalence, albeit sparse, ranging between 300 and 1300 per million population [6,7]. Estimates of mortality following SCI have unilaterally, across global regions, suggested an increased risk of mortality after SCI in comparison to the general population, but also according to SCI-specific characteristics. Available evidence points towards the magnitude of such discrepancies in mortality risk to vary across countries, although direct country-comparison is difficult due to differences in underlying study and sample characteristics.

In recent years, shifts in the conceptual thinking and the introduction of new conceptual models for injury prevention have fostered opportunities and pathways to reduce injury risk and ultimately promote prevention. Unfortunately, what is reported in the current spinal cord injuries literature is often not sufficient to install targeted interventions, as estimates of parameters that are key to prevention are not provided stratified by characteristics (e.g., age, sex,). For instance, several population-based studies have shown a progressive increase in average age at spinal cord injury, but it is often unclear whether this merely reflects the aging general population or an actual increase in SCI incidence among the elderly [8,9]. Furthermore, in Switzerland no accurate, or reliable epidemiological indicators for SCI existed prior to this doctoral thesis.

Therefore, the objective of this doctoral thesis was to contribute towards global evidence on SCI and Swiss-specific evidence, while ensuring robustness of key epidemiological indicators for TSCI in Switzerland. To achieve this objective, the specific aims of this thesis were three-fold:

1. To evaluate survival following traumatic and non-traumatic SCI worldwide.
2. To estimate the incidence and etiology of TSCI in Switzerland.
3. To investigate robustness of epidemiological indicators using data from the Swiss Spinal Cord Injury study (SwiSCI).
Encompassed within this doctoral thesis are therefore three studies. The first study seeks to contribute to the global evidence on spinal cord injuries through the evaluation of mortality and longevity following traumatic and non-traumatic SCIs, worldwide. The reason for which is both to provide a context within which to fit Switzerland, but also to contextualize the importance of SCI prevention. The second and third studies provide evidence specific to Switzerland, with the second study providing age- and sex-stratified rehabilitation-based incidence rates according to SCI characteristics and etiology of TSCI, and the third study following up to ensure the accuracy and robustness of reported incidence rates and future epidemiological indicators of TSCI for Switzerland.

The first study, titled “Mortality and longevity after spinal cord injury: Systematic review and meta-analysis” provides an updated summary of SCI literature and provides pooled estimates to highlight potential shortcomings of local or national healthcare systems, and disparities in mortality outcomes. Overall, this study found evidence on mortality outcomes to be limited, especially for low-income countries; large variation across global regions of in-hospital mortality exists, suggesting the influence of differences in healthcare capacity; and found substantial variation in mortality outcomes according to socio-demographic and SCI-specific characteristics, as well as compared to the general population. The estimates and accumulation of evidence generated by this first study can help to provide insight for countries, especially those limited in resources for data-generation, to identify priorities and areas for improvement based on existing comparable evidence.

In the second study, “Epidemiology and contemporary risk profile of traumatic spinal cord injury in Switzerland”, data collected from the Swiss Spinal Cord Injury Cohort study were used to estimate incidence and etiology of TSCI in Switzerland. With this data, the rehabilitation-based incidence rate (IR) for Switzerland was estimated to be 18 per one million population, which is similar in comparison to other European countries. Age- and sex-stratified incidence rates estimated in this study found the highest risk of TSCI to be for men, especially in relation to sports/leisure- and transport-related accidents, and the elderly with respect to falls. These results
suggest that targets for future prevention policies should focus on reduction of sports/leisure- and transport-related accidents in young men and falls among the elderly. An important aspect of this study is the contextualization of these results within a conceptual model for identifying targets of prevention.

To quantify the extent to which rehabilitation-based estimates from the second study might underestimate the true incidence, the final study of this doctoral thesis used a secondary, population-based data source to identify incident cases of TSCI in Switzerland. This study, “Estimating the incidence of traumatic spinal cord injuries in Switzerland: Using administrative data to identify potential coverage error in a cohort study”, found evidence that the SwiSCI-based study could miss between 28% and 68% of the TSCI cases in Switzerland, resulting in the underestimation of the true IR of TSCI. Furthermore, this study found that the youngest ages, men, and injuries at the highest neurological level were more likely to visit a specialized rehabilitation center. Together, these results point towards the likely absolute coverage error and selection bias in the SwiSCI study, as specialized rehabilitation centers within Switzerland risk missing incident TSCI cases of TSCI among the elderly and persons with less-severe SCIs.

This doctoral thesis estimates and summarizes epidemiological indicators for SCI, identifies high-risk groups for TSCI in Switzerland, and aims to set standards for future reporting in TSCI literature. Furthermore, results from this thesis provide a basis for future prediction models to project epidemiological indicators of TSCI. Contextualizing the results within a conceptual framework and highlighting how evidence produced within this thesis can contribute towards informing health systems and support prevention efforts is a strength of this doctoral thesis as it provides the direct linkage between research and practice. Finally, this thesis provides a detailed list of recommendations towards which future prevention and research efforts for spinal cord injury should be aimed.
References


