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# Understanding longer-term disability outcomes for Māori and non-Māori after hospitalisation for injury: results from a longitudinal cohort study

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ABSTRACT

*Objectives:* The objectives are to (1) describe disability outcomes at 24 months after injury and (2) identify factors contributing to disability outcomes at 24 months after injury, for Māori and non-Māori who have been hospitalised for injury.
*Study design:* This is a prospective cohort study.
*Methods:* Prospective Outcomes of Injury Study participants were injured New Zealanders aged 18–64 years and recruited from New Zealand's no-fault injury insurer, the Accident Compensation Corporation's entitlement claims register. Data about a number of pre-injury, injury-related and early post-injury characteristics were collected from interviews held at 3 and 24 months after injury. Disability was measured using the World Health Organization Disability Assessment Schedule (WHODAS). Modified Poisson regression modelling was used to estimate relative risks (RRs) of disability for Māori and non-Māori who were hospitalised for injury.
*Results:* Analyses were restricted to 375 Māori and 1824 non-Māori participants for whom complete data were available. Of these, 105 (28%) Māori and 446 (24%) non-Māori were hospitalised for their injury. Of these hospitalised groups, 26% of Māori and 10% of non-Māori were experiencing disability (WHODAS ≥10) at 24 months after injury. Māori who were hospitalised for injury and who were not working for pay before their injury (RR = 2.7; 95% confidence interval [CI] 1.4–4.9), who were experiencing disability before their injury

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(RR = 3.1; 95% CI 1.6–5.8) or who reported trouble accessing healthcare services for their injury (RR = 2.6; 95% CI 1.3–5.2) were independently at increased risk of disability 24 months after injury. Non-Māori who were hospitalised for injury and who had inadequate household income before injury (RR = 2.4; 95% CI 1.4–4.1), less than the secondary school qualifications (RR = 2.0; 95% CI 1.1–3.8), were not working for pay before injury (RR = 2.8; 95% CI 1.5–5.1), were experiencing disability before their injury (RR = 3.0; 95% CI 1.7–5.2), had ≥2 chronic conditions (RR = 3.5; 95% CI 2.0–6.4) or had body mass index ≥30 kg/m$^2$/ undisclosed (RR = 2.4; 95% CI 1.3–4.4) were at increased risk of disability 24 months after injury.

*Conclusions:* Variables predicting disability 24 months after injury for Māori, also predict disability 24 months after injury for non-Māori, with one notable exception—trouble accessing healthcare services. Our findings show that having access to healthcare services for injury plays an important role after injury and must be focussed on to ensure that the burden of poor injury-related outcomes and injury-related inequities are reduced and ultimately eliminated.



## Introduction

Māori, the indigenous population of New Zealand, consistently have poorer health outcomes than non-Māori; a trend that is seen throughout the colonial history of New Zealand.[1–5] Injury and injury-related disability are no exception to this, where striking disability outcome inequities exist for Māori.[6,7] Injury accounts for approximately 33% of disability for Māori,[8] and Māori have higher age-adjusted rates of disability than non-Māori (32% compared with 24%, respectively).[9] Moreover, Māori have higher rates of hospitalisation for unintentional injuries when compared with non-Māori (18 per 1000 and 11 per 1000, respectively), twice the rate of mortality and twice the rate of health loss (12% vs 6% of disability-adjusted life years, respectively).[10]

Hospitalisation for injury is often found to be an important predictor of injury-related disability.[11,12] Other predictors identified by previous research include age, injury severity and pre-injury disability.[13–16] However, these factors may not be equally relevant for different ethnic groups, and our extensive literature search found very little (other than our own previous work) that specifically investigates post-injury outcomes for Māori or other indigenous populations.[17,18] The literature that does exist has often been focussed on specific injury types (for example, traumatic brain injury or road traffic–related injury), where findings are not necessarily generalisable to other, or all, injury types, or outcomes experienced after a wide range of injuries.[19–21]

The Prospective Outcomes of Injury Study (POIS) is a cohort study of 2856 (566 Māori and 2290 non-Māori) injured New Zealanders that investigates the factors that contribute to disability after 'all injury' in New Zealand.[22] POIS was intentionally designed and developed to explicitly address the Treaty of Waitangi principles and responsibilities,[23] and the Māori-specific components were informed by kaupapa Māori research principles.[24] We have previously reported that when hospitalised for injury, Māori are at 1.7 times the risk of disability 24 months after injury than non-Māori.[25] Additionally, we have previously identified predictors for poor post-injury outcomes for Māori including inadequate pre-injury household income, ≥2 chronic conditions and having trouble accessing healthcare services for injury.[26] Despite this growing knowledge base, more research is required to gain a better understanding of these identified relationships, including a more detailed picture of the complex pre-injury and post-injury pathways for Māori.

Given the disproportionate injury burden that indigenous populations experience with regard to hospitalisation and mortality, investigating outcomes after a range of injury types and severities is essential to identify key factors that influence post-injury recovery and life adjustments. Such investigation will help to identify potentially suitable interventions that can be developed to assist in the prevention and progression of postinjury disability for Māori. In an effort to inform the future support and rehabilitation initiatives and interventions, this article aims to (1) describe disability outcomes at 24 months after injury and (2) identify factors contributing to disability outcomes at 24 months after injury, for Māori and non-Māori who have been hospitalised for injury.

## Methods

This study uses data obtained from the POIS, which has been described in detail previously.[6,15,22,23] However, briefly, participants were recruited from five regions throughout New Zealand (Auckland City, Manukau City, Gisborne, Otago and Southland) from late 2007 until mid 2009. Eligible participants were aged between 18 and 64 years at the time of their injury and were recruited via the New Zealand no-fault injury insurer, the Accident Compensation Corporation (ACC). The ACC scheme supports everyone who is injured in New Zealand through payment of some costs associated with treatment and loss of income, home help and supporting people to return to work.[27] POIS participants were ACC entitlement claimants (an injury claim that warrants support beyond medical fees only, such as home help or income compensation).[27] Those whose injuries that were the result

of sexual assault or self-harm were not eligible for this study. Participants were interviewed at approximately 3, 12 and 24 months after injury about a range of pre-injury, injury-related and post-injury factors. This article uses data collected at 3- and 24-month interviews from the 566 Māori and 2290 non-Māori participants. All POIS participants were asked the New Zealand census ethnicity question[28] at the 3-month interview. Those who identified Māori as one of their ethnic groups were included in the Māori POIS cohort. Those who did not report Māori as one of their ethnic groups have been included in the non-Māori cohort for these analyses. Ethical approval was obtained from the New Zealand Health and Disability Multiregion Ethics Committee (MEC/07/07/093).

Variables used in these analyses have been described in detail previously;[15,26,29–32] however, they are described briefly in the following section.

### Outcome

The World Health Organization Disability Assessment Schedule II (WHODAS II)[33] was used to measure disability. WHODAS assesses activity and participation limitations during the previous 30 days across six dimensions using 12 questions with five difficulty-level response options. Responses are then summed, resulting in WHODAS scores ranging from 0 to 48.[33] For the purposes of this study, participants with WHODAS scores ≥10 were classified as experiencing considerable 'disability' and as experiencing 'no (or lesser) disability' if their WHODAS score was <10.[25,26,29,34] Participants were asked about their pre-injury WHODAS status during 30 days before their injury ('pre-injury disability'), at their first POIS interview (3 months after injury, on average). Participants were also asked about their post-injury WHODAS status in the 30 days before their 24-month post-injury interview ('24-month post-injury disability').

### Explanatory variables

As in previous analyses, explanatory variables were grouped into six dimensions: pre-injury sociodemographic, pre-injury socio-economic, pre-injury health related, health service related, injury related and early post-injury related.

*Pre-injury sociodemographic characteristics*

Participants were asked, at the first interview, about a range of pre-injury socio-demographic characteristics. The New Zealand census questions[28] were used to collect information about age, sex and living arrangements (classified as living 'alone or with non-family' and 'with family' [including partner/spouse]).

*Pre-injury socio-economic characteristics*

At the first interview, participants were also asked about a range of pre-injury socio-economic characteristics. The New Zealand census question about the highest educational qualification[28] was also used (classified as 'secondary school or higher' and 'less than secondary school'). Participants also reported adequacy of household income[35] (classified as 'adequate' if participants reporter having 'enough' or 'more than enough' total household income to meet every day needs and 'inadequate' if they reported 'not enough' or 'just enough'). Participants were asked if they were working for pay before their injury (classified as 'yes' if working full or part time and 'no' if not).[36]

*Pre-injury health-related characteristics*

Also at the first interview, participants were asked about pre-injury health characteristics. Participants reported whether they had been told by a doctor, before their injury, that they had one or more of a list of 21 chronic conditions (including diabetes, depression, cancer and asthma) that had lasted, or were expected to last, for more than 6 months. Pre-injury general health was rated using a five-point scale ('excellent', 'very good', 'good', 'fair' or 'poor') from the SF-36 questionnaire[37] (classified as 'excellent/very good', 'good' or 'fair/poor'[30]). Participants' body mass index (BMI) was calculated using the participants' reported weight and height (classified as 'BMI <30 kg/m$^2$' and 'BMI ≥30 kg/m$^2$/undisclosed').[29,38]

*Health service–related characteristics*

Participants were asked to rate their experiences of both health services and ACC (via separate questions) for their injury as 'very good', 'good', 'moderate', 'bad', 'very bad' and 'do not know'. Participants were also asked at the first interview if they had trouble getting to, or contacting, healthcare services for their injury (classified as 'trouble/mixed' or 'no trouble').[30] Participants were also asked how long after their injury that they saw a health professional, aggregated in hours for our analyses.

*Injury-related characteristics*

Injury severity was assessed using a derived New Injury Severity Score (NISS) grouped into NISS 1–3 (least severe), 4–6 (severe) and >6 (most severe).[29,39] Participants were asked whether their injury was intentional or not (classified as 'assault' or 'unintentional', respectively). Participants also reported at the 3-month interview whether, at the time of their injury, they thought their injury was a threat to their life or of severe longer-term disability (classified together as 'yes' if answered affirmatively to either question or 'no' otherwise).

*Early post-injury-related characteristics*

At the 3-month interview, participants were asked to report their expectations of future recovery in relation to their injury. They were asked whether their injury was still affecting them ('yes' or 'no, I have completely recovered') and if so, whether they thought they would get 'better soon', 'better slowly' (classified as 'better soon/slowly'), 'do not know' or 'never get better'. Participants were also asked how financially secure they expect to be in the next 10 years, with 'secure' and 'fairly secure' classified as 'secure,' and 'fairly insecure' and 'insecure' classified as 'insecure'. Participants were also asked whether they were still experiencing pain or discomfort (on the day of the interview) because of their injury with responses being 'no pain or discomfort', 'moderate pain or discomfort' or 'extreme pain or discomfort'. Those reporting the latter two responses were grouped together.

### Statistical analyses

Univariate analyses with Modified Poisson regression were used to identify characteristics that are likely to be associated

with disability 24 months after injury, for Māori and non-Māori, via assessing univariate relative risks (RRs) of disability between categories. Then, for each dimension of variables (pre-injury socio-demographic, pre-injury socio-economic, pre-injury health-related, health services-related, injury-related and early post-injury-related) and for Māori and non-Māori separately, we used multivariable modified Poisson regression modelling[40] to identify variables associated with disability 24 months after injury after accounting for other variables. We used a stepwise backward selection algorithm with a *P*-value threshold of ≤0.10. This threshold was intended as a safeguard against eliminating variables that are only marginally significant. To mitigate shortcomings associated with stepwise procedures based purely on *P*-values, prior knowledge[6,7,15,25,26,29] and the univariate analysis results were also used to inform the selection of variables to be retained in this process. All statistical analyses were carried out using Stata, version 14.2.[41]

## Results

Of the 384 Māori POIS participants who completed the 24-month interview, nine participants were missing either pre-injury or 24-month WHODAS disability scores, restricting these analyses to 375 (97.7%) Māori POIS participants. For these participants, the median post-injury time to complete the 24-month interview was 24.6 months (interquartile range [IQR] = 24.2–25.3 months). For the non-Māori POIS participants, 1869 completed the 24-month interview with 45 participants missing WHODAS disability scores, restricting these analyses to 1824 (97.6%) non-Māori POIS participants. For these participants, the median post-injury time to complete the 24-month interview was 24.3 months (IQR = 24.1–24.8 months).

Of the 375 Māori participants, 105 (28%) were hospitalised for their injury, and 26% of this group were experiencing disability (WHODAS ≥10) 24 months after injury. Of the 1824 non-Māori participants, 446 (24%) were hospitalised for injury, and 10% were experiencing disability (WHODAS ≥10) at 24 months after injury.

Table 1 presents separate univariate analyses relating to the prevalence and RR of disability at 24 months after injury separately for Māori and non-Māori who were hospitalised for their injury according to the pre-injury socio-demographic, pre-injury socio-economic, pre-injury health-related, health service–related, injury-related and early post-injury-related characteristics.

Among Māori who were hospitalised, those who were not working for pay, were experiencing disability before injury, had ≥2 chronic conditions, had trouble accessing healthcare services for their injury, did not know if they would recover from their injury or expected to be financially insecure in the future were at increased risk of disability at 24 months after injury, compared with their reference categories (Table 1). Similarly, among non-Māori who were hospitalised, those who reported inadequate pre-injury household income, were not working for pay, were experiencing disability before injury, had ≥2 chronic conditions, had fair/poor or good/very good pre-injury general health, had a BMI ≥30 kg/m$^2$, reported that they perceived their injury to be a threat to life or long-term disability, did not know if they would recover from their injury or thought they would never recover, expected to be financially insecure in the future or were experiencing pain from their injury 3 months later were at increased risk of disability at 24 months after injury, compared with their respective reference categories.

Table 2 presents data from separate multivariable models for the six dimensional groups of variables for Māori and non-Māori who were hospitalised for their injury. Small numbers of participants were missing responses to one or more variables in each separate model, and therefore, the numbers of participants in each model differ slightly.

Māori who were not working for pay before their injury were at increased risk of disability 24 months after injury compared with those who were working for pay (RR = 2.7; 95% confidence interval [CI] 1.4–4.9), as were those who were experiencing disability before their injury compared with those who were not (RR = 3.1; 95% CI 1.6–5.8), and those reporting trouble accessing healthcare services for their injury compared with those who did not (RR = 2.6; 95% CI 1.3–5.2). The estimates also suggest that those with ≥2 chronic conditions, those reporting that they perceived their injury to be a threat to life or long-term disability, those who did not know if they would recover and those who expected to be financially insecure in the future were at increased risk of disability 24 months after injury. However, these 95% CIs are of borderline statistical significance and indicate that these relationships could be due to chance.

Non-Māori who had inadequate household income before injury compared with those reporting adequate household income (RR = 2.4; 95% CI 1.4–4.1), less than secondary school qualifications compared with those with higher educational qualifications (RR = 2.0; 95% CI 1.1–3.8), were not working for pay before injury compared with those who were (RR = 2.8; 95% CI 1.5–5.1), those experiencing disability before their injury compared with those who were not (RR = 3.0; 95% CI 1.7–5.2), those with ≥2 chronic conditions compared with those with none or one (RR = 3.5; 95% CI 2.0–6.4), those with a BMI ≥30 kg/m$^2$/undisclosed compared with those with a BMI <30 kg/m$^2$ (RR = 2.4; 95% CI 1.3–4.4) were at increased risk of disability 24 months after injury. Additionally, those reporting that they perceived their injury to be a threat to life or long-term disability compared with those who did not (RR = 2.6; 95% CI 1.3–5.0), those who did not know if they would recover (RR = 2.1; 95% CI 1.1–3.5) or who expected to never recover, both compared with those who expected to recover soon or slowly (RR = 4.5; 95% CI 2.3–8.7), those who expected to be financially insecure in the future compared with those who expected to be financially secure (RR = 2.0; 95% CI 1.1–3.5) and those who reported being in pain compared with those who were not (RR = 3.4; 95% CI 1.1–10.5) were all at increased risk of disability 24 months after injury. The effect estimates also suggest that those aged 45–65 years were at increased risk of disability 24 months after injury. However, the 95% CI indicates that this finding could be due to chance.

**Table 1 – Univariable models for hospitalised Māori (N = 105) and Non-Māori (N = 446).**

| Variables | Māori | | | | | | Non-Māori | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | N disability[c] (N = 27) | RR | 95% CI for RR | | P value | N | N disability[c] (N = 46) | RR | 95% CI for RR | | P value |
| **Demographic characteristics** | | | | | | | | | | | | |
| Age (years) | | | | | | | | | | | | |
| 18–44 | 68 | 17 | Ref | | | | 240 | 19 | Ref | | | |
| 45–65 | 37 | 10 | 1.08 | 0.55 | 2.12 | 0.821 | 206 | 27 | 1.66 | 0.95 | 2.89 | 0.076 |
| Sex | | | | | | | | | | | | |
| Male | 71 | 19 | Ref | | | | 288 | 30 | Ref | | | |
| Female | 34 | 8 | 0.88 | 0.43 | 1.81 | 0.727 | 158 | 16 | 0.97 | 0.55 | 1.73 | 0.923 |
| Living arrangements | | | | | | | | | | | | |
| With family | 89 | 21 | Ref | | | | 356 | 35 | Ref | | | |
| Alone/with non-family | 16 | 6 | 1.59 | 0.76 | 3.33 | 0.219 | 89 | 11 | 1.26 | 0.66 | 2.38 | 0.481 |
| **Pre-injury socio-economic characteristics** | | | | | | | | | | | | |
| Adequacy of household income | | | | | | | | | | | | |
| Adequate | 67 | 16 | Ref | | | | 304 | 21 | Ref | | | |
| Not adequate | 38 | 11 | 1.21 | 0.63 | 2.34 | 0.567 | 132 | 23 | 2.52 | 1.45 | 4.40 | 0.001 |
| Highest educational qualification | | | | | | | | | | | | |
| Secondary school or higher | 79 | 18 | Ref | | | | 387 | 37 | Ref | | | |
| Less than secondary school | 24 | 9 | 1.65 | 0.85 | 3.18 | 0.139 | 55 | 9 | 1.71 | 0.87 | 3.35 | 0.117 |
| Working for pay | | | | | | | | | | | | |
| Yes | 92 | 20 | Ref | | | | 408 | 37 | Ref | | | |
| No | 13 | 7 | 2.45 | 1.31 | 4.69 | 0.005 | 38 | 9 | 2.61 | 1.36 | 5.00 | 0.004 |
| **Pre-injury health-related characteristics** | | | | | | | | | | | | |
| Pre-injury disability (WHODAS) | | | | | | | | | | | | |
| 0–9 | 97 | 20 | Ref | | | | 423 | 36 | Ref | | | |
| ≥10 | 8 | 7 | 4.24 | 2.65 | 6.81 | 0.000 | 19 | 9 | 5.57 | 3.15 | 9.83 | 0.000 |
| Chronic conditions | | | | | | | | | | | | |
| 0–1 | 85 | 16 | Ref | | | 0.000 | 349 | 21 | Ref | | | 0.000 |
| ≥2 | 18 | 10 | 2.95 | 1.61 | 5.42 | | 84 | 23 | 4.55 | 2.65 | 7.83 | |
| Pre-injury general health | | | | | | | | | | | | |
| Excellent/very good | 69 | 16 | Ref | | | 0.1726 | 323 | 22 | Ref | | | 0.0001 |
| Good | 28 | 7 | 1.08 | 0.50 | 2.34 | | 106 | 18 | 2.49 | 1.39 | 4.47 | |
| Fair/poor | 8 | 4 | 2.16 | 0.95 | 4.89 | | 15 | 5 | 4.89 | 2.15 | 11.13 | |
| BMI (kg/m$^2$) | | | | | | | | | | | | |
| <30 | 28 | 4 | Ref | | | | 183 | 11 | Ref | | | |
| ≥30/undisclosed | 77 | 23 | 2.09 | 0.79 | 5.54 | 0.138 | 263 | 35 | 2.21 | 1.15 | 4.25 | 0.017 |
| **Health service–related characteristics** | | | | | | | | | | | | |
| Health services rating | | | | | | | | | | | | |
| Good/very good | 89 | 21 | Ref | | | | 364 | 34 | Ref | | | |
| Moderate/very bad | 16 | 6 | 1.59 | 0.76 | 3.33 | 0.219 | 80 | 12 | 1.61 | 0.87 | 2.96 | 0.13 |
| ACC rating | | | | | | | | | | | | |
| Very good/good/moderate | 95 | 24 | Ref | | | | 419 | 42 | Ref | | | |
| Bad/very bad | 7 | 2 | 1.13 | 0.33 | 3.86 | 0.844 | 18 | 2 | 1.11 | 0.29 | 4.23 | 0.88 |
| Access to healthcare services | | | | | | | | | | | | |
| No trouble | 91 | 19 | Ref | | | | 389 | 38 | Ref | | | |
| Trouble/mixed | 13 | 7 | 2.58 | 1.35 | 4.92 | 0.004 | 52 | 7 | 1.38 | 0.65 | 2.93 | 0.404 |
| Hours from injury to be first seen by a health professional | | | | | | | | | | | | |
| Hours from injury[a] | | | 1.00 | 1.00 | 1.00 | 0.000 | | | 1.00 | 0.99 | 1.00 | 0.559 |
| **Injury-related characteristics** | | | | | | | | | | | | |
| Injury severity (NISS) | | | | | | | | | | | | |
| 1–3 | 26 | 8 | Ref | | | 0.752 | 108 | 12 | Ref | | | 0.006 |
| 4–6 | 49 | 12 | 0.80 | 0.37 | 1.70 | | 226 | 15 | 0.60 | 0.29 | 1.23 | |
| >6 | 27 | 6 | 0.72 | 0.29 | 1.80 | | 102 | 19 | 1.68 | 0.86 | 3.28 | |
| Cause of injury | | | | | | | | | | | | |
| Unintentional | 92 | 25 | Ref | | | | 425 | 42 | Ref | | | |
| Intentional (assault) | 12 | 2 | 0.61 | 0.16 | 2.28 | 0.466 | 20 | 4 | 2.02 | 0.80 | 5.10 | 0.135 |
| Threat to life or long-term disability | | | | | | | | | | | | |
| No | 33 | 4 | Ref | | | | 198 | 11 | Ref | | | |
| Yes | 71 | 23 | 2.67 | 1.00 | 7.14 | 0.05 | 232 | 33 | 2.56 | 1.33 | 4.94 | 0.005 |
| **Early post-injury-related characteristics** | | | | | | | | | | | | |
| Expectation of the future recovery | | | | | | | | | | | | |
| Already recovered[b] | 11 | 0 | 0.000 | – | – | 0.015 | 53 | 1 | – | | | 0.00 |
| Expect to recover soon/slowly | 72 | 17 | Ref | – | – | | 316 | 27 | Ref | – | – | |
| Never recover | 2 | 0 | 0.000 | – | – | | 11 | 5 | 5.32 | 2.53 | 11.17 | |

**Table 1 – (continued)**

| Variables | Māori | | | | | | Non-Māori | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | N disability[c] (N = 27) | RR | 95% CI for RR | | P value | N | N disability[c] (N = 46) | RR | 95% CI for RR | | P value |
| Do not know | 20 | 10 | 2.12 | 1.15 | 3.88 | | 63 | 13 | 2.42 | 1.32 | 4.42 | |
| Expectation of the future financial security | | | | | | | | | | | | |
| Secure | 73 | 14 | Ref | | | | 344 | 25 | Ref | | | |
| Insecure | 30 | 12 | 2.09 | 1.09 | 3.98 | 0.026 | 89 | 19 | 2.94 | 1.70 | 5.09 | 0.00 |
| Pain | | | | | | | | | | | | |
| No | 25 | 2 | Ref | | | | 125 | 4 | Ref | | | |
| Yes | 80 | 25 | 3.91 | 0.99 | 15.45 | 0.052 | 321 | 42 | 4.09 | 1.50 | 11.18 | 0.01 |

RR, relative risk; CI, confidence interval; WHODAS, World Health Organization Disability Assessment Schedule; BMI, body mass index; ACC, Accident Compensation Corporation; NISS, New Injury Severity Score.
Column totals for each variable may vary and do not necessarily add to 105 (for Māori) or 446 (for non-Māori) as those with missing values have not been reported.
[a] Continuous variable.
[b] This category is excluded from statistical models because of the 'expectation of future recovery' variable not being applicable for those 'already recovered'.
[c] No. with WHODAS scores ≥10.

## Discussion

This article has described disability outcomes and investigated the pre-injury and injury-related predictors of disability 24 months after injury for Māori and non-Māori who were hospitalised for their injury with a range of injury types and severities. We have previously reported that Māori who were hospitalised for injury had an increased risk of disability 24 months after injury compared with non-Māori who were hospitalised for their injury (RR = 1.7; 95% CI 1.0–2.9)[25] and that a range of pre-injury socio-demographic, health and psychosocial and injury-related characteristics independently predict disability 24 months after injury for hospitalised and non-hospitalised injured Māori. These factors include inadequate household income before injury, having ≥2 chronic conditions, being hospitalised for injury and having difficulty accessing healthcare services for injury.[26] Previous analyses have not allowed us to specifically, and independently, investigate the predictive factors of the observed increased risk of disability for Māori who have been hospitalised for injury as we have performed so here. Not directly statistically comparing Māori and non-Māori prevalence and predictors of disability allows us to gain a greater insight into the nature of post-injury disability, especially for Māori, and reduces the risk of a deficit approach, whereby Māori ethnicity is used as an explanation for observed inequities.[15,23,42] This approach also reflects the original intentions of POIS, where meaningful and appropriate analyses and findings are presented for Māori.[23]

Our analyses showed that the prevalence of disability 24 months after injury for Māori was 26%, noticeably higher than 10% for non-Māori who were hospitalised for injury. While this was less than the prevalence of disability for the Māori cohort at 3 months after injury (49%), it is still considerably higher than that for the total Māori cohort before injury (9%).[7] Univariable analyses for hospitalised Māori and non-Māori revealed a number of potential predictors, across a number of variable dimensions, of disability 24 months after injury (Table 1). These analyses helped inform the subsequent multivariable analyses (Table 2) that show at least one variable in five of the six dimensions predict disability 24 months after injury.

Separate multivariable dimensional analyses indicate that for Māori, variables within each of the three different dimensions independently predict disability 24 months after injury. These were not working for pay (pre-injury socio-economic), experiencing disability before injury (pre-injury health-related) and having trouble accessing healthcare services (health services-related) for injury. There was some evidence to suggest that variables within two other dimensions (injury-related and early post-injury-related) also independently predict disability 24 months after injury, i.e. perceiving the injury to be a threat to life or long-term disability and being insecure about future financial security. Additionally, there was some evidence to suggest that having ≥2 chronic conditions (pre-injury health-related) independently predicts disability 24 months after injury.

Separate multivariable dimensional analyses indicate that for non-Māori, variables within four different dimensions independently predict disability 24 months after injury. These were having inadequate household income, having less than the secondary school qualifications, not working for pay (pre-injury socio-economic), experiencing disability before injury, having ≥2 chronic conditions, having a BMI ≥ 30 kg/m$^2$ (pre-injury health-related), perceiving the injury to be a threat to life or long-term disability (injury-related), not knowing if they would recover from their injury or expecting to never recover, being insecure about future financial security and experiencing pain 3 months after injury (early post-injury-related).

The multivariable dimensional analyses revealed that variables predicting disability 24 months after injury for Māori, also predict disability 24 months after injury for non-Māori, with one notable exception. The area of difference was that trouble accessing healthcare services for injury placed Māori (but not non-Māori) at considerably increased risk of disability at 24 months (RR = 2.58; 95% CI 1.4–4.9) compared with non-Māori who did not report such trouble. Previous POIS analyses have also identified that having trouble

**Table 2 – Dimensional multivariable models for hospitalised Māori and non-Māori.**

| Variables | Māori | | | | | | Non-Māori | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | N disability[b] | RR | 95% CI for RR | | P value | N | N disability[b] | RR | 95% CI for RR | | P value |
| **Model 1: demographic dimension (Māori: N = 105; 27 WHODAS ≥10) (Non-Māori: N = 445; 46 WHODAS ≥10)** | | | | | | | | | | | | |
| Age (years) | | | | | | | | | | | | |
| 18–44 | | | | | | | 240 | 19 | Ref | | | |
| 45–65 | | | | | | | 205 | 27 | 1.66 | 0.95 | 2.90 | 0.073 |
| **Model 2: socio-economic dimension (Māori: N = 103; 27 WHODAS ≥10) (Non-Māori: N = 433; 44 WHODAS ≥10)** | | | | | | | | | | | | |
| Adequacy of household income | | | | | | | | | | | | |
| Adequate | | | | | | | 303 | 21 | Ref | | | |
| Inadequate | | | | | | | 130 | 23 | 2.37 | 1.36 | 4.11 | 0.002 |
| Highest educational qualification | | | | | | | | | | | | |
| Secondary school or higher | | | | | | | 378 | 35 | Ref | | | |
| Less than secondary school | | | | | | | 55 | 9 | 2.02 | 1.06 | 3.82 | 0.032 |
| Working for pay | | | | | | | | | | | | |
| Yes | 91 | 20 | Ref | | | | 400 | 35 | Ref | | | |
| No | 12 | 7 | 2.65 | 1.43 | 4.93 | 0.002 | 33 | 9 | 2.77 | 1.51 | 5.09 | 0.001 |
| **Model 3: pre-injury health-related dimension (Māori: N = 103; 26 WHODAS ≥10) (Non-Māori: N = 429; 44 WHODAS ≥10)** | | | | | | | | | | | | |
| Pre-injury disability (WHODAS) | | | | | | | | | | | | |
| 0–9 | 95 | 19 | Ref | | | | 412 | 35 | Ref | | | |
| ≥10 | 8 | 7 | 3.05 | 1.61 | 5.75 | 0.001 | 17 | 9 | 2.96 | 1.67 | 5.24 | 0.000 |
| Chronic conditions | | | | | | | | | | | | |
| 0–1 | 85 | 16 | Ref | | | | 347 | 21 | Ref | | | |
| ≥2 | 18 | 10 | 2.02 | 0.99 | 4.09 | 0.052 | 82 | 23 | 3.54 | 1.95 | 6.40 | 0.000 |
| BMI (kg/m$^2$) | | | | | | | | | | | | |
| <30 | | | | | | | 173 | 10 | Ref | | | |
| ≥30/undisclosed | | | | | | | 256 | 34 | 2.35 | 1.25 | 4.40 | 0.008 |
| **Model 4: health service–related dimension (Māori: N = 98; 24 WHODAS ≥10) (Non-Māori: N = 419; 39 WHODAS ≥10)** | | | | | | | | | | | | |
| Access to healthcare services | | | | | | | | | | | | |
| No trouble | 87 | 18 | Ref | | | | | | | | | |
| Trouble/mixed | 11 | 6 | 2.64 | 1.33 | 5.21 | 0.005 | | | | | | |
| **Model 5: injury-related dimension (Māori: N = 101; 26 WHODAS ≥10) (Non-Māori: N = 423; 44 WHODAS ≥10)** | | | | | | | | | | | | |
| Injury severity (NISS) | | | | | | | | | | | | |
| 1–3 | | | | | | | 106 | 12 | Ref | | | 0.023 |
| 4–6 | | | | | | | 220 | 15 | 0.58 | 0.29 | 1.19 | |
| >6 | | | | | | | 97 | 17 | 1.46 | 0.73 | 2.91 | |
| Threat to life or long-term disability | | | | | | | | | | | | |
| No | 32 | 4 | Ref | | | | 197 | 11 | Ref | | | |
| Yes | 69 | 22 | 2.55 | 0.95 | 6.83 | 0.062 | 226 | 33 | 2.58 | 1.34 | 4.98 | 0.005 |
| **Model 6: early post-injury-related dimension (Māori: N = 98; 23 WHODAS ≥10) (Non-Māori: N = 423; 40 WHODAS ≥10)** | | | | | | | | | | | | |
| Expectation of the future recovery | | | | | | | | | | | | |
| Already recovered[a] | 11 | 0 | – | – | – | | 53 | 1 | – | | | 0.000 |
| Expect to recover soon/slowly | 71 | 17 | Ref | – | – | | 305 | 25 | Ref | | | |
| Never recover | 2 | 0 | 0.00 | – | – | | 11 | 5 | 4.43 | 2.28 | 8.63 | |
| Do not know | 19 | 9 | 1.79 | 0.93 | 3.45 | | 61 | 13 | 2.06 | 1.10 | 3.86 | |
| Expectation of the future financial security | | | | | | | | | | | | |
| Secure | 73 | 14 | Ref | | | | 342 | 25 | Ref | | | |
| Insecure | 30 | 12 | 1.84 | 0.97 | 3.51 | 0.062 | 88 | 19 | 2.01 | 1.14 | 355 | 0.016 |
| Pain | | | | | | | | | | | | |
| No | | | | | | | 121 | 3 | Ref | | | |
| Yes | | | | | | | 309 | 41 | 4.17 | 1.02 | 17.07 | 0.047 |

RR, relative risk; CI, confidence interval; WHODAS, World Health Organization Disability Assessment Schedule; BMI, body mass index; NISS, New Injury Severity Score.

[a] This category is excluded from statistical models because of the 'expectation of future recovery' variable not being applicable for those 'already recovered'.

[b] No. with WHODAS scores ≥10.

accessing healthcare services for injury predicted a range of poor outcomes, including specifically for injured Māori.[25,26,29] Our results show that having access to healthcare services for injury appears to play an important role in reducing the burden of poor injury-related outcomes and injury-related inequities. This article has focussed on data from participants who had already accessed ACC and had been hospitalised for their injury, suggesting significant healthcare service contact, and one would assume support from such services, compared with those who were not hospitalised for their injury. Despite this, our results show that Māori participants still reported having trouble accessing such services, which is independently predicting experiencing disability 24 months after injury. It is unclear exactly what aspects relating to having trouble accessing healthcare services for injury occur for Māori. Factors such as distance or time taken to reach the

healthcare service that was used for injury are likely to play a large part, but there may be other factors that we have not considered such as participants' healthcare service expectations or experiences, costs associated with visiting a healthcare professional or the lack of awareness of the injury and rehabilitation health services and entitlements, including ACC. Additionally, Māori often have lower rates of access for healthcare services for a range of health issues and often receive a lower quality of care.[5,43] Such inequities are seen across the health sector, as well as for other indigenous populations, and therefore, contribute to a wide range of poorer health outcomes. Studies have found that a variety of issues including socio-economic inequities,[44–46] geographic isolation from healthcare facilities,[45] financial costs of treatment[45,47,48] and a lack of culturally appropriate care[49] may have an impact on Māori and other indigenous populations accessing and receiving high-quality health care. Such adverse care experiences can result in disengagement from health care or delay in seeking care.[50,51]

Our results show that Māori, but not non-Māori, who have trouble accessing health care for injury-related healthcare services, have poorer outcomes. This finding indicates that there is still considerable work to be performed to ensure adequate access to healthcare services for Māori in this sector of the health system to improve postinjury outcomes. We hypothesise that Māori who have trouble accessing healthcare services for their injury initially, continue to do so for injury and rehabilitation-related services, which therefore impacts on, and prevents, improved post-injury outcomes such as longer term disability.

Limitations of this study include the small sample sizes in these analyses, particularly for Māori who were hospitalised for injury, which limit the number of potential explanatory variables able to be included in the multivariable models. The small sample sizes may also mean that, for example, some factors that do in truth predict disability 24 months after injury may not have been revealed in our analyses. POIS was originally designed to enable findings specific for injured Māori to be reported. However, owing to loss to follow-up and our complete case approach, our multivariable dimensional models (Table 2) only included between 98 and 105 Māori participants who had been hospitalised. Additionally, the small numbers of participants were insufficient for building a single multivariable model for each cohort; however, our study is one of the largest prospective cohort studies of Māori in New Zealand. There is also the possibility that some important factors that predict disability 24 months after injury were not collected during POIS or were not included in our current analyses. Despite these limitations, to the best of our knowledge, POIS has the largest longitudinal cohort of Māori who have experienced 'all injuries', and therefore of Māori who have been hospitalised for 'all injuries'. Therefore, these analyses contribute to the currently limited pool of knowledge relating to Māori post-injury outcomes.

To gain greater insights into the post-injury experiences of Māori who were hospitalised for their injury, and to complement these quantitative analyses, we are currently analysing qualitative data from interviews with a subgroup of these participants. These analyses will provide further details about some of the barriers for Māori when accessing healthcare services, particularly for injury. There is much to be done to improve Māori access to, and experiences within, the healthcare system more broadly, and there are many recent positive developments, for example, the Whānau Ora policy and subsequent navigators where health and social services are required to operate in a more cohesive and complementary manner. Owing to the relatively recent nature of the implementation of this policy, it is difficult to gain a full appreciation of its effectiveness, but feedback and evaluations are largely positive.[52]

An integral part of this present study is the active engagement and involvement of an advisory group which is made up of representatives from ACC, a primary health organisation, a Māori health provider, a Māori rehabilitation clinician and researcher, and Māori with experience of using injury and rehabilitation services. These current findings have been collaboratively discussed and have raised a number of key points and ideas. Our results are consistent with ACC's data/research which show that Māori access less ACC injury and rehabilitation entitlements compared with non-Māori, especially for mild or moderate injuries (personal communication, ACC manager, 2017). The need to further understand the barriers and reasons for injured Māori reporting trouble in accessing healthcare services is crucial. Additionally, identifying whether such barriers are specific to injury or whether they are playing a role across a wider range of healthcare services is important to consider and develop future interventions. Those who are hospitalised for injury have contact with a number of health professionals, providing multiple opportunities and points in the pathway for future interventions to improve postinjury outcomes. Potential solutions might include health professional training to facilitate additional support for Māori who do have trouble in accessing services and improved service communications and collaborations.

## Author statements

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### *Competing interests*

None declared.

### Author contributions

E.H.W. led the preparation of this article, wrote the draft manuscript and leads the Māori Disability Outcomes: Pathways and Experiences After Injury project. A.S. undertook the statistical analyses. S.D. leads the Prospective Outcomes of Injury Study. E.H.W., S.D., M.H. and A.S. contributed to the design of the study. All authors contributed to the interpretation of data and the writing and editing of the manuscript. All authors have read and approved the final manuscript.

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