Transport Planning and Design
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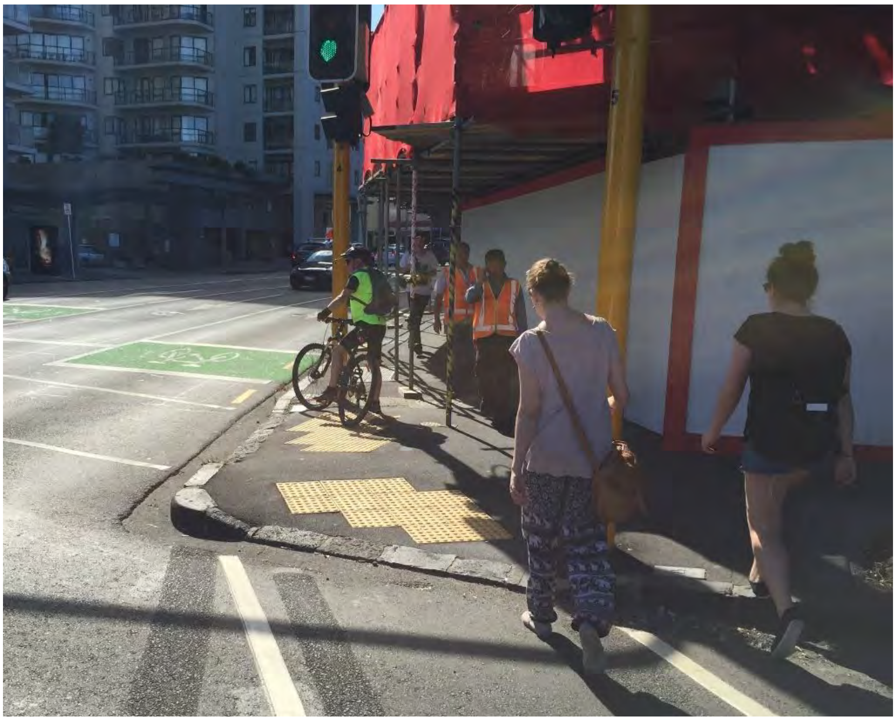
Safety of people travelling outside vehicles

Deep dive review: First and second phase



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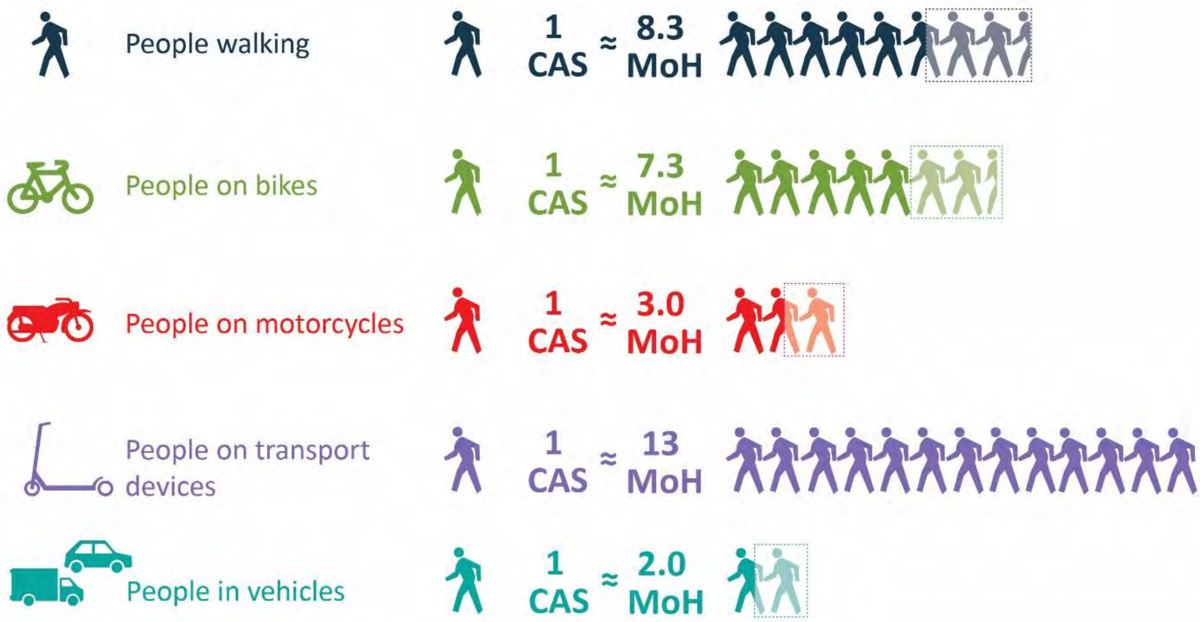
Auckland Transport would like to acknowledge and thank Paul Graham of Waka Kotahi for his time and expertise during this research project.

Executive Summary

Strategic priority one in Vision Zero for Tāmaki Makaurau (Auckland) is reducing transport deaths and serious injuries, especially for vulnerable transport users (VTUs) outside of motor vehicles, i.e. people walking, biking, motorcycling and using other wheeled transport devices like skateboards and e-scooters. However, recent data monitoring suggests that these reductions are not happening as quickly as desired, and VTU deaths may even be trending upwards.

The purpose of this deep dive was to provide insight into the extent, nature and causes of serious harm to VTUs in Auckland. Following an initial "Phase 1" report provided to AT in March 2021, some further questions and clarifications were identified ("Phase 2") that have now also been addressed in this combined report. This report aims to provide evidence to support leadership positions needed to make change on this important safety issue.

Whilst there appears to be one primary source that reports the fatalities on the transport network, the number of serious injuries depends on the data used. The Crash Analysis System does not generally report on incidents not involving a motor vehicle (e.g. trips, slips and falls) and, with only a proportion of non-fatal vehicle crashes being recorded in CAS (due to under-reporting to Police), it is clear that there is a big issue with under-reporting in the system. A review of CAS and data from the Ministry of Health also highlights that not only is VTU under-reporting a lot higher than motor vehicles but there are also fewer user-only incidents in CAS.



Serious Injury under-reporting – Crash Analysis System (CAS) v Ministry of Health (MoH) – dashed boxes highlight where another party was involved

(Note: The above figure has revised values following the completion of Phase 2 of the study)

The following figure shows the relative splits of serious injuries involving VTUs (2016-19) in terms of other parties involved. This greatest numbers of injuries recorded are those that do not involve another party, such as the falls/trips/slips, collisions with stationary objects and lost control incidents for faster vehicles.

Motor vehicles also have a big involvement in VTU injuries, especially light vehicles (although there appears to be some coding anomaly with the way that transport device injuries with motor vehicles are captured in the data). Interestingly, relatively few serious injuries involve a heavy motor vehicle, such as truck or bus. There are relatively few crashes *between* VTUs.

Serious injuries involving vulnerable road users 2016 – 19

Road users ▶	Pedestrian	Transport device	Bicycle	Motorcycle
Falls, trips, slips not involving another party/object	2074	110	685	668
In collision with: Stationary object	0	36	173	253
In collision with: Pedestrian	10	11	0	0
In collision with: Transport device	0	4	0	0
In collision with: Bicycle	40	0	54	0
In collision with: Motorcycle	0	2	15	46
In collision with: Light vehicle	851	20	276	701
In collision with: Heavy vehicle	18	1	22	22
In collision with: Bus	18	0	5	6
In collision with: Other	21	0	25	61

Who is being injured in a collision and with whom?

(Note: Phase 2 of the study identified that a small proportion of incidents captured in Auckland hospital data occurred outside of the Auckland region; this figure is based on the data outcomes from Phase 1 and has not been updated to reflect the out-of-region incidents)

VTU casualties are predominantly an urban problem, due to the greater level of activity there. However, motorcycle casualties involve a large number of rural incidents (often involving no other party) and rural crashes are also more likely to be fatal. Public worksites, such as AT-managed roadworks sites, also contribute to a steady number of serious injuries by VTUs, but monitoring and analysis of this data is relatively limited.

While speed is identified as a common factor in motorcycle crashes, it is systematically under-reported in crashes involving active travel modes. This may be because vehicle impact speeds are often at or below the current speed limit. However, a better focus would be identifying VTU crashes on the many roads with existing speed limits above the calculated safe and appropriate speeds.

Analysis of hospital data identifies a large number of "slip, trip, fall" injuries by people walking that appear to be due to environmental issues such as uneven paths, slippery/wet surfaces, tree roots, kerbs, traffic control devices (e.g. bollards and signs) and the like. In urban areas, the data would suggest that improving road and path quality and maintenance would greatly reduce the trauma from pedestrian-only injuries. A focus on improving urban arterial corridors (in terms of speed management, better crossing facilities, and better facilities along the routes) would also address many problems identified there.

With the expected (and encouraged) growth in numbers walking, cycling and using transport devices, it is possible that safety statistics for these modes may not necessarily fall in the short term. However, it may be more prudent to focus on broader health-related metrics instead, such as increases in physical activity and reduction in mortality due to vehicle emissions.

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1 Introduction to the study

Strategic priority #1 in Vision Zero for Tāmaki Makaurau (Auckland) is reducing transport deaths and serious injuries, especially for vulnerable transport users (VTUs) outside of motor vehicles, i.e. people walking, biking, motorcycling and using other wheeled transport devices like skateboards and e-scooters.

2020 Auckland road fatality results show a small decrease in deaths compared to recent years. However, this decrease has largely been in people travelling inside vehicles (drivers and passengers). Analysis shows in 2020 to December, compared to the five-year average, VTU deaths are trending upwards, particularly in people on foot and on bikes. The five-year (2016-20) average proportion of all road deaths inside vs outside a motor vehicle is 64% vs 36%; the 2020 proportions are 53% vs 47%. Interestingly, the Police-reported number of serious injuries sustained by VTUs in the 12-month period to Sep 2020 was 227 people, which is lower compared to the preceding 12-month period to Sep 2019.The AT safety team is also aware of additional fatalities where a motor vehicle was not involved and on the rail corridor.

The safety team at Auckland Transport (AT) has shared high-level information on the nature, extent and trends in harm to people travelling outside vehicles with the AT board of directors who have requested a deep dive into this issue.

The purpose of this deep dive was to provide insight into the extent, nature and causes of serious harm to people travelling outside vehicles in Auckland[1]. Following an initial "Phase 1" report provided to AT in March 2021, some further questions and clarifications were identified ("Phase 2") that have now also been addressed in this combined report. This report aims to provide evidence to support leadership positions needed to make change on this important safety issue.

1.1 Phase 1 questions to be addressed

Some key questions were initially identified by AT for investigation:

1. **How big is the problem?** *How many people have been killed or seriously injured using Auckland's transport network in 2020? How does this compare with the previous five years?*

   Currently the Crash Analysis System (CAS) provides a limited view of harm and AT are seeking the combined analysis of CAS data with additional sources to fully answer this question, such as Ministry of Health (MoH) and Accident Compensation Corporation (ACC) data. This should include the extent of harm to VTUs where a motor vehicle was not involved, such as footpath falls, micro-mobility crashes, and level-crossing crashes.

   2020 has been a highly unusual year due to Covid-19 impacts. Some consideration of the impact of Covid on trends and patterns will be included and commentary on how trends may have been without this disruption.

   AT would also like to benchmark Auckland's safety performance for VTUs with other cities nationally and internationally, particularly leading global cities for safety performance for VTUs.

2. **What does the problem look like?** *Who is being harmed? Where is this occurring? What does the problem look like for different transport users?*

   A strategic priority in AT's Vision Zero strategy is ensuring safety is equitable regardless of age, ethnicity and socio-economic status. They also seek to meet Treaty of Waitangi obligations and ensure safety and equitable outcomes for Māori.

[1] For conciseness, where necessary in this report this group will be collectively referred to as "vulnerable transport users" or VTUs.

Where possible, further analysis of the data should provide insights into the nature of the problem, including analysis by local board area, age and ethnicity. If the data set is sufficient, further categories such as socio-economic status, work-related travel, being appropriately licensed and mobile phone use could also be considered.

3. **What are the causes of the problem?** *What critical risks are not being controlled that are exposing people to harm? What systemic factors contribute to this issue?*

   AT wish to take a systems view to understand the root causes of this harm; they are seeking insight into the causes of the problem. The includes transport infrastructure, speed environments, behaviour of users, vehicle technology, level of Police enforcement, road type, land use and any other relevant factors.

   AT are also interested in the systemic causes of fatal harm in recent years and how this may be different to serious injury causes. An observed pattern in Auckland over 2019 and 2020 is that numbers of road deaths has fallen while serious injury numbers have remained relatively similar. They would like to understand more about why this is occurring particularly in relation to VTUs.

   A Vision Zero approach means we would expect to see the worst harm (deaths) reduce first due to transformational projects – is this what is happening in Auckland?

   Also in relation to vulnerable transport users, this year we are seeing an increase in deaths for those modes, a drop in serious injuries for cycling and motorbikes and a rise in serious injuries for peds. What is behind these trends?

   AT also seek to understand risks relating to injuries on footpaths (including shared paths and walkways) as they would like to understand the level of current risk and how this can be quantified, e.g. the percentage of footpaths in acceptable condition in Auckland.

4. **If critical risks are not controlled, what is the extent of harm expected to occur?**

   If recent trends continue, how many VTUs do we expect to be killed or seriously injured in Auckland in the next ten years? What groups might we expect to bear more of this harm?

1.2 Phase 2 of the study

The purpose of phase 2 of this deep dive was to provide further investigations of data issues relating injuries by VTUs on Auckland roads and paths, particularly serious and fatal injuries.

Some key areas were identified by AT for investigation:

- Investigation of the scale of VTU fatalities not captured by CAS data, e.g. by considering Police and Coroner data sources;
- Review of the relevant VTU data from MoH, particularly looking into out-of-region transfers in/out of Auckland, and the presence of other medical events (e.g. heart attack, stroke) at the time of a user-only injury;
- Review of the relevant VTU data from ACC, particularly looking into identifying the relative severity of different injuries reported, and the identification of accidents that occurred on roads/paths vs other locations;
- A demographic analysis of communities in Auckland to identify those where residents may be more susceptible to user-only serious injuries such as falls (particularly where more older populations reside);

- A greater understanding into VTU incidents that have occurred at AT-controlled transport worksites around Auckland such as roadworks; and
- Calculation of an alternative under-reporting adjustment table for the Waka Kotahi (NZ Transport Agency) Monetised Benefits & Costs Manual (MBCM) that takes into account user-only VTU injuries.

1.3 Report structure

Figure 1 summarises graphically the overall structure of the report. The next part of this investigation (commissioned separately) will help to develop an appropriate Action Plan.

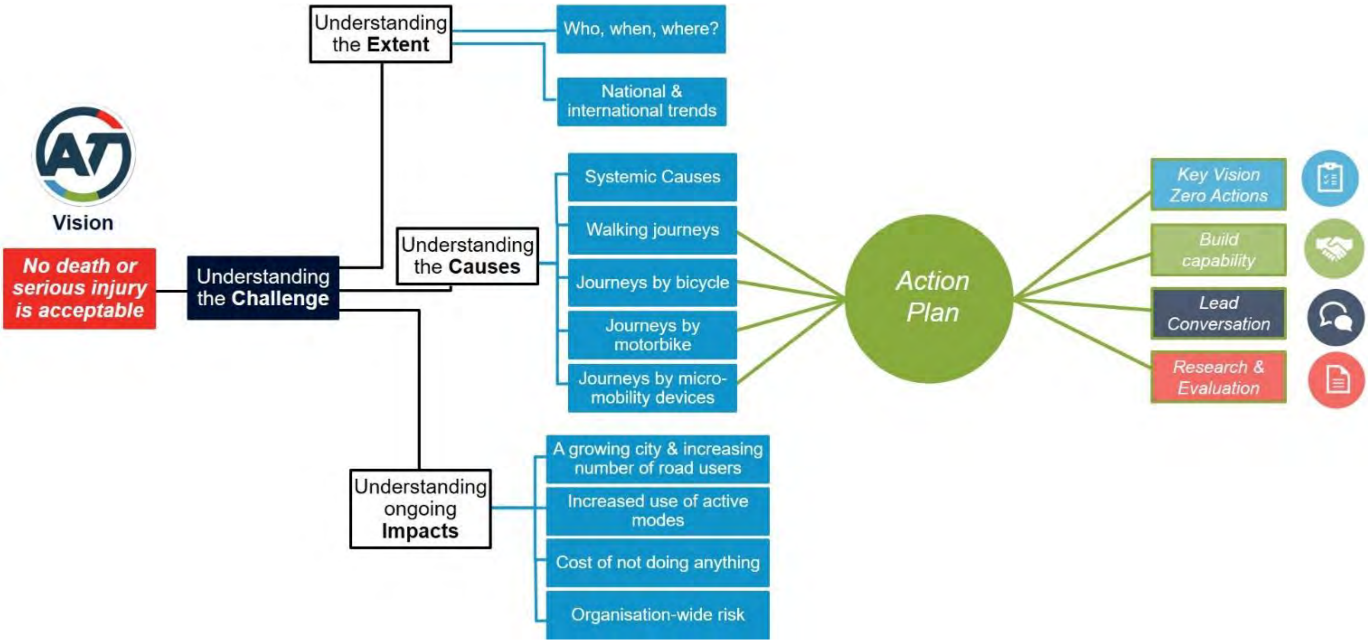


Figure 1: Overall structure of report

1.4 Method of investigation

To examine these questions, various data sources were reviewed, primarily to capture both road casualty information and user exposure figures. The main injury data sources examined were:

- Crash Analysis System (CAS) – Waka Kotahi (NZ Transport Agency)
- Hospital overnight stay data – Ministry of Health (MoH)
- Accident treatment data – Accident Compensation Corporation (ACC)
- Road safety data and reports from AT
- Other data sources identified, e.g. fatality data from NZ Police or Coroners

While typically at least five-year data was obtained (e.g. 2016-20 or 2015-19), there are some differences in timeliness of collation of the data, making it slightly difficult to always provide a direct comparison between data sources.

In addition, the investigation reviewed various relevant background agency documents, as well as other relevant literature and overseas data from comparison cities. These included:

- Auckland Vision Zero Plan
- Incident Reporting Information System – KiwiRail
- Types of User Killed & Injured, by Year - Ministry of Transport
- 2018 Census Place Summaries – Stats NZ

A number of meetings were held with Auckland Transport staff to understand data and work being undertaken on E-scooters, Red Light Running, Motorcycle volumes, and Worksite safety. For Phase 2, discussions were also undertaken with Paul Graham, Principal Scientist at Waka Kotahi (NZ Transport Agency) who is experienced with inter-agency road safety data analysis.

2 MoH and ACC Data - Information relating to the data

While road safety practitioners and researchers are often fairly familiar with the nature of the data captured by CAS, they may be less aware of how other data sources can be used for road safety analysis, and their respective limitations.

Table 1 identifies and summarises the attributes and the limitations of the data that is collected by the Ministry of Health (MoH) and Accident Compensation Corporation (ACC); this information is based on correspondence with staff at these two agencies.

Table 1: Summary of injury data attributes

	MoH	***ACC***
Care record	*Episode of Care* Documented account of a patient's inpatient journey from admission to discharge and includes, but is not limited to, their physical examination, history of present illness, past history, health care plan(s), consultations, observations, investigations and evaluation, diagnoses, treatment (including medications), intervention(s), progress and health outcome for the episode of care. Some patients may be readmitted multiple times or be transferred between facilities as part of their care. Each time, a new record is created, but they typically report the date of the original incident in each one. Repeat records for the same patients make up ~17% of the raw data for Auckland.	ACC45 claim lodgement form ACC is focused on paying claims: supplementary information collection is secondary as it is not specifically relevant to assessing a claim. Secondary information is coded based on the supplied information which is often not very specific and provided in a description of the accident. ACC is no-fault scheme: no need to prove you had an accident or the actual cause.
Location	There is no way to search for the location of where a crash took place, so cannot look for events that relate to crashes that occurred in Auckland. Agency code is used to ensure only events that took place in 'Auckland based' hospitals (using Counties Manukau DHB, Auckland DHB, Waitemata DHB agency codes) are captured. A "domicile code" indicating usual place of residence can be used as a rough proxy for possible location of incident, particularly for shorter journeys such as walking.	Actual geographic location is only at the TLA level (74 TA districts, Auckland is 7 former TA's) and accident scene may not always be apparent (e.g. mountain biking may or may not be on a road).

	MoH	ACC
Accident scene	"Y codes" are used to identify types of places where injuries occurred. Particularly relevant ones for this work include: • Street and highway – sidewalk • Street and highway – cycleway • Other specified/unspecified public highway, street or road It's not entirely clear where a path away from a road corridor would be captured; inspection of the raw data would only suggest "Other specified place of occurrence", which also includes quite a lot of paths in parks.	Eight location options are provided: Home, Farm, **Road or Street**, Industrial Place, Commercial / Service Location, School, **Place of Recreation or Sports**, and Place of Medical Treatment. Only two (in **Bold**) are considered of potential interest to this study. Unfortunately it is not always clear what type of "recreation or sports" place is being referred to, e.g. a recreational pathway vs a hiking trail
Severity	We have defined serious as "hospital admissions > 1 day". This excludes people who are treated in the emergency department and discharged, or people who may just be held overnight for observation. While it provides a reasonable differentiating point between serious and more minor injuries, there will be a few exceptions in each case, e.g. a serious injury discharged within a day and a minor injury where the patient stays overnight.	ACC covers the full spectrum of injuries from minor to life-changing and in some cases ultimately fatal. It is difficult to use the ACC injury data to correctly ascertain the relative injury severity; however a more pragmatic approach is to subtract the number of serious injuries captured by the hospital admissions data (typically referred to as "entitlement claims" or "serious/fatal claims") and presume that the remainder are relatively minor (often captured as "other costs paid").
Coding	The ICD-10AM/ACHI/ACS classification system, based on international standards, contains classification conventions, over 220 coding standards and an additional 550 coding rules. These classification conventions, standards and rules provide guidelines, and specify what and how clinical information can be used to classify clinical concepts into ICD-10-AM/ACHI codes.	Accident description is a free text field so a client or their provider can write whatever they like in there or leave it blank. ACC does sometimes receive ICD codes (as well as other diagnosis classification systems) but these are provided for injury diagnosis only rather than codes for services received or the circumstances surrounding it. ACC does have internal codes for services where payments have been made – these will exclude services at public hospitals in the acute phase of an injury (which translates to something like the first six weeks following an accident) as all these services are paid out of a bulk payment from ACC to the MoH. There are conversion tables for ACC to SNOMED codes, another internationally recognised injury classification system.
Personal Information collected	Age, gender and ethnicity.	Demographics such as client age, gender and ethnicity. There is an occupation field – this is free text for the client but is then grouped by an algorithm.
Classification purposes	The primary source of information within the health care record is the current episode of care.	ACC is focused on paying claims; supplementary information collection is secondary as it is not specifically relevant to assessing a claim.

	MoH	ACC
Data Entry	The listing of clinical concepts (e.g. diseases and interventions) on the front sheet and/or the discharge summary (or equivalent) for an episode of care is the responsibility of the clinician. These responsibilities include identifying and documenting the principal diagnosis, and listing all additional diagnoses, injuries, external cause and interventions performed during the episode of care. Each diagnostic statement and intervention must be as informative as possible for a clinical coder to classify the clinical concept to the most specific ICD-10-AM or ACHI code. Before classifying any documented clinical concept, the clinical coder must verify information on the front sheet and/or the discharge summary (or equivalent) by reviewing pertinent documents/data within the body of the current episode of care. Therefore, if it is not documented in the health care record – it didn't happen.	ACC receives data from providers (such as GPs) who get information from the injured person which may not contain information that may be of interest. ACC only receive claims from people who claim: an unknown number of injured people may not claim (mostly for minor accidents as major accidents usually require medical care). Claims relate to people being injured: not the actual accidents which may involve multiple people. Care is taken to capture information accurately, but some situations may be ambiguous: e.g. if you get injured on a road in a farm do you put the place as road or farm? Motor vehicle accidents are funded and paid from the Motor Vehicle Account and more detail on the accident is recorded accordingly. ACC reviews information for accidents with more serious injuries as ACC has direct contact with these cases (about 8% of all claims*). ACC only has detailed data for medical costs (and other costs) that are paid directly by ACC. Other treatment by DHBs/hospitals are bulk funded and are not included in ACC costs.

* ACC have been contacted to further clarify the level of severity for the 8% of claims. ACC have confirmed:

- The 8% refers to claims where more benefits/entitlements than the initial medical treatment is provided. This may include additional medical treatment, rehabilitation or weekly compensation is paid for time off work.
- These 8% are where most of the costs are: maybe serious trauma (about 1000 cases per year) which may have extended periods of disability (the rest of their lives) or injuries that require substantial time off work or vocational rehab to support not being fully able to return to their occupation fully.
- It is fairly complex depending on particular cases (injuries, time off work, social/vocational rehab, etc.) so depends on the particular view you are interested in.

The potential for these datasets to be used in conjunction with the standard CAS database for road transport-related injuries has been explored before by the SORTED inter-agency pilot study[2]. While there was great potential in matching injuries across the various datasets, it would require a concerted ongoing effort. There are also differences in how the relative injury severities are reported in each case; while CAS uses a "minor/serious/fatal" system of categorising, elsewhere a "minor/moderate/severe/fatal" scale is common, often based on the 75-point Injury Severity Score (ISS) and the 6-point Maximum Abbreviated Injury Scale (MAIS).

[2] SORTED Study 2018: *Indicative findings of the Study of Road Trauma Evidence and Data: Proof of Concept*.

3 Understanding the Extent of the Problem

While we have presented some information on this issue for the collective cohort of all vulnerable transport users, for the most part we have undertaken separate analyses for four main groups:

- **Pedestrians**, including those using a mobility aid like a wheelchair or mobility scooter
- People on **cycles**, including e-bikes
- People on **motorcycles**, including mopeds
- People using other "micro-mobility" **transport devices**, such as skateboards scooters and e-scooters

3.1 Transport deaths in Tāmaki Makaurau

In general, the most reliable data for road fatalities is provided by the Ministry of Transport[3]. While there has been an overall long-term downward trend the data shows that, in recent times, there was a spike of road deaths in 2017 (Figure 2). The Ministry of Transport data is the most relevant and accurate source of data for road deaths.

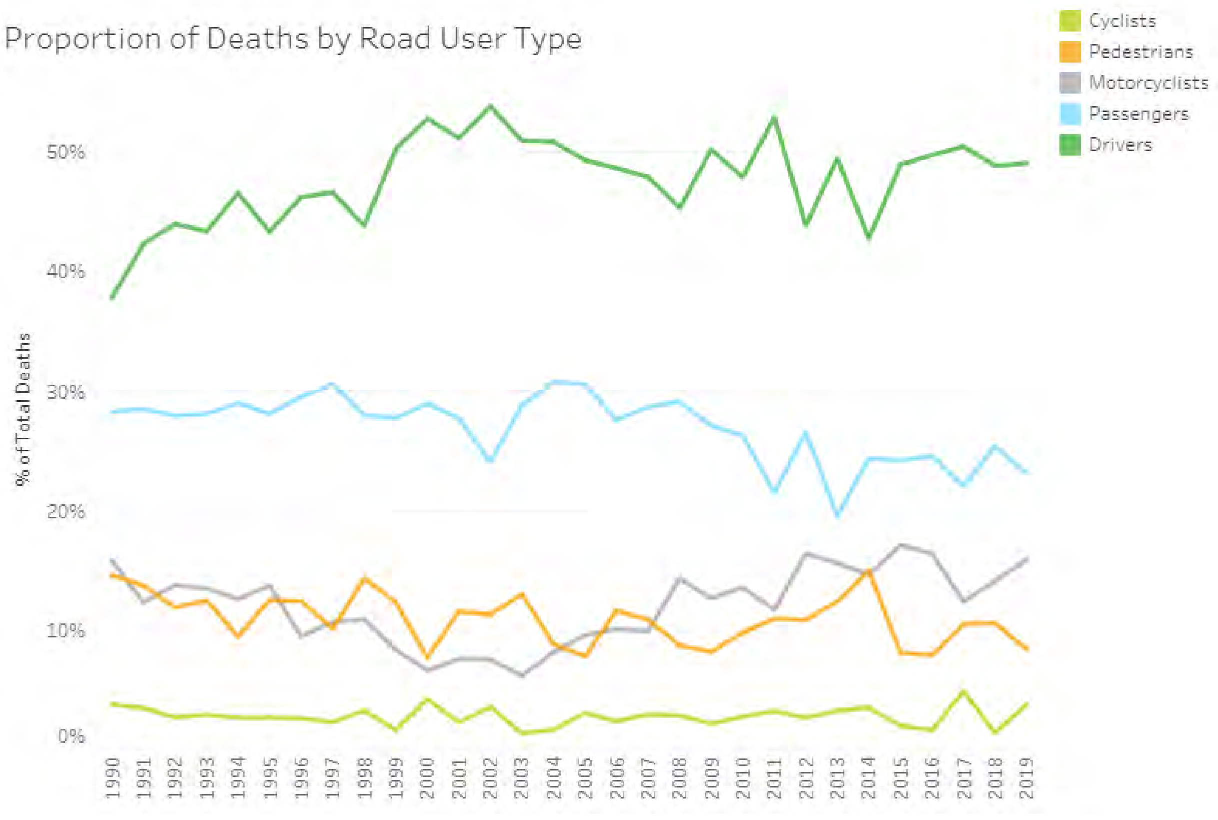


Figure 2: Historic Fatal Casualties in Auckland - Percentages (Source: MoT)

Figure 2 shows the proportion of deaths by road user type. Collectively the proportion of fatalities from VTUs is typically 25-30% but that has risen in 2020. While there are increases and decreases in VTU deaths from year to year, long-term there has been no real change in the proportion of pedestrian cycle fatalities and an increase in motorcycle fatalities.

It should be noted that, while CAS and the MoT are generally fairly reliable in capturing most land transport fatalities, it is possible that some fatal incidents that don't involve a motor vehicle may still "slip

[3] https://www.transport.govt.nz/statistics-and-insights/safety-annual-statistics/road-user/

through the cracks" and not be captured by either CAS or Ministry of Health records (for example, if no hospitalisation ever happened). So some ongoing monitoring of separate fatal events may still be required by AT. Further exploration of this is covered in Section 6.

3.2 Serious crashes in Tāmaki Makaurau involving VTUs

Whilst there appears to be one reliable source that reports the fatalities on the transport network, the number of crashes that result in a serious injury depends on the data used.

Currently, a serious crash is defined by Waka Kotahi as,

"fracture, concussion, severe cuts or other injury requiring medical treatment or removal to and retention in hospital"

The detention in a hospital generally means an overnight stay in a hospital as a "rule of thumb". As noted in section 2, medical records often use a different scale for categorising injury severity (such as ISS and MAIS) and there may be some merit in adopting a similar approach in CAS that differentiates for example the "hospitalised but recoverable" from the "survived but life-changing injuries" cases (currently both recorded as "serious" injuries).

In addition to extracting data from CAS, hospitalisation data from the MoH was used to understand the number of admissions from a collision that has occurred on the transport network that resulted in at least one night's stay at hospital (equates to a midnight spent in hospital). This is also included a review of the number of non-collisions that occur on the transport network involving vulnerable transport users. Repeat admissions for the same incident were identified and filtered out to avoid double-counting.

CAS does not generally report on incidents not involving a motor vehicle (e.g. trips, slips and falls) and, with only a proportion of non-fatal vehicle crashes being recorded in CAS (due to under-reporting to Police), it is clear that there is a big issue with under-reporting in the system. Figure 3 shows that for every motorcyclist injury reported in CAS there are three times (3.0) as many recorded within the hospital data. The differences are even more stark for other travel modes such as cycling (7.3 times more), walking (8.3 times more), and other transport devices (13 times more). By way of comparison, the equivalent level of under-reporting for serious injuries by motor vehicle occupants (not motorcycles) is only just over twice as much (2.1). Figure 3 has been updated to reflect the out of region transfers by applying the percentages to the data from Section 7.1.

Given that Auckland is a primary medical treatment centre in New Zealand, particularly for certain injuries, it is possible that the above estimates of under-reporting of VTU injuries in CAS are somewhat due to significant numbers of out-of-region incidents transferring into Auckland medical facilities. Section 7.1 explores this possibility further and makes some adjustments to these scaling factors.

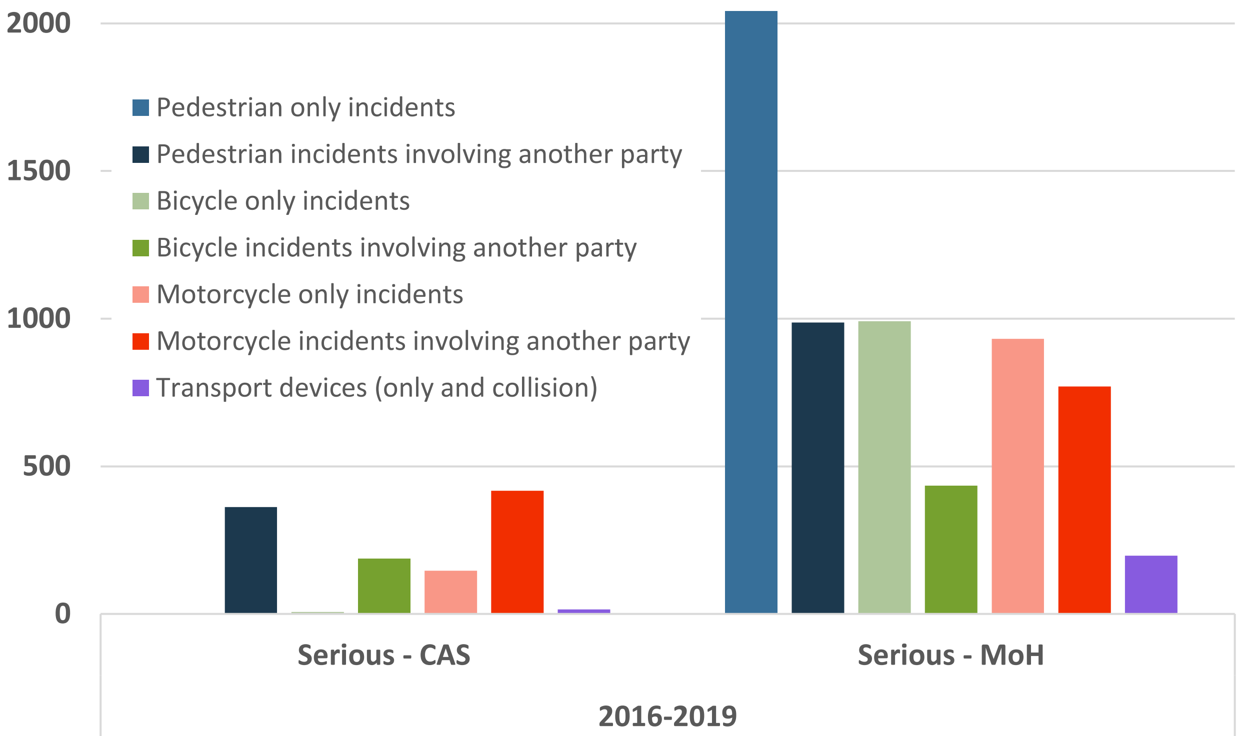


Figure 3: Number of serious injuries recorded in CAS and by the MoH (2016-19 full year data)

There is also an issue with CAS in that new micro-mobility transport devices do not have their own categories; there is also no current way to differentiate between powered and un-powered devices (e.g. e-scooters, e-bikes). Therefore, a user has to analyse the data in depth to find crashes involving these road users as they can often be found in other road user categories.

The difference in numbers captured between CAS and MoH is illustrated graphically in Figure 4 and Figure 5. The absolute numbers of casualties recorded is greatly increased in MoH (as illustrated by the respective size of the pie graphs) and the relative proportion of casualties from within motor vehicles is also greatly reduced.

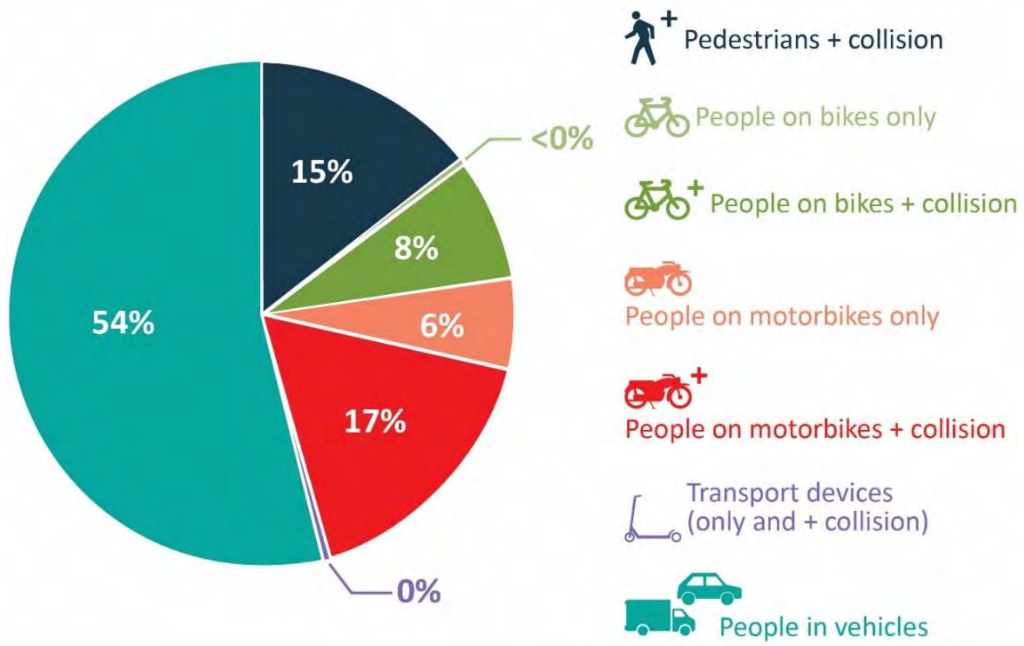


Figure 4: Proportion of 2,457 serious injuries recorded in CAS over a four-year time period (2016-19)[4]

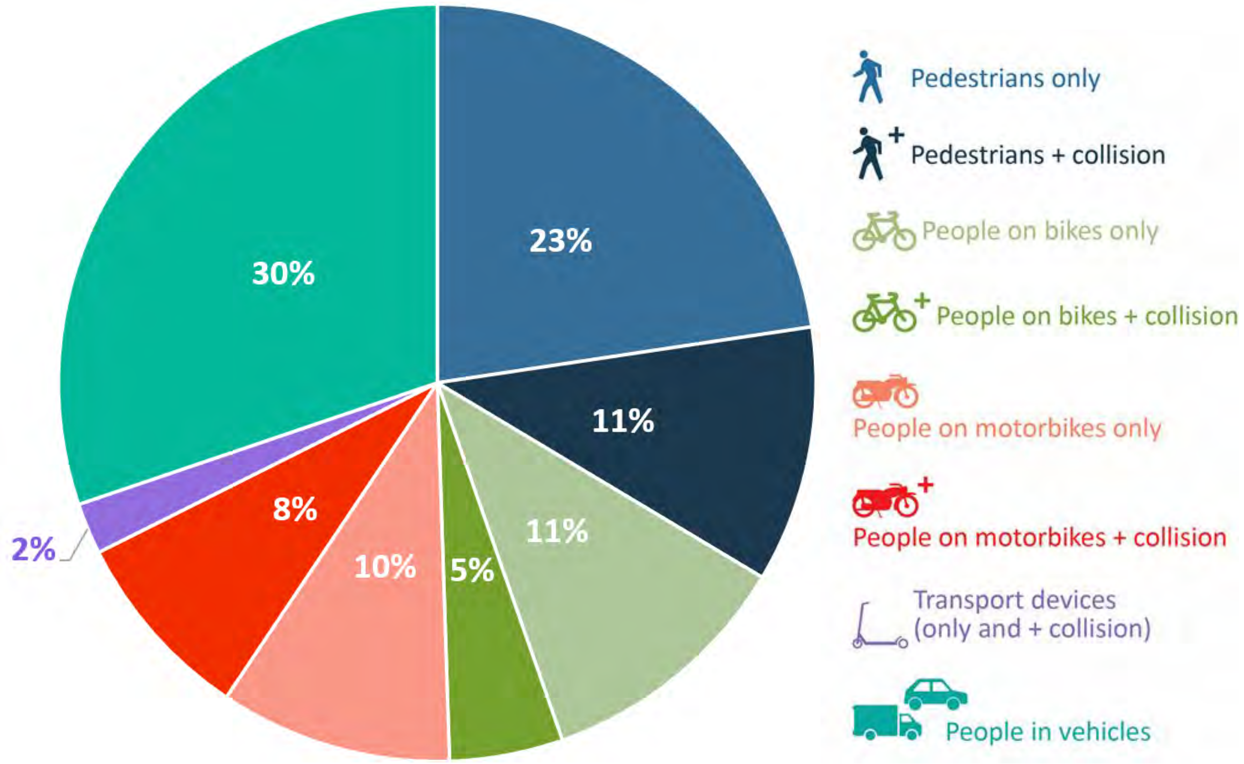


Figure 5: Proportion of 8,514 serious injuries recorded by MoH for a four-year time period (2016-19)

Figure 6 shows the relative splits of serious injuries involving VTUs (2016-19) in terms of other parties involved. This greatest numbers of injuries recorded are those that do not involve another party, such as the falls/trips/slips, collisions with stationary objects and lost control incidents for faster vehicles.

[4] Due to lags with data there is no full 2020 year of data in CAS or from the MoH

Motor vehicles also have a big involvement in VTU injuries, especially light vehicles (although there appears to be some coding anomaly with the way that transport device injuries with motor vehicles are captured in the data). Interestingly, relatively few serious injuries involve a heavy motor vehicle, such as truck or bus. There are relatively few crashes *between* VTUs.

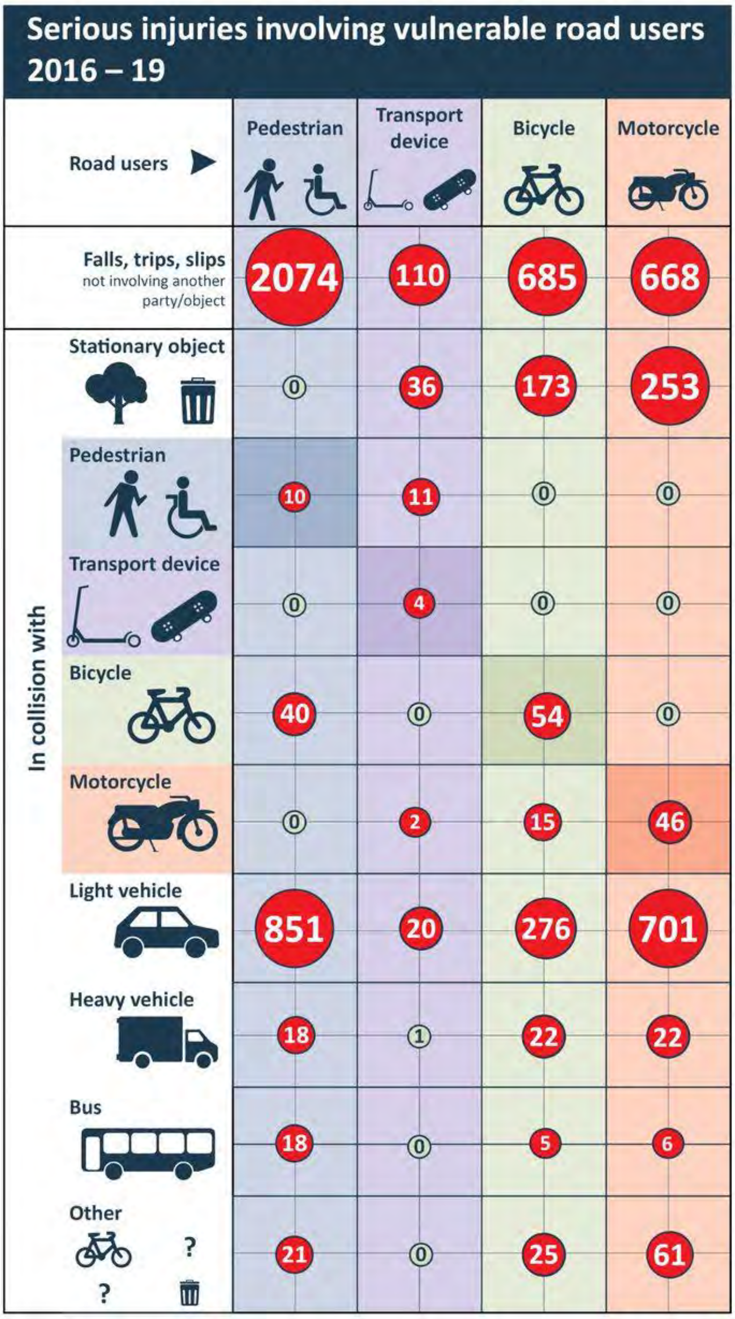


Figure 6: Who is being injured in a collision for different crash types for four full years from 2016-19

Regarding Figure 6, Phase 2 of the study identified that a small proportion of incidents captured in Auckland hospital data occurred outside of the Auckland region; this figure is based on the data outcomes from Phase 1 and has not been updated to reflect the out-of-region incidents.

Recommendations

Agency	Recommendation
Auckland Transport	▪ CAS & MoH identify 'serious injury' as an overnight stay in hospital. It is recommended that AT identify the ACC definition of 'serious injury'. ▪ To use a consistent approach for 'serious injuries' for all data sources, including consideration of moving to the international MAIS scale for minor, moderate and severe trauma. ▪ That reporting to the Board provides numbers for walking, cycling, motorcycling and transport devices. The recommendation to separate out Transport Devices from Pedestrian journeys is because they are likely to require a different response to journeys made on foot or with an aid that is needed for the purpose of the walking trip. ▪ That AT look to use specific scaling factors identified in this study to estimate likely true DSI numbers based on reported CAS numbers.
Auckland Road Safety Partners	▪ Agree on consistent categorising of "wheeled transport devices" of all types
Government transport agencies	▪ Further improvements to the CAS database to recognise the different and new alternative transport devices in the system so that they are not coded as pedestrians, other, null etc and to recognise motorcycle riders and cyclists as such and not as drivers. This would help in reporting data more accurately and more efficiently. ▪ Further changes to the CAS reporting processes (particularly in terms of categorisation of serious vs minor crashes, and data that is made available about non-vehicle participants such as pedestrians). ▪ Continue to link information from different agencies to provide an accurate picture of road trauma in New Zealand for all modes of transport.

3.3 Walking journeys

Walking, as well as being a journey in itself, also forms part of the first and last leg of every trip made from a public transport or private vehicle journey (albeit sometimes for a very short distance). It is an easy and free way to move around for short trips. In seeking to make Auckland a liveable city, the pedestrian network needs to be attractive, accessible and safe.

Census data shows that the trip mode share for walking as a main means of travel to work in Auckland is stable (see Figure 7). However, as well as general population increase, it could be assumed that more walking is occurring due to the increase in the number of walking trips as part of a longer journey made by public transport given the proportional increases in those trip types.

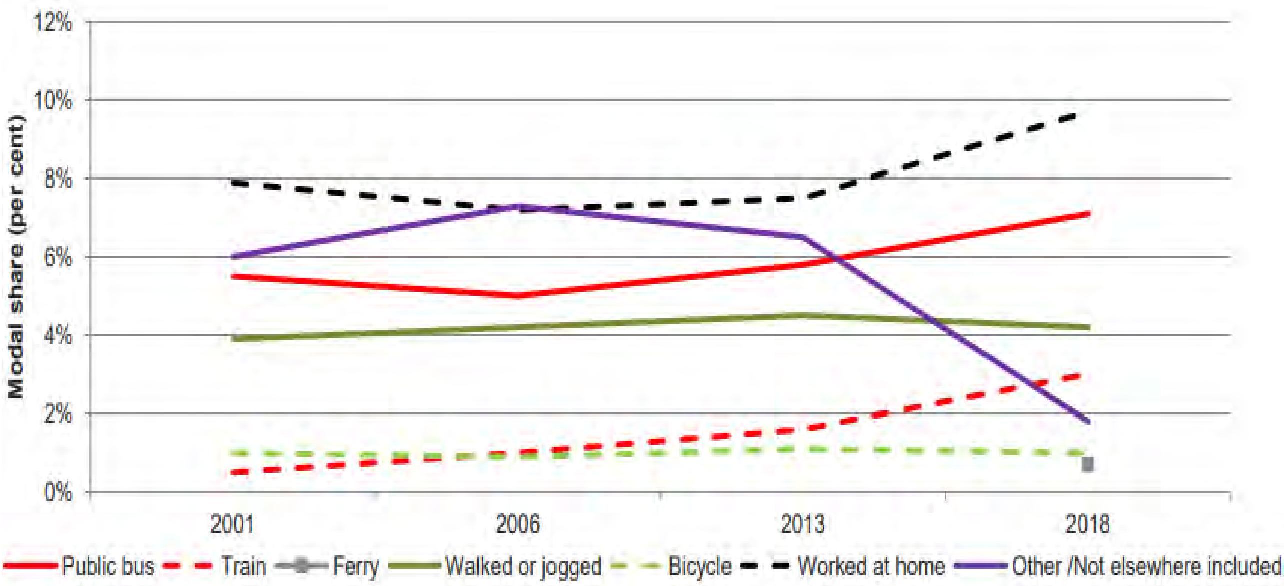


Figure 7: Changes in Mode Share for Journey to Work in the Auckland area (Census data – Auckland Transport)

For trips assessed by origin, the Auckland city centre has a high share of active mode trips. This is likely to be reflective of people living and working within the Central area and having access to high quality and frequent public transport services.

Furthermore, as the population continues to grow in Auckland, and with intensification in the central area, walking is a mode that should start to grow further particularly as a programme of transformational development continues to be delivered. Trips by active modes reduce as the trip origin moves further from the centre.

The challenge will be meeting the demands of more walking and at the same time reducing the number of pedestrians involved in collisions, but also trips, slips and falls, on the transport network. This is particularly so with an ageing population, as the risk of being seriously injured increases with age, with older pedestrians being less likely to recover from injury.

As shown in Figure 8, progress appears to have been made in reducing the number of reported fatal and serious injury collisions involving pedestrians, but with 2020 seeing a slight increase. Reducing these numbers is key to increasing walking as a mode and reducing casualties as walking needs to be, and feel, safe. A poor perception of safety can reduce the number of trips, particularly by those that are elderly, have a mobility or visual impairment.

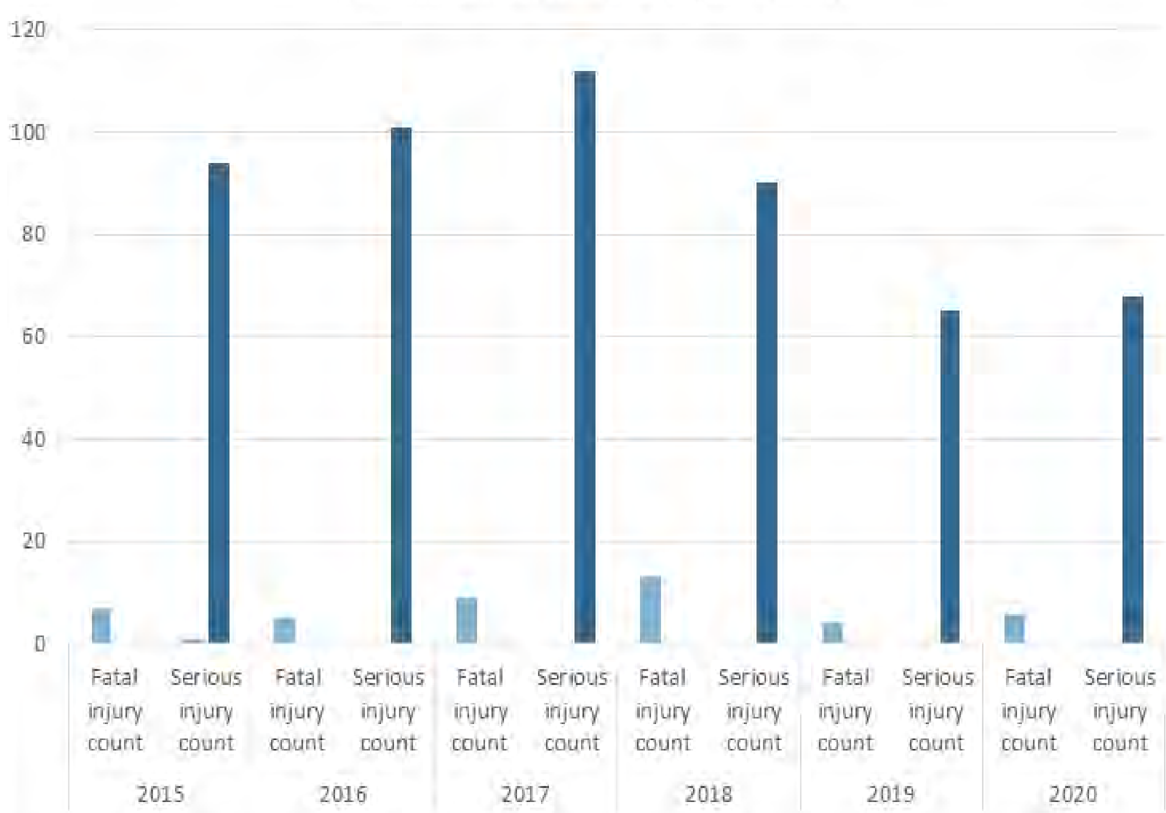


Figure 8: Number of fatal and serious injuries per year for pedestrians (CAS data 2015-20)

For pedestrian incidents involving vehicles, light motor vehicles (cars, Utes, SUVs and vans) are the primary vehicle involved in both fatal and serious crashes (Figure 9).

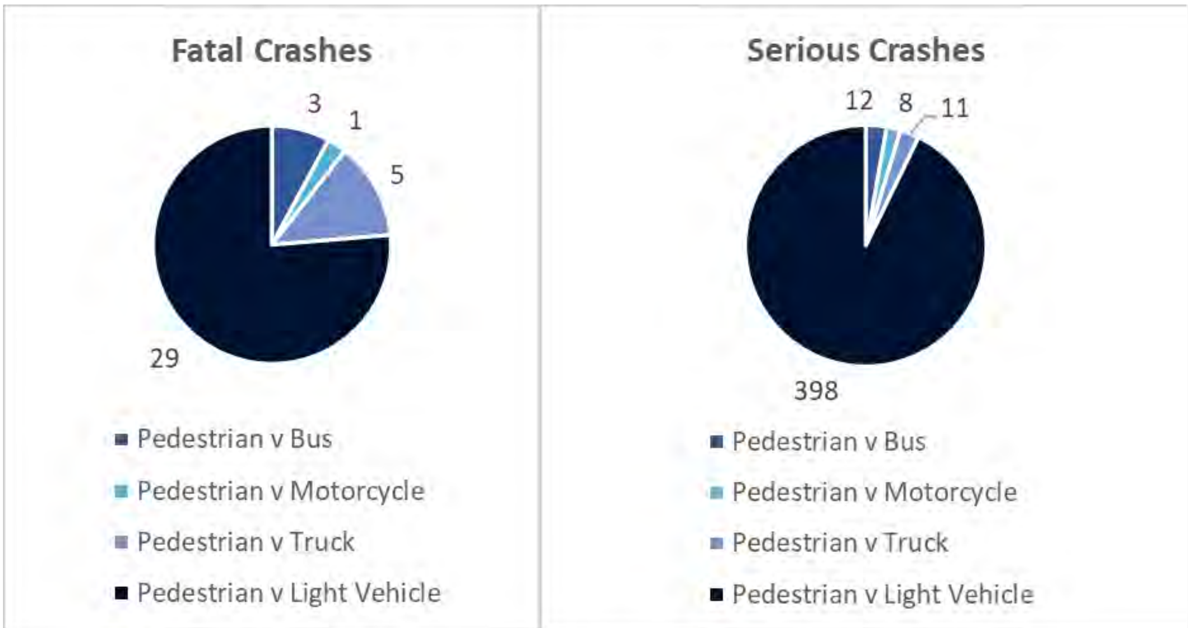


Figure 9: Pedestrian type collisions (CAS data - 2015-20)

As noted earlier, in addition to fatal and serious injuries involving people walking and vehicles, there are also injuries sustained from people slipping, tripping or falling. Figure 10 shows the breakdown of these types of hospitalised incidents within the transport network (i.e. roads and paths), based on MoH data.

Tripping over some surface hazard (e.g. tree root, raised concrete block edge) is by far the most common issue, with slipping (e.g. on a gravel or wet surface) the next most likely.

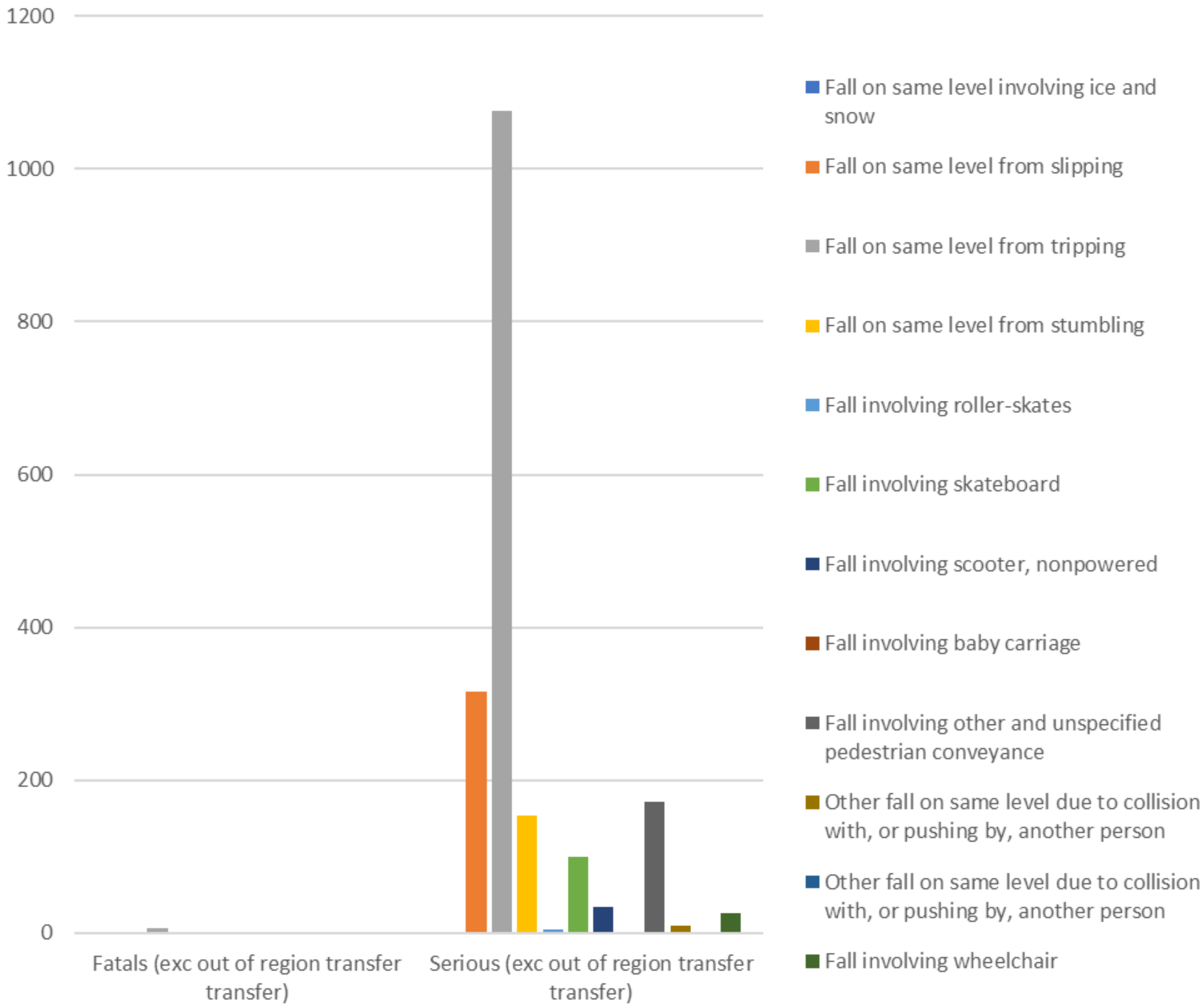


Figure 10: Trips, slips and falls (2016-2019) excluding out of region transfers

The data from the Ministry of Health also shows that typically those involved in a trip or slip requiring hospital treatment are in the higher age groups; Figure 11 summarises the breakdown by age group. This highlights the relative fragility of the older population, where a simple fall can lead to quite serious injuries (including broken bones) that would not affect a younger person as badly.

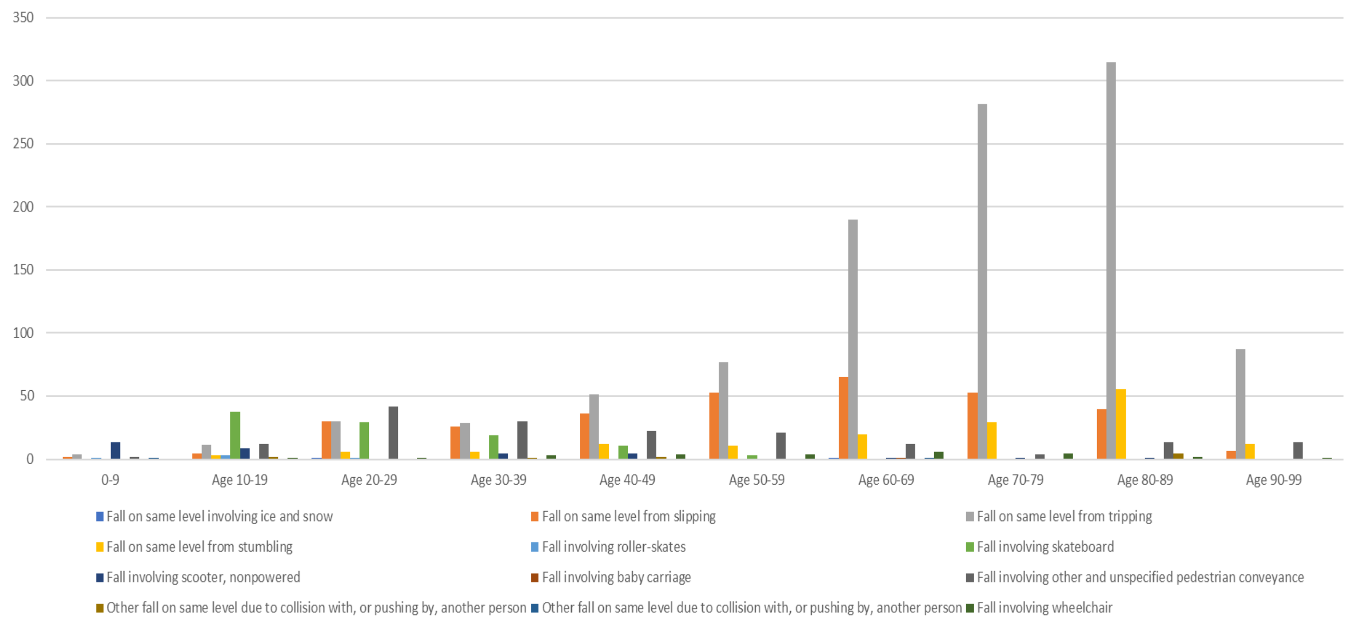


Figure 11: Trips, slips and falls by age (2016-2019)

Figure 12 summarises where in the transport network these incidents are occurring. While the greatest proportion of these non-motor vehicle injuries occur on footpaths (or "sidewalk"), a large proportion of the remainder occur in the roadway itself although this is likely to include tripping over kerbs at the edges of the roadway.

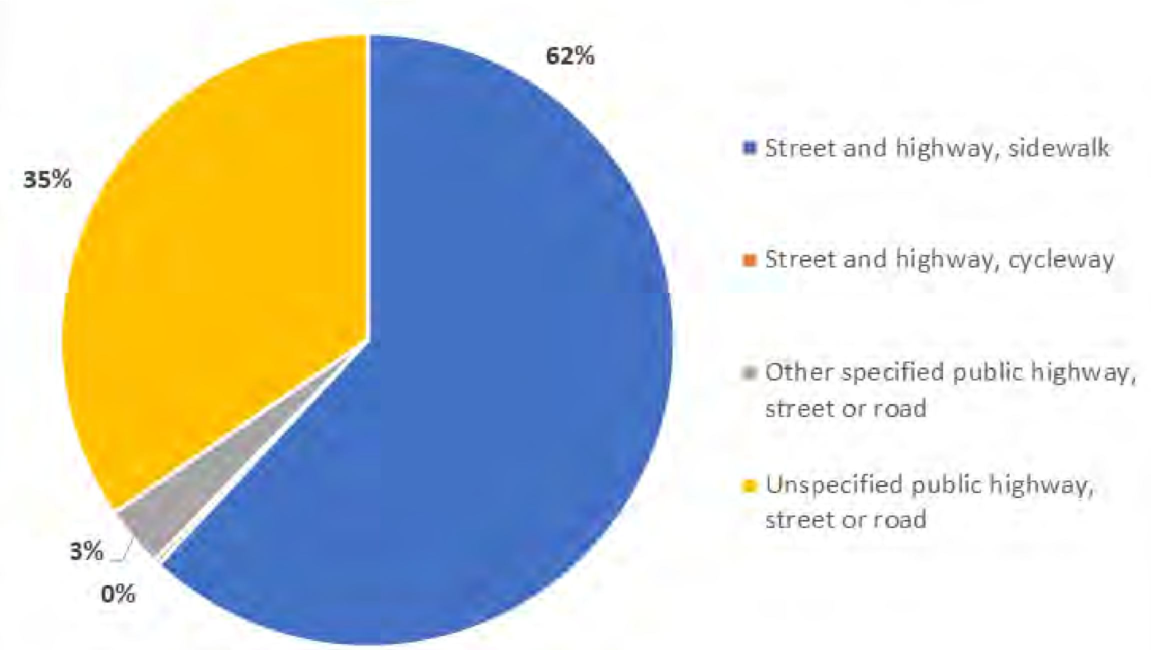


Figure 12: Trips, slips and falls by location (2016-2019)

3.4 Journeys by Transport Devices

The way people travel on Auckland's streets has changed over the last few years with the introduction of new ways of mobility. E-scooters, kick scooters, skateboards and other forms of micro-mobility have increased but, due to the way they are coded in the Crash Analysis System and that injuries resulting from a user-only crash are not typically reported in the system, there appears to only be a low number of crashes involving this type of road user.

However, the ACC data for the number of new claims for given transport types in Auckland registered between 1 January 2015 and 31 December 2020 is a lot higher – see Figure 13. Due to the way these are coded by ACC it is not possible to narrow down which of the scooter claims are strictly transport-related claims (for example, some may have occurred at recreational locations like skateparks). The same applies for skateboard injuries. It should also be noted that the scooter field is also populated with kick / non-powered scooters, but it is not clear if there are no motorised or moped scooters included in this field. Regarding e-scooters, it is not clear yet whether the drop in numbers in 2020 reflects the impacts of Covid-19 on travel behaviour, any slight lag in reported cases, or a settling down of injury patterns after the "novelty" effect of the initial public e-scooter launches in 2018-19 – all three possibilities may be contributing to the figures shown.

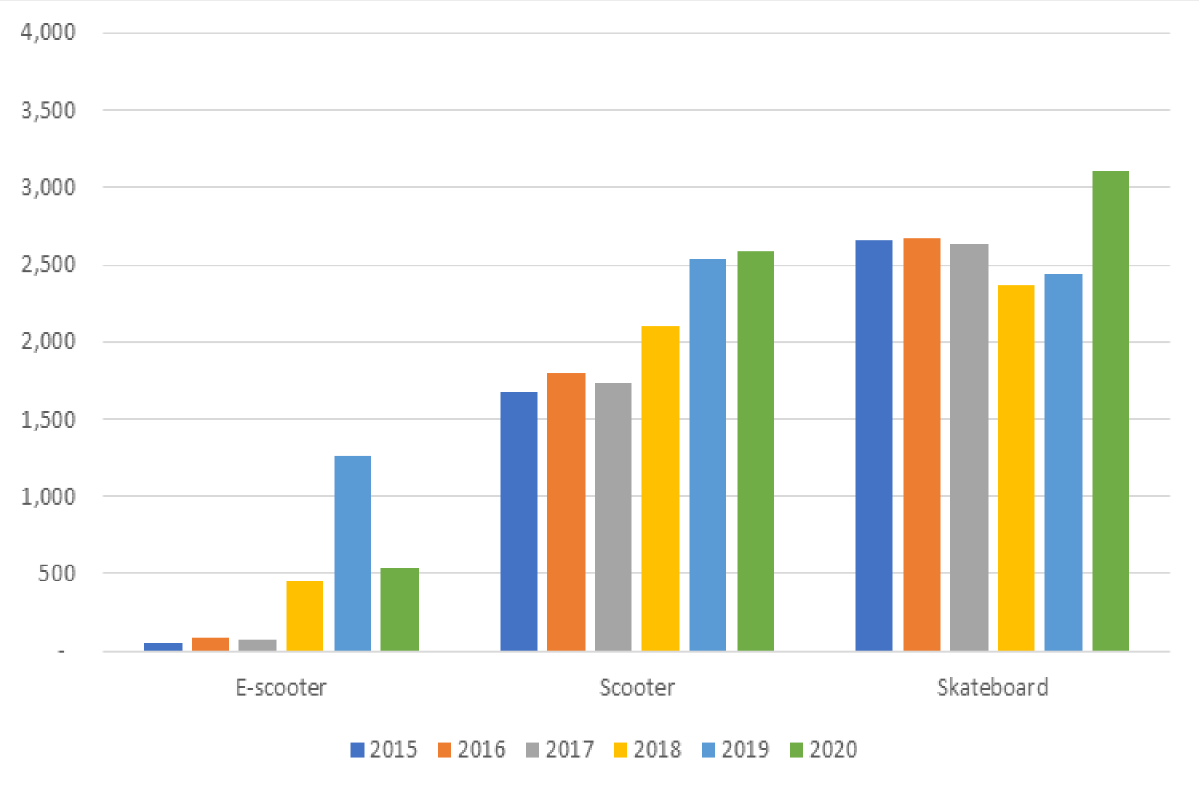


Figure 13: New ACC claims involving scooters, skateboards and e-scooters

Whilst the ACC data should therefore be used with caution, anecdotally the numbers of these types of devices has been increasing over the years as a mode of transport.

The CAS system when reviewed in detail does include some serious injury data of crashes involving these devices but the numbers are very small, as can be seen in Figure 14. In most cases, they involved a collision with a light motor vehicle (see Figure 14).

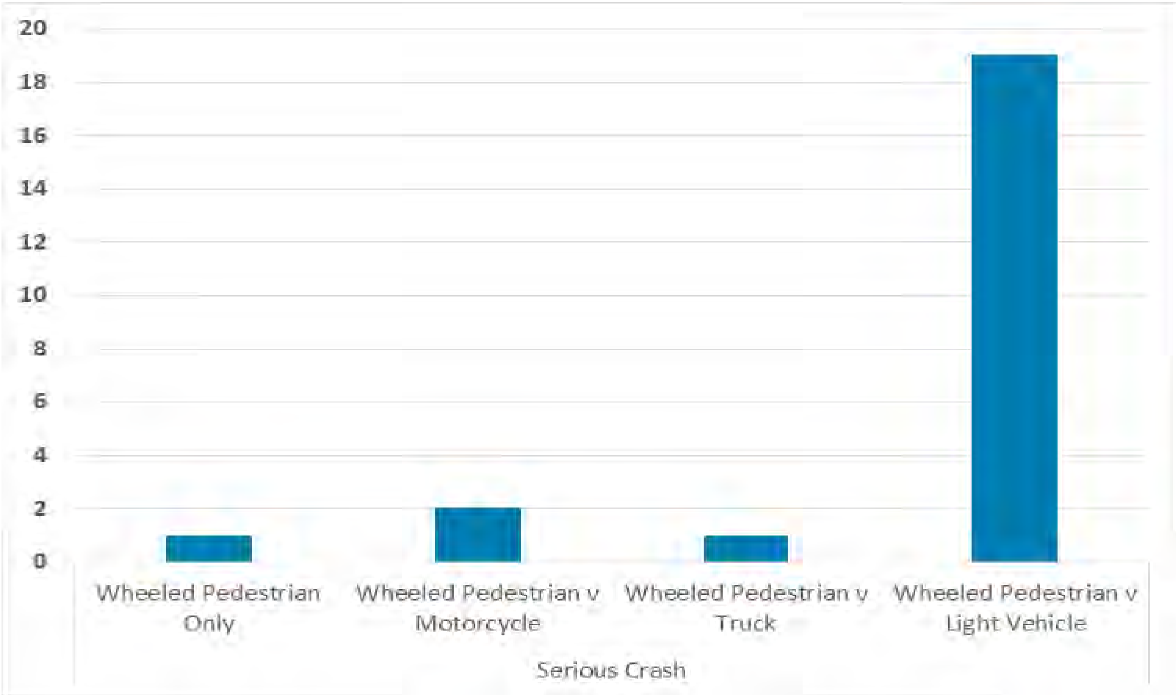


Figure 14: Different transport devices involved in a serious crash (CAS)

3.5 Cycling journeys

The improvements made for cycling in Auckland over recent times has seen an increase in users over the network. The Programme Business Case identified that improvements in safety and the perception of safety was needed to get Aucklanders to consider trying this mode of transport. There is some anecdotal evidence that more recreational cycling happened during the 2020 lockdowns in Auckland[5], albeit at the same time that commuter cycling was down. Figure 15 shows the trends in CAS-reported serious and fatal cycling injuries since 2015; although 2019 saw a notable drop in serious injuries that was countered by slightly more fatalities.

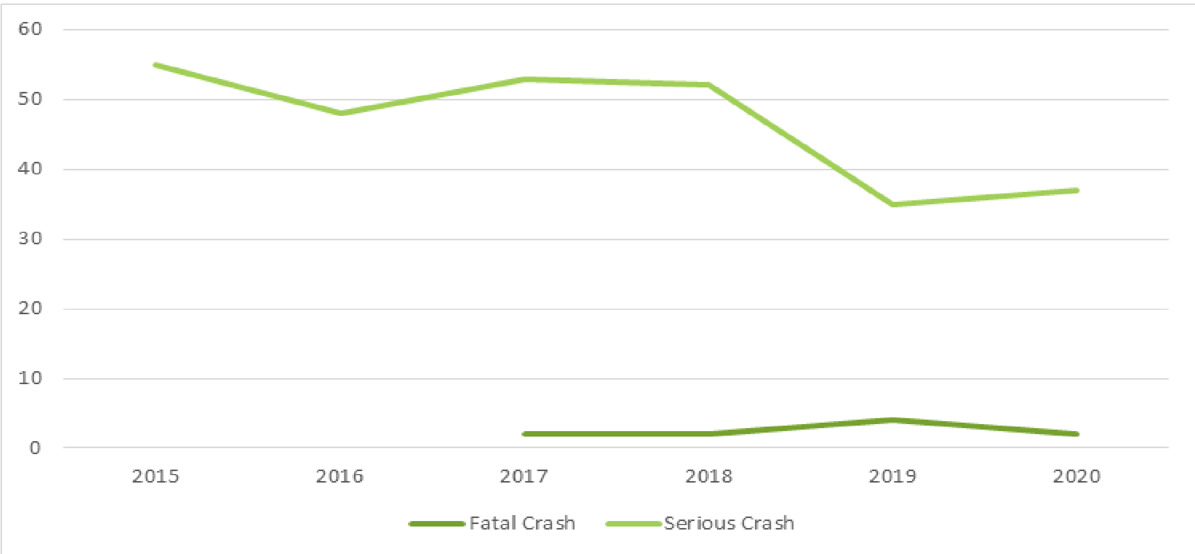


Figure 15: Number of cycle crashes per year (CAS 2015-20)

[5] See https://www.bikeauckland.org.nz/the-big-backyard-bike-count-report-local-revolutions-in-lockdown/

Crashes captured in CAS are dominated by light vehicles (over 80% of serious injuries as seen in Figure 16). However, albeit from a small sample but reflective of the trends nationwide, a greater proportion of fatalities involve heavy vehicles (especially trucks) or are cycle-only crashes.

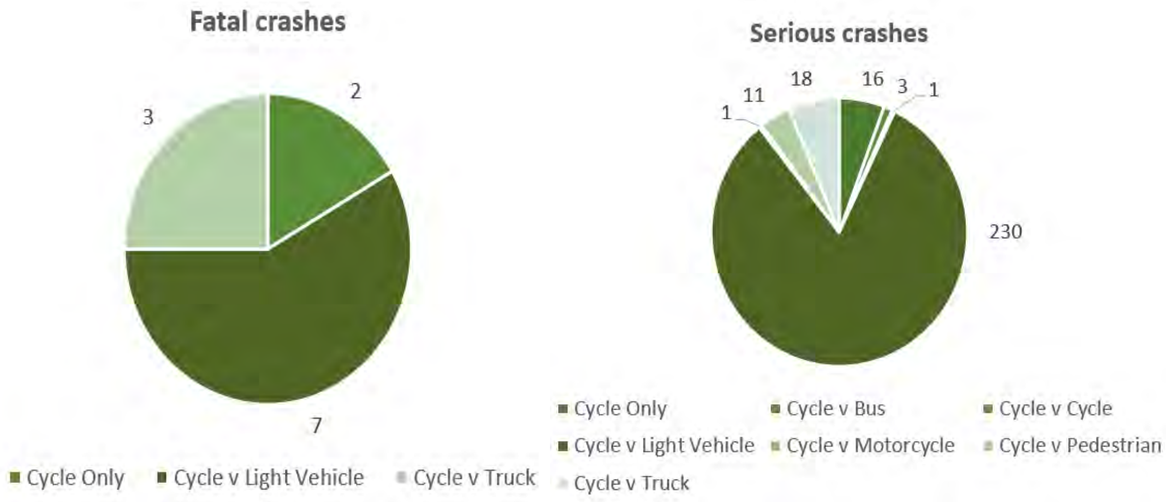


Figure 16: Vehicle crash involvement for cyclists

As noted previously, CAS under-reports a large number of cycle crashes, especially those not involving a motor vehicle. Analysis of the MoH hospitalisation data reveals less changing trends across this larger set of casualties, as shown in Figure 17. It is notable that there appears to be less obvious change in overall casualty numbers throughout this period.

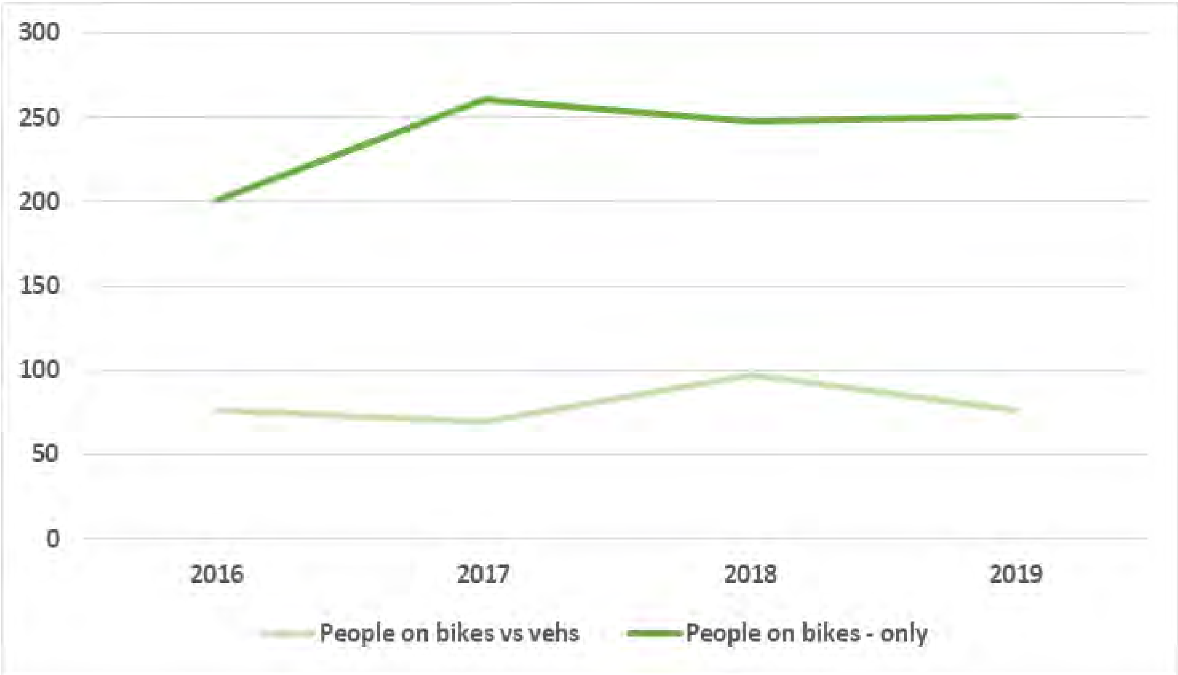


Figure 17: Number of overnight cycling hospitalisations as recorded by MoH (2016-19)

3.6 Motorcycle Journeys

The number of crashes involving motorcycle journeys has actually been declining when looking at the data from CAS. However, when looking at the MoH information, the trend is less clear about a notable decline.

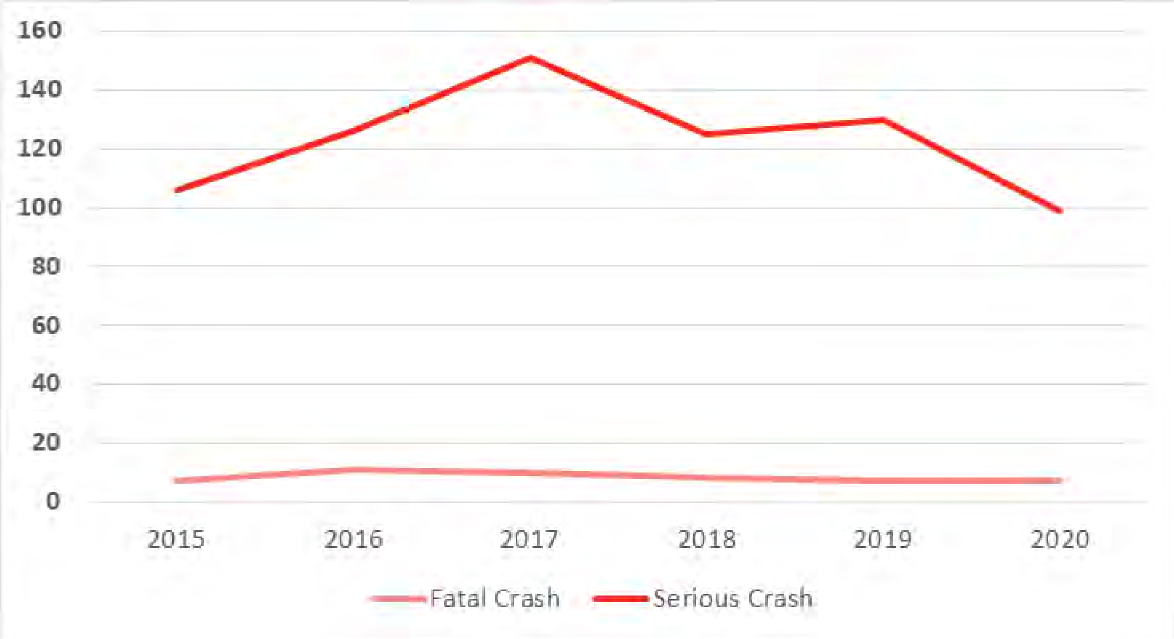


Figure 18: Number of crashes per year involving motorcycles (CAS)

A key difference with motorcycle crashes over other VTU crashes is that motorcycle-only crashes are more likely to be captured in CAS because they involve a motor vehicle (i.e. the motorcycle). Therefore, although there is still under-reporting in CAS, approximately one-quarter of recorded serious and fatal motorcycle crashes involve no other vehicle (e.g. motorcyclist lost control on a curve) – see Figure 19.

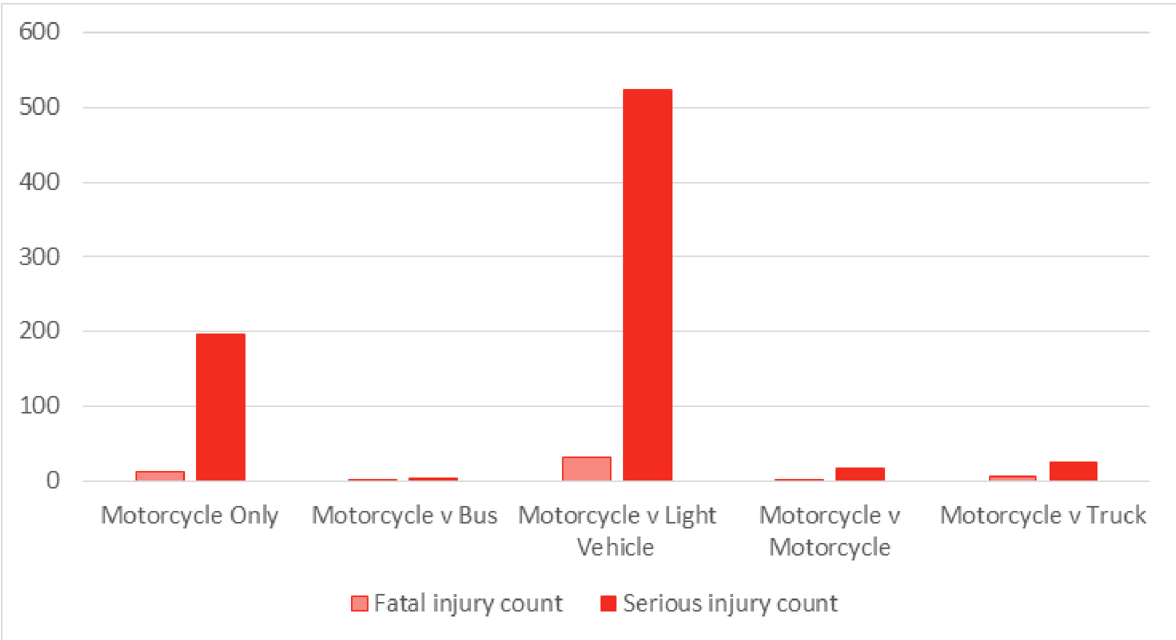


Figure 19: Motorcycle injuries by crash with vehicle type (CAS 2015-20)

Again, MoH hospitalisation data paints a somewhat different story, with relatively little change in casualty numbers over time, as shown in Figure 20. The MoH data also highlights a much greater proportion of motorcycle crashes not involving another motor vehicle.

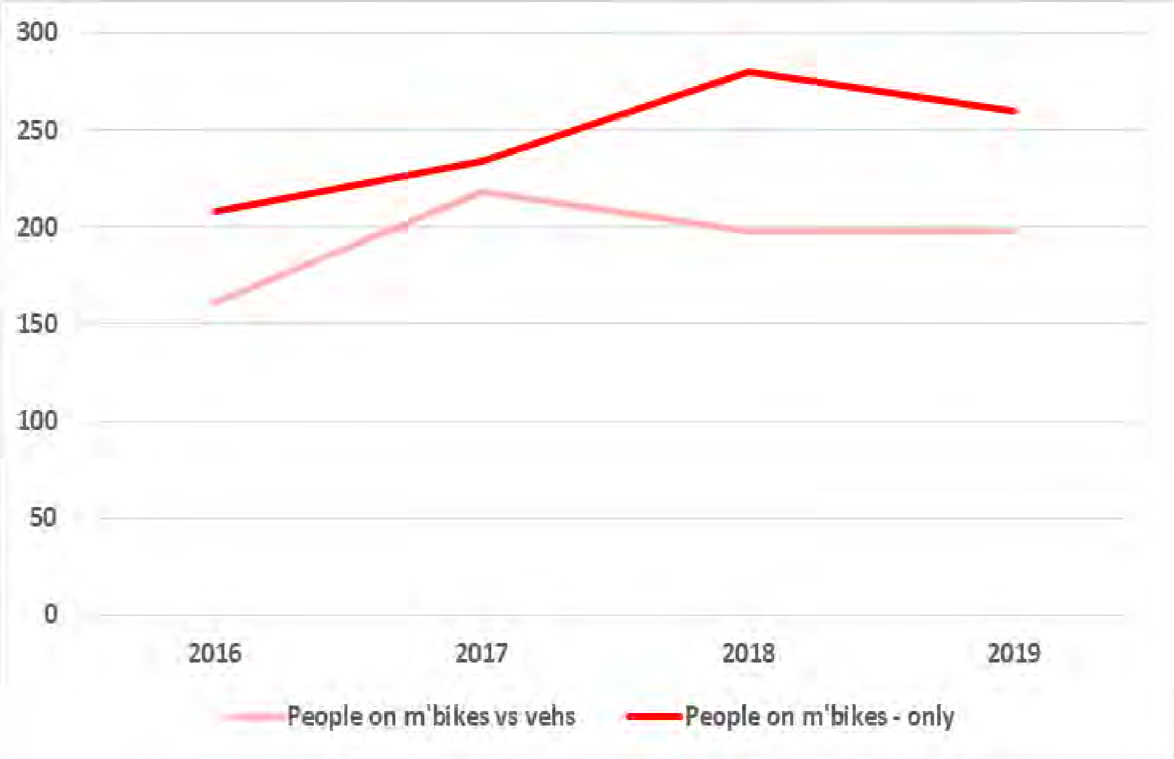


Figure 20: Number of overnight motorcycling hospitalisations as recorded by MoH (2016-19)

Recommendations

Agency	Recommendation
Auckland Transport	▪ Identify slips, trips and falls through other data sources such as the Customer Response Management Database. ▪ Continue to monitor casualties and collisions with further analysis and research into the causes of pedestrian death and serious injury crashes. This should include interviews with those hospitalised as a result of a collision. ▪ Undertake research examining pedestrian behaviour at different types of crossings to understand what is happening and look at the length of time pedestrians are waiting at the crossing. ▪ Review the survey findings currently being undertaken on Transport Devices to understand the use of micro-mobility in Auckland. ▪ in-depth research into all cyclist fatalities to understand all the factors leading to a collision resulting in a cycle fatality or a serious injury. ▪ In-depth research into all motorcyclist fatalities to understand all the factors leading to a collision resulting in a cycle fatality or a serious injury. ▪ Determine a clear programme of what data is being collected, what is it for and what is being measured. This should include user surveys as well as quantitative data to understand how users feel travel around the network.

Agency	Recommendation
Auckland Road Safety Partners	N/A
Government transport agencies	N/A

3.7 Effects of COVID-19 lockdowns

One complicating factor for the 2020 safety data was the presence of two Level 3-4 lockdown periods in Auckland during the year (Level 4: 25 Mar – 27 Apr; Level 3: 28 Apr – 13 May, 12 Aug – 30 Aug). These had the effect of significantly reducing overall traffic volumes around the city, with evidently a flow-on effect to crash patterns. Public transport usage in Auckland was also down during these periods, which would have also affected "first/last mile" journeys on foot or other wheeled transport devices. Interestingly, while walking and cycling journeys to major generators such as the central city and other town centres and learning institutions were generally down, the reduced traffic in suburban areas and enforced periods of lockdown at home saw large increases in the use of active modes in these areas.

Some analysis of travel patterns during the COVID-19 lockdowns[6] noted a fall in typical Auckland weekday traffic volumes of 80%. Public transport patronage fell even more during full lockdown and even returning to Level 1 has seen an ongoing reduction of 20-30% using PT. The analysis that the initial lockdown period last March-May may have been a factor in saving up to seven deaths and approximately 80 serious injuries in the district. However, the lack of traffic may have increased travel speeds and as a result also the fatality rate for VTUs. Some analysis suggests that the DSIs per veh-km travelled in Auckland was over twice the normal rate during the initial lockdown.

COVID aside, it should be noted that another complicating factor when considering 2020 safety data in this analysis is the relative lag in reporting of the relevant information through official channels such as the Police and hospitals. Certainly, it is not expected that the data provided through the likes of CAS, ACC and the Ministry of Health contains a complete set of all incidents towards the latter part of the year. For this reason, some of the following analyses only consider the years 2015-19 in their analysis.

3.8 Comparison with other cities

The *Safer City Streets: Global Benchmarking for Urban Road Safety*[7] document aims to support cities in setting road safety targets and to monitor progress in improving urban road safety. It places a particular attention on measuring the risk of fatality per unit distance travelled.

The document states that in most cities:

"…the proportion of vulnerable road users (VRUs) in the total number of fatalities is high {Figure 21 of this report}*. The median is close to 80% and figures range from 36% to more than 90%. Vulnerable road users make up 85% of fatalities in high-density cities, those with over 10 000 inhabitants per square kilometre. In cities where the population density is lower than 5 000 inhabitants per square kilometre, VRUs still make up two thirds of road fatalities. It is remarkable that much of the difference can be attributed to the lower*

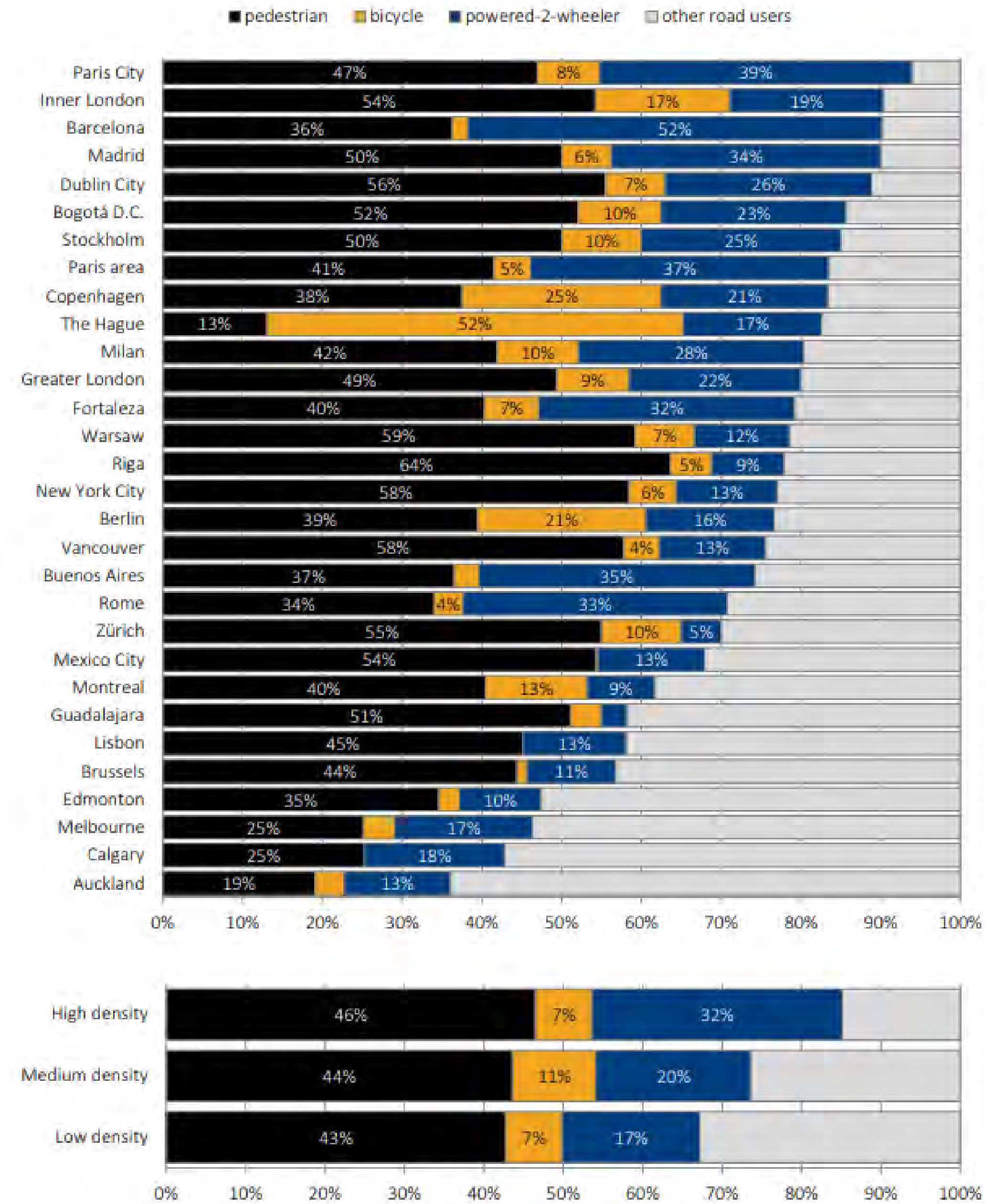
[6] Colin Brodie Consulting (2020), "What does Covid-19 mean for Transport Safety?", report for Auckland Transport, 29/5/20

[7] https://www.itf-oecd.org/safer-city-streets-global-benchmarking-urban-road-safety

share of powered-2-wheeler fatalities in low-density cities. Pedestrians and cyclists together still make up 50% of fatalities in low density-cities."

The differences in fatalities across various global cities can be seen in Figure 21; it is quite notable how low the relative proportion of VTU deaths is in Auckland, although that is likely to reflect relative modal usage rather than relative safety of these modes.

To compare the fatality risk across modes of transport, the authors assembled a comprehensive dataset covering five modes of transport in five cities: Auckland, Barcelona, Berlin, London and Paris. Figures for each city and each mode are provided in Table 2, along with the median risk across all five cities. The risk of fatality is four times higher when riding a powered-two-wheeler than when riding a pedal cycle over the same distance. The risk of fatality is ten times higher on foot than in a passenger car travelling the same distance. Travelling on board a bus is an order of magnitude safer than all other modes of travel.



Note: low population density (n=12) is less than 5 000 inhabitants per square kilometre, medium (n=13) is less than 10 000, high (n=5) is 10 000 and above. Where cities are grouped, we represent the unweighted average across n cities in the group

Figure 21: Modal shares of road fatalities 2013-15 (Figure 6 from Safer City Streets)

Table 2: Number of fatalities per billion passenger-kilometres (Table 3 from Safer City Streets)

City	Bus	Passenger car	Pedal cycle	Pedestrian	Powered-2-wheeler
Auckland	0.4	1.9	24	35	161
Barcelona	0.0	0.7	10	14	22
Berlin	0.0	0.5	6	13	28
Greater London	0.2	1.4	15	17	97
Paris area	NA	1.4	11	12	45
Median	0.1	1.4	11	14	45

4 Understanding the Causes behind the Problem

4.1 Walking journeys

People walking are most commonly hit when crossing the road, as this is when they are generally exposed to conflict. This is the case here in Auckland, with the most common crash type being N-Pedestrian Crossing (see Table 3) with some P-Pedestrians Other also featuring in the most common conflict types as shown in Figure 22.

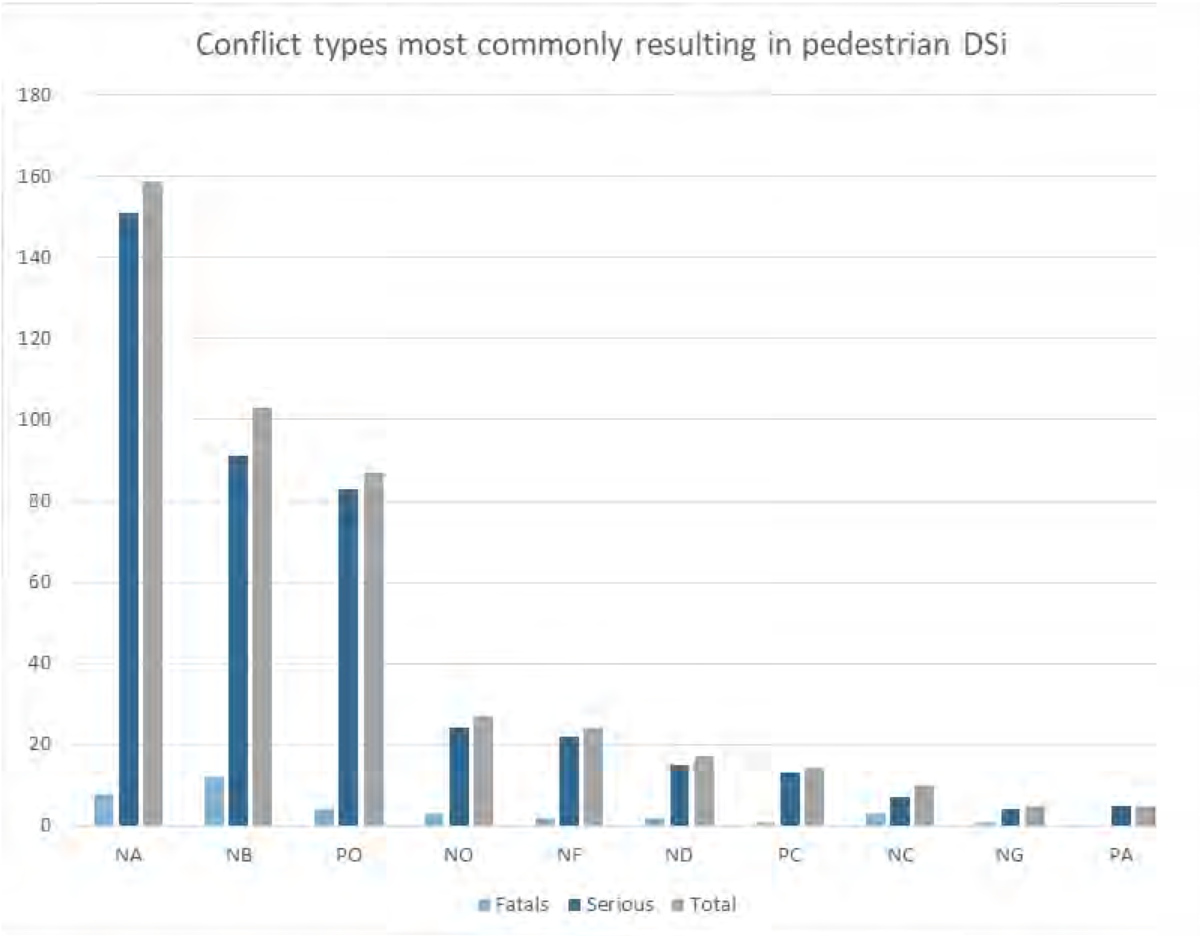


Figure 22: Conflict types most commonly resulting in pedestrian DSi (CAS 2015-20)

Table 3: Details of different crash movement codes

	TYPE	A	B	C	D	E	F	G	O
N	PEDESTRIANS CROSSING ROAD	LEFT SIDE	RIGHT SIDE	LEFT TURN LEFT SIDE	RIGHT TURN RIGHT SIDE	LEFT TURN RIGHT SIDE	RIGHT TURN LEFT SIDE	MANOEUVRING VEHICLE	OTHER
P	PEDESTRIANS OTHER	WALKING WITH TRAFFIC	WALKING FACING TRAFFIC	WALKING ON FOOTPATH	CHILD PLAYING (INCLUDING TRICYCLE)	ATTENDING TO VEHICLE	ENTERING OR LEAVING VEHICLE		OTHER

It is also clear that the majority of crashes are occurring on the 50 km/h streets (see Figure 23), predominantly as this speed limit operates on a large proportion of the network. The higher number of serious crashes occur at intersections for both serious and fatal injury crashes.

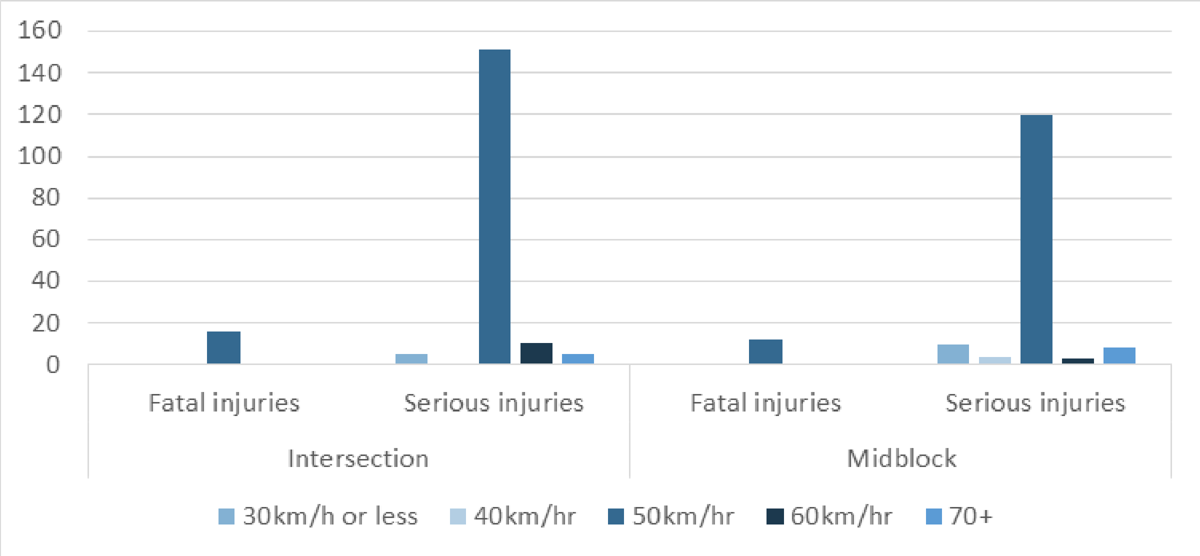


Figure 23: Location and speed of conflict locations (CAS data 2015-20)

In mid-block locations the main crash type is pedestrians being hit by a vehicle when crossing the road followed by 'other' type crashes (see Figure 24). A further data dive would be required to fully understand the 'other' category.

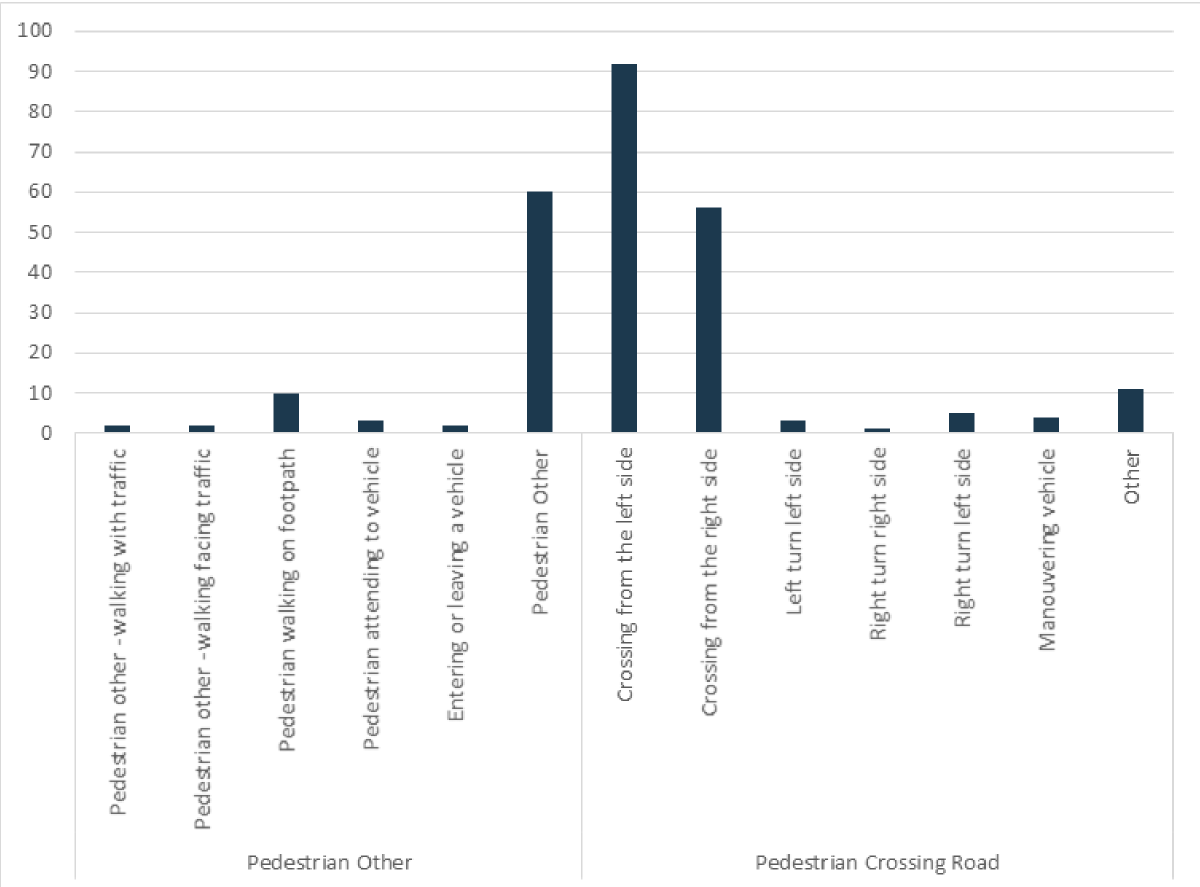


Figure 24: Pedestrian crash types at mid-block locations

Crashes involving pedestrians crossing the road can be broken down further using the different types of road marking recorded in CAS (see Figure 25):

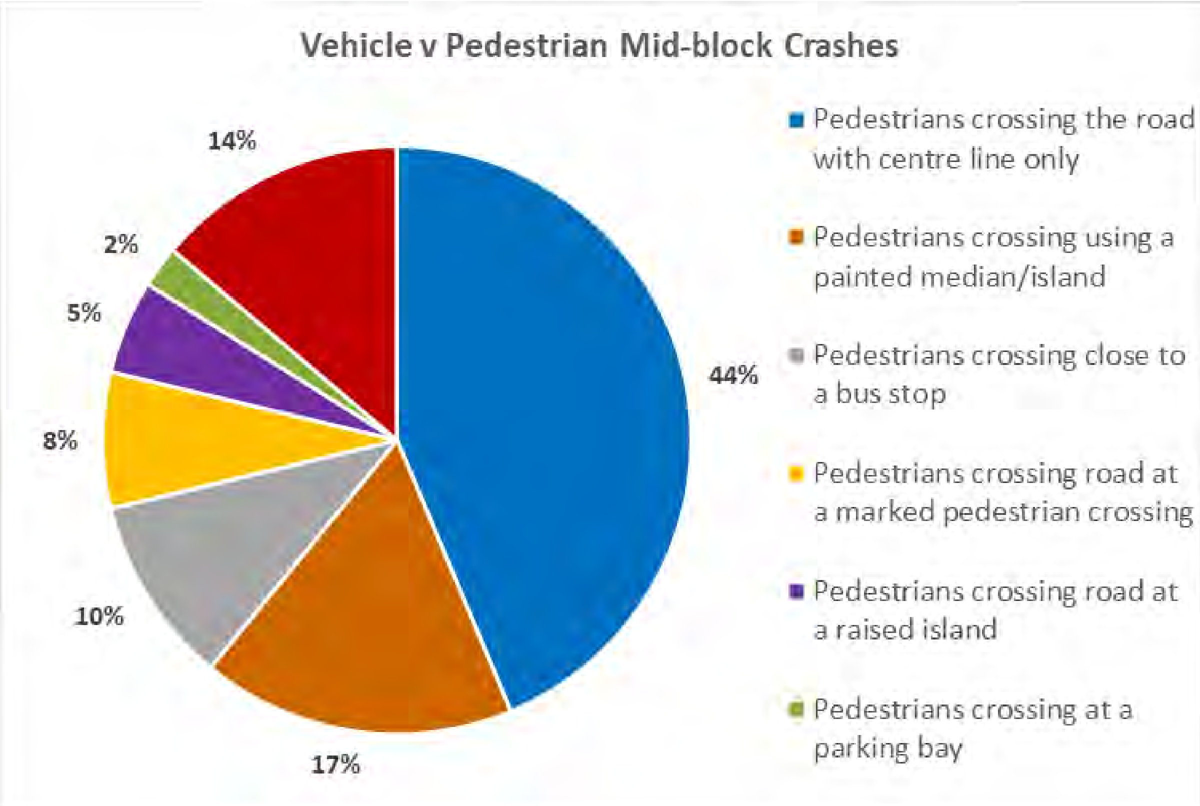


Figure 25: Pedestrian crashes occurring at mid-block locations when crossing the road (CAS 2015-20)

When looking at the above figure and after a brief look into the crash descriptions the reasons for the collisions could be associated with the following:

- Lack of pedestrian crossings or not in locations where pedestrians want to cross.
- People waiting on centre lines and medians to cross being hit by turning vehicles or drivers using the lane in congested conditions.
- Pedestrians crossing mid-block multi-lane roads (sometimes running across) when traffic in a lane is stationary, but traffic is moving in adjacent lane.
- Walking out into the road after getting off a bus.
- Crossing with limited visibility if crossing from between parked vehicles or stopped buses.
- At pedestrian crossings
  - Impatient drivers at congested times
  - Lack of good lighting
- Visibility - Sun strike, lack of street lighting.

To fully understand the causes behind the 250 crashes (approx.), a further deep dive would be required.

In terms of intersection locations, the greatest number of crashes have occurred at give-way controlled intersections (see Figure 26).

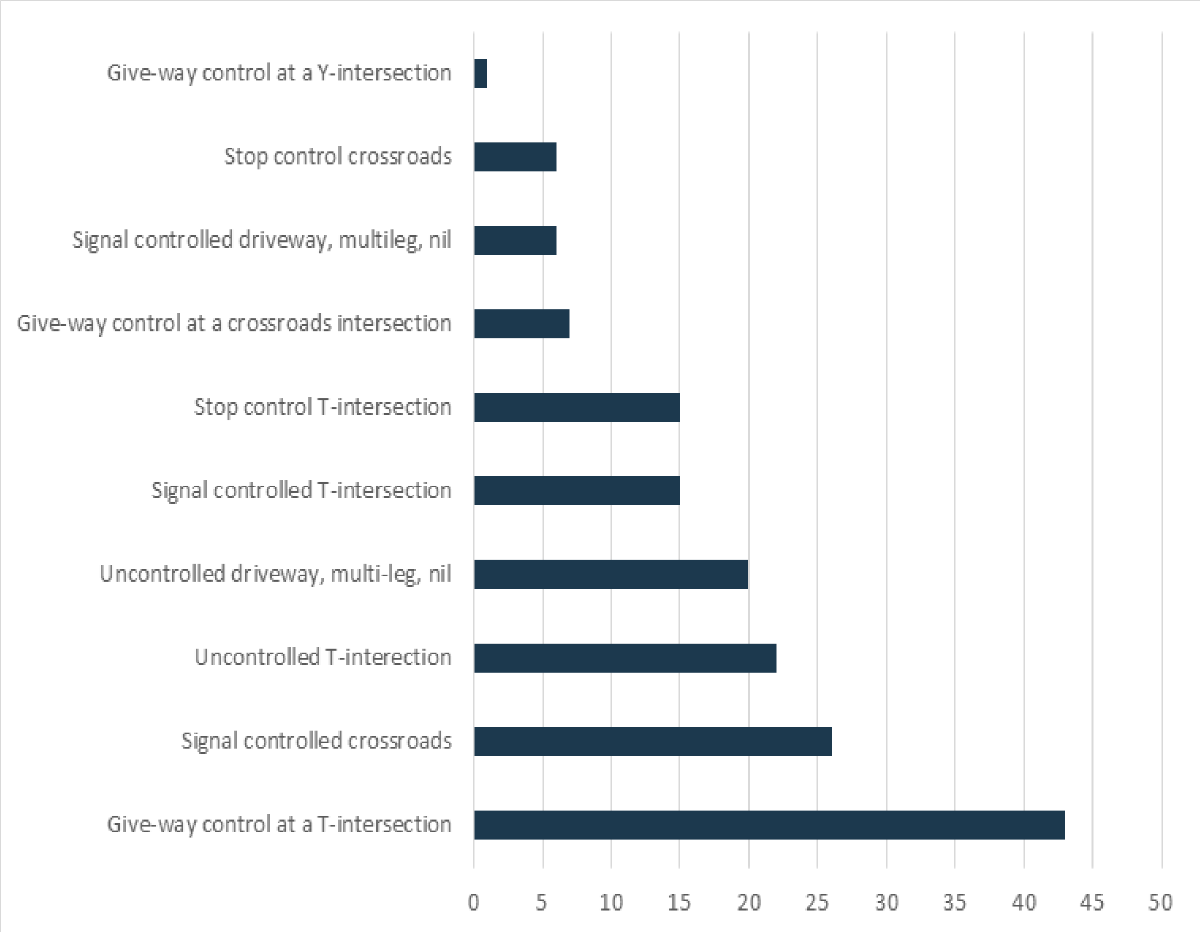


Figure 26: Pedestrian crashes occurring at different types of intersection with different controls (CAS 2015-20)

When looking at intersections that are controlled by traffic signals some of the following causes/factors were identified:

- Pedestrians crossing on green man and being hit on crossing
  - Turned on red arrow
  - Didn't see pedestrian
  - Pedestrian still crossing when green arrow has lit
- Pedestrians crossing against red signal
- Children running into the road, Pedestrians running at crossings
- Crossing between waiting vehicles close to signals or just away from the lights and being hit by vehicles exiting the intersection.

Figure 27 summarises the distribution of pedestrian crashes by AT board area. It is likely that, with the higher proportion of walking trips, there is a higher proportion of fatal and serious crashes involving pedestrians in the Waitematā Board with other higher proportions of crashes occurring in more southern areas of Ōtara-Papatoetoe and Manurewa, and the inner suburb of Albert-Eden.

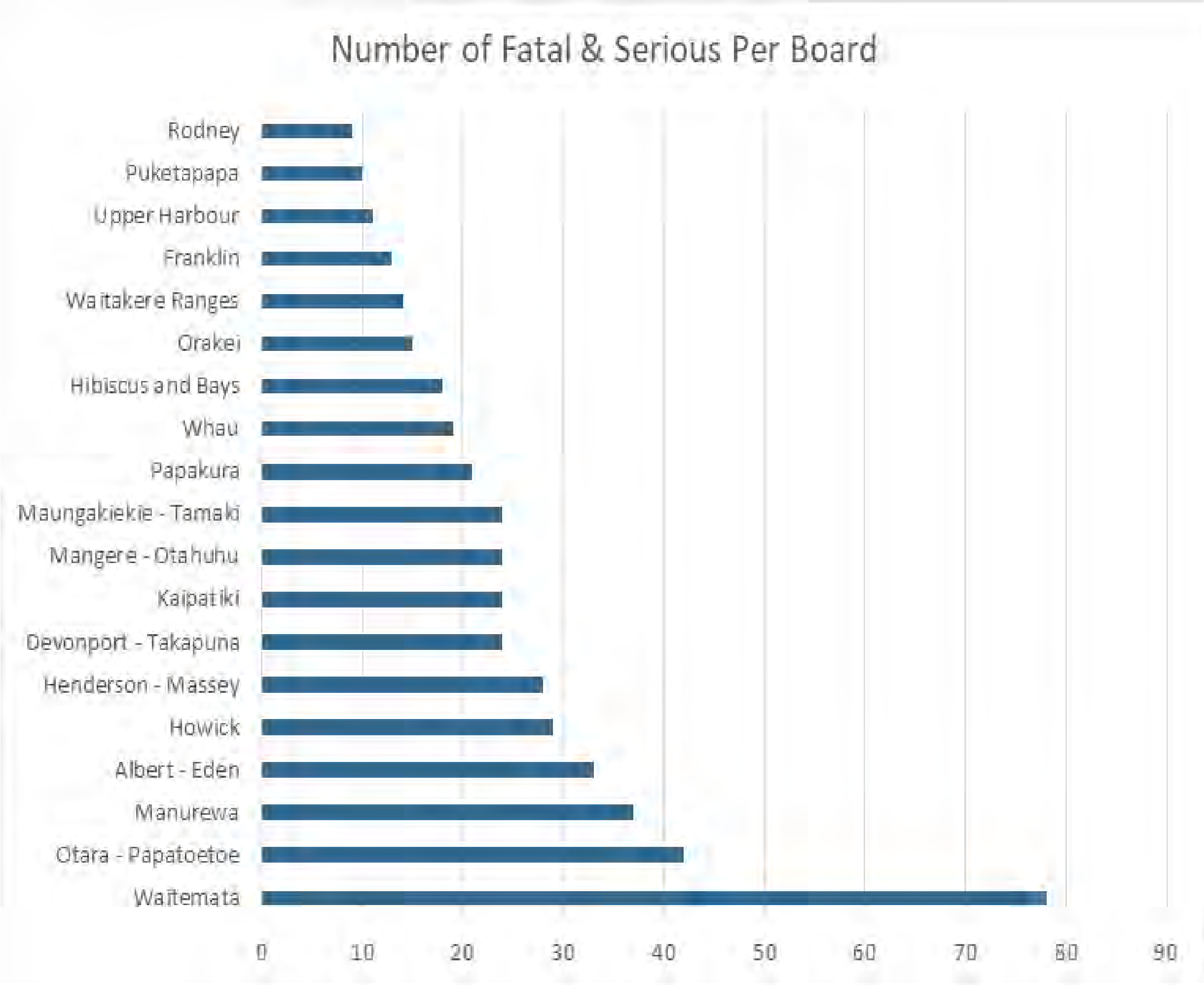


Figure 27: Number of pedestrian crashes across Auckland boards (CAS 2015-20)

4.2 Micro-mobility journeys

There is insufficient evidence in the CAS crash information to really understand the issues around collisions involving transport devices. We understand that a separate micro-mobility safety study is underway that may help to address this question.

4.3 Cycling journeys

With the greatest number of trips by active mode being within Waitematā it is not unexpected that this is where most collisions have occurred over the past five years (see Figure 28). Given the proximity of inner board areas such as Albert-Eden, Devonport-Takapuna, and Ōrākei, and being within an acceptable range for a bicycle commute (perhaps involving an additional mode such as a ferry) to central city again it is not unexpected that these areas have also seen higher numbers of cycle collisions.

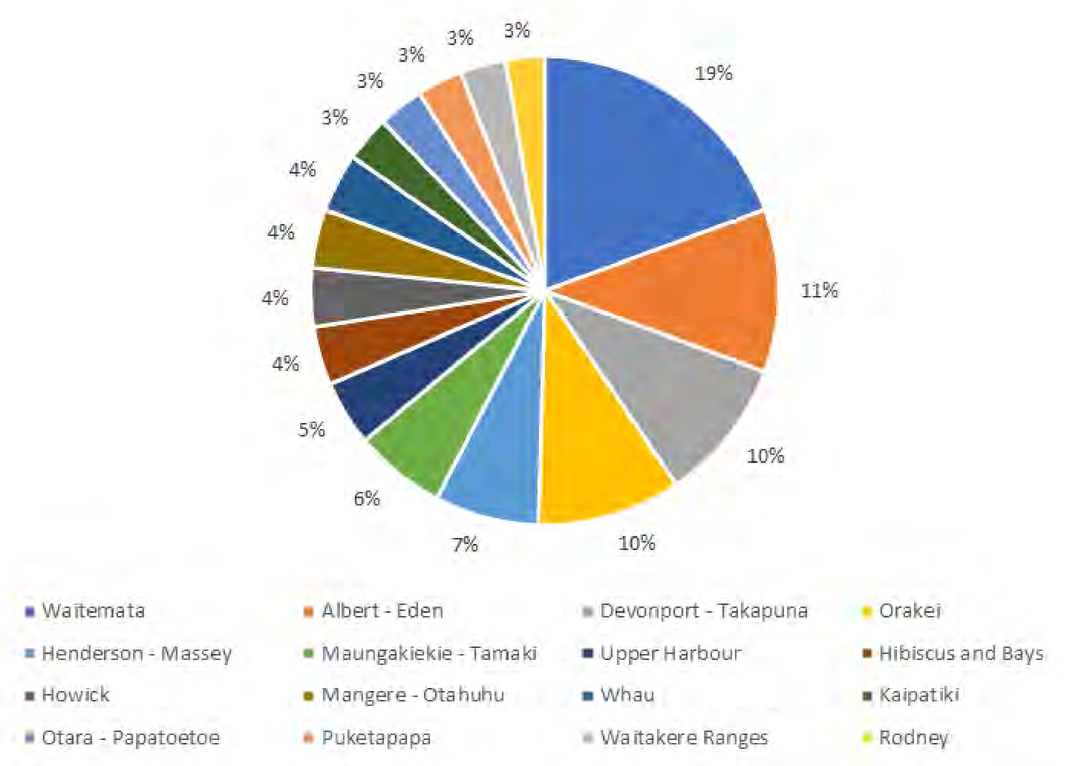


Figure 28: Proportion of cycle crashes across Auckland boards (CAS 2015-20)

In reviewing the data, there were a high proportion of cycle-only crashes. On further review:

- 18 crashes
  - 3 fatal (alcohol/drugs & possible medical) and 15 serious
- All loss of control
  - 7 on a bend and 11 on straight road
- Gradient
  - 13 on hill road, 4 on the flat, 1 not specified

Factors contributing to the crash involved:

- Alcohol or drug impaired (4)
- Speed
- Lost control downhill hit object
- Lost control downhill rider distracted

Not wearing helmet

- E-bike rider with pillion

Not wearing helmet

- Medical event

Interestingly, the MoH data also suggests that collisions with heavy vehicles do not make up a large proportion of the cycle crash numbers, with only 9% of captured collisions with motor vehicles involving a heavy vehicle. Nevertheless, heavy vehicles are invariably undertaking commercial activities, and workplace safety is a growing focus in New Zealand; Section 5.2 discusses this further.

4.4 Motorcycling journeys

With motorcycles it is important to understand the locality of the crash and the nature of the speed environment as the outcomes of a collision involving a motorcycle are likely to be very different in an urban environment and rural environment.

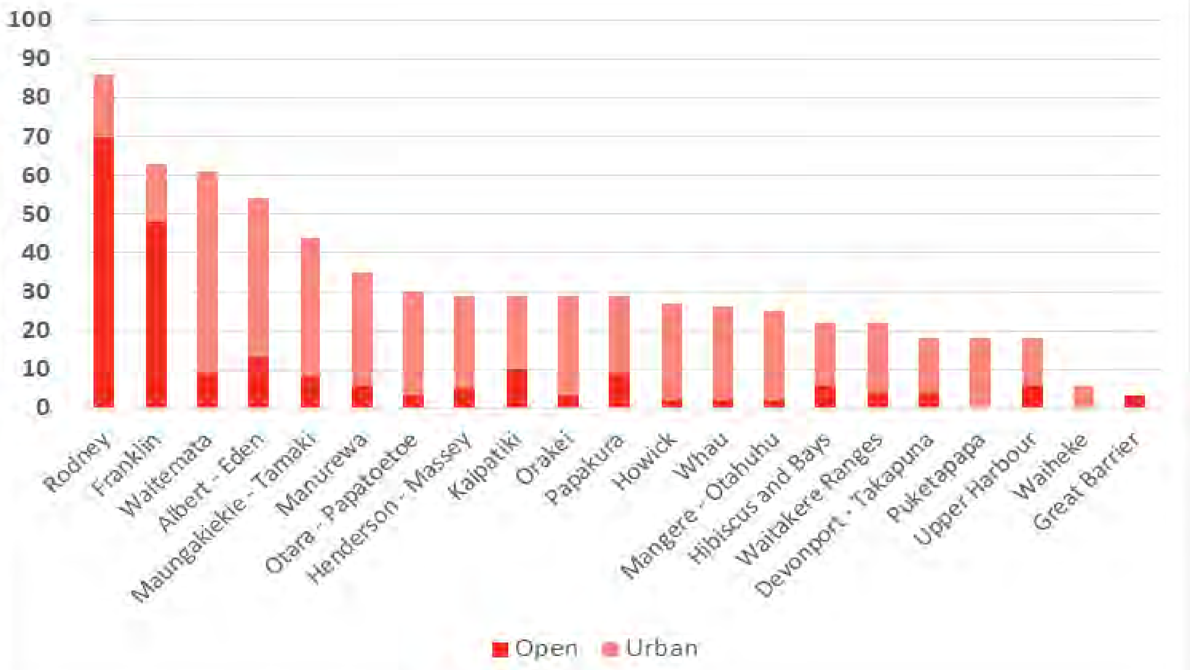


Figure 29: Number of motorcycle crashes across Auckland boards (CAS 2015-20)

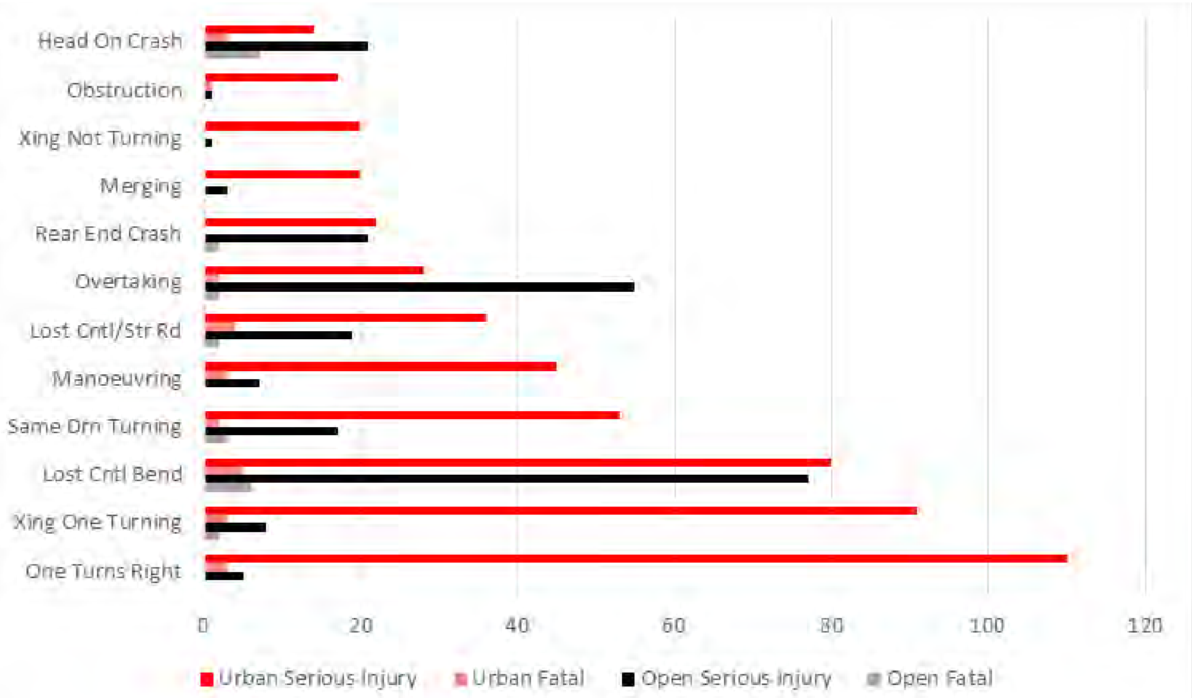


Figure 30: Motorcycle crash types at different locations (CAS 2015-20)

It is not unexpected that a large number of crashes involving motorcycles occur in boards that have large rural networks that are well used by motorcycle riders (see Figure 29); likewise it is not unexpected to see Waitematā high on the list, but this is likely to be more due to the increased number of conflict risk in a dense urban area. Figure 30 highlights the danger particularly posed by lost-control crashes on bends. Although speeding isn't an issue in these rural areas in terms of exceeding the posted speed limit, it could be more accepted that the rider is approaching a bend at an inappropriate speed (or advisory signage missing etc). Interestingly, similar lost-control issues are also noted in urban areas as well (Figure 31).

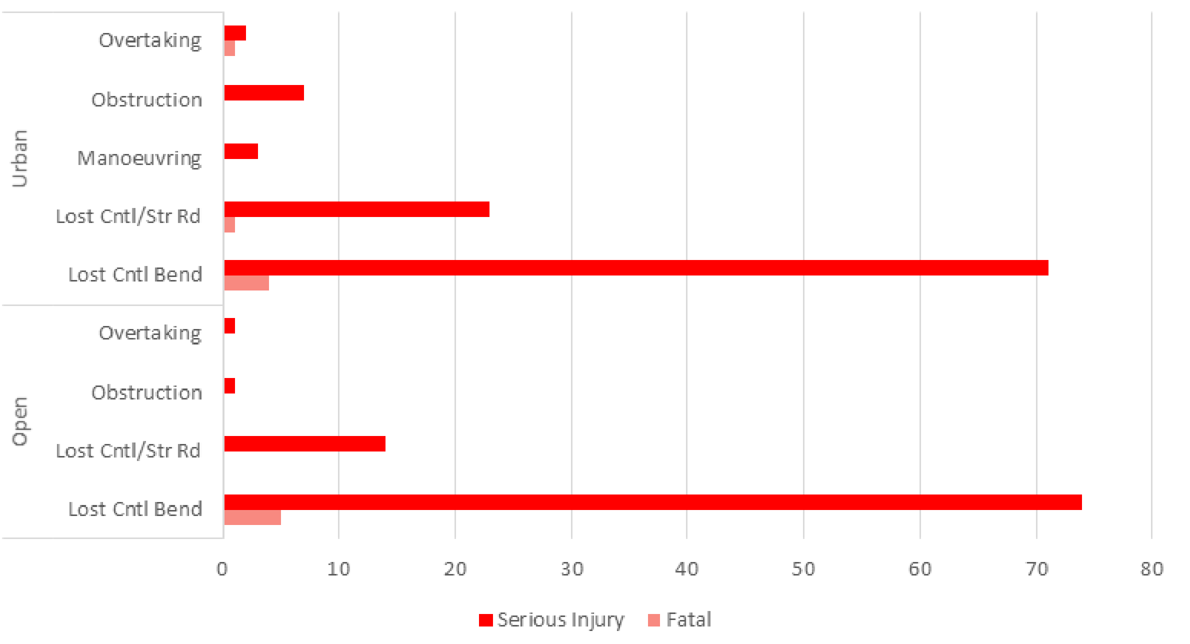


Figure 31: Types and location of motorcycle only crashes (CAS 2015-20)

While speed does feature strongly as a major contributing factor to rural lost-control crashes (Figure 32), the presence of gravel or loose metal on the road is also significant.

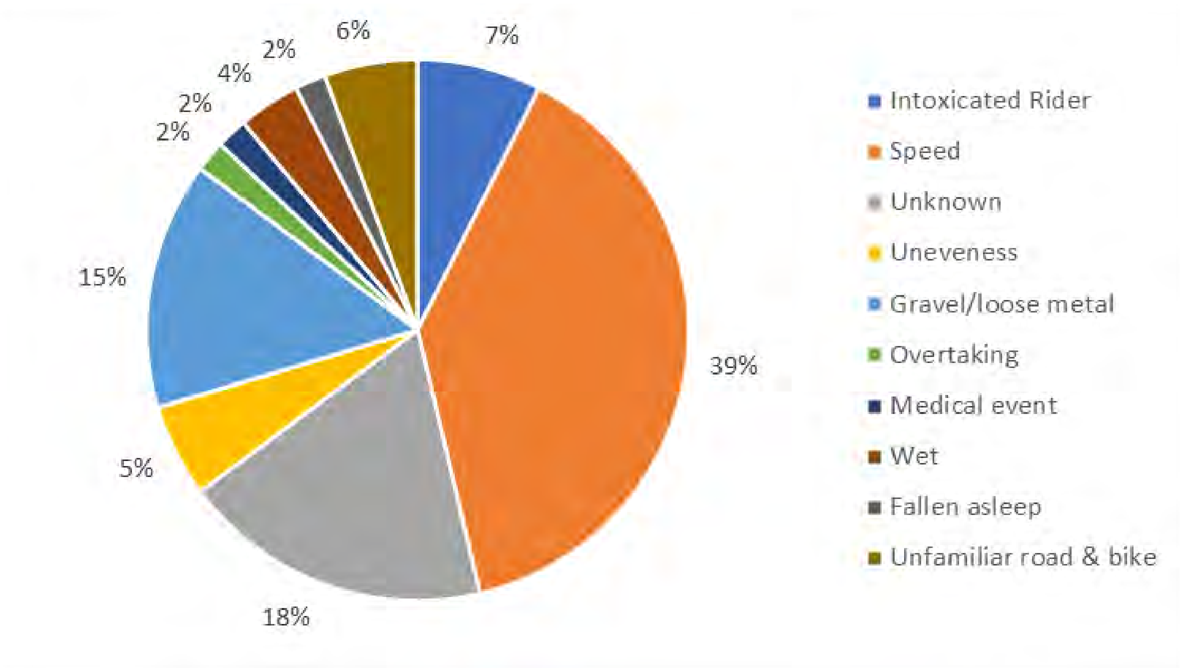


Figure 32: Contributing factors to open road loss of control motorcycle crashes (CAS 2015-20)

4.5 Systemic causes

Whilst not necessarily always the cause of a collision, the impact of a higher-speed crash is more likely to create serious injury or fatality. Interestingly, relatively few crashes involving active travel modes have "speed" cited as a contributing factor (typically less than 5% of pedestrian/cycle crashes, compared with over 20% for serious/fatal motor vehicle crashes). Although part of that could be explained by the relative urban/rural mix of each group of crashes, there appears to be a systematic bias in recording speed against walking and cycling crashes. In many cases, while the actual impact speed may technically not be exceeding the current speed limit it is often too fast for a safe interaction with a VTU.

When analysing posted speed limits against calculated "safe and appropriate speeds" from Waka Kotahi's MegaMaps tool, it is clear that existing speeds are still too high for much of the road network, even after the first tranche of speed limit changes in 2020. Table 4 summarises the respective breakdowns of the appropriateness of current speed limits within Auckland. This is particularly an issue on more minor parts of the road network (i.e. collector and local streets) where the proportion of road length with existing posted limits too high is often over 90%.

Table 4: Proportion of Auckland road network (km) that has inappropriate speed limits

Speed limit is…	…Correct	…Too High	…Too Low	Total
High-speed roads (includes motorways)	423.1 km (14.2%)	2435.5 km (81.8%)	117.3 km (3.9%)	**2975.9 km**
Urban roads (speed limit ≤70km/h)	1808.5 km (37.3%)	2871.6 km (59.2%)	172.7 km (3.6%)	**4852.7 km**
Total network	2231.5 km (28.5%)	5307.0 km (67.8%)	290.0 km (3.7%)	**7828.6 km**

If the current speeds are maintained, it is likely to result in more deaths and serious injuries on the network for VTUs and likely to continue to be a barrier for people to want to try using active modes as transport environments will continue to remain hostile and inaccessible.

Recommendations

Agency	Recommendation
Auckland Transport	▪ Identify when a road where a VTU crash has occurred is currently posted with too high a speed limit.
Auckland Road Safety Partners	▪ A greater focus on the role of speed when reporting active mode crashes (particularly relative to the calculated "Safe and Appropriate Speeds")
Government transport agencies	N/A

5 Understanding the ongoing impacts

5.1 Changes in user numbers

Currently Auckland Transport has some objectives to reduce DSIs by ~60-70% between 2018 and 2028. Although not entirely clear from the PBC, it is assumed that VTU casualty numbers are expected to reduce (in absolute terms) by a similar proportion. However, at the same time there is a considerable push to increase the use of active modes within Auckland; external factors have also seen a considerable rise in use of transport devices like e-scooters (both public and privately owned). A similar planned growth in patronage across the city's public transport network is also likely to see accompanying growth in "first/last mile" journeys to and from transport stops.

While this growth in sustainable transport modes is to be welcomed, there is a very real likelihood that it will be accompanied by a growth in casualty numbers for these modes, even if efforts are made to improve the environment for travelling using these means. As a comparison, the Netherlands (generally agreed as the safest place internationally to cycle on a per-km basis) still see approximately 200 cycling deaths a year[8] (compared with the NZ average of 10 a year). Therefore if, hypothetically, the amount of cycling in Auckland doubled and the number of DSIs increased by only 50%, the resulting 25% reduction in per-km casualty rate may not be considered a "success" due to the absolute increase in casualty numbers. This is despite the fact that the additional people cycling are likely to be gaining considerable improvements to their personal health.

This dilemma suggests that Auckland Transport may need to consider other performance metrics to better reflect the overall "life mortality costs" of any intervention. For example, a 2011 paper[9] found that shifting 5% of short urban vehicle-kilometre trips in New Zealand to cycling would result in about 116 deaths avoided annually as a result of increased physical activity, six fewer deaths due to local air pollution from vehicle emissions, but an additional five cyclist fatalities from road crashes.

5.2 The cost of "business as usual"

The current concern is that the numbers of serious and fatal casualties from VTUs have not dramatically reduced in the past five years, and have also increased as a proportion of the overall Auckland road safety picture (due to greater improvements in motor vehicle safety). Currently that seems to translate to roughly 20 fatalities (MoT data) and 1600 serious injuries (MoH data) a year for VTUs (including the user-only and un-reported injuries not accounted for in CAS). As well as the social cost of this ongoing trauma (conservatively estimated as at least $790 million annually), there is also the flow-on impacts on the poor perception of safety of these modes and their relative take-up. This has major implications for the health of communities who feel constrained to continue using motor vehicles for transport needs.

Figure 33 illustrates the timeline trends in serious injuries between 2016 – 2019 for the different travel modes in Auckland. While the CAS data suggests some slight improvements over time (and the 2020 data improves on this further), the hospitalisation data from MoH paints a less positive story when it comes to VTUs. The MoH data also highlights the proportion of serious injuries missed in CAS, particularly those incurred without involving a motor vehicle. While only 46% of CAS-recorded serious injuries during 2016-19 involve VTUs (44% in the most recent 2020 year), that figure is 66% of MoH-recorded casualties.

[8] See https://bicycledutch.wordpress.com/2020/07/28/road-fatalities-declined-in-the-netherlands-but-less-for-cycling/

[9] Lindsay G., Macmillan A., Woodward A. (2011). Moving urban trips from cars to bicycles: impact on health and emissions, *Aust NZ Jnl Public Health*, Feb 2011; 35(1), pp.54-60. doi:10.1111/j.1753-6405.2010.00621.x

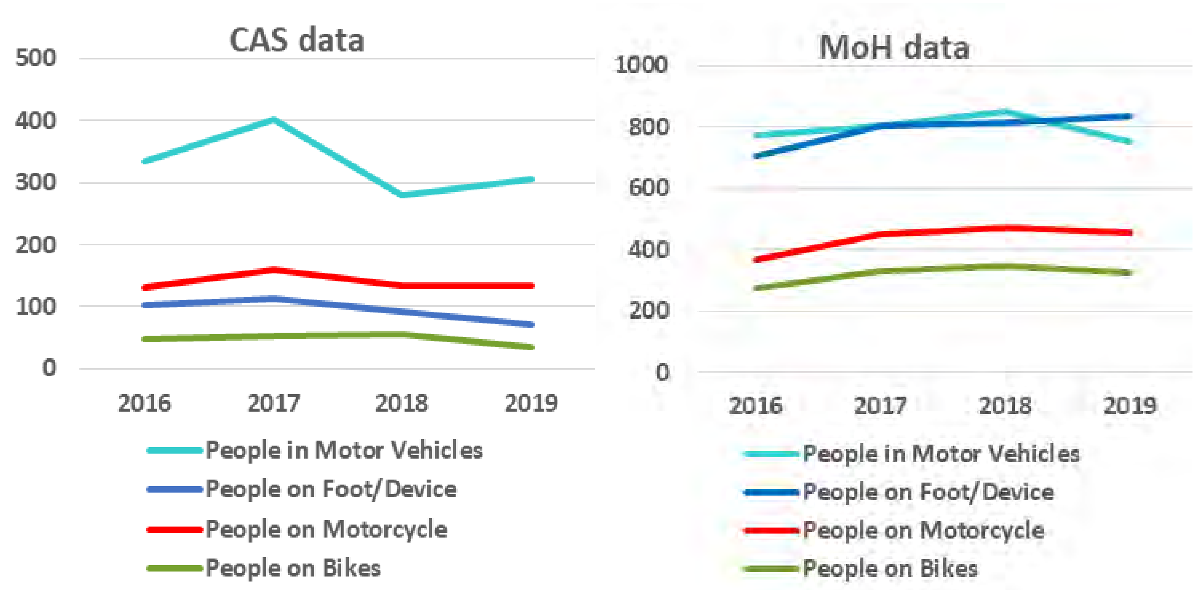


Figure 33: Timeline trends in serious injuries (2016-19) from CAS (LHS) and MoH (RHS)

Transport-related workplace safety is also a growing concern, particularly by larger organisations, and is now recognised as one of the focus areas in the 2020 Road to Zero national road safety strategy. At present, it is difficult to completely determine the number of serious injuries and deaths on Auckland's transport networks that are related to workplace activities such as commercial freight movements, courier deliveries, and travel to work/site meetings. CAS now has a data field for capturing the trip purpose of vehicles involved in a crash, but it doesn't appear to be used yet. WorkSafe NZ maintain data on various workplace-related injuries; from this it appears that between 2016-19 there were 118 "serious harm incidents" in Auckland from activities categorised as "road transport" or "postal courier pickup and delivery services", roughly 30 a year. One suspects that this greatly undercounts work-related trips for other purposes.

5.3 Organisation-wide risk

One of the growing concerns for Auckland Transport is its obligations as a responsible entity for health and safety, to its employees and contractors (including ancillary services like public transport) and to the general public at large as well. Any serious injury or death, particularly if it is multi-casualty or high-profile for some other reason, could reflect poorly on AT if there were clear steps they could have taken to prevent or mitigate its impact. The recent revelation of many thousands of speeding tickets by AT service bus drivers is an example of a situation that not only incurs reputational harm but has the very real possibility of causing actual serious physical harm to VTUs.

6 Fatalities on the network

Further investigation was undertaken into the scale of VTU fatalities not captured by CAS data, e.g. by considering other data sources, such as Police and Coroner. As stated in Section 3.1, in general, the most reliable data for road deaths is provided by the Ministry of Transport[10]. However, this is still only a proportion of transport deaths involving vulnerable transport users due to definitions or data lags.

[10] https://www.transport.govt.nz/statistics-and-insights/safety-annual-statistics/road-user/

6.1 Definitions and requirements for injury/fatality reporting

A road death in New Zealand is usually defined as a person that died at the scene, *en route* to, or in hospital within 30 days of admission (30 days being the internationally agreed limitation for consistency between countries).

Fatal and serious injury data should be being collected and reported to Waka Kotahi for inclusion in CAS where a *vehicle* is involved. However, there is some inconsistency about whether all relevant incidents involving injury to a VTU are collected. The Land Transport Act 1998 has this to say about "accidents" (***bold*** emphasis added):

22 Driver's duties where accident occurs

*(1) If an accident arising directly or indirectly **from the operation of a vehicle** occurs to **a person or to a vehicle**, the driver or rider of the vehicle must—*

(a) stop and ascertain whether a person has been injured; and

(b) render all practicable assistance to any injured persons.

(2) The driver or rider of the vehicle must, if required by an enforcement officer or any other person involved in the accident, give the officer or other person—

(a) the driver's or rider's name and address; and

(b) the name and address of the owner of the vehicle; and

(c) if the vehicle concerned is a motor vehicle, the number or letters or other expression on the registration plates assigned to the vehicle.

(3) If the accident involves an injury to or the death of a person, the driver or rider must report the accident to an enforcement officer as soon as reasonably practicable, and in any case not later than 24 hours after the time of the accident, unless the driver or rider is incapable of doing so by reason of injuries sustained by him or her in the accident.

The definition of "vehicles" under the Act are quite broad, as follows:

(a) means a contrivance equipped with wheels, tracks, or revolving runners on which it moves or is moved; and
(b) includes a hovercraft, a skateboard, in-line skates, and roller skates; but
(c) does not include—
- *(i) a perambulator or pushchair:*
- *(ii) a shopping or sporting trundler not propelled by mechanical power:*
- *(iii) a wheelbarrow or hand-trolley:*
- *(iv) [Repealed]*
- *(v) a pedestrian-controlled lawnmower:*
- *(vi) a pedestrian-controlled agricultural machine not propelled by mechanical power:*
- *(vii) an article of furniture:*
- *(viii) a wheelchair not propelled by mechanical power:*
- *(ix) any other contrivance specified by the rules not to be a vehicle for the purposes of this definition:*
- *(x) any rail vehicle*

It should be noted that this definition includes cycles and various small-wheeled devices such as kick scooters and skateboards, as well as mobility scooters. Manual wheelchairs and children's prams/pushchairs appear to be the only normal transport user exceptions, aside from pedestrians. Also, because the Act refers to accidents arising from the "operation of a vehicle", it could be argued that a situation where a transport user has a medical event does not fall under the reporting requirements.

Based on those definitions, anything other than a single-person pedestrian-only incident/crash (or one only involving a manual wheelchair or pram) should be captured by Police (typically through a Traffic Crash Report) if Police and/or emergency services attend the crash. For incidents causing injury to any party, they should also be reported to Police by those involved.

In practice, this is generally not happening; certainly not all cycle-only or e-scooter-only incidents are currently being captured in CAS, although they're more likely to be if there is a fatality or serious injury.

If the police do not attend a crash or incident, there will not be a traffic crash report and it is unlikely that it will be self-reported to the Police for a report to be completed.

6.2 Fatalities and exclusion from reporting

The Ministry of Transport provided the full list of road deaths that occurred in Auckland from 2015-2021. The number of reported deaths per mode is provided in Figure 34.

In addition, they provided information on deaths that were excluded from the official count. These mostly included deaths that occurred:

- on a driveway (7) including at work sites (2)
- suicide or possible suicide (5)
- medical event/possible medical event (2)

However, there were three fatalities that occurred in the road space that were excluded involving VTUs using e-scooters. At the current time, e-scooter only road deaths are not counted as an official road death, unless a motor vehicle is involved in the crash. These three crashes comprised:

- 2 x single person incident whilst travelling on an e-scooter
- 1 x crash between two e-scooters.

Therefore, when considering this type of incident by a person using this mode, data should be sought specifically from the Ministry of Transport otherwise there will be under-reporting.

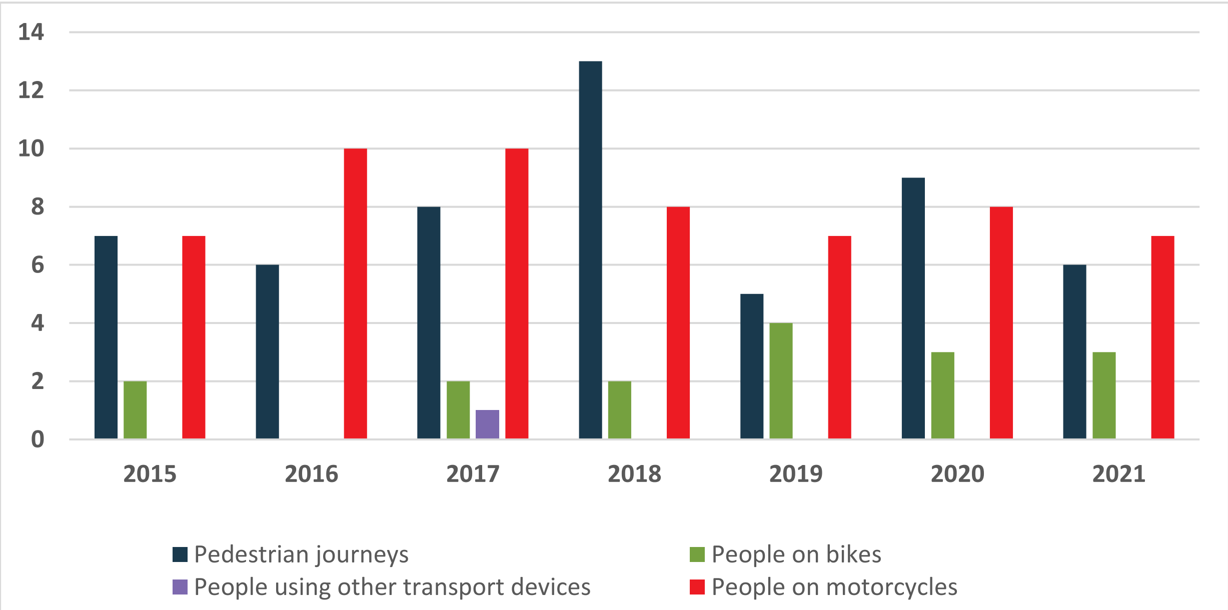


Figure 34: Road Deaths per Mode (Source: MoT)

There are no serious crashes excluded from the official road toll information.

6.2.1 Previous cycling fatality investigation

A previous investigation into cycling fatalities across New Zealand since 2006[11] identified 33 fatalities within Auckland between 2006 – 2019 (14 years). While most were picked up within the CAS reporting system, a number were not recorded there and only identified through either the previous MoT Fatals system[12] or Police/Coroner/media reports. Of the 33 identified cases:

- 13 did not involve a motor vehicle
- 5 did not have a CAS Crash ID number
- Another 5 used an MoT Fatal Crash ID number that was not linked to CAS
- 6 did not die at the scene but in hospital later, including one who died >30 days later
- 6 suffered a medical event (heart attack, stroke, etc)
- 1 occurred in an off-road location (a park)
- 3 did not have a name recorded for the victim
- Only 6 had specific findings and recommendations reported in a Coroner inquest (including the 2013 national Coronial Review into cycling safety) that could be found

These findings (and similar observations from the 173 cases captured nationally over the same period) highlight the fact that there are some gaps in what is captured by CAS on VTU fatalities. While it is understandable that some were excluded due to location or medical events, it is worrying that basic details of other incidents (generally not involving a motor vehicle) could not always be easily obtained despite searching across multiple data sources.

6.3 Reporting from the Serious Crash Unit

To understand some of the terminology below during a major incident, definitions were sought from the St John Ambulance procedures and guidelines[13], which provides the following initial triage urgency status codes (previously referred to as condition status):

- Zero – Dead
- One – Immediate (previous - immediate threat to life)
- Two – Urgent (previous - potential threat to life)
- Three – Delayed (previous - unlikely threat to life)
- Four – Delayed (previous - no threat to life)

Auckland has two Serious Crash Units (SCU), Auckland North and Counties Manukau. The following information has been provided by the units.

The North Auckland North SCU covers from Panama Road in Mount Wellington and Mangere Bridge in the south, through to Kaiwaka in the north. The Counties Manukau team cover from Panama Road and Mangere Bridge to Orams Road in Mercer and the boundary there angles over to Glen Murray and Highway 22 on the western side of the Waikato River. From west to east they cover Port Waikato and Awhitu over to Kaiaua and Maramarua with the boundary at Koheroa Stream.

[11] Koorey G.F. (2014), "Investigating common patterns in New Zealand cycling fatalities", *IPENZ Transportation Group Conference*, Wellington, 23-26 Mar 2014, 11pp. https://ir.canterbury.ac.nz/handle/10092/9718

[12] Unfortunately, with the development of the new CAS system, the previous "CAS Fatals" tool that provided ready access to recent fatality data and associated information such as Serious Crash Investigation Review reports by Police has been removed, thus requiring more effort to find the necessary information from the relevant sources.

[13] https://www.stjohn.org.nz/globalassets/documents/health-practitioners/clinical-procedures-and-guidelines---comprehensive-edition.pdf

From information received from Auckland Transport and the two SCUs, there appears to be slight difference in the types of crashes (and more importantly severity) that the units attend, but the aim is to have uniform consistency of service.

The Serious Crash Units provided the following information:

- SCU attend all fatal and status 1 crashes. Status 2 crashes are attended subject to certain requirements.
- The SCU are contacted through the Police Communication Centre following initial assessment from the team at the scene of the crash.
- Traffic Crash Reports must be completed at each crash. A copy is sent to Waka Kotahi (NZTA).
- If the crash is at a level crossing, involving a vehicle or a pedestrian, a Traffic Crash Report should be completed as the train is classified as a vehicle and the crash has occurred on a road.

6.4 Mortality data

Mortality data with cause of death is only available at this point in time to the end of 2018. The reason for this delay is that all mortality data in our collection is coded individually by a team of mortality coders, and there is significant lag time for deaths that require the coroner's ruling.

In particular, suicides can take several years to be give a primary cause of death ruling for a number of reasons, and this slows down the release of all mortality data with cause of death.

The following ICD–10AM codes were used to identify relevant cases from the mortality collection:

- Motorcyclist [V20–V28]
- Pedal cyclist [V12–V14] and Pedestrian [V02–V04]
- Other: [V80-89]
- Falls [W00-19]

These ICD codes are consistent with the classification of external cause of injury used by the Centres for Disease Control and Prevention (2002).

Unfortunately, the hospital admissions data from MoH is of limited use in considering the numbers of VTU fatalities involving motor vehicles versus CAS numbers, as it only includes those people who were taken to a medical facility and subsequently died – people who died at the scene will not be captured.

The variations in the different data sources can be seen in Figure 35 when considering full years of data from 2016 to 2018;

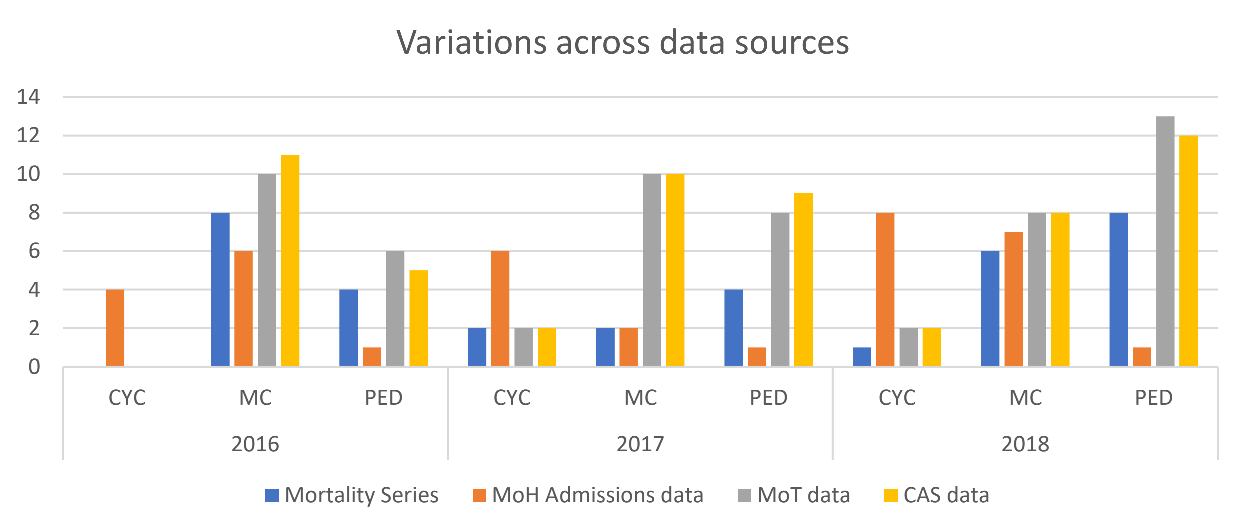


Figure 35: Variations across data per Mode (Source: As stated)

The mortality data does capture a small number of VTU-only incidents (typically a fall of some kind) where the patient subsequently died at hospital. For the period 2015-18, 4 such fatalities were recorded in Auckland (3 in 2017 and 1 in 2016).

Overall, it makes sense to continue to use the CAS fatal data set as the best source of "truth", but to also be alert to any reported fatal incidents that "slip through the cracks" due to aspects of definition.

Recommendations

Agency	Recommendation
Auckland Transport	▪ Due to the lags in data and the unknowns around hospitalisation/no hospitalisation, It is recommended that AT continue to use the data source by the Ministry of Transport for fatalities, but again the data sourced should include the excluded crashes to understand the numbers of e-scooter and new micro-mobility devices to ensure all deaths by a transport mode are captured.
Auckland Road Safety Partners	▪ Standardise approaches to reporting serious crashes on the network and when Serious Crash Units attend.
Government transport agencies	N/A

7 Further analysis of Ministry of Health Data

A more detailed review was undertaken of the relevant VTU data from MoH, particularly looking into two questions:

- Were there significant numbers of out-of-region transfers in/out of Auckland that were affecting the original estimates of under-reporting of VTU injuries in CAS?
- Was there evidence of the presence of other medical events (e.g. heart attack, stroke) at the time of a user-only injury, suggesting reasons other than road/path environment for a trip or fall?

7.1 Out of region transfers

There is no way for the Ministry of Health to be certain where the initial crash occurred using the data that they collect, as it is not a required variable. The original data was requested using a search query to look at Auckland-based District Health Board treatments as the best proxy available to filter for events that occurred in the region.

In terms of the transfers, there is the ability to search for transfers using the two variables 'facility transfer to' and 'facility transfer from'; however, these were not originally requested. This involves a manual process of matching the NHI and 'facility transfer to' field from the initial event to the 'facility transfer from' field on any hospital events that occurred after the discharge data of the initial event.

In the interim, the 'domcodes' field has been used to identify the number of admissions from people who reside (or "domicile") inside or outside of Auckland (2015-2020 data).

Using GIS the number of incidents that have occurred involving people with domcodes in and outside of Auckland can be found below. In total, 6745 out of 7215 recorded were found to reside in Auckland (93.5%). This suggests that fewer than 7% of the Auckland hospital admissions for VTUs involve a person who did not have their injury in Auckland. A graphical summary of the distribution of cases can be seen in Figure 36 and Figure 37; other than Auckland, Northland districts are by far the next biggest contributors. While it is possible that some Auckland residents may have been injured outside of Auckland, similarly some non-Auckland residents may also have incurred injuries while visiting Auckland, so the two effects are likely to have little bearing on the overall proportions.

In comparing the relative split across each of the vulnerable transport modes (Table 5), only minor differences in out-of-region reporting are observed, with motorbike users being slightly more inclined to be from out of region. Generally no significant difference was noted between single-party and multi-party incidents:

Table 5: Serious and fatal incidents reported in Auckland hospitals 2015-20 (5 years)

Mode	Total recorded	Reside in Auckland	% in Auckland
Motorbike	2032	1844	90.7%
Pedestrian	3223	3042	94.4%
Bicycle	1537	1458	94.9%
Wheeled transport device	424	401	94.6%
TOTAL	**7216**	**6745**	**93.5%**

Note: The focus of the study is around the safety of people travelling outside of vehicles. Further analysis would be required to understand the number of transfers into Auckland hospitals from harm received inside a vehicle.

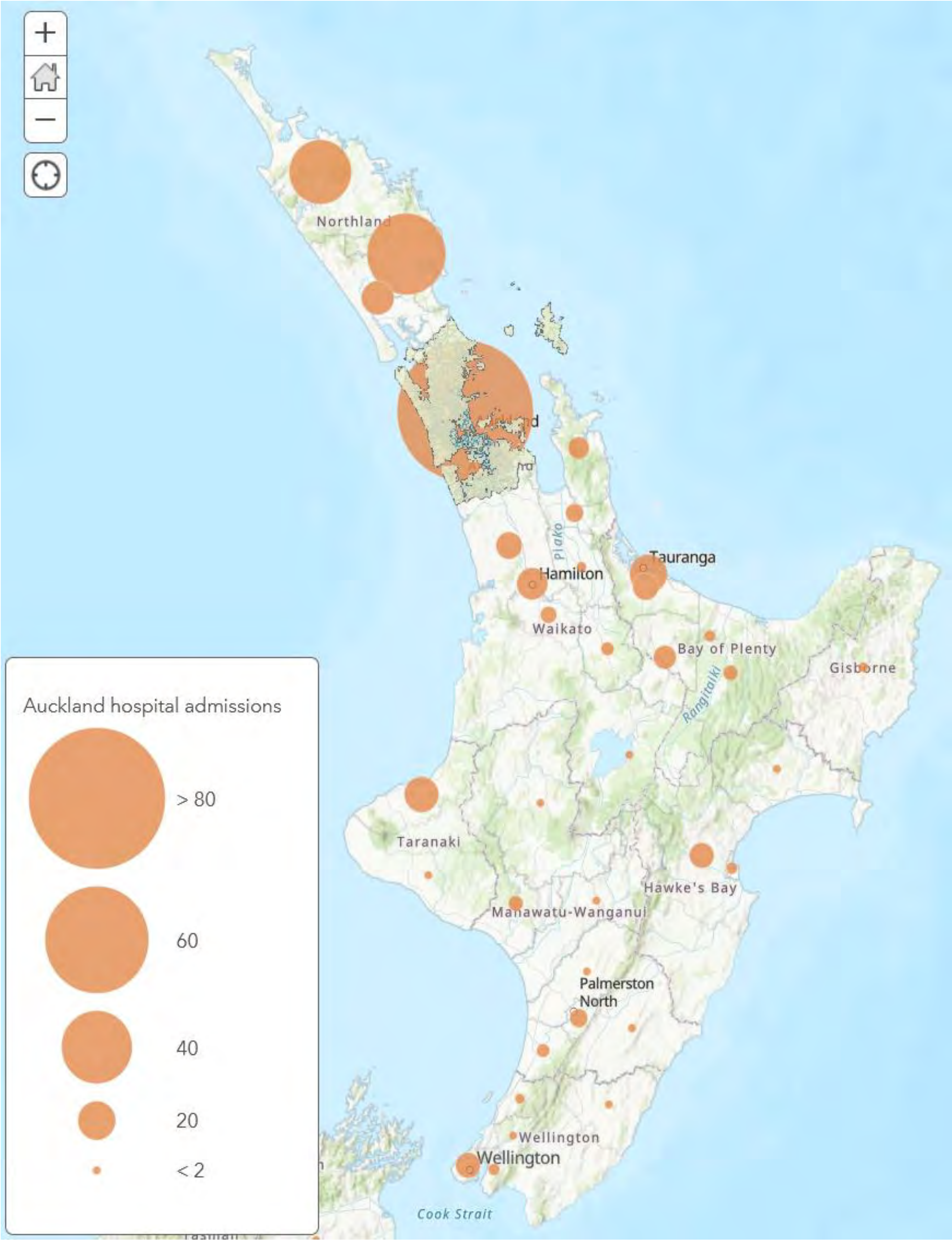


Figure 36: Admissions per territory (North Island) where serious harm has occurred to people travelling outside vehicles (2015-2020)

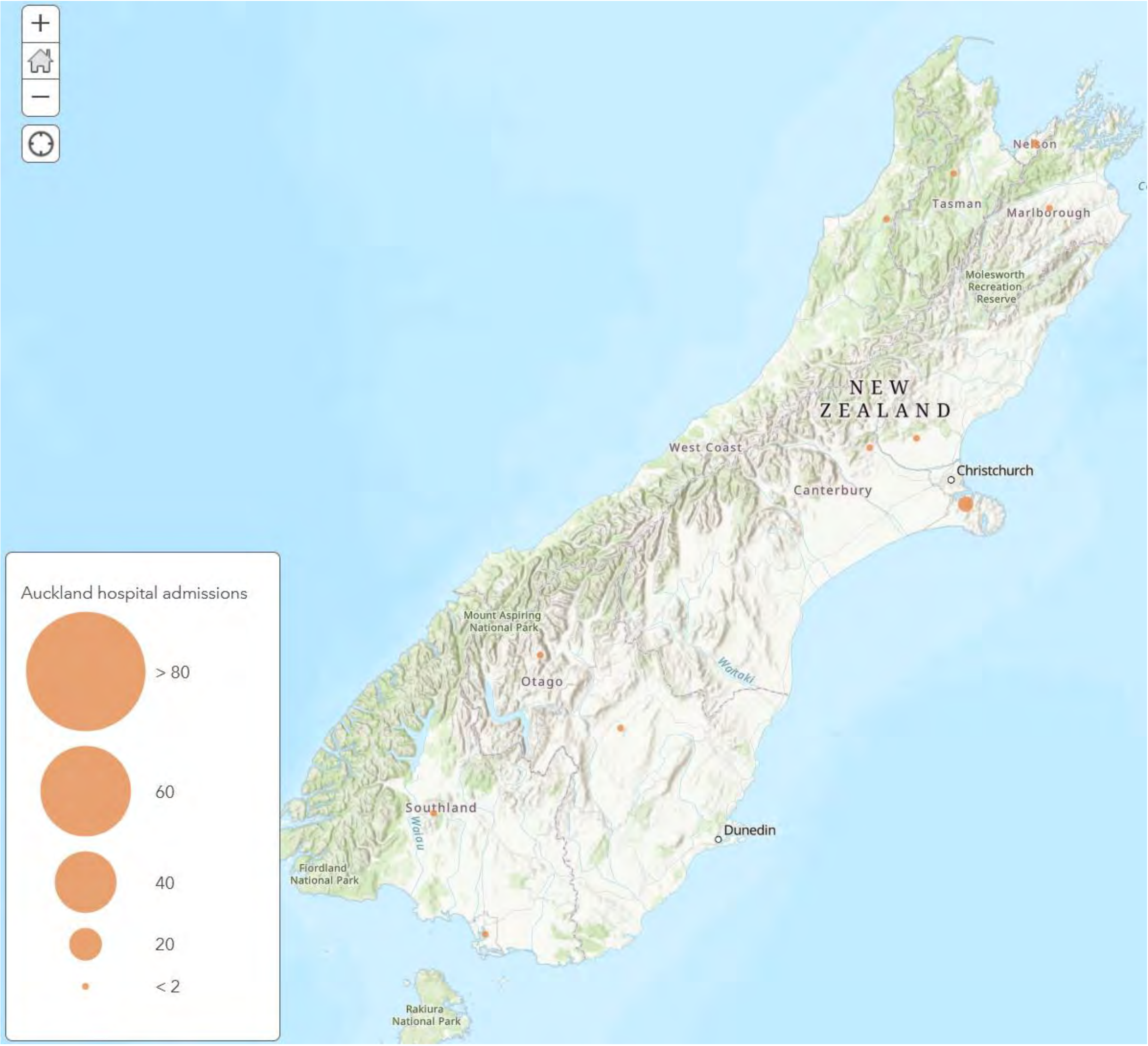


Figure 37: Admissions per territory (South Island) where serious harm has occurred to people travelling outside vehicles (2015-2020)

Taking the above findings and applying them to the previous under-reporting of VTU injuries factors found in Section 3.2 results in the following amended rates in Table 6:

Table 6: Adjusted CAS/MoH under-reporting rates (2016-19) for people harmed outside of vehicles

Mode	CAS Serious Injuries	MoH Serious Injuries	Original Ratio	% of cases from Akld	Adjusted Ratio
Pedestrian	362	3209	8.86	94.4%	**8.37**
Cycle	194	1503	7.75	94.9%	**7.35**
Motorcycle	563	1876	3.33	90.7%	**3.02**
Transport devices	15	208	13.8	94.6%	**13.1**

These figures are not notably changed from the original data, and still highlight the huge discrepancies in injuries reported to the CAS system and the hospital system. A reminder that, for comparison, the equivalent scaling factor for occupants of other motor vehicles (cars, trucks, etc) was 2.28 before adjustment; if a similar 90-95% adjustment was made that scalar would reduce to 2.0-2.1.

Further analysis can split the ratios to determine how much is typically made up of single-party incidents against those involving another motor vehicle. This can be achieved by comparing the relative numbers of hospital cases for each sub-group and then assigning their share of the scaling factor (note that, due to the small numbers, wheeled transport devices have not been split out here). Table 7 provides a breakdown of those figures, which is graphically illustrated by Figure 38.

Table 7: CAS/MoH under-reporting rates by modal sub-groups (2016-19)

Travel mode	MoH hospitalisations	Scaling factor
Pedestrian-only incidents	2042	5.64
Pedestrian incidents involving another party	987	2.73
ALL PEDESTRIANS	**3029**	**8.37**
Bicycle-only incidents	992	5.11
Bicycle incidents involving another party	434	2.24
ALL BICYCLES	**1426**	**7.35**
Motorcycle-only incidents	931	1.65*
Motorcycle incidents involving another party	770	1.37*
ALL MOTORCYCLES	**1701**	**3.02**
Other wheeled transport devices (only and collision)	**208**	**13.1**

*Note: For pedestrian and bicycle injuries, the above scaling factors are reasonably valid because there are virtually no ped'n/cycle-only crashes in CAS. For motorcycles however, there are single and multi-vehicle crashes already recorded in CAS and the scaling factors given above were if they were each applied to the ***total*** number of motorcycle serious injuries. To scale up *separately* the numbers of m'cycle-only and m'cycle-vs-vehicle injuries in CAS, the relevant scaling factors would be:

- Motorcycle-only incidents 6.38
- Motorcycle incidents involving another party 1.85

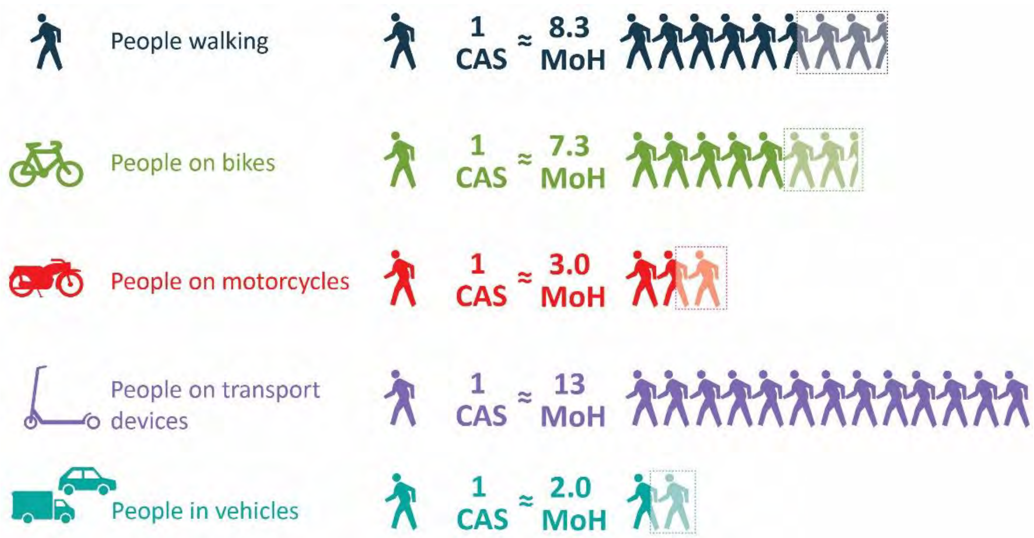


Figure 38: CAS/MoH under-reporting rates by modal sub-groups (2016-19) – dashed boxes highlight where another party was involved

Further calculations can be determined for various groups of different road users, as well as combining deaths and serious injuries (DSIs). Appendix A provides a wide range of different scaling factors to apply examples of how to use them.

7.2 Secondary causes of incidents

The high number of serious injury events not involving a motor vehicle (particularly involving slips, trips and falls) raises the question of whether defects in the transport environment led to these injuries, or whether they were precipitated by medical events that led to the person suffering a fall of some sort.

There are no secondary codes in the MoH data that can easily determine the cause of the incident. There are classification rules about sequencing of codes and there is the "condition onset" flag, which is a means of differentiating those conditions that arise *during* an admitted patient episode of care, from those arising *before*. If there is clinical documentation within a health care record that states a medical event led to a fall, then the clinical coders will likely capture this information using free text in the code description field.

"Free text" descriptive information was requested from MoH to see whether this might glean additional clues about the nature of various incidents recorded at hospitals. Manual inspection of the text fields identified various common terms that were counted to ascertain their prevalence.

Using the free text field and the relevant codes, it was possible to further understand the issues that have led to death or serious injury from single person incidents in the transport environment. Understanding the causes of these incidents, could lead to Auckland Transport influencing changes to reduce the likelihood and severity of these incident types. The following selection criteria has been used:

External factor code W (falls) excluding:

- Falls involving water skiing and snow (skiing, boarding, skating)
- Other fall on same level due to collision with or pushing by another person
- Falls whilst being carried by another person

Where the incident occurred (Y codes):

- Street and highway (sidewalk)
- Street and highway (Cycleway)
- Other public highway/street/road

This identified the largest portion of these injuries were a result of a person slipping, tripping or stumbling, with tripping being the most reported cause of an injury (Figure 39). "Serious" injury is defined as at least one night stay in hospital.

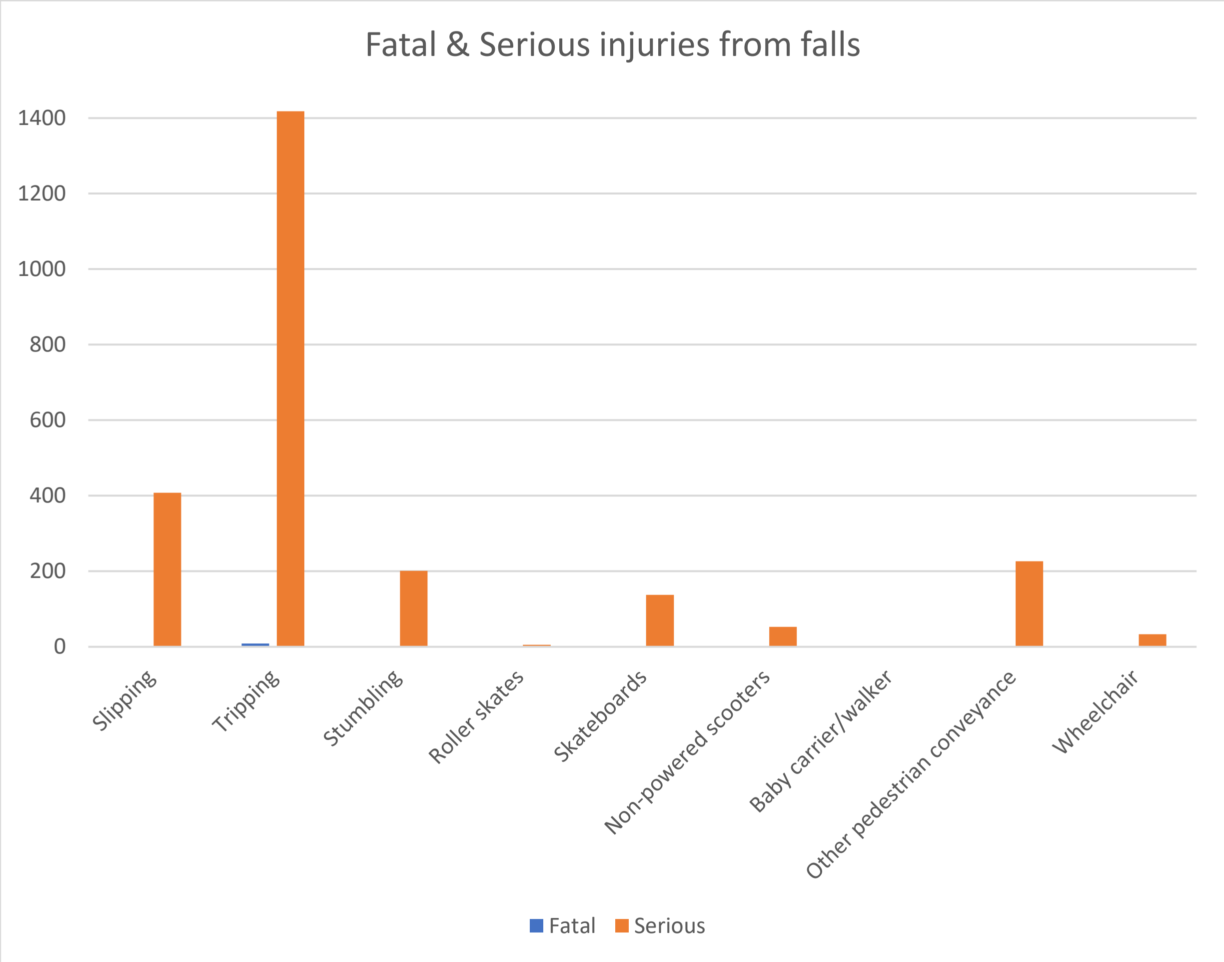


Figure 39: Admissions from slips, trips and stumbles in the transport space

While a reasonable proportion (around 6%, see Figure 40) of incidents noted the presence of alcohol, morphine or other drugs (including medicine) in the patient's system that may have contributed to their injuries, very few (less than 1%) identified some other kind of medical incident (e.g. heart attack) that may have precipitated the resulting fall (see Figure 40). Therefore, it can be reasonably assumed that most VTU injuries captured here are either result of user error/behaviour, vehicle/device faults, or defects in the road/path environment.

The following sections look more closely at the different causes of these types of injuries.

7.2.1 Fall on same level (slips, trips and stumbles)

On review of the MoH entries, the three different causes of all falls on the same level have been considered together due to coding of "trip, slip, fall" being common through the three codes (W010-W012 codes, 3246 entries). From these entries, just over 2000 injuries involved at least one night stay or more in hospital, and there were 10 fatalities.

There was insufficient information to further clarify what happened in the incident for approximately 790 records and were recorded therefore recorded as unspecified activities, leaving just over 1200 records for further investigation. Figure 40 summarises the key causes identified in the data.

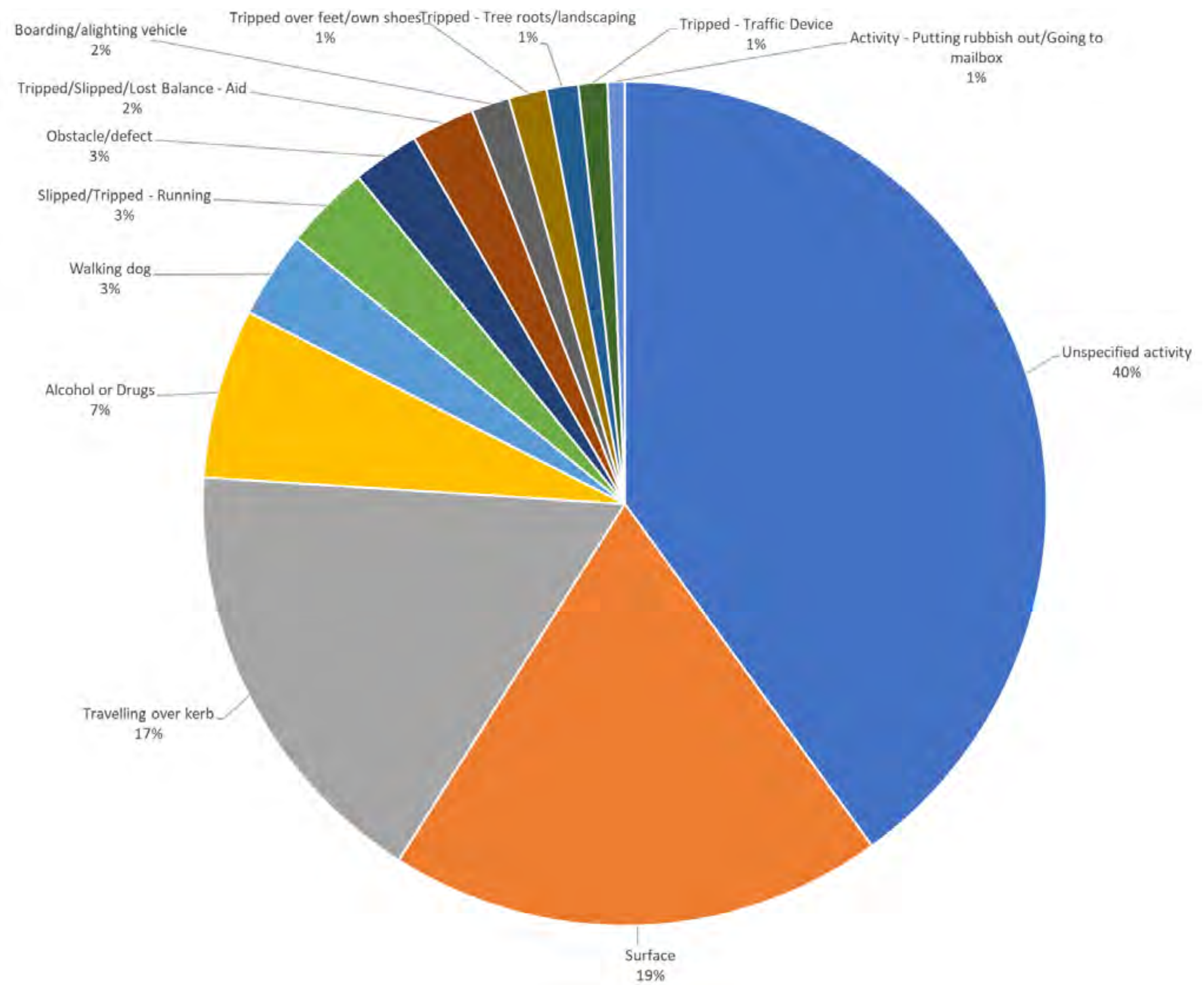


Figure 40: Causes of slips, trips and stumbles in the transport space (2015/16 financial year – 19/20 fy)

Factors that are 0% have been removed from the above graphic. Exclusions include slip/trip when playing, traversing a steep grade, being distracted and from a medical event (4 from 2004 incidents).

The largest group of trips, slips and falls that required one or more nights stay in hospital (excluding those who died) occurred due to:

- surface issue (375),
- at the kerb (337),
- involving alcohol or drugs (129).

Uneven surfaces comprising cobblestones, gravel/stones, mud, loose pavers, and utility covers also caused a large number of injuries followed by wet surfaces (Figure 41). The main type of wet surface was the footpath/roadway but grass and leaves (18) also contributed to these single-person incidents.

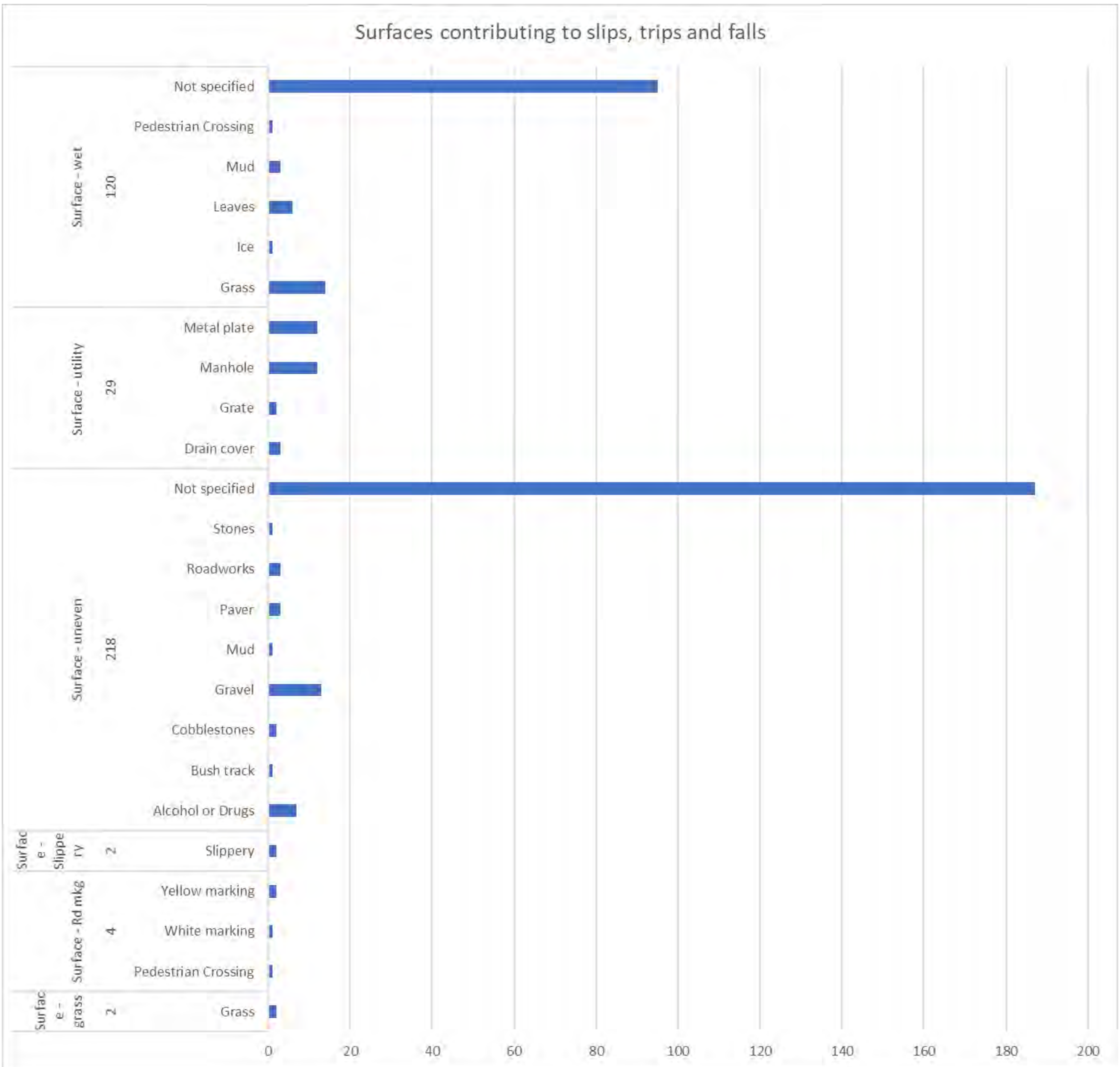


Figure 41: Surface issues contributing to slips, trips and stumbles in the transport space (2015/16 financial year – 19/20 fy)

Transport infrastructure and amenity also contributed to slips, trips and falls as can be seen in Table 8.

Table 8: Causes of Tripping

Tripped - Traffic Device	**22**	**Tripped - Tree roots/landscaping**	**24**
Barrier	1	Branch	3
Bollard	5	Flax	5
Fire hydrant	1	Flower	1
Island	3	Garden bed	2
Median	2	Grass	5
Raised marker	3	Lawn	1
Sign	6	Tree root	7
Signals	1		

The issue of people tripping over the kerb or slipping off the kerb is largely an issue for older pedestrians, with a large number of patients being over 60 and the highest number of patients being over 80 (see Figure 42). Where there was extra information, it could be determined that these generally involved people just walking to carry out daily activities such as shopping, going to the bank or church, or eating out.

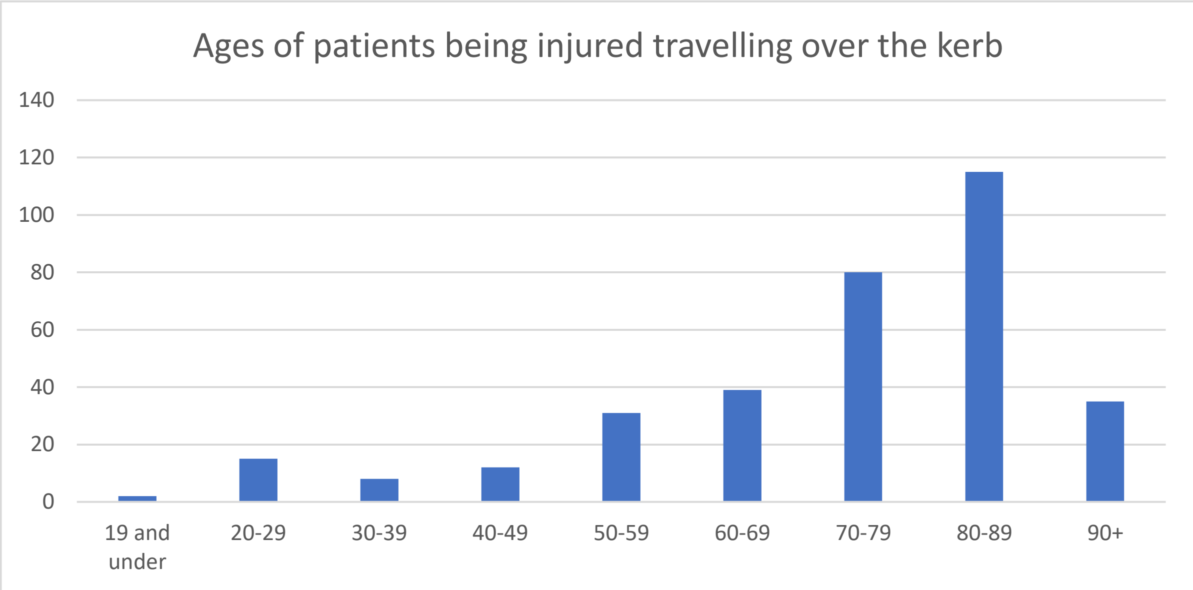


Figure 42: Ages of slip, trip and stumble casualties in the transport space (2015/16 financial year – 19/20 fy)

Unfortunately, there were 48 incidents were people who use an aid for mobility that tripped, slipped or fell. The causes can be broken down further, as shown in Figure 43:

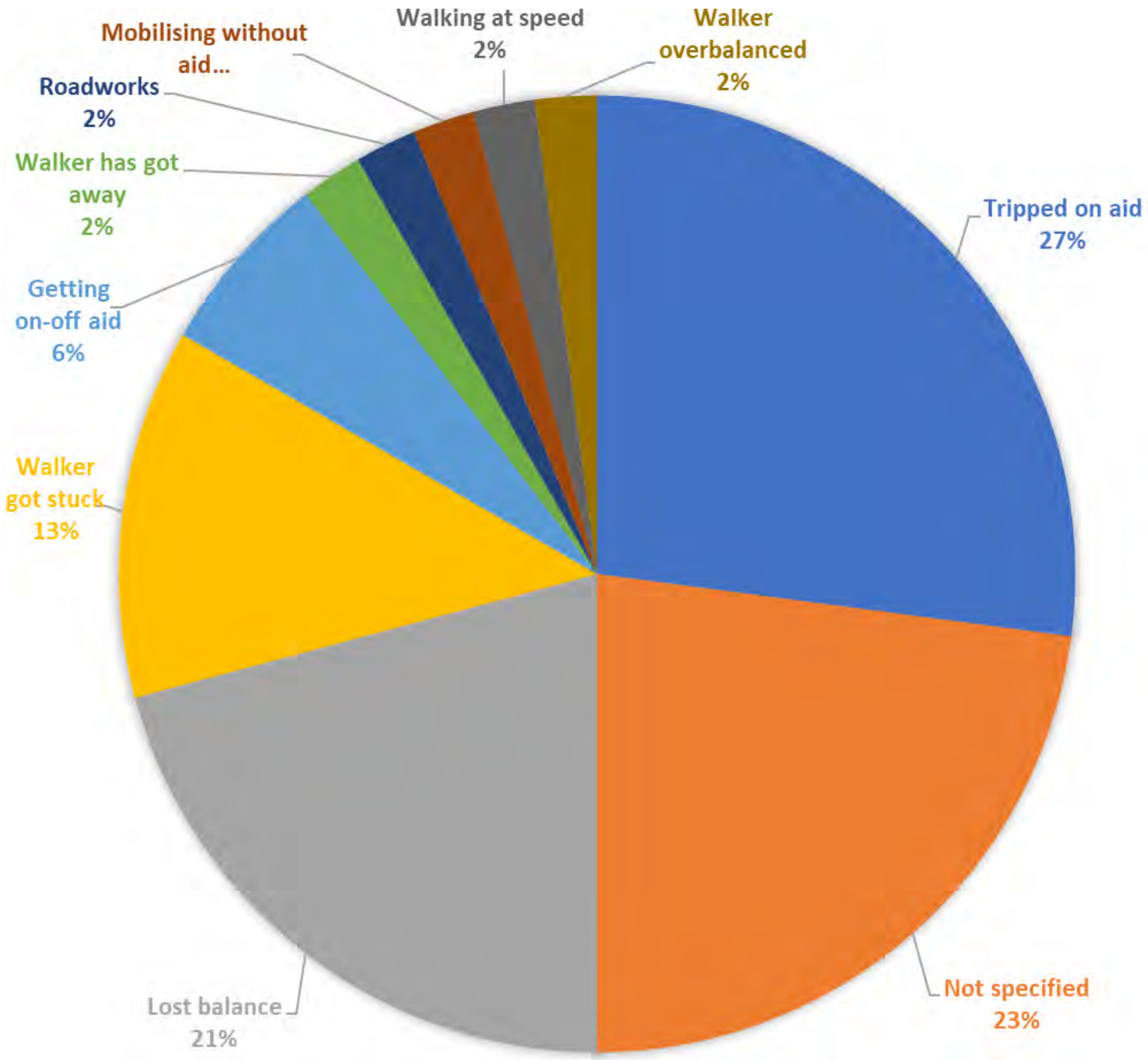


Figure 43: Causes of slip, trip and stumbles with aid(2015/16 financial year – 19/20 fy)

Two incidents occurred on Browns Bay Road and two occurred on Tamaki Drive. Three occurred outside of a rest home/hospital but locations in Auckland were not provided.

There were 62 incidents involving journeys by public transport, with 37 resulting in an overnight stay. Many public transport journey incidents involved a person either tripping or slipping (12) when running for the bus or slipped/tripped on an uneven surface whilst catching the bus (17) or just when boarding (1). Table 9 breaks down the key causes.

Table 9: Injuries related to public transport

Footpath (bus stop)		**33**	%
Not specified	Surface - uneven	3	*9%*
Footpath	Surface - wet	1	*3%*
Tripped on aid	Tripped/Slipped/Lost Balance - Aid	1	*3%*
Bricks/Pavers	Surface - uneven	1	*3%*
Lost balance	Unspecified activity	4	*12%*
Running to catch bus	Slipped	1	*3%*
	Slipped/Tripped - Running	9	*27%*
	Unspecified activity	2	*6%*
Rushing to catch bus	Slipped/Tripped - Running	1	*3%*

Walking to catch bus	Tripped on kerb	1	*3%*
	Tripped over feet/own shoes	1	*3%*
	Unspecified activity	5	*15%*
Boarding/alighting bus	Boarding/alighting vehicle	1	*3%*
	Surface - uneven	1	*3%*
	Travelling over kerb	1	*3%*
Footpath (ferry)		**1**	
Crossing bridge at ferry	Unspecified activity	1	*100%*
Footpath (Train Station)		**3**	
Running to catch train	Slipped/Tripped - Running	2	*67%*
Running to catch train	Travelling over kerb	1	*33%*

Figure 44: Causes of incidents in public transport journeys (2015/16 financial year – 19/20 fy)

7.2.2 Falls involving wheeled transport modes (excluding skateboards)

There were 379 incidents involving these modes, 225 of which resulted in at least one night stay in hospital (Figure 45).

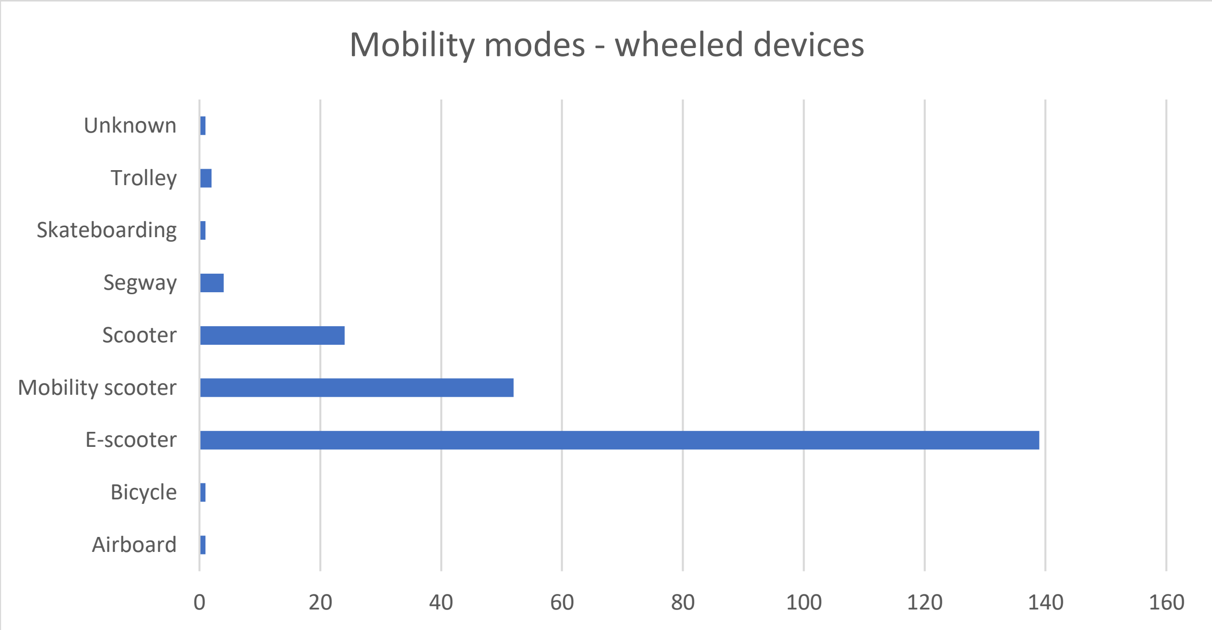


Figure 45: wheeled devices involved in single party incidents in Auckland (2015/16 financial year – 19/20 fy)

The definition of scooter is fairly loose in this category as it includes incidents involving motorised scooters in Rarotonga and Samoa, with a moped referenced in one of the incidents.

From those 139 incidents involving e-scooters in Auckland, the greatest cause of appears to be speed (19) with many injuries occurring when travelling downhill (14 of 19) – see

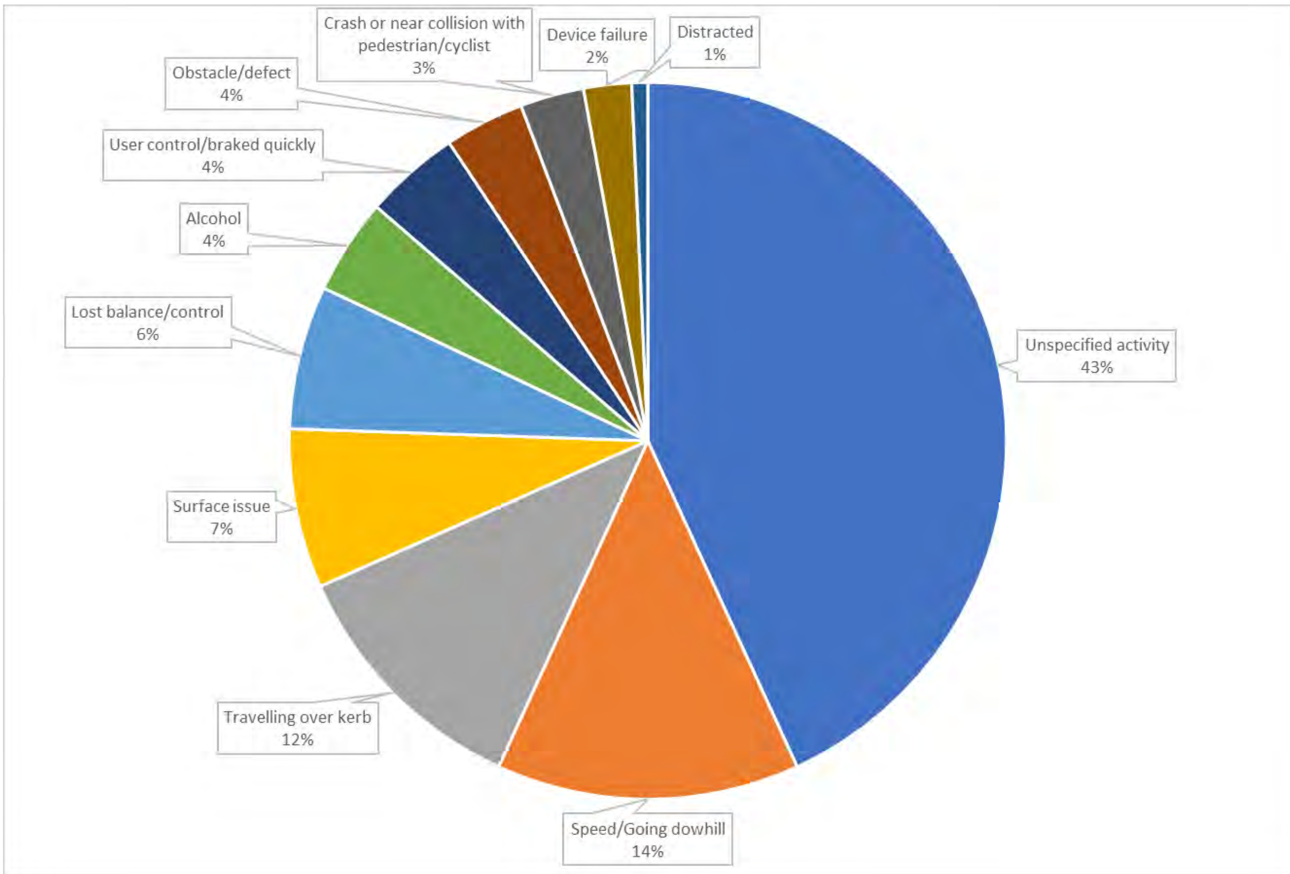


Figure 46.

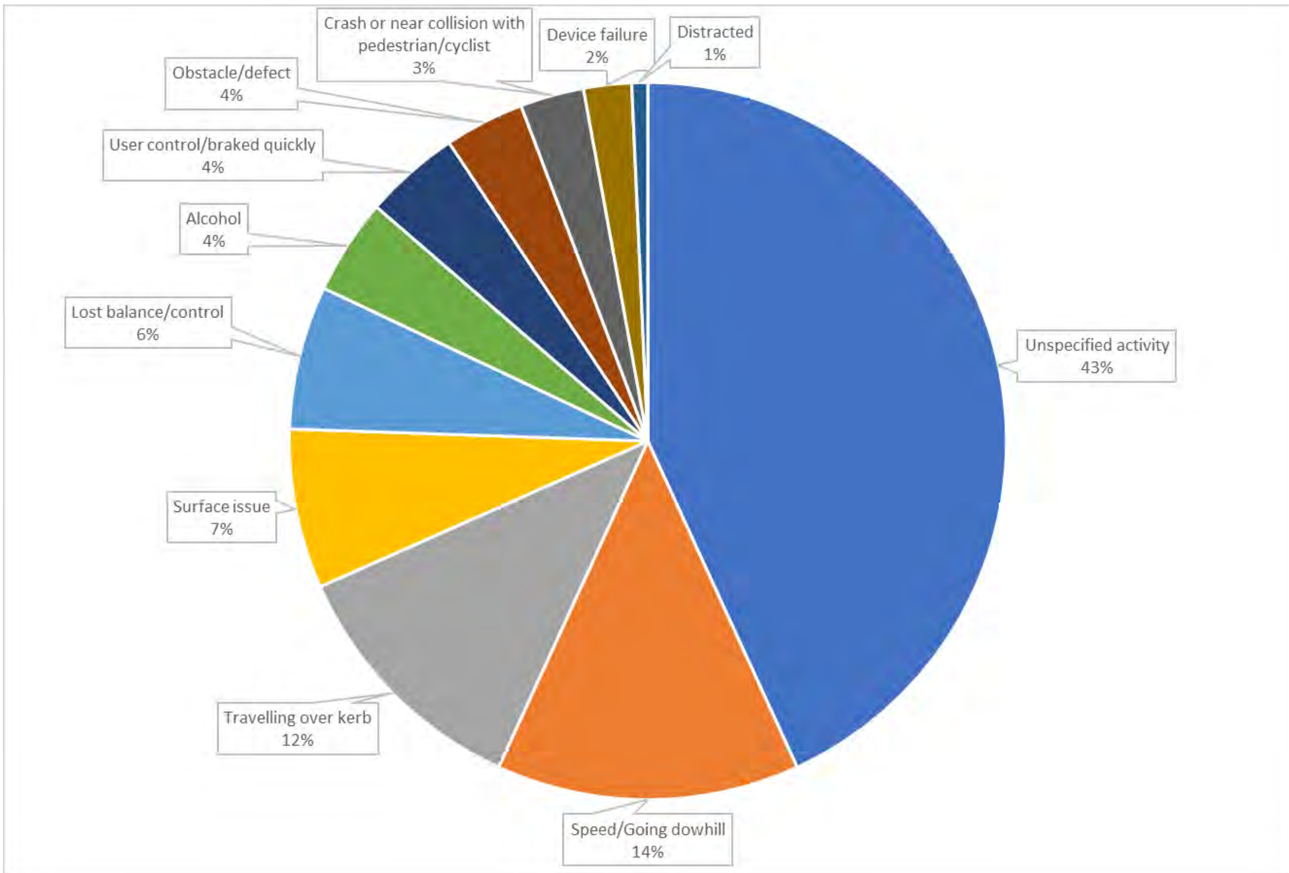


Figure 46: E-scooters in single party incidents in Auckland (2015/16 financial year – 19/20 fy)

The next biggest cause of falls on an e-scooter were a result of riders were travelling over the kerb. Other incidents were a result of the surface (wet, uneven, tram tracks, tree roots), riding whilst being towed by a vehicle (2) or pulled by a dog (2) and when performing wheelies and tricks (1).

From the remaining incidents the next largest group were incidents involving mobility scooters, with 56 of the 66 incidents resulting in an overnight stay or more on being admitted to hospital. The greatest cause of this type of incident was when the mobility scooter travelled over the kerb and the user has fallen from the scooter.

Speed when travelling downhill, footpath defects and tree roots, and device failure were also contributing factors to single party incidents involving a mobility scooter.

The modes that make up the remaining incidents (excluding bicycle and skateboards as these are coded incorrectly) involve scooter users, again the definition is quite varied, Segways, a hoverboard and airboard. Similar contributing factors as identified for other wheeled transport devices above, are also identified in the free text fields for these modes also.

7.2.3 Falls involving skateboards and non-powered scooters

There were 373 incidents involving these modes, 196 of which resulted in at least one night stay in hospital. Unfortunately there was little further information for 118 of the incidents, but from the remaining entries, the following contributing factors (Table 10) were included (using keywords in free-text field):

Table 10: Main factors involving skateboards and non-powered scooters

Speed	Infrastructure	Hazards	Behaviour
Travelling downhill	Hitting kerb	Swerved to avoid pedestrian	Alcohol/intoxicated
Speed	Footpath/roadway defect		Completing tricks
	Surface issue		Being towed by a vehicle

7.2.4 Fall involving other transport modes (baby carriers/walker)

There was only one entry (W027/W028 codes) where an overnight stay was recorded. The incident involved a person walking pushing pram and slipped (unspecified location).

There are possibly 3 minor incidents (based on stay in hospital) from 12 recorded in this category that are related to infrastructure:

- Wheel stuck on pavement edge (Gardner Road)
- Grandmother tripped on footpath (Woodward Road)
- Fall involving walker at curb (unspecified location)

Others appear to be a fall from the chair (sitting/standing on top) or through a defect with the chair (buckling wheels).

7.2.5 Fall involving wheelchair

There were 33 incidents involving a fall from a wheelchair (W05 code), where the patient spent one or more nights in hospital. There were several incidents where the person had due to infrastructure in the transport space:

- Going over the kerb/Rolled over kerb (7)
- Footpath defects, rough surfaces and potholes (5)
- Wheels trapped in gutter/drain (2)

The above analyses provide useful insight into the data available from the free-form codes.

Recommendations

Agency	Recommendation
Auckland Transport	▪ That reporting to the Board provides numbers for walking, cycling, motorcycling and transport devices, and also includes single person incidents so that projects and programmes can be developed to reduce the number of serious hospital admissions. ▪ Arrange data sharing agreement with MoH.
Auckland Road Safety Partners	▪ Agreed consistent categorising of "scooters" of all types to differentiate between powered and non-powered scooters, moped style scooters and mobility scooters.
Government transport agencies	▪ AT work with the MoH to standardise entries to make analysis more efficient, especially regarding transport-related injuries. ▪ Encourage MoH to collect location data (where incident occurred) as a free-text field to allow data to be used to identify localised issues that can be addressed.

8 Further analysis of Accident Compensation Corporation Data

A further review was made of the relevant VTU data from ACC, particularly looking into identifying the relative severity of different injuries reported, and the identification of accidents that occurred on roads/paths vs other location.

The original query in Phase 1 of the Deep Dive to ACC provided aggregated data that was difficult to determine much from. In order to request further information that would provide more insights, enquiries were made into how the data was sourced from clients that presented with an injury. A more comprehensive request was sent to ACC but for they were unable to provide that level of detail without significant suppression for confidentiality, so it was modified further. This avoided having the original data request needing to be submitted through the ACC Ethics process[14]. The specific information scope requested was:

- **Location** - Auckland (breakdown initially based on the territorial authorities prior to the creation of the super city rather than aggregated to Auckland location, but replaced with Auckland as one location to expedite request)
- **Accident scene/place of injury** - 'Road or Street' or 'Place of Recreation or Sports'
- **Period of time – 2015-2020** (per year, not aggregated)
- **Specified transport modes (not aggregated)**: Pedestrians, Wheelchair users, Bicycle, Motorcycles, Other transport Devices/Micro-mobility - E-scooter, Scooter (non-motorised), Skateboarders

Particular targeted data requested was:

1. New claims, active claims, and claim costs for specified transport modes for **single-party incidents** (single part incidents include slips, trips and falls and loss of control it does not involve a crash with another mode and motor vehicles are not involved).
2. New claims, active claims, and claim costs for specified transport modes above where there is a **crash with another mode** or a motor vehicles is involved.
3. New claims, active claims, and claim costs for specified transport modes for both single-party incidents and crashes involving other modes including motor vehicles by **ethnicity**.
4. Data for the **severity** of injury for specified transport method (as specified above) and **age** for single-party incidents and crashes with another mode including motor vehicles.
    - Fatal claims
    - Serious Injury claims (mostly includes claims that require 24 support, like spinal injuries, severe brain injuries, etc.)
    - Claims with an entitlement (weekly compensation, vocational rehabilitation, hospital treatment, or support for independence)
    - Claims with medical fees or miscellaneous costs only
    - Claims with no active costs
5. Data from **diagnosis category** for specified transport method (as specified above) for single-party incidents and crashes with another mode including motor vehicles.
    - soft-tissue injuries (contusion, internal organ, strain)
    - fractures and dislocations
    - lacerations and puncture wounds
    - burns and scalds

[14] See https://www.acc.co.nz/about-us/research/ for more information.

- concussion or brain injury
- dental injuries

In addition, a separate general ACC dataset of claims from falls was also obtained for comparison, although this was not specific to just the road environment or focused on VTU incidents.

8.1 Preliminary analysis of data

Despite attempts to be specific about the type of data required, the resulting dataset was still constrained in what was provided. Unless a specific *"accident sport"* or *"accident vehicle"* category was available for a particular transport mode of interest, the data analysis was reliant on picking up relevant keywords in the *"accident description"* field; for example, looking for "lime scooter", "wave scooter", etc to identify an e-scooter incident. It is likely therefore that the dataset underestimates the full extent of the injuries that have occurred; typically only 5300-6000 VTU injuries a year in Auckland have been captured.

This is particularly so for pedestrian injuries not involving a motor vehicle, which would not have been funded by the ACC Motor Vehicle account and therefore not captured in this dataset. The data records on average fewer than 750 pedestrian injuries a year in Auckland, far fewer than the serious slip/trip/fall injury numbers noted in Section 7.2.1, and probably generally only capturing those incidents involving a motor vehicle.

Due to covering everything from minor injuries treated by a GP to major incidents requiring ongoing care, ACC data in theory captures far more events than the MoH data that only records hospital-based admissions. For example, ACC fall data suggests that ~17,000 fall-related claims are made for road-based incidents in the Auckland region every year on average, whereas the previous MoH analysis of falls in Section 0 indicated that only ~2500 of those each year are pedestrian or wheeled transport device incidents serious enough to end up in hospital at least overnight. Of those 17,000 falls, the main mechanisms noted are "loss balance / personal control" (58%), "tripping or stumbling" (24%), and "slipping, skidding on foot" (15%). If we focus on instances of people tripping or slipping on surfaces, then this suggests that ~40% of the total falls could be considered related to hazards in the transport environment rather than a failing of the user. It should be noted that this larger dataset may possibly include falls within motor vehicles as well; for example, stumbling while on board a bus.

Although targeted data was obtained for both the "road or street" and "place of recreation or sport" locations, the latter category was still problematic in being used for understanding VTU injuries away from road corridors. This is due to it also capturing incidents in non-transport locations such as skate-parks and mountain-bike trails, which are not really of interest to Auckland Transport (whereas the likes of off-road pathways such as the Northwestern Cycleway or Twin Streams Pathway would be). As a result, considerably more fall incidents are recorded in recreation/sports locations than on the street; for example, approximately 52,000 falls a year in the Auckland region – no doubt many of them not involving walking/running or a transport device but rather arising from other activities like playing sports. Generally it was difficult to infer much of relevance from the recreation/sports claim data, so the focus was put on the road/street data, even with its limitations noted above too.

In terms of ethnicities, Europeans are by far the most predominant group (typically 55-65% of injuries), ranging from 43% of pedestrian injuries to 71% of wheelchair injuries. Asians tend to be the next most common, particularly with e-scooters (24%) and as pedestrians (23%) but not so much with motorcycles, skateboards and bicycles (10-12%). Māori are more prevalent in motorcycle injuries (15%) and as pedestrians (13%) and less so for wheelchairs and e-scooters (7%). Pasifika people, typically featuring in 6-7% of injuries, are more commonly involved in pedestrian injuries (13%) and less so with e-scooters (3%).

The data does suggest that by far the bulk of ACC VTU injuries are not "serious" or "entitlement" claims (e.g. if ACC has paid for weekly compensation, rehabilitation, or elective surgery) but rather for just minor other costs such as medical treatment at a local GP or hospital outpatient, or in some cases no costs paid at all. For example of the ~2300-2700 bicycle injury claims a year, typically only ~10% are serious or entitlement claims and a further ~7% receive no costs paid. Perhaps not surprisingly, given their higher speeds, motorcycle injuries are more likely to result in serious/entitlement claims (~26%). Other serious/entitlement rates for other transport modes include ~20% for pedestrians, ~16% for e-scooters, ~11% for skateboards, and ~6% for kick-scooters. The relative fragility of different age groups no doubt has some influence on the likelihood or not of serious vs minor injuries; for example, the median age of kick-scooter injury claimants is under 15 years whereas the median age of pedestrian injury claimants is ~35 years.

Soft tissue injuries comprised by far the most common injury types (typically 40-60% of claims in each transport user type). Lacerations and puncture wounds were generally next most common (ranging from 16% of pedestrian injuries to 37% of scooter injuries), followed by fractures and dislocations (13 – 20%). Notable exceptions were motorcycle injuries, where fractures (21%) were more prevalent than lacerations (19%), and wheelchair users, 73% of whom suffered soft tissue injuries and just 5% fractures. Relatively few dental, concussion or other injuries were noted; typically about 7-8% of injuries collectively. Figure 47 summarises the key injuries by mode.

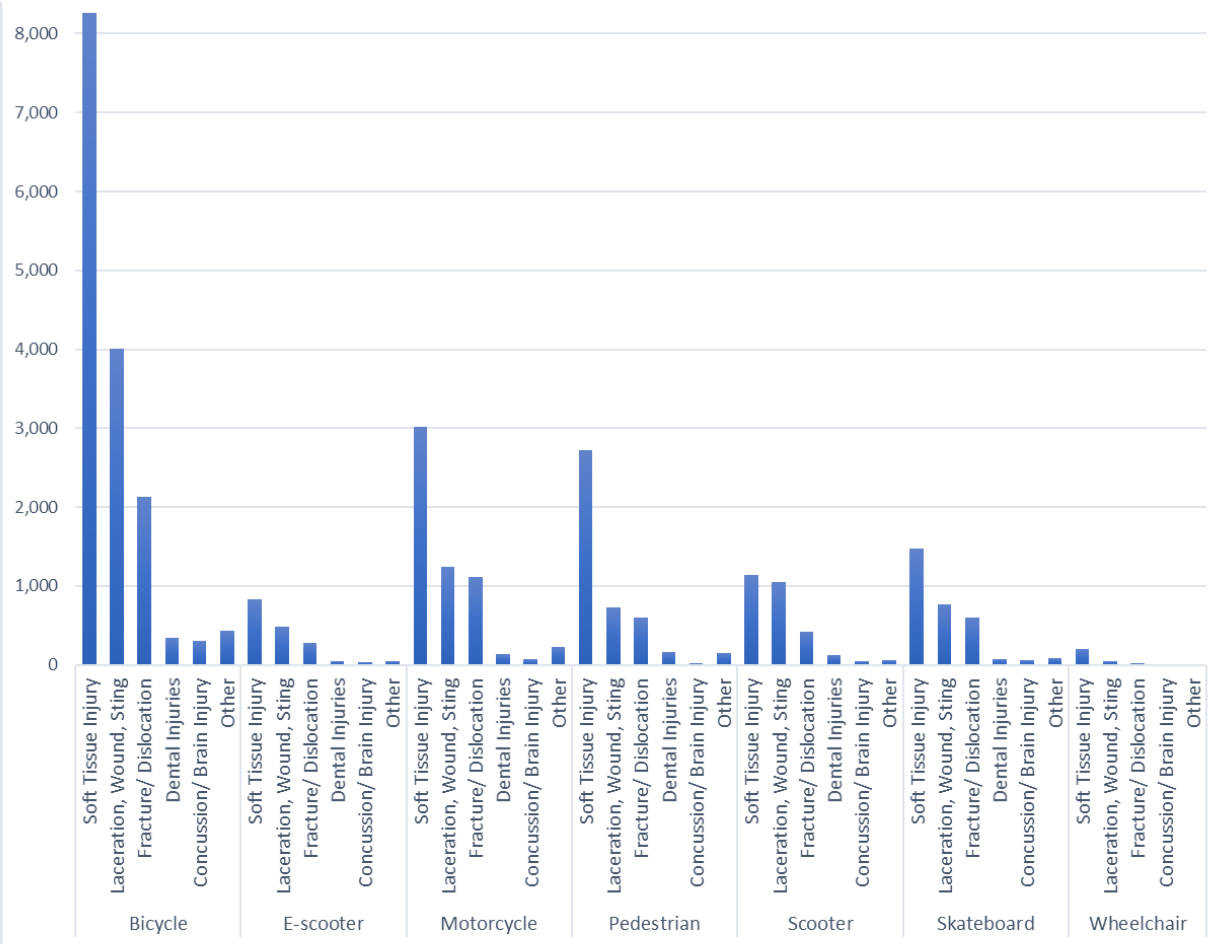


Figure 47: Injury type by mode (2015-2020) that occurred in the road or street category

As noted above, unfortunately the ACC data has still proven to be somewhat limited in what it can explain, due to difficulties in identifying the specific data of interest.

Recommendations

Agency	Recommendation
Auckland Transport	• AT to seek ACC data sharing agreement
Auckland Road Safety Partners	N/A
Government transport agencies	▪ Further work is recommended with ACC to make better use of the existing data and to also investigate options for making captured data going forward even more useful (including standardised use of free-text fields). ▪ ACC to consider how to better differentiate trips/falls on public paths (both next to or away from road corridors) from trips/falls in other private, commercial or recreational settings.

9 Demographic analysis of walking injuries

A demographic analysis of communities in Auckland has been conducted to identify those areas where residents may be more susceptible to user-only serious injuries when walking such as falls (particularly where more older or disabled populations reside). Details of this analysis are described below.

Note that a similar exercise could also be undertaken to ascertain higher priority areas for cycling improvement although, given the typically further distances that people cycle, personal residential locations may be less relevant to the analysis.

9.1 Estimation of higher priority areas

To understand where the areas of higher risk are for pedestrian journeys, particularly for older and impaired people, GIS was used to map the indicative numbers of "high priority" people across the Auckland region.

The analysis used data from the 2018 national Census. The 2018 Census data is built up from small "meshblocks" into units called Statistical Area 1 (SA1), which are typically 100-200 residents each, and in turn into Statistical Area 2 (SA2) units, typically with 1000-4000 residents. While some initial testing of this data used plots with SA1 units, many of them are too small to give meaningful comparative statistics (and practical information related to adjacent/nearby paths), so SA2 units have been used instead; geographically they still seem sufficiently fine-grained enough (over 550 units in Auckland).

For each SA2 unit, the following inputs from our Census 2018 dataset have been collated:

- Area of the SA2 unit in square km: used to normalise data on a density basis
- Modal data on main means of travel to work and study: While interested primarily in those who walk/jog, those using a bus/train/ferry are also considered as it's likely that they may use an active mode to get to their PT mode.
- Older demographic data: The numbers aged in their 50s, 60s, and 70+ have been grouped. For now, the 50-59 group haven't been included in the calculations (the previous work in Section 3.3 showed that serious injury walk risk increased notably from age 60 up), but they could be included as an option for future-proofing.
- Impairment data: Those who reported either "some difficulty" or "a lot of difficulty" with walking and climbing steps, seeing, or hearing have been identified.

Using this raw information, the following hypothesis can be tested:

The demand for good/safe path standards/maintenance ***is highest*** *in areas with greater densities of older or impaired people* ***and*** *where there is more likelihood of people walking (inferred from the amount of walking travel for work & study)*

This thinking has been applied to calculate the following variables:

- Estimated total "people of interest" – currently combining those over 60 years old and some of the mobility (physical) and sensory (hearing & sight) impaired. The 2013 *Statistics NZ Disability Survey* has the most recent data on disability prevalence in Auckland; it found that ~50-60% of those with some physical, hearing or vision disability were aged under 60, so a 0.5 factor has been applied to these numbers to minimise double-counting (notwithstanding the fact that some people will have multiple impairments).

  People of interest = {Age group 60-69} + {Age group 70+) + 0.5 × {Difficulty walking} + 0.5 × {Difficulty hearing} + 0.5 × {Difficulty seeing}

- The total number of people of interest is divided by the SA2 area (sq.km) to determine the "people of interest" density per area. Not surprisingly, it's typically the highest for the area units in the central city and around some town centres.

  People of interest density = {People of interest} / {SA2 area}

- The relative proportions of walk to work/study (relative to the total numbers of people who travelled to work/study and did not stay home)_are combined with a proportion of those who used PT to estimate the "propensity to walk" in an area. For now, it is assumed that 80% of PT users walked there first.

  Propensity to walk = {Proportion of people WALK or JOG to work or study} + 0.8 × {Proportion of people using PT to work or study}

- The final "walk scores" are multiplicative combination of the density of high priority people and the propensity to walk proportions. The resulting absolute numbers aren't of themselves directly meaningful; rather, it's the relative differences between them that are of interest

  Walk score = {People of interest density} × {Propensity to walk}

Taking all of the above factors into consideration, the walk scores have then been plotted on the SA2 units on a map; the attached plots (Figure 48 & Figure 49) show the resulting spread of values across Auckland.

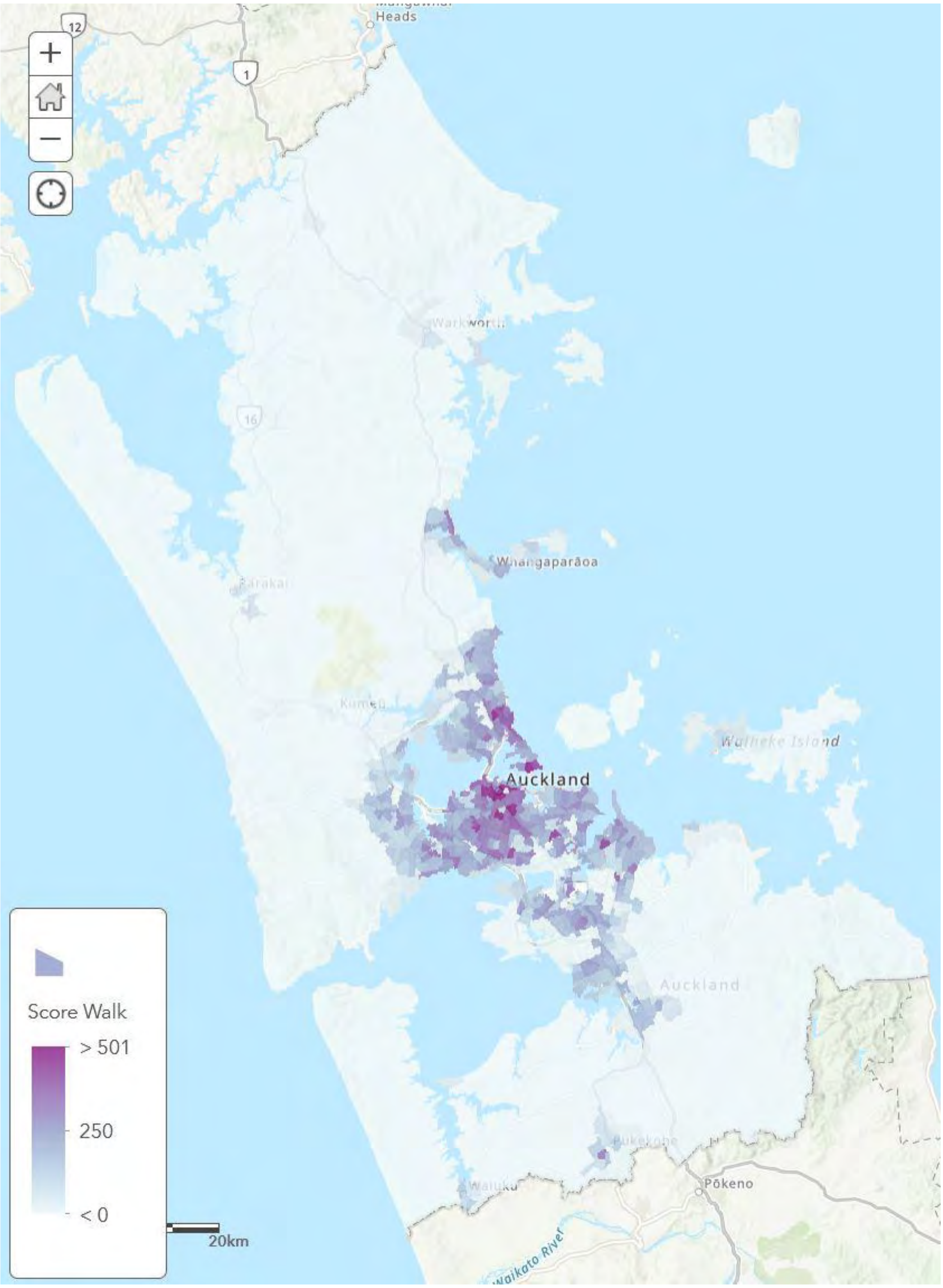


Figure 48: Walk score for greater Auckland

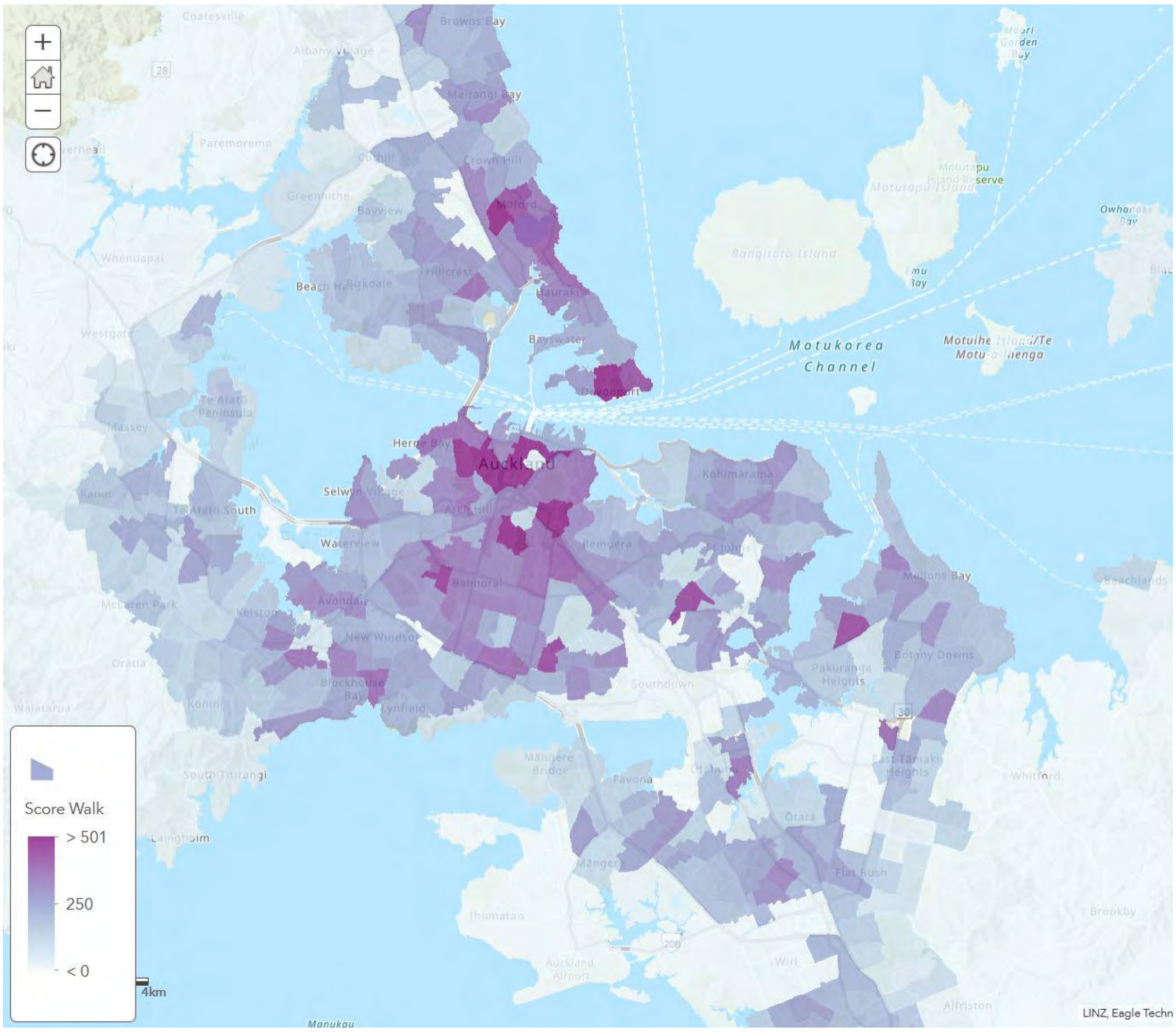


Figure 49: Walk score for central Auckland

Note that these maps don't show where the serious walk injuries actually *happened*; just where it is estimated (all other things being equal) they would *most likely* be (and where it might be best to ensure adequate path maintenance funding occurs). If higher than expected serious injuries occurred in some locations other than where these plots would suggest, then one could also look in more detail as to why that is.

9.2 Locations of actual walking incidents

One potential way to do this is to plot the MoH serious injury data against their domicile code locations as a basis of comparison (i.e. do they somewhat match with the above analysis? If not, why not?). However, there are at least a couple of aspects that make this difficult:

1. The MoH domicile code locations don't match the Stats NZ SA2 units; in Auckland there are ~450 of the former and ~560 of the latter.
2. There is no certainty that people had their incident in the same location as where they live (indeed; quite unlikely in many cases one suspects). So a map of serious incidents per domicile may not be useful.

Nevertheless, an analysis has been undertaken of the pedestrian user-only injuries in Auckland over the five years 2015-20, disaggregated by the reported domicile code locations for each patient. To control for variations between domicile areas, the data has again been normalised by the size of each domicile area to produce a relative "pedestrian injury density". Figure 50 and Figure 51 show the respective distributions of these injuries across Auckland.

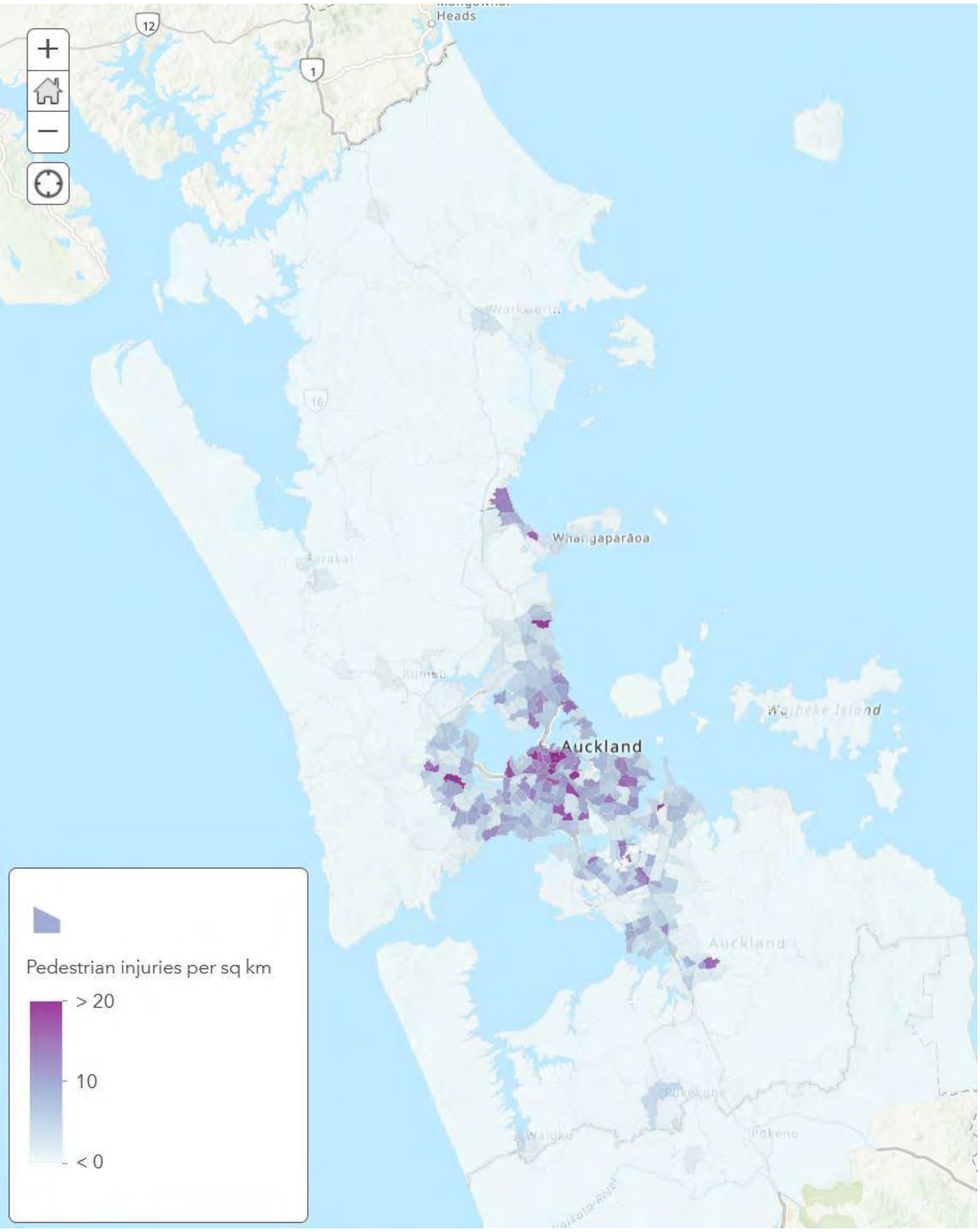


Figure 50: Pedestrian injury density for greater Auckland

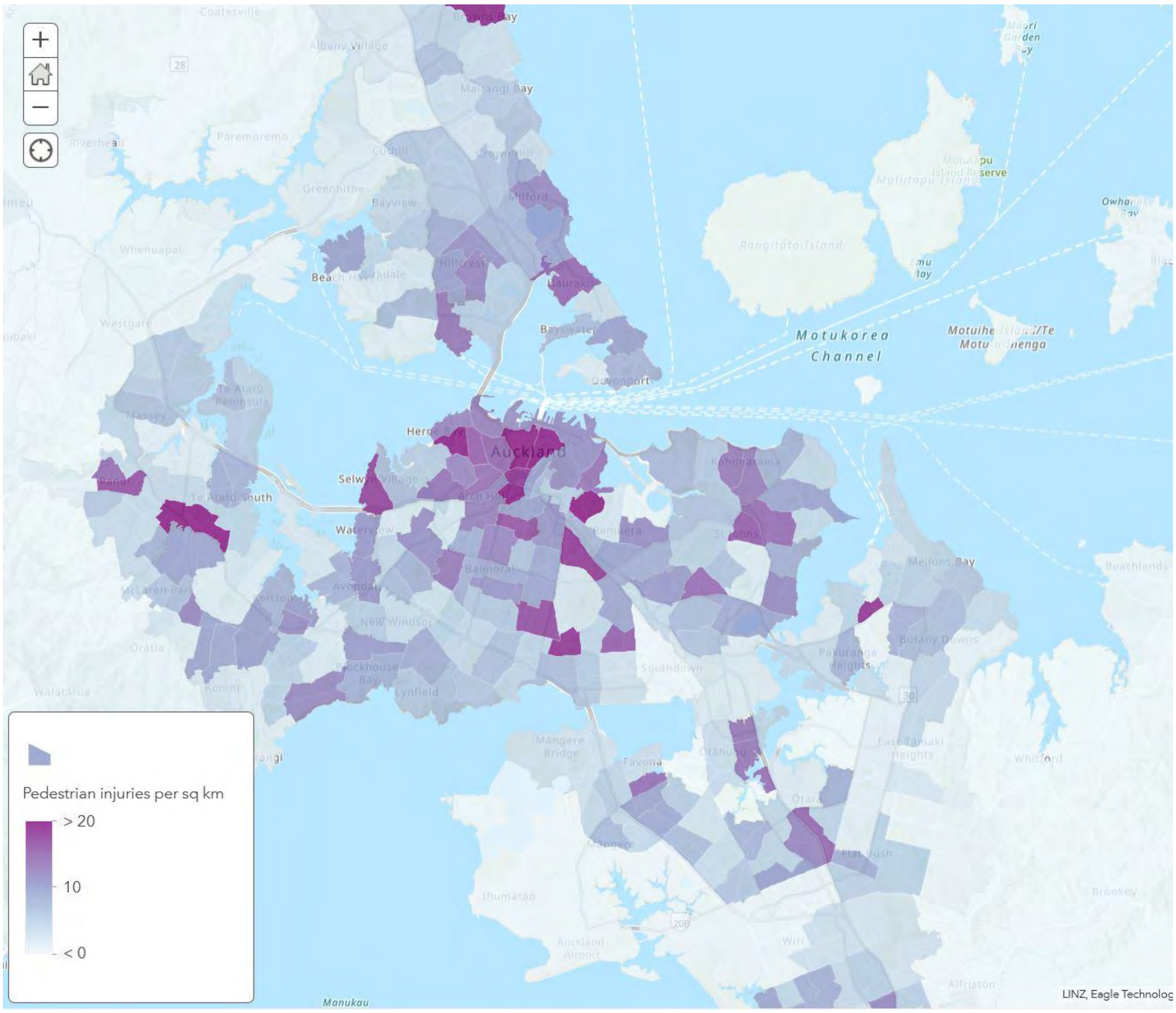


Figure 51: Pedestrian injury density for central Auckland

Comparison of these plots with the theoretical analyses in Section 9.1 reveal some differences in the highest scoring areas. For example, reported injury density appears to be higher than expected in Stanmore Bay West, Browns Bay, Henderson North, Point Chevalier West, and Papakura East. Conversely, locations where injury density appears to be less than expected include Westlake, central Devonport, Newmarket and Pukekohe South. Meanwhile, some locations do seem to be fairly correct in matching high walk scores with high reported injuries, including parts of downtown central Auckland, Royal Oak and Pakuranga North.

Recommendations

Agency	Recommendation
Auckland Transport	▪ Consider targeted investment of footpath maintenance in areas identified as high priority or where pedestrian injury density is already high
Auckland Road Safety Partners	N/A
Government transport agencies	▪ Waka Kotahi to consider the safety role of footpath maintenance, and the relative risk metrics from Census/MoH data when allocating funding for this work across RCAs

10 Health & Safety

10.1 Worksite data

A number of single-person-only incidents have occurred at transport worksites around Auckland such as roadworks (see Figure 52). This information is collated by the Temporary Traffic Management (TTM) Team at Auckland Transport, and it is an area where further reporting and monitoring should be completed. They provided the following feedback:

- The Team started reporting incidents from 2014 using CAS as a starting point. This was then used to trigger requests for reporting of crashes by the parties involved. Unfortunately, due to the delayed reporting of crashes in CAS and staff changes it wasn't possible to keep up with this method. There are insufficient resources in the team to re-initiate this process and use the data collected.
- On the plus side, since 2014, there has been an increase in reporting from contractors and typically the Team receive about 6 per month on average. Lack of resource is again cited as a reason for not being able to collate and use data.
- Monitoring indicates about 50% of worksites are passing the site inspections whilst the remainder show a failure to meet the required standards. This could be at the low end of a failure with some key controls missing (increasing the risk of more significant safety risks) through to significantly dangerous worksites (which we will typically issue a Stop work order for). The likelihood is that crashes of more than 6 per month are actually occurring and most will probably not be shown in CAS.
- It is agreed that the reporting could be more sophisticated than it is currently but would need additional resources.
- The Team have collated information on fatal incidents. They have picked up these crashes through a variety of sources (customer reports, complaints, evidence on site, questions and occasionally police & media reports) but WorkSafe is not one of them. Thus, invariably they will also be reported as transport related.

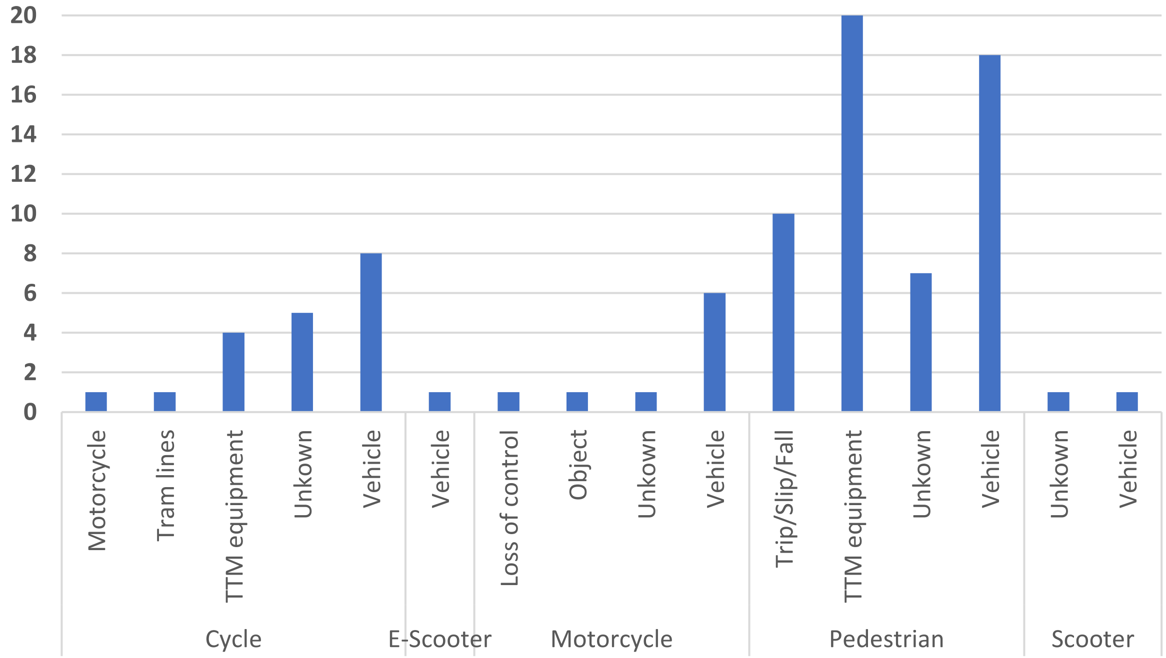


Figure 52: Contributing factors for VTU incidents at worksites from 2015-2021

TTM equipment such as cones, signs, and temporary fencing has been a contributing factor in single only person incidents. The details of the incidents are very short, but allude to pedestrians tripping over TTM, pedestrians hitting sign, a child running out between signs, and a cyclist nearly being hit by machinery.

It is also important to note the slips, trips and falls that have occurred at worksites. Details show that pedestrians have tripped on temporary surfaces/reinstatements, loose material, manholes and tripping over a curb possibly due to poor pedestrian management.

10.2 Heavy Vehicles and Construction Logistics and Community Safety (CLOCS)

CLOCS[15] is the United Kingdom national Standard that requires all stakeholders in construction to take responsibility for health & safety beyond the hoardings. It was initiated following a spate of construction-related fatalities in London around 2015, particularly involving cyclists and heavy vehicles. It demands collaborative action to prevent fatal or serious collisions between vehicles servicing construction projects and vulnerable road users: pedestrians, cyclists, and motorcyclists. Examples of practical measures are the use of additional mirrors and proximity detectors, and the installation of side under-run protection on workplace trucks.

CLOCS aims to ensure the safest construction vehicle journeys:

- zero collisions between construction vehicles and the community
- improved air quality and reduced emissions
- fewer vehicle journeys
- reduced reputational risk

A similar scheme, CLOCS-A[16], has also now been set up in Australia, and would have the potential to be picked up and applied New Zealand as well.

Recommendations

Agency	Recommendation
Auckland Transport	▪ There would be benefits for understanding the scale and detail of workplace incidents and providing additional time and resources to improve reporting in this area is recommended. ▪ Consider the potential to require CLOCS-like standards in vehicles for all companies working on AT construction projects.
Auckland Road Safety Partners	N/A
Government transport agencies	▪ Promote regulatory change to require improved vehicle design that considers the safety impact of the vehicle and that commercial vehicles are designed to give the driver maximum direct visibility around their vehicle.

[15] https://www.clocs.org.uk/

[16] https://www.clocs-a.org.au/

11 Monetised Benefits and Costs Manual

The Waka Kotahi *Monetised Benefits & Costs Manual* (MBCM, Aug 2020)[17] states that *'Only a proportion of non-fatal crashes that occur are recorded on TCR [Traffic Crash Reports] and in CAS. This is referred to as under-reporting. It is generally assumed that all fatal crashes are reported.'*

To counteract the effect of under-reporting, factors are applied to reported crash numbers (TCR numbers) to estimate the total number of crashes that actually occur. The table below, A18 reproduced from the MBCM, shows the under-reporting typically used for economic evaluation purposes.

Table A18: Factors for converting from reported injury crashes to total injury crash

		Fatal	Serious	Minor
50, 60 and 70km/h speed limit	Pedestrian	1.0	1.5	4.5
	Other			2.75
80 and 100km/h speed limit (excluding motorways)	Pedestrian	1.0	1.9	7.5
	Other			4.5
100km/h speed limit remote rural area	Pedestrian	1.0	2.3	13.0
	Other			7.5
Motorway	All	1.0	1.9	1.9
All	All	1.0	1.7	3.6

These figures illustrate the fact that:

- Under-reporting is typically greater in more remote and rural locations, further away from emergency services
- Under-reporting is typically greater for less severe crashes, i.e. not likely to require emergency services or medical treatment
- Under-reporting is typically greater for crashes involving pedestrian over those only involving vehicles, partly reflecting greater obligations on reporting for insurance purposes when a vehicle is damaged

Also of note is the fact that the current MBCM values do not differentiate between motor vehicles and other vehicles such as cycles or transport devices.

It should also be noted that the table focuses on scaling up of crash numbers, not injury numbers. While there is often a close (but not exact) one-to-one relationship between the two metrics for VTUs, this is less so for motor vehicle crashes where multiple occupants often within multiple vehicles (and thus multiple injuries) are more common, including lesser injuries within crashes with more serious injuries as well (and sometimes those more serious injuries are to VTUs).

There is some suggestion that, due to different demographic and operational differences, typical under-reporting rates in Auckland differ notably from these national rates. These rates also don't capture the significant under-reporting of VTU user-only incidents that are typically not recorded in CAS at all. Given the relative scale of casualty numbers in Auckland (particularly VTU numbers), it is considered important to develop specific under-reporting factors for Auckland only.

The findings from Phase 1 of this study (as documented in Section 3.2), showed that when comparing data collected by CAS and admissions numbers to hospital from the Ministry of Health, the actual injury numbers to drivers and passengers are slightly more than double what is captured by the Police (CAS); for other Vulnerable Transport Users the difference can be up to 8-9 times greater (including user-only incidents).

[17] https://www.nzta.govt.nz/resources/monetised-benefits-and-costs-manual/

Therefore, an attempt will be made to calculate an updated under-reporting adjustment table for Auckland, based on that in the Waka Kotahi MBCM, that takes into account motor vehicle and VTU injuries (including separate accounting for user-only incident numbers) and observed differences locally.

Notwithstanding some of the issues identified in Section 6 regarding fatality data, it will be assumed that there is no under-reporting of fatalities, i.e. the factors remain at 1.0. As discussed in Section 7.1, 93.5% of locally recorded serious hospitalisation injuries were found to reside in Auckland. As there were slight differences between VTU modes, the proportion of crashes per mode that occurred to people outside of Auckland were determined and also separated into user-only and motor-vehicle injuries, as previously listed in Table 7.

One problem that remains difficult to resolve is how to account for different reporting rates in different road environments. At best, a tenuous link could be made between residential domicile and likelihood of having an injury nearby and the relative urban or rural nature of each domicile area. However, it would require some data matching of CAS data localities against MoH domicile areas as well, which is beyond the scope of this current task.

Minor injury data presents a greater challenge to establish suitable under-reporting factors. Some of the issues identified include:

- The MoH data allows us to identify those patients who were only in hospital for <1 day and thus can be considered to have minor injuries; this also provides a relatively useful indicator of the split of user-only and motor-vehicle involved injuries for each mode. However, this dataset will not include those minor injuries that were treated elsewhere (e.g. local medical practitioners) and thus would only be picked up by ACC data.
- Within ACC data, a reasonable split of severity could be made by treating "serious" and "entitlement" claims as sufficiently serious injuries, whereas "other costs" or "no costs paid" claims could be considered at least a minor injury. However, the resulting figures appear to have fairly limited correlation with the equivalent MoH numbers; for example with ACC appearing to under-estimate serious pedestrian injuries and seriously over-estimate minor cycling injuries.
- As discussed in Section 8, ACC data provided may have some limitations in what has been collected. For example, ACC note: *"The accident vehicle variable is usually not populated if the claim is not funded from the motor vehicle account, so injuries to pedestrians that do not involve a moving motor vehicle on a public road are unlikely to be included."* While separate ACC data from falls provides another data point, this figure appears to be very overstated.
- Likewise the selection of cycling claims is potentially too broad: *"If the accident sport variable is "cycling" OR the accident vehicle is "cycling" (indicating the client was riding a bicycle and was struck by a motor vehicle) or the accident external agency is "vehicle - cycle" (indicating the client was struck by a bicycle)"*. It's not clear whether this definition may have possibly captured some recreational mountain-biking activity as well.

All this suggests that, for now at least, it may only be serious injuries where localised under-reporting factors can be applied. This might be sufficient at this stage to help inform DSI (deaths and serious injury) calculations for the likes of Urban KiwiRAP reviews. Table 11 provides some suggested under-reporting factors to use; more detailed figures and calculation examples can be found in Appendix A.

Table 11: Suggested CAS serious crash under-reporting rates by modal sub-groups

Mode	Crash type	Serious crash
Pedestrian	*Pedestrian-only incidents*	*5.6*
	Pedestrian vs motor vehicle	2.7
Bicycle	*Bicycle-only incidents*	*5.1*
	Bicycle vs motor vehicle	2.2
Motorcycle	*Motorcycle-only incidents*	*1.6*
	Motorcycle vs motor vehicle	1.4
Other wheeled transport devices (all crash types)		13

There is still a reasonable question about whether the presence of some pedestrian or cycle crashes with motor vehicles recorded in CAS in an area is likely to correlate to a similar number of user-only crashes. However, at an area-wide or corridor-wide level of analysis, this should be a reasonable assumption.

Note that these findings are currently only directly applicable to the Auckland context and should not be applied to crash/injury numbers in other parts of New Zealand.

Recommendations

Agency	Recommendation
Auckland Transport	▪ AT complete analysis to determine minor injury crash under-reporting rates. ▪ At complete analysis to determine under-reporting rates for crashes involving people in vehicles. ▪ Investigate further the relationship between road environment (urban, rural, etc) and typical under-reporting rates. ▪ That AT works with Waka Kotahi is use these updated scaling factors instead of ones currently in benefits cost manual
Auckland Road Safety Partners	▪ Work further with ACC to identify suitable injury data for VTUs in Auckland that could help properly quantify minor injuries
Government transport agencies	N/A

12 Conclusion

The above investigations have highlighted the considerable under-reporting of injuries to vulnerable transport users in Tāmaki Makaurau, particularly for incidents not involving a motor vehicle. It is likely that commonly used transport data sources such as CAS under-estimate the true scale of harm occurring to our least protected users, both from motor vehicles and from hazards in the surrounding transport corridor environment. Evidence also suggests that we are yet to see significant reductions in these numbers from recent road safety efforts in the city.

13 Recommendations from Phase 1 and 2

13.1 For Auckland Transport

That Auckland Transport investigates the following recommended actions:

- CAS & MoH identify 'serious injury' as an overnight stay in hospital. It is recommended that AT identify the ACC definition of 'serious injury'.
- To use a consistent approach for 'serious injuries' for all data sources, including consideration of moving to the international MAIS scale for minor, moderate and severe trauma.
- That reporting to the Board provides numbers for walking, cycling, motorcycling and transport devices. The recommendation to separate out Transport Devices from Pedestrian journeys is because they are likely to require a different response to journeys made on foot or with an aid that is needed for the purpose of the walking trip.
- That AT look to use specific scaling factors identified in this study to estimate likely true DSI numbers based on reported CAS numbers.
- Identify slips, trips and falls through other data sources such as the Customer Response Management Database.
- Continue to monitor casualties and collisions with further analysis and research into the causes of pedestrian death and serious injury crashes. This should include interviews with those hospitalised as a result of a collision.
- Undertake research examining pedestrian behaviour at different types of crossings to understand what is happening and look at the length of time pedestrians are waiting at the crossing.
- Review the survey findings currently being undertaken on Transport Devices to understand the use of micro-mobility in Auckland.
- in-depth research into all cyclist fatalities to understand all the factors leading to a collision resulting in a cycle fatality or a serious injury.
- In-depth research into all motorcyclist fatalities to understand all the factors leading to a collision resulting in a cycle fatality or a serious injury.
- Determine a clear programme of what data is being collected, what is it for and what is being measured. This should include user surveys as well as quantitative data to understand how users feel travel around the network.
- Identify when a road where a VTU crash has occurred is currently posted with too high a speed limit.
- Due to the lags in data and the unknowns around hospitalisation/no hospitalisation, It is recommended that AT continue to use the data source by the Ministry of Transport for fatalities, but again the data sourced should include the excluded crashes to understand the numbers of e-scooter and new micro-mobility devices to ensure all deaths by a transport mode are captured.
- That reporting to the Board provides numbers for walking, cycling, motorcycling and transport devices, and also includes single person incidents so that projects and programmes can be developed to reduce the number of serious hospital admissions.
- Arrange data sharing agreement with MoH.

- Consider targeted investment of footpath maintenance in areas identified as high priority or where pedestrian injury density is already high
- There would be benefits for understanding the scale and detail of workplace incidents and providing additional time and resources to improve reporting in this area is recommended.
- Consider the potential to require CLOCS-like standards in vehicles for all companies working on AT construction projects.
- AT complete analysis to determine minor injury crash under-reporting rates.
- At complete analysis to determine under-reporting rates for crashes involving people in vehicles.
- Investigate further the relationship between road environment (urban, rural, etc) and typical under-reporting rates.
- That AT works with Waka Kotahi is use these updated scaling factors instead of ones currently in benefits cost manual

13.2 For Auckland road safety partners

That Auckland Transport leads the conversation with their strategic road safety partners to ensure:

- Agree on consistent categorising of "wheeled transport devices" of all types
- A greater focus on the role of speed when reporting active mode crashes (particularly relative to the calculated “Safe and Appropriate Speeds”)
- Standardise approaches to reporting serious crashes on the network and when Serious Crash Units attend.
- Agreed consistent categorising of "scooters" of all types to differentiate between powered and non-powered scooters, moped style scooters and mobility scooters.
- Work further with ACC to identify suitable injury data for VTUs in Auckland that could help properly quantify minor injuries

13.3 For Government transport agencies

That Auckland Transport leads the conversation with Government agencies to investigate:

- Further improvements to the CAS database to recognise the different and new alternative transport devices in the system so that they are not coded as pedestrians, other, null etc and to recognise motorcycle riders and cyclists as such and not as drivers. This would help in reporting data more accurately and more efficiently.
- Further changes to the CAS reporting processes (particularly in terms of categorisation of serious vs minor crashes, and data that is made available about non-vehicle participants such as pedestrians).
- Continue to link information from different agencies to provide an accurate picture of road trauma in New Zealand for all modes of transport.
- AT work with the MoH to standardise entries to make analysis more efficient, especially regarding transport-related injuries.
- Encourage MoH to collect location data (where incident occurred) as a free-text field to allow data to be used to identify localised issues that can be addressed.
- Further work is recommended with ACC to make better use of the existing data and to also investigate options for making captured data going forward even more useful (including standardised use of free-text fields).

- ACC to consider how to better differentiate trips/falls on public paths (both next to or away from road corridors) from trips/falls in other private, commercial or recreational settings.
- Waka Kotahi to consider the safety role of footpath maintenance, and the relative risk metrics from Census/MoH data when allocating funding for this work across RCAs
- Promote regulatory change to require improved vehicle design that considers the safety impact of the vehicle and that commercial vehicles are designed to give the driver maximum direct visibility around their vehicle.

Appendix A Calculation factors for under-reporting

These factors can be used to scale up the reported injury numbers in CAS to derive estimates of overall deaths and/or serious injuries in Auckland, based on hospital data (2016-19):

		FATALITIES	SERIOUS INJURIES		DEATHS & SERIOUS INJURIES (DSIs)	
			Total Mode No.s Only	By Vehicle Involvement	Total Mode No.s Only	By Vehicle Involvement
Pedestrians	Ped'n only	**1.0** Assumed that **all** fatalities are reported	5.64	*	5.06	*
	Ped'n vs Veh		2.73	2.73	2.51	2.58
	TOTAL PED'NS		***8.37***		***7.57***	
Cycles	Cycle only		5.11	*	4.91	*
	Cycle vs Veh		2.24	2.32	2.19	2.28
	TOTAL CYCLES		***7.35***		***7.10***	
Transport Devices	***TOTAL TRPT DEVICES***		***13.1***		***13.1***	
Cycles & Wheeled Trpt Devices			**7.77**		**7.52**	
TOTAL ACTIVE TRPT MODES	User-only		5.31	*	4.89	*
	User vs Veh		2.84	2.87	2.66	2.75
	TOTAL		***8.15***		***7.55***	
Motorcycles	M'cycle only		1.65	6.38	1.57	6.10
	M'cycle vs Veh		1.37	1.85	1.33	1.79
	TOTAL M'CYCLE		***3.02***		***2.90***	
TOTAL VULNERABLE TRPT MODES	User-only		3.49	8.38	3.26	7.65
	User vs Veh		2.11	2.44	2.02	2.35
	TOTAL		***5.60***		***5.27***	
TOTAL OTHER MOTOR VEHS			**2.05**		**1.96**	
ALL TRANSPORT MODES	User-only		2.00	8.38	1.88	7.65
	User vs Veh		1.64	2.16	1.56	2.06
	TOTAL		**3.64**		**3.44**	
CAS-REPORTED CRASHES ONLY #			**2.42**		**2.28**	

* *Numbers in CAS are zero or too small to derive a meaningful estimate*

*# This is based on reported crashes in CAS that involve at least one motor vehicle and possibly some other party. The scaled-up figures do **not** include solo non-motorised user injuries*

Note: these figures should only be applied at an **area or district-wide** level. Due to the variations in user numbers at different locations, they are not applicable for applying to specific sites or corridors

To use this table:

- If you have total reported CAS numbers for each mode, split by **vehicle involvement** or not:
  - Use the "By Vehicle Involvement" factors to scale up each sub-group
- If you have only **total** reported CAS numbers for each mode, ***not*** split by vehicle involvement:
  - Use the "Total Mode No.s Only" scaling factors to estimate the totals in each sub-group
- If you have only **total** reported CAS numbers overall, ***not*** split by mode or vehicle involvement:
  - Apply the "CAS-REPORTED CRASHES ONLY" factors to the overall crash numbers if you don't want solo non-motorised user injury numbers included

Use the "Serious Injuries" or "Deaths & Serious Injuries (DSIs)" columns depending on whether you want to base your calculations on CAS serious injury crash stats only *OR* {serious + fatal} crash stats combined.

Examples:

*In CAS there are **42** reported **pedestrian** serious injuries and **6** reported pedestrian deaths*

Using Serious Injuries, "Total Mode No.s Only" column for Pedestrians:

- *Estimated serious ped'n injuries (including ped'n-only) = 42 x 8.37 = **352***
  *(Estimated breakdown is **237** "ped'n only" and **115** "ped'n v veh" using 5.64 & 2.73 factors)*

Using DSIs, "Total Mode No.s Only" column for Pedestrians:

- *Estimated ped'n DSIs (including ped'n-only) = (42 + 6) x 7.57 = **363***

*CAS also reports **29 cycling** serious injuries and **2** deaths*

Using Serious Injuries, "Total Mode No.s Only" column for Cycles:

- *Estimated serious cycle injuries (including cycle-only) = 29 x 7.35 = **213***

Using DSIs, "Total Mode No.s Only" column for Cycles:

- *Estimated cycle DSIs (including cycle-only) = (29 + 2) x 7.10 = **220***

*Only **3** serious **transport device** injuries and **0** deaths were reported in CAS*

Using Serious Injuries, "Total Mode No.s Only" column for Total Active Trpt Modes:

- *Combined active mode (walk/bike/device) serious injuries = (42+29+3) x 8.15 = **603***

Using DSIs, "Total Mode No.s Only" column for Total Active Trpt Modes:

- *Combined active mode DSIs (including user-only) = (42 + 6 + 29 + 2 + 3) x 7.55 = **619***

*In CAS there are **9** serious **motorcycle-only** injuries and **2** deaths, as well as **23** serious **motorcycle vs veh** injuries and **1** death*

Using Serious Injuries, "By Vehicle Involvement" column for Motorcycles:

- *Estimated serious motorcycle injuries = (9 x 6.38) + (23 x 1.85) = **100***

Using DSIs, "By Vehicle Involvement" column for Motorcycles:

- *Estimated motorcycle DSIs = (9+2 x 6.10) + (23+1 x 1.79) = **110***

*In CAS there were also **97** & **11 other motor vehicle** serious injuries and deaths*

Using Serious Injuries, "Total Mode No.s Only" column for CAS-Reported Crashes Only:

- *Combined serious injuries for all modes = (42+29+3+9+23+97) x 2.42 = **491***
- *Combined deaths for all modes = (6+2+0+2+1+11) x 1.0 = **22***

Alternately, using DSIs, "Total Mode No.s Only" column for CAS-Reported Crashes Only:

- *Combined DSIs involving motor vehicles for all modes = [(42+29+3+9+23+97) + 22] x 2.28 = **513***

(Note these figures do not include ped'n/cycle/device-only injuries)