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Subsequent Injury Study (SInS): Improving outcomes for injured New Zealanders

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ABSTRACT

Background Subsequent injury (SI) is a major contributor to disability and costs for individuals and society.

Aim To identify modifiable risk factors predictive of SI and SI health and disability outcomes and costs.

Objectives To (1) describe the nature of SIs reported to New Zealand's no-fault injury insurer (the Accident Compensation Corporation (ACC)); (2) identify characteristics of people underaccessing ACC for SI; (3) determine factors predicting or protecting against SI; and (4) investigate outcomes for individuals, and costs to society, in relation to SI.

Design Prospective cohort study.

Methods Previously collected data will be linked including data from interviews undertaken as part of the earlier Prospective Outcomes of Injury Study (POIS), ACC electronic data and national hospitalisation data about SI. POIS participants (N=2856, including 566 Māori) were recruited via ACC's injury register following an injury serious enough to warrant compensation entitlements. We will examine SI over the following 24 months for these participants using descriptive and inferential statistics including multivariable generalised linear models and Cox's proportional hazards regression.

Discussion Subsequent Injury Study (SInS) will deliver information about the risks, protective factors and outcomes related to SI for New Zealanders. As a result of sourcing injury data from New Zealand's 'all injury' insurer ACC, SInS includes people who have been hospitalised and not hospitalised for injury. Consequently, SInS will provide insights that are novel internationally as other studies are usually confined to examining trauma registries, specific injuries or injured workers who are covered by a workplace insurer rather than a 'real-world' injury population.

BACKGROUND

Injury is a leading cause of disability, contributing to 11% of the global disability burden.[1–6] Subsequent injury (SI) is increasingly recognised as an important contributor to the overall injury burden.[7–9] The New Zealand five-year Injury Prevention Strategy review made a key recommendation that SI required exploration.[10] Notwithstanding, we are unaware of research in New Zealand focused on SIs in the general 'all injury' population, aside from our research undertaken to inform the development of the Subsequent Injury Study (SInS).[11]

SInS builds on the earlier Prospective Outcomes of Injury Study (POIS; 2007–2013; HRC Ref ID# 10/052).[12–14] SInS combines data from three sources: (1) already-collected comprehensive POIS interviews with injured New Zealanders (N=2856) including 20% Māori (n=566); (2) information collected (with participants' consent) from the Accident Compensation Corporation's (ACC's) electronic database about each POIS participant's SI treatments, rehabilitation and related costs; and (3) information from the National Minimum Dataset (NMDS) about SI hospitalisations for each participant.

What is subsequent injury?

Various terms exist for SI; 'trauma recidivist' and 're-injury' are sometimes used, and laypeople may refer to themselves or others as being 'accident prone'.[15–17] Such terminology is problematic as it can imply predictors of SI are located exclusively at the level of the individual (ie, ignoring social and environmental factors) or that SI narrowly focuses on repeat injuries of the same injury type (eg, fracture), body region (eg, lower limb), mechanism (eg, intentional assault) or location (eg, workplace) rather than the broader category of 'all injury'.[13] In SInS, we will examine SI reported to ACC (ACC-SI) over a 24-month period for POIS participants who had experienced an initial (sentinel) injury resulting in an ACC entitlement claim (discussed below).

Reasons for research focused on SI

1) Injury and SI result in disability

In New Zealand, injuries are ranked in the top five causes of health loss and in 2006 were associated with a loss of approximately 76 000 years of healthy life.[18] Importantly, in New Zealand, Māori experience a disproportionate burden following injury relative to non-Māori.[18–20] A recent report showed that the rate of health-related loss due to injury for Māori is at least twice that of non-Māori.[21] We found that Māori have poorer outcomes 12 months after the sentinel injury,[22] and are at 70% increased risk of disability 24 months after the sentinel injury compared to non-Māori.[23] These findings are concerning and warrant urgent attention. It is possible, for example, that SI contributes to the disability burden by extending the period of disability following a sentinel injury. SInS will provide insights into these possible inequities and increase our understanding of the nature, extent, predictors and protective factors of SI for Māori in a manner that is not possible when considering each of the three above-mentioned data sets in isolation from each other.

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SI contributes to the total injury burden. For example, we recently reported that in New Zealand 28% of POIS participants 'self-reported' SI within 12 months of their sentinel injury.[11] In the 2013/2014 year, ACC, New Zealand's universal no-fault injury insurer, received 1.8 million new injury claims.[24] Given New Zealand's small population (~4.2 million people),[25] ACC's annual injury claims, together with our above-mentioned self-reported SI findings,[11] indicate that SIs are a substantial contributor to the total injury burden. In addition, research from other countries, albeit mostly limited to work-related injury, suggests that SIs result in even greater disability burden than from the initial ('sentinel') injury.[7–9]

2) Injury and SI are costly to individuals, families and society

In New Zealand, as in other countries, injury is costly. In the 2013/2014 year alone, ACC spent $2.9 billion on injury claims;[24] and social and economic costs have been estimated at more than $10 billion.[24] In other countries too, the financial costs associated with SI have been found to be higher than the costs for a sentinel work-related injury.[7–9] SInS will clarify the magnitude and composition of these costs in New Zealand. A wide range of potential confounders are able to be considered through the linking of our three data sets.

3) Little information regarding SI internationally and nationally

Previous research examining SI has several limitations, including a narrow focus on specific injury types or locations (eg, work-related injuries only),[7 26–28] consideration of only a small range of potential predictors or a focus on restricted populations (eg, recruited via hospital or trauma centres).[29–35] Recent studies, in the USA, were also limited to work-related SI or, more narrowly, work-related lower back SI.[36 37] In New Zealand, researchers have found that people hospitalised for assault were 40 times more likely to be hospitalised for assault-related SI over the subsequent 12 months compared to people without an assault-related hospitalisation.[29] However, this research also focused on a very specific cause (assault), was limited to those hospitalised and examined only a small range of possible predictors.

Although research focused on specific types, locations or causes of SI is undeniably important, it does not address New Zealand's macro-social context with the presence of our no-fault compensation injury insurer, ACC. ACC covers all personal injury claims for all physical injury (and mental injury arising from a physical injury), regardless of fault, location or cause.[38] Therefore, in New Zealand 'all injuries' are important in terms of the costs incurred for the provision of treatment, rehabilitation, earnings-related compensation and/or other supports—as well as being important to injured people in terms of their participation in paid and unpaid activities and their health and disability burdens.

Shouldn't we simply be concerned about 'injury'?

No; subsequent injury is a special case. The above-mentioned reasons of burden and increased costs make SI a health issue of national importance. Further, we cannot assume predictors of sentinel injury are the same for SI; both primary and secondary prevention are important. Indeed, researchers found that the factors reducing the risk of subsequent ankle injury are different to those leading to the sentinel injury.[39] We do not know whether this general relationship holds for the 'all injury' population. SInS will address this by combining pre-sentinel injury and post-sentinel injury participant-reported data about predictors and outcomes[3 13] with data collected from ACC and NMDS hospital records.

Earlier research undertaken to inform SInS

SI also matters because of its high incidence. As mentioned, earlier research found that 28% of people, already registered with ACC for an important (sentinel) injury, self-reported at least one SI in the next 12 months.[11] Data came from POIS,[14] which recruited a cohort of injured New Zealanders from ACC's entitlement claims register.[12 13 40] ACC-entitlement claimants are people with an injury likely to be at least one week away from paid employment, home help or other longer-term rehabilitative assistance (whereas injured treatment-only claimants require shorter-term treatments from health professionals).[38] POIS data were collected via in-depth interviews 3, 5, 12 and 24 months after the sentinel injury. Participants' responses were entered by highly trained interviewers into computer-administered telephone interview software for analysis.[13 41] One of POIS' strengths, now extending to SInS, are the follow-up rates: 80% at 12 months and 79% at 24 months.[42]

Self-reported SI was found to be more likely among: (1) non-workers and trade/manual workers relative to professionals, (2) people with two or more chronic conditions compared with those with none, (3) people whose injury was caused by assault rather than unintentional injury and (4) those who reported being affected by a prior injury at the time of their sentinel injury compared to those not.[11] However, a limitation is that this analysis is based entirely on participant self-reported SI.

Analysing ACC-SI claims data in SInS means that we no longer need to rely solely on participant recall;[11] and that we can identify ACC-SI frequency, mechanism, location, severity, treatments and costs along with the risk of ACC-SI for all 2856 participants (ie, including those lost to POIS interview follow-up). Hospital discharge data associated with ACC-SI for the same 24-month period will add another dimension.

SINS AIMS AND OBJECTIVES

SInS aims to improve outcomes for injured New Zealanders, including for Māori (New Zealand's indigenous population), and to reduce the burdens and costs for individuals and society. To achieve these aims, as necessary first steps towards developing interventions, we intend to identify modifiable risk factors predictive of ACC-SI and the health and disability burdens for people with ACC-SI, and the costs associated with ACC-SI. The specific objectives of SInS are to:

1. describe the nature and extent of ACC-SIs to inform objectives 2–4 and compare characteristics of ACC-SIs with those of sentinel injuries;
2. identify characteristics of people who may be underaccessing ACC for SI, with a particular focus on access for Māori;
3. determine factors that predict or protect against ACC-SI (including specific analyses of predictors and protective factors for Māori);
4. investigate participation, health and disability burden outcomes for individuals, and costs to society (via ACC), in relation to ACC-SI (including specific analyses of outcomes for Māori).

DESIGN AND METHODS

Design

Prospective study design using data already collected, or readily available, from three sources: POIS interviews, ACC electronic data and the NMDS.

Participants

SInS will analyse interview data already collected from all 2856 POIS participants, including 566 Māori (20%).[14 40] The cohort comprises acutely injured ACC-entitlement claimants.[12] Participants were aged 18–64 years from five regions of New Zealand: Auckland, Manukau City, Gisborne, Otago and Southland. Of the POIS participants, 61% were male, 68% New Zealand European and 92% in paid employment prior to their sentinel injury.[12] Participants had a range of sentinel injuries (eg, lower extremity fractures (17%), upper extremity dislocations, sprains or strains (14%), upper extremity fractures (17%) and intracranial injuries (4%));[43] and 25% had been hospitalised within one week as a consequence of their sentinel injury.[23]

Data

Participant-level data has already been, or will be, collected from three sources (with participants' consent) as summarised in figure 1.

1. *POIS interviews (3, 5, 12 and 24 months after sentinel injury)*: Provide information about a wide range of predictor and outcome variables encompassing all domains of the WHO International Classification of Functioning, Disability and Health framework.[13 44] Data include (1) demographic information, (2) pre-sentinel injury factors (eg, 95% confidence intervals general and psychological health, comorbidities, self-efficacy, occupational status, disability), (3) sentinel injury data (including whether participants perceived the injury to be a threat to life or disability), (4) post-sentinel injury factors (such as expectations of recovery, access to and satisfaction with health services) utilisation and Chi-square outcomes over 24 months (eg, physical and mental health, functioning, disability and participation in unpaid activities, social activities and paid employment) (table 1). POIS interviews also collect information about major life events and new comorbidities in the 24 months following the sentinel injury.[45 46] For many measures, participants were asked about their status before their sentinel injury, as well as at 3, 5, 12 and 24 months afterwards,[13] allowing adjustment for pre-sentinel injury status. Validated outcome measures include WHO Disability Assessment Schedule (WHODAS; disability),[47] Kessler-6 (psychological distress)[48] and the EQ-5D (general health status)[49] allowing the estimation of quality-adjusted life-years (QALYs; health states given an overall social preference value or 'utility') for ACC-SI.[50 51]
2. *The ACC electronic database*: Provides information about SI not available from the POIS interviews in isolation, including (1) date of ACC-SI event, (2) ACC-SI nature of injury grouping, (3) anatomical site, (4) diagnosis codes to derive ACC-SI severity, standard errors (5) mechanism and location of SI event, (6) whether ACC-SIs were entitlement or treatment-only claims, (7) whether ACC-SIs resulted in ACC earnings-related compensation payments (and dates) and (8) health and rehabilitation services provided and associated costs.
3. *The NMDS*: Provides information about ACC-SI resulting in hospitalisation (and hospital treatment exceeding 3 hours), including the length of stay, procedure codes and diagnoses at discharge.

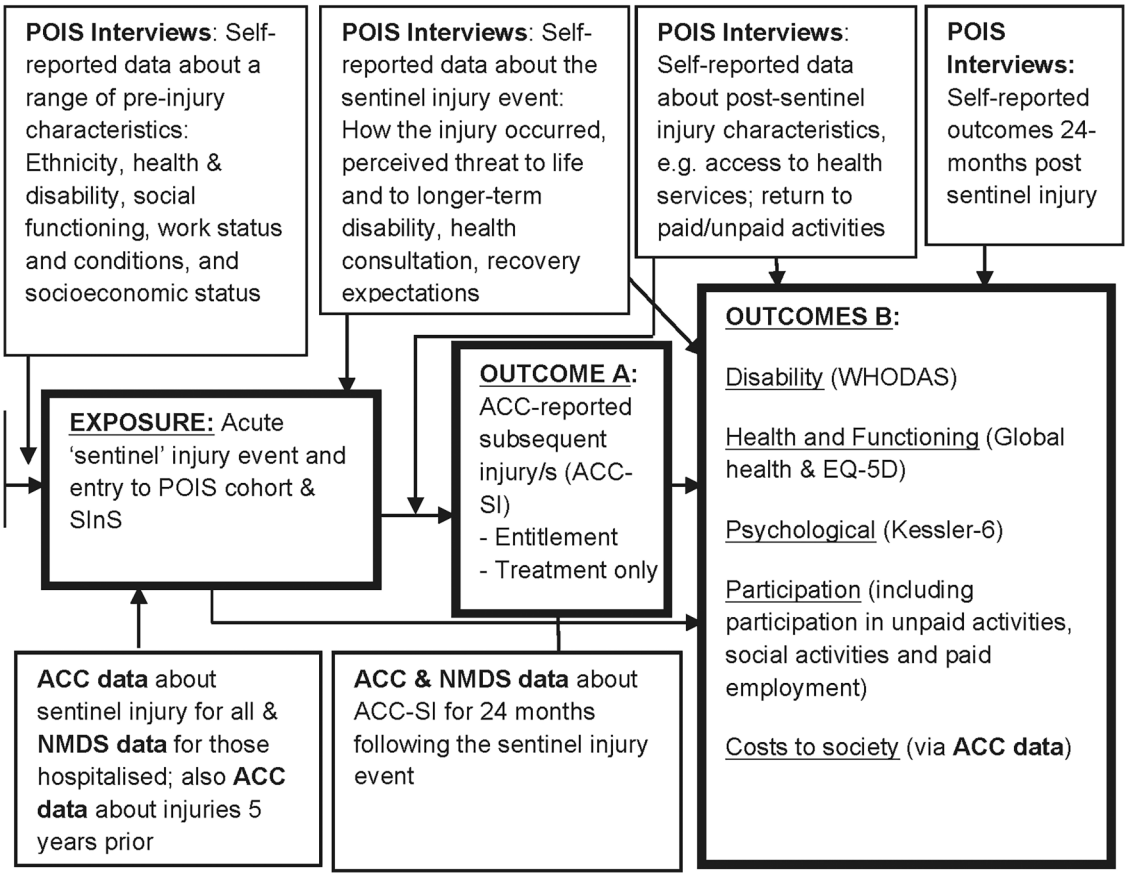

Figure 1 Overview of the Subsequent Injury Study (SInS). ACC, Accident Compensation Corporation; NMDS, National Minimum Dataset; POIS, Prospective Outcomes of Injury Study; WHODAS, WHO Disability Assessment Schedule

Table 1 Overview of the data available from the three sources

Categories of data	Examples of specific variables*	Source of data
Sociodemographic	Age, sex, ethnicity,[52] education,[52] living arrangements,[52] family involvement,[53] sense of community,[54] relationship status, socioeconomic status,[55] NZDep index,[56] rurality,[57] employment status, occupation, hours of work, job demand[58]	POIS interviews
Pre-sentinel injury health and psychosocial	Functional status (EQ-5D),[49] general health,[59] depression/anxiety (Kessler-6),[48] optimism,[60] disability (WHODAS),[47] 21 specific comorbidities,[45] physical activity,[61] body mass index, self-efficacy,[62] alcohol and drug use,[63] sleep	POIS interviews
	Information about injuries in the five years prior to the 'sentinel' injury event	ACC electronic data
Sentinel injury (ie, the injury that led to original recruitment to POIS and analysis of participants' data in SInS)	Perceived threat to life/severe disability, work-relatedness, assault/unintentional cause of injury, alcohol and injury event, and expectations of recovery	POIS interviews
	READ/ICD diagnosis codes (used to calculate injury type, body region and NISS severity),[64] date of injury, how the injury occurred, costs of treatments and rehabilitation services, payment for earnings-related compensation	ACC electronic data
	Hospitalisation, dates and length of stay in hospital, procedures	NMDS
Post-sentinel injury and interim outcomes	Access to healthcare services, provider type, satisfaction with healthcare and ACC services, occurrence of new illnesses, occurrence of major life events,[46] functioning,[49] disability,[47] general health,[59] depression/anxiety,[48 65] expectations of recovery, participation in unpaid activities, participation in social activities, return to work and receipt of benefits/income	POIS interviews
Subsequent injuries over 24 months (figure 1, outcome A)	*Self-reported* occurrence of one or more subsequent injuries[11]	POIS interviews
	Injury type, anatomical site, severity of injury (calculated from READ/ICD diagnosis codes),[64] cause of injury, date of injury/injuries, number of subsequent injuries per person, entitlement/medical fees claim, earnings-related compensation paid, health and rehabilitation services and costs	ACC electronic data
	Hospitalisation, dates and length of stay in hospital, and procedures for subsequent injury	NMDS
Outcomes at 24 months (figure 1, outcome B)	Disability,[47] health and functioning (and QALYs),[49] psychological health,[48] participation in unpaid activities, participation in social activities and return to work	POIS interviews
	Health treatments, rehabilitation and earnings-related costs	ACC electronic data

*The list of examples within each category is not exhaustive; POIS participants responded to >600 questions.
ACC, Accident Compensation Corporation; ICD, International Classification of Disease; NISS, New Injury Severity Score; NMDS, National Minimum Dataset; NZDep index, New Zealand's deprivation index; POIS, Prospective Outcomes of Injury Study; QALY, quality-adjusted life-year; SInS, Subsequent Injury Study; WHODAS, WHO Disability Assessment Schedule.

ANALYSES

Linking the data sets

POIS interview and ACC data sets will be linked using unique participant identifiers. POIS sentinel injuries have a unique ACC event ID, and ACC-SIs a new event ID, which enables these injuries and their associated services and costs to be differentiated. The National Health Index (NHI) is the NMDS unique person-level identifier. The NHI is not consistently provided in the ACC data; where possible, the NHI will be used; otherwise, probabilistic linkage using participants' surname, first name, sex, age and region will be used to link to the NMDS to obtain data about ACC-SIs.[66]

To address objective 1 (Obj 1), we will calculate ACC-SI incidence rates (and 95% CIs) for a range of time periods up to 24 months following the sentinel injury, for subgroups identified according to claim type (ie, entitlement and/or treatment-only claims) and for the Māori cohort. Average costs to ACC of both entitlement and medical treatment-only claims in the 12 and 24 months following both the sentinel injury and ACC-SI will be calculated and compared.

For those with an ACC-SI, we will compare the distributions of ACC-SI characteristics (eg, body region, type, cause, location, severity, hospitalisation and length of stay, and other health and rehabilitation service use) to those of the sentinel injuries that led to recruitment to POIS using χ^2 tests. Type, location and severity will be derived from ACC-SI diagnosis codes. In ACC electronic data, these are collected as READ codes, International Classification of Diseases (ICD)-9 and ICD-10 codes; where necessary, these will be mapped to ICD-10 diagnoses.[43 64] Eleven variables chosen to capture the most common nature of injury and body region groupings of sentinel injuries will be used to capture the multiple diagnoses possible from any ACC-SI event (eg, intracranial injury; lower extremity fracture).[43] Injury severity (New Injury Severity Score (NISS)) will be determined by mapping ICD-10 diagnoses to the Abbreviated Injury Scale (AIS; an anatomic-based coding system) and then calculating a range of severity levels from NISS 1–3 (least severe), NISS 4–6 and NISS>6; proportions in each level for the POIS sentinel injuries were 43%, 47% and 10%, respectively.[43 64]

To help identify whether people who had ACC-SIs within 24 months of their sentinel injury differ from people who did not, we will compare distributions of person-level characteristics from POIS interviews (eg, age, sex, ethnicity, rurality, socioeconomic status and occupation) between the two groups. Geographical coordinates of the residential address at the time of ACC-SI will be obtained allowing census mesh blocks to be applied and mapped to New Zealand Deprivation scores and the Statistics New Zealand Urban/Rural profile classification.[56 57]

To address Obj 2, we will examine concordance between the presence/absence of an ACC-SI with participant self-report of SI as collected in the POIS interview 12 months after the sentinel injury by, for example, age group, socioeconomic status and rurality[11] and seek to identify groups with lower proportions of ACC-SI claims given self-reported SI. To investigate whether (or not) Māori have similar access to ACC for ACC-SI as non-Māori, we will compare rates of self-reported SI with rates of ACC-SI for Māori and non-Māori using Poisson regression.[11]

To address Obj 3, we will use a binary outcome measure (ie, an ACC-SI within 24 months of the sentinel injury, or not) and

estimate RRs from multivariable modified Poisson regression models with robust SEs to identify personal pre-sentinel injury, sentinel injury-related and post sentinel injury-related risk and protective factors predictive of ACC-SI (or not). In addition, we will use ACC data about the timing between the sentinel injury and ACC-SI (see figure 1) and use Cox's proportional hazards regression to test for differences in ACC-SI incidence timing between two or more groups of interest while adjusting for a range of covariates (made possible by comprehensive POIS interview data).[67]

To address Obj 4, we will develop separate multivariable models to determine how ACC-SI affects participation in (1) unpaid activities, (2) social activities, (3) paid employment, as well as (4) health, functioning, psychological and disability outcomes 24 months post-sentinel injury (see figure 1, outcome B). We will also consider relationships between costs incurred and QALY outcomes.[23 49] Outcomes will be modelled using multivariable generalised linear models as appropriate, while adjusting for potential confounders such as injury severity.

DISCUSSION

SInS will provide information about risks of, and outcomes for, New Zealanders with ACC-SI. In addition, because of the nature of New Zealand's 'all injury' ACC insurance system, SInS will also provide insights that are novel and potentially informative internationally where, for pragmatic reasons, studies are often confined to trauma or workplace insurer registries.[7 26–37] Furthermore, injuries and outcomes are known to be influenced by the litigious nature of fault-based injury insurance systems in many other countries, in contrast to New Zealand's no-fault injury system.[68–71]

As highlighted, Māori experience marked injury and disability inequities compared with non-Māori.[19 20] Despite disproportionate burdens being borne by injured Māori, very little is known about this important area and the modifiable factors related to such burdens.[23] We need to understand the individual, societal and environmental factors that lead to people being at risk of SI to reduce SI and to improve outcomes for injured New Zealanders. SInS analyses data from a cohort who have already come to the attention of health services and ACC for an important (sentinel) injury, making this a population that is readily identifiable for future intervention.

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