

Disparities in fatal and non-fatal injuries between Irish travellers and the Irish general population are similar to those of other indigenous minorities: a cross-sectional population-based comparative study

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To cite: Abdalla S, Kelleher CC, Quirke B, *et al*. Disparities in fatal and non-fatal injuries between Irish travellers and the Irish general population are similar to those of other indigenous minorities: a cross-sectional population-based comparative study. *BMJ Open* 2013;**3**: e002296. doi:10.1136/bmjopen-2012-002296

► Prepublication history and additional material for this paper are available online. To view these files please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2012-002296>).

Received 1 November 2012
Revised 19 December 2012
Accepted 7 January 2013

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ABSTRACT

Objectives: To assess recent disparities in fatal and non-fatal injury between travellers and the general population in Ireland.

Design: A cross-sectional population-based comparative study.

Setting: Republic of Ireland.

Participants: Population census and retrospective mortality data were collected from 7042 traveller families, travellers being those identified by themselves and others as members of the traveller community. Retrospective injury incidence was estimated from a survey of a random sample of travellers in private households, aged 15 years or over (702 men and 961 women). Comparable general population data were obtained from official statistical reports, while retrospective incidence was estimated from the Survey of Lifestyle, Attitude and Nutrition 2002, a random sample of 5992 adults in private households aged 18 years or over.

Outcome measures: Potential Years of Life Lost (PYLL), Standardised Mortality Ratios (SMR), Standardised Incidence Ratios (SIR) and Case Fatality Ratios (CFR).

Results: Injury accounted for 36% of PYLL among travellers, compared with 13% in the general population. Travellers were more likely to die of unintentional injury than the general population (SMR=454 (95% CI 279 to 690) in men and 460 (95% CI 177 to 905) in women), with a similar pattern for intentional injury (SMR=637 (95% CI 367 to 993) in men and 464 (95% CI 107 to 1204 in women). They had a lower incidence of unintentional injury but those aged 65 years or over were about twice as likely to report an injury. Travellers had a higher incidence of intentional injuries (SIR=181 (95% CI 116 to 269) in men and 268 (95% CI 187 to 373) in women). Injury CFR were consistently higher among travellers.

Conclusions: Irish travellers continue to bear a disproportionate burden of injury, which calls for scaling up injury prevention efforts in this group. Prevention and

ARTICLE SUMMARY

Article focus

- Assessing recent disparities in fatal and non-fatal injury between Irish travellers, a disadvantaged indigenous minority in Ireland, and the Irish general population, using national population and mortality data from the All-Ireland traveller Health study, routine population-based statistical reports and population surveys.

Key messages

- Irish travellers continue to bear a disproportionately higher mortality burden of unintentional and intentional injury than the Irish general population in the 21st century, with higher case fatality ratios.
- Despite lower traveller rates of non-fatal injury overall, elderly travellers had higher rates of non-fatal injury than the general population.
- Injury prevention efforts and further research should address the problems of alcohol, suicide and elderly injury among travellers.

Strengths and limitations of this study

- Strengths include the use of census and survey data for Irish travellers from a national study with a high household response rate in a generally hard-to-reach population. Also, part of the analysis accounts for an underestimation of non-fatal injury incidence due to incomplete recall.
- Limitations include under-reporting of injury events for reasons other than incomplete recall, different methodologies for intent ascertainment between fatal and non-fatal injury in the data sources used, lack of ascertainment of injury risk differentials among survey non-respondents and the use of 2002 general population survey data to compare with 2007–2008 traveller survey data.

further research should focus on suicide, alcohol misuse and elderly injury among Irish travellers.

INTRODUCTION

Injuries are one of the leading causes of mortality and morbidity worldwide, accounting for 5.8 million deaths (10% of world deaths). They are the leading cause of death among youth aged 15–29 years.¹ Disadvantaged indigenous minorities are known to bear a greater burden of injuries than the general population in their countries.^{2–9} Most of this information comes from the classical parts of the world such as Australia, New Zealand and Canada, where the dire health and social conditions of their indigenous minorities have long been recognised and systems set up and operated to capture reliable information on their trends. In Europe too, Sami men in Sweden, Sami men and women in Finland,^{10–12} Roma women in Serbia¹³ and Roma men and women in Bulgaria,¹⁴ all had higher injury mortality than the corresponding general population in those countries.

Irish travellers are an indigenous minority in Europe who have been part of Irish society for centuries, with a distinct culture, language and value system, based on a nomadic tradition. They are similar to many other indigenous minorities in their experience of assimilative social policies and of disadvantage and social exclusion due to discrimination, unemployment and lower education achievement,^{15–17} although cultural and contextual differences remain. Injuries are the leading cause of death among young people in Ireland,¹⁸ and while a wealth of information on injuries in the general population continues to be generated by a range of national routine mortality and morbidity data sources, the lack of ethnic or cultural group identification in such sources hinders their use to investigate the patterns of injuries among travellers. Such epidemiological information is critical for informing targeted injury prevention policies and detecting areas that warrant action and further research. Yet, apart from a 20-year-old record, from a national study, of higher injury mortality than the general population,¹⁹ very little is known about the current burden of injuries among Irish travellers. Recently, the All-Ireland traveller Health Study (AITHS) provided census and survey data that allowed such investigation. We thus aimed to use these data to assess recent disparities in fatal and non-fatal injury between travellers and the general population in Ireland.

METHODS

Study design

This is a comparative study based on cross-sectional population-based data.

Study settings and participants

The study included Irish travellers in the Republic of Ireland together with the general population of the Republic of Ireland as a comparison group.

Outcome measures

Potential Years of Life Lost (PYLL) were used to measure the burden of premature mortality due to injury. PYLL are the number of years lost due to death occurring earlier than an arbitrarily determined reference age. Overall and gender-specific disparities between travellers and the general population were expressed as directly age-standardised PYLL rate ratios. Standardised Mortality Ratios (SMR) were used to express overall and gender-specific disparities in unintentional and intentional injury mortality as intent disaggregation of PYLL was not possible with the data available. We expressed disparities in non-fatal injuries as Standardised Incidence Ratios (SIR). We also calculated overall and gender-specific injury Case Fatality Ratios (CFR) for each group.

Data

Traveller mortality and population data

We used traveller data from the AITHS. The methodology of the study was published in a series of technical reports.^{20–21} Ethical approval for AITHS in the Republic of Ireland was obtained from the University College Dublin Human Research Ethics Committee, and all participants provided a written informed consent. The definition of a traveller in AITHS was a person identified by him or herself and others as a member of the traveller community, in keeping with the definition of the traveller community in the Equal Status Act in Ireland.²² The study included a census of Irish travellers conducted over 6 weeks starting from mid-October 2008, with a response rate of 78% of traveller families in the Republic of Ireland. All families completed the census section. In addition, mothers completed a child health status interview if there was a child aged 5, 9 or 14 years in the family. Otherwise, an adult aged 15 years or over was selected at random from available adults to complete either a health status or a health service utilisation interview. In this way, all eligible households completed the census survey and, if eligible, one further subinterview.

The mortality substudy of AITHS provided the number of deaths, including injury deaths, over the year preceding the census. Travellers' deaths were reported mainly by census respondents, with additional reports by Public Health Nurses working with traveller families. Following duplicate elimination, a final list of traveller deaths was successfully matched with the official database of death records maintained by the General Registrar Office (GRO) for 104 (63%) of a total of 166 identified deaths, with the identification of 22 further deaths not reported by the other sources, but with dwelling or occupation characteristics that were typical of travellers. Ninety-three per cent of the reported ages for those successfully matched with the official database were within a 5-year range of the ages in the official death record. The GRO death records were matched next with the Central Statistics Office (CSO) database of

International Classification of Disease (ICD)-10 coded causes of death to obtain the traveller death codes for comparability with the general population. Deaths coded to mental and behavioural disorder (F00-F99) were included with those coded to external causes (V01-Y89), in keeping with the current CSO practice of reporting the former as unintentional injuries. Among the successfully matched deaths, 22 of 26 deaths coded to external causes (V01-Y89) were also reported as injury deaths by traveller respondents. The latter reported a total of 23 injury deaths. We thus considered unconfirmed injury deaths to be of acceptable validity and included them in the total injury death count. We used traveller population counts from AITHS census for rate calculations.

Traveller non-fatal injury data

The adult health status survey (a sample size of 1663; 702 men and 961 women) provided retrospective data on the occurrence of any injury serious enough to limit daily activity among travellers over the 2 years preceding the survey, and intent of the most recent injury (table 1).

General population mortality and population data

General population injury deaths by age, gender and intent were obtained from the 2008 CSO report of prospectively registered deaths coded to external causes (V01-Y89) and to mental and behavioural disorder (F00-F99).²³ Population counts from census 2006 were used for rate calculations.²⁴

General population non-fatal injury data

The publicly available national Survey of Lifestyle, Attitude and Nutrition (SLAN) 2002 of adults aged 18 years or over with a sample size of 5992 provided comparable retrospective data on non-fatal injury,²⁵ using the same survey items as the travellers' adult health status survey (table 1). The survey was originally powered to detect differences in key lifestyle factors by socioeconomic status, with allowances for non-response and likelihood of ineligibility. A national postal sample was generated randomly and proportionately distributed by population size of the former Irish health boards and their urban-rural distributions.²⁶

Analysis

Potential Years of Life Lost

PYLL were calculated with 100 years as the reference age. The average age at death was taken as 0.1 years for infants and 2.6 years for the 1–4 years' group. For the remaining groups, it was age at the beginning of the age group added to half the age group width, assuming a uniform distribution of deaths across the age group. For the open-ended group, it was twice the mean survival for that age according to Silcock *et al.*²⁷

Age-specific PYLL rates and the direct age-standardised PYLL rate for travellers were computed, with the general population as the reference. Age-standardised PYLL rate ratios were calculated as the ratio of the traveller's estimate to the general population estimate, with 95% CIs computed using the method described by Kuroishi *et al.*²⁸

Standardised Mortality Ratios

Using indirect standardisation, we calculated SMR by gender and intent, as the small age-specific number of traveller deaths prohibited intent disaggregation of PYLL. SMRs were the ratio of the observed number of traveller injury deaths to that expected if the traveller population experienced the age-specific injury death rates of the general population. The intent breakdown of observed numbers was obtained by applying the distribution by intent of ICD-10 coded deaths (unintentional: V01-X59, F00-F99, intentional: X60-Y09) to the total number of deaths in each gender group, and redistributing the injuries of unspecified intent proportionately over unintentional and intentional injuries where applicable. The exact 95% Poisson confidence limits were calculated for SMRs using the χ^2 distribution as proposed by Ulm.²⁹ Statistical significance was indicated by 95% CIs that did not include 100.

Standardised Incidence Ratios

SIRs were calculated by gender and intent overall and for those aged 15–64 years and those aged 65 years and over, separately. SIR was the ratio of the observed number of traveller non-fatal injuries to that expected if travellers experienced the age-specific retrospective incidence of non-fatal injury of the general population. Ninety-five per cent CIs for SIRs were calculated in the same way as those for SMRs.

Table 1 Injury items used in the All-Ireland travellers Health Study (AITHS) adult health survey in 2008 and the Survey of Lifestyle, Attitude and Nutrition (SLAN) in 2002

Concept	Survey item
Occurrence of injury	'In the last two years have you had one or more injuries serious enough to interfere with your daily activities?' Yes [] No [] Don't know [] Refused []
Intent of injury	'Was your most recent injury mainly...' Accidental [] Non-accidental [] Don't know [] Refused []

Disparities in injury between Irish travellers and the general population

The online supplementary appendix table details the formulas used in the calculation of the estimates and their CIs.

Case Fatality Ratios

We estimated injury CFR as the ratio of injury deaths to the total number of fatal and non-fatal injuries over 1 year. The number of non-fatal injuries was obtained by correcting the 2-year-recall non-fatal injury rate for underestimation due to failure to recall injuries far back in the recall period, and then annualising it by dividing by two. Recall correction factors were based on recall patterns observed in the 2003 World Health Surveys conducted by the WHO. The recall analysis was performed for the Global Burden of Disease-2010 Study (Bhalla K, personal communication, Harvard School of Public Health, 2012. Publication reporting results is forthcoming). Using recall patterns for medically attended and non-medically attended injuries separately, correction factors based on four recall periods, 1, 3, 6 and 12 months preceding the surveys were estimated. Logarithmic models were fitted to the change in annualising factors with recall time ($R^2=0.89$ for medically attended injuries, 0.98 for non-medically attended injuries), and were used to predict the correction factor for 2-year recall; 2 for medically attended injuries and 3.8 for non-medically attended injuries. Using the predicted factor for medically attended injuries to correct the annualised rate of emergency department attended injuries from the SLAN 2002 data yielded an estimate (6%) that was reassuringly not substantially different from the independently derived overall rate of emergency department attended injuries in those aged 15 years and over (8%), based on national extrapolations of the results of a pilot injury surveillance project in 2005,³⁰ and converted from episode-based rate to a person-based rate using injury data from the SLAN 2007 survey. We applied the same factors to unintentional and intentional injuries, as the available data did not allow the development of intent-specific factors. We used the same factors to correct traveller and general population

rates, which were then applied to the traveller population aged 15 years and over in 2008 and the general population aged 15 years and over in 2006, respectively.

Survey data were analysed using BM-SPSS (V.18). All other calculations were conducted in Excel 2007 spreadsheets.

RESULTS

Comparing the burden of injury deaths between travellers and the general population (table 2), a total of 188 traveller deaths occurred over 1 year, 27% of which were due to injury (33% in men and 18% in women), compared with 8% in the general population (10% in men and 6% in women). The median age at death from injuries was 35 years in men and 32 years in women, much lower than that in the general population (47 years in men and 78 years in women). Injuries accounted for 36% of PYLL among travellers (41% in men and 25% in women), compared with 13% in the general population (17% in men and 8% in women).

Unintentional deaths represented a larger proportion of injury deaths in travellers and the general population, but the proportion of intentional injuries was higher in travellers than the general population (figure 1). In both travellers and the general population, the majority of deaths of the intentional category were suicides and intentional self-harm (12 of 13 traveller deaths identified at GRO, and 424 of 463 (92%) of the general population deaths). Of the unintentional category, more than half of the traveller deaths (12 of 17) were accidental poisoning, half of them due to alcohol, while only 24% (229 of 974) of the general population unintentional deaths were due to accidental poisoning.

Table 3 displays the disparities in fatal and non-fatal injuries between Irish travellers and the Irish general population in terms of age-standardised PYLL rate ratios, SMRs and SIRs for those aged 15 years and over, by gender and intent. Both PYLL rate ratios and SMRs indicated higher injury mortality among travellers (PYLL rate ratio of 490 (95% CI 368 to 652 and SMR of 496

Table 2 Injury deaths and burden of premature mortality due to injury among Irish travellers and the general population, Republic of Ireland 2008*

	Men		Women		Total	
	Travellers	General population	Travellers	General population	Travellers	General population
Total deaths	124	14413	64	13779	188	28192
Median age at death (IQR)	50 (36)	75 (20)	61 (40)	81 (19)	54 (38)	78 (20)
Proportion of deaths due to injury	33%	10%	18%	6%	27%	8%
Median age at death from injury in years (IQR)†	35 (18)	47 (40)	32 (33)	78 (38)	34 (20)	56 (47)
Total PYLL (100) in years†	6124	422056	2816	310168	8940	732224
PYLL (100) due to injury (% of total)†	2520 (41%)	71943 (17%)	710 (25%)	25702 (8%)	3230 (36%)	97645 (13%)

*As the mortality study included traveller deaths that occurred 1 year before the census interviews that started in mid-October 2008, some of the deaths would have occurred in October–December 2007.

†Excluding four male deaths and two female deaths with missing age data.

PYLL(100): Potential Years of Life Lost with a reference age of 100 years.

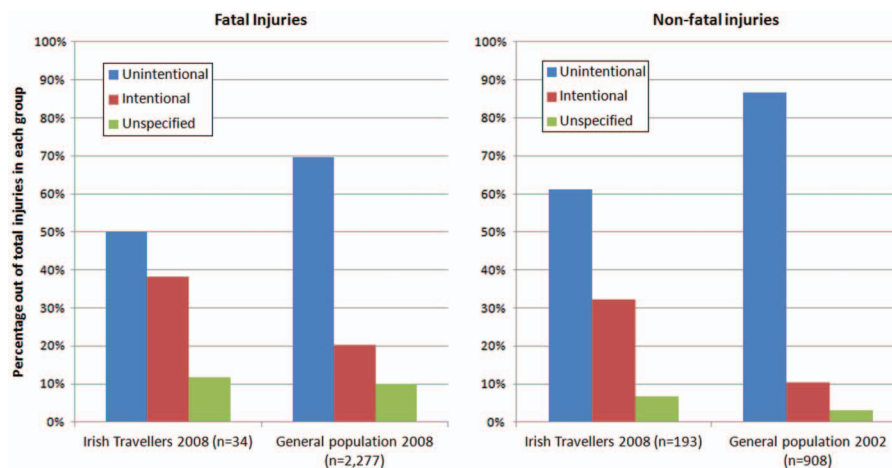


Figure 1 Distribution of fatal and non-fatal injuries by intent for Irish travellers and the general population, Republic of Ireland. The figure displays vertical bar charts of the distribution of fatal and non-fatal injuries by intent among Irish travellers and the general population. The x-axis represents the categories of Irish travellers with 34 injury deaths in All-Ireland traveller Health Study (AITHS) mortality study and 193 non-fatal injuries among those aged 15 years or over in AITHS adult health status survey sample in 2008, and the general population with 2277 injury deaths in 2008 and 908 non-fatal injuries among those aged 18 years or over in SLAN 2002 sample. The y-axis represents the percentage of unintentional, intentional and unspecified intent injuries out of the total for each category. Unintentional deaths represented a larger proportion of injury deaths in travellers and the general population, but the proportion of intentional injuries was higher in travellers than the general population, with a similar pattern for non-fatal injury.

(95% CI 368 to 654)). At the intent level, men and women were more than four times more likely to die of unintentional injury than their general population counterparts. Traveller men were more than six times more likely to die of intentional injuries, and traveller women were more than four times more likely to die of intentional injuries. Travellers had a lower incidence of unintentional injury than the general population (SIR of 42 (95% CI 32 to 55) in men and 46 (95% CI 34 to 61) in

women), but those over the age of 65 were about twice as likely to report an injury as the general population. All these differences were statistically significant. The same pattern was apparent for unintentional injuries, although the differences in those aged 65 years and over were not statistically significant. Travellers had a statistically significantly higher incidence of intentional injuries (SIR of 181 (95% CI 116 to 269) in men and 268 (95% CI 187 to 373) in women).

Table 3 Disparities in injury deaths and non-fatal injuries between Irish travellers and the general population in the Republic of Ireland

	Men	Women	Total
Fatal injury			
Age-standardised PYLL rate ratio* (95% CI)	541 (392 to 748)	429 (219 to 841)	490 (368 to 652)
Overall injury SMR† (95% CI)	523 (372 to 715)	462 (230 to 826)	496 (368 to 654)
Unintentional injury SMR (95% CI)	454 (279 to 690)	460 (177 to 905)	446 (292 to 634)
Intentional injury SMR (95% CI)	637 (367 to 993)	464 (107 to 1,204)	583 (362 to 885)
Non-fatal injury			
Overall injury SIR‡ 15+ (95% CI)	57 (46 to 71)	73 (59 to 90)	65 (56 to 75)
15–64	53 (42 to 66)	67 (53 to 83)	59 (50 to 69)
65+	237 (108 to 450)	191 (102 to 327)	208 (130 to 314)
Unintentional injury SIR 15+ (95% CI)	42 (32 to 55)	46 (34 to 61)	44 (36 to 53)
15–64	39 (29 to 51)	42 (31 to 57)	40 (33 to 49)
65+	176 (64 to 383)	115 (46 to 238)	137 (73 to 235)
Intentional injury SIR 15+ (95% CI)	181 (116 to 269)	268 (187 to 373)	224 (171 to 289)
15–64	170 (107 to 258)	258 (176 to 364)	213 (160 to 278)
65+	607 (73 to 2192)	471 (97 to 1375)	517 (168 to 1206)

*Ratio of Potential Years of Life Lost (PYLL) for Irish travellers to that of the general population in the Republic of Ireland in 2008.

†Standardised Mortality Ratio of Irish travellers using 2008 age-specific death rate of the general population in the Republic of Ireland as standard.

‡Standardised Incidence Ratio of Irish travellers using 2002 age-specific incidence rate of the general population in the Republic of Ireland as standard.

Disparities in injury between Irish travellers and the general population

The overall injury CFR was 25/1000 in traveller men and 8/1000 in traveller women, compared with 4/1000 in general population men and 3/1000 in general population women (table 4). The CFR was consistently higher in travellers than the general population, a gap that was, in its relative form, more marked for unintentional (15/1000 among travellers compared with 3/1000 among the general population) than intentional injuries (20/1000 among travellers compared with 8/1000 among the general population) and for men than women.

DISCUSSION

Summary of main findings

Our analysis revealed stark inequalities in the burden of injury affecting one of Europe's indigenous minorities, with a higher proportion of injury deaths and PYLL, and death at younger ages in comparison to the general population, contributing to the shape of their population pyramid (see online supplementary appendix figure). After two decades, Irish travellers are still at higher risk of dying of an injury than the general population, more so for intentional than unintentional injuries. Although they fared better in terms of non-fatal injuries, this was not the case in older travellers and nor was it the case for all types of injuries. Intentional injuries occurred at a higher rate among travellers than the general population in both the young and the old, and travellers had a higher CFR from both intentional and unintentional injuries.

Strengths and limitations

The strength of this study is that it used census and survey data for Irish travellers from a national study with a high household response rate in a generally hard-to-reach population. Also, part of the analysis accounted for underestimation of non-fatal injury incidence due to recall bias. However, before discussing the

findings, we note their limitations. Injury events are subject to under-reporting in mortality and morbidity surveys for other reasons apart from incomplete recall, and intentional injuries in particular might have been under-reported. There is no reason to suspect differential under-reporting of non-fatal injuries, and in this case conclusions about differentials between travellers and the general population in non-fatal injury would be unaffected. As multiple sources were used to identify traveller deaths, it is also unlikely that under-reporting of retrospectively identified traveller deaths is a major issue, and even if this was the case, travellers would have an even higher injury mortality than that observed here. Another limitation is that the intent for injury deaths was mainly medicolegally determined, while the intent for non-fatal injuries was self-reported, which could have caused some mismatch in the numerator and denominator of the intent-specific CFR. There are no pointers to potential differential misclassification of intent between travellers and the general population. It is also unlikely that differential misclassification of non-fatal injury intent had a role in generating the considerably lower unintentional injury rate among travellers, as it cannot similarly explain the reversal of this pattern in older travellers. The non-fatal differential findings are generalisable insofar as the non-respondents to the surveys were not different from respondents with respect to injury risk, which could not be ascertained here. Finally, we used 2002 general population survey data to compare with 2007–2008 traveller survey data, as it was the only comparable dataset available. A change in general population injury rates since 2002 could partly explain the disparities, but probably negligibly, as the general population rate previously declined minimally between 1998 and 2002 in men (23% in 1998 and 21% in 2002) with no obvious trend in women (14% in 1998 and 2002),²⁶ predicting a similarly minimal decline from 2002 onwards for men.

Table 4 Injury deaths, non-fatal injury cases and case fatality ratios (CFR) for Irish travellers and the general population aged 15+ in the Republic of Ireland

	Injury deaths 15+		Non-fatal Injury incidence 15+		CFR/1000 injured	
	Traveller	General population	Traveller	General population	Traveller	General population
Men						
All injuries	38	1402	1474	384778	25	4
Unintentional	21	998	1054	351398	20	3
Intentional	17	404	420	33380	39	12
Women						
All injuries	10	832	1319	276035	8	3
Unintentional	7	729	766	242816	9	3
Intentional	3	103	554	33219	5	3
Total						
All injuries	48	2234	2793	660813	17	3
Unintentional	28	1727	1819	594214	15	3
Intentional	20	507	974	66599	20	8

Some totals do not add up due to rounding.

Discussion of findings

The findings largely echo what is known about the burden of injury in other disadvantaged indigenous minorities. The lower rate of reported unintentional non-fatal injury among young travellers, however, is not in keeping with the higher unintentional non-fatal injury among the indigenous people of Australia, who had 1.5–1.8 times the hospitalisation rates of the non-indigenous population for transport and other unintentional injuries among those aged less than 74 years compared with the general population.⁸ It is likely that the higher travellers' CFR resulted from the distribution of injury causes being skewed towards more fatal causes than in the general population, namely alcohol poisoning, which featured strongly as a cause of unintentional injury deaths. Although travellers report a lower frequency of alcohol consumption than the general population, they have higher proportions of excessive alcohol consumption than a socioeconomically comparable group of the general population.²⁰ The problem of excessive alcohol consumption among travellers could in fact be underestimated in a cross-sectional survey of survivors. It is also possible that while alcohol poisoning was classified as an injury in mortality data, non-fatal alcohol intoxication was not conceptualised by survey respondents as an injury. The higher mortality could also partly be due to differences in care seeking behaviour or access to appropriate medical care such as alcohol dependence services.

Another reason why young travellers had lower unintentional injuries rate overall could be fewer opportunities for engagement in activities such as education, work related activities and sports that would put them at risk of transport and other unintentional injury. Factors implicated in the higher unintentional transport injury mortality and morbidity among indigenous minorities in Australia, Canada and Scandinavia, namely remoteness and the use of off-road vehicles,^{3 5 12} are unlikely to affect travellers. Although 'going on the road' is a defining feature of traveller culture, nearly 80% of traveller families have not travelled for more than 3 days in a year, and only a small proportion of travellers (less than 20%) live in accommodation conditions perceived by them as unsafe or associated with environmental hazards, such as proximity to a main road.²⁰ A higher unintentional injury rate among older travellers would not be surprising on the other hand, as older travellers report higher proportions of poor health and chronic illnesses.³¹ Those would compound ageing-related factors such as gait problems, which increase the risk of falls, the commonest cause of elderly injury.^{31 32} This was also reflected in the finding of a higher hospitalisation rate for head injury among Australian indigenous people aged 60 years or over, where 80% of injuries were due to falls.⁷

Suicide has recently overtaken road traffic injury as the main cause of injury death in Ireland,³³ and the finding that it caused the majority of travellers' intentional injuries indicates that this is an even greater

problem among travellers. Non-fatal intentional self-harm could also be more common among travellers, accounting for the higher rates of intentional injury together with interpersonal violence. Fatal and non-fatal self-harm and assault also occur at a higher rate among other disadvantaged indigenous minorities.^{5 8} It is quite likely that behind these findings lie complex pathways translating distress from adverse social circumstances into physical harm. Excessive alcohol consumption could have a role in these pathways, being closely related to suicide and interpersonal violence,^{34–36} and alongside other substance misuse, it was found to be associated with suicide in other disadvantaged groups.^{37–41} Despite the lack of exact estimates, illicit drug use too seems to be a substantial and increasing problem among travellers.^{20 42}

Conclusion and implications

Irish travellers continue to bear a disproportionate burden of injury in patterns that seem to fit well with the circumstances of social exclusion and deprivation that affect most of them, and the expected negative impact of such circumstances on mental and physical health. Injury prevention efforts targeting Irish travellers should thus be scaled up, utilising evidence-based effective interventions within a social determinants framework. While the experience of other countries with similarly affected culturally distinct minorities in Europe and elsewhere may offer useful guidance, the specificity of Irish travellers' circumstances, which is quite likely reflected in some of the findings, should be taken into consideration when planning such efforts. In the case of Irish travellers, a focus on preventing suicide, alcohol misuse and elderly injury should materialise in existing and future policies, action and research.

Acknowledgements The authors wish to thank the Irish travellers, traveller peer researchers, study coordinators, Public Health Nurses, the General Registrar Office, Central Statistics Office and the AITHS Technical Steering Group. The authors also wish to thank Dr Kavi Bhalla for providing World Health Survey recall patterns.

Collaborators The AITHS study team members were Ms Fran Cronin, Dr Anne Drummond, Dr Patricia Fitzpatrick, Dr Kate Frazier, Dr Noor Aman Hamid, Ms Claire Kelly, Ms Jean Kilroe, Mr Juzer Lotya, Dr Catherine McGorrian, Dr Ronnie G Moore, Ms Sinead Murnane, Ms Roisin Nic Carthaigh, Ms Deirdre O'Mahony, Ms Brid O'Shea, Prof Anthony Staines, Mr David Staines, Dr Mary Rose Sweeney, Dr Jill Turner, Ms Aileen Ward and Dr Jane Whelan.

Contributors SA participated in the collection of the traveller data, designed and implemented the analysis strategy and drafted the manuscript. CCK is the Principal Investigator of the All Ireland traveller Health Study. She designed and supervised the implementation of the traveller studies on which this paper is based and contributed to the writing and revision of the manuscript. BQ supervised the field activities, participated in the traveller data collection and management and reviewed the manuscript. LD designed and supervised the implementation of the traveller studies, supervised the analysis and reviewed the manuscript. All authors approved the final manuscript.

Funding This work is based on the All-Ireland traveller Health Study, commissioned and funded by the Department of Health and Children (DoHC) and the Health Service Executive in the Republic of Ireland and the Department of Social Services and Personal Safety of Northern Ireland

(DSSPSNI) (grant no. V0350). The views expressed in this study are the authors' own and do not necessarily reflect the views and opinions of the Department of Health and Children or the Department of Health, Social Services and Public Safety.

Competing interests None.

Ethics approval University College Dublin Human Research Ethics Committee.

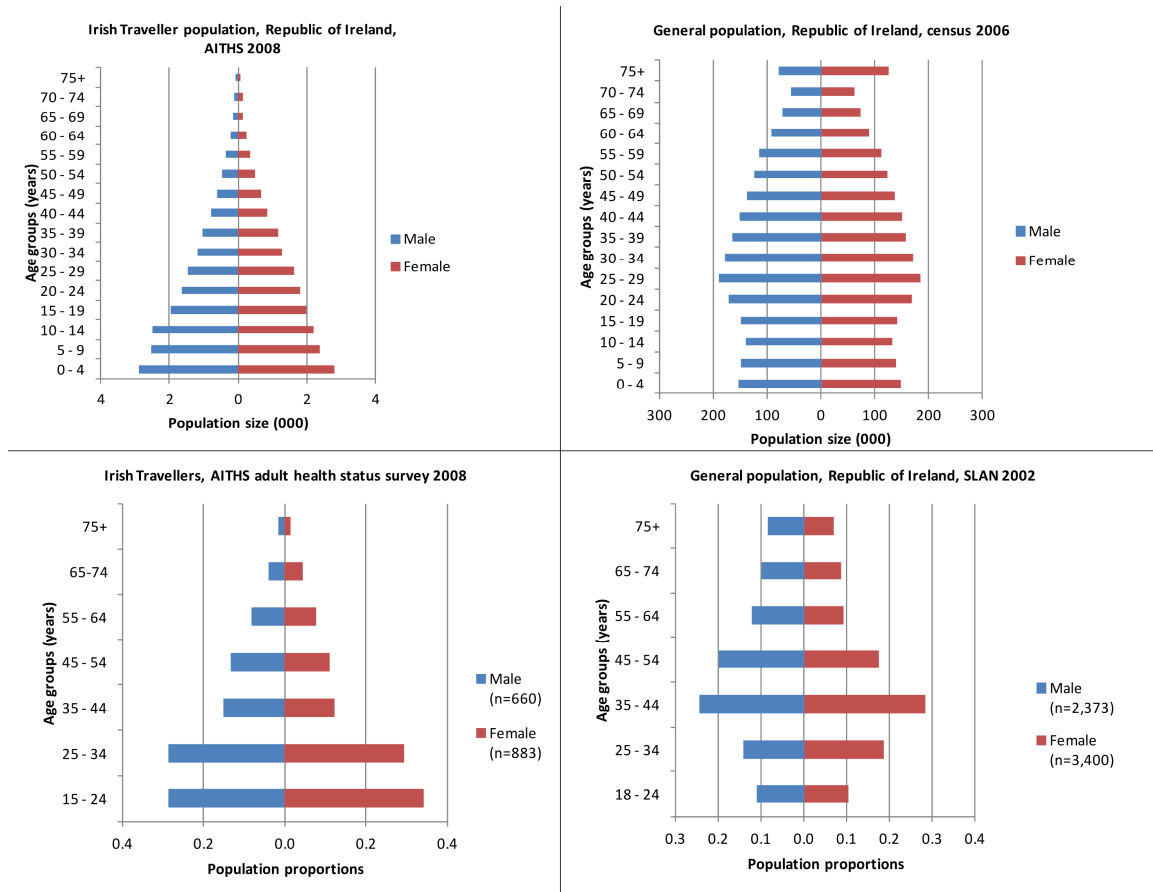
Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

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Appendix figure: Age-gender distribution of Irish Travellers and the general population in the population and survey data. The figure displays horizontal bar charts by gender of the age distribution of the Irish Traveller population in 2008, the general population in 2006, the All-Ireland Traveller Health Study (AITHS) adult health status survey sample, and the Survey of Lifestyle, Attitude and Nutrition (SLAN) in 2002, Republic of Ireland. The Traveller population had a triangular population structure with children under-five years of age forming the largest population group. The population size declines steadily in the older age groups. The general population had a different pattern with a relatively small population in the age groups less than 20 years old, and a larger population aged between 20 and 34 years, declining steadily in older age groups. The survey sample for each group more or less mirrors the pattern observed in its respective population.



Appendix table: Formulas used in calculating Potential Years of Life Lost (PYLL), Standardized Mortality Ratios (SMR) and Standardized Incidence Ratios (SIR), with their confidence intervals

Formula	Description of parameters
PYLL: $\sum_{i=1}^{\omega} d_i a_i$ $a_i = 100 - x_i$	i = age group (ten year age groups as very small numbers would arise from finer disaggregation; separate groups for infants and for those aged 1-4 years were formed to accommodate differences in average age of death) ω = open-ended age group (85 years or over) d = number of injury deaths and a = number of years remaining x = average age at death
Age Standardized PYLL rate: $\sum_{i=1}^{\omega} \frac{d_i a_i}{n_i} \cdot \frac{N_i}{N}$	n = Irish Travellers population number N = General population number
Confidence interval for age-Standardized PYLL rate ratio (27): $V = Var(z) = \sum_{j=1}^2 \left[\frac{\sum a_i^2 N_i^2 \pi_{ji} (1 - \pi_{ji})}{n_{ji}} \right] / (r_j^2 N^2)$ $CLL, CLu (r_2/r_1) = \exp(Z_0 \pm 1.96\sqrt{V}) - 1$	z = age-standardized PYLL ratio π = r_1 = PYLL rate of the general population r_2 = age-standardized PYLL rate ratio of Irish Travellers CLI = Lower Confidence Limit CLu = Upper Confidence Limit

Formula	Description of parameters
SMR and SIR: $SMR/SIR = 100 \times \frac{o}{e}$ $e = \sum_{i=1}^k n_i R_i$	o = observed number of Traveller deaths for SMR or Traveller respondents with injury for SIR e = expected number of deaths or respondents with injury i = age group (ten year age groups) k = open-ended age interval (85 years or over for SMR and 75 years or over for SIR) n_i = number of Travellers in the i^{th} age group R_i = mortality rate (for SMR) or retrospective incidence rate (for SIR) in the i^{th} age group of the general population. Incidence rate was based on those who responded to the injury question
Confidence intervals for SMR/SIR (28): $Lower\ Limit = \frac{\left(\chi^2_{\frac{\alpha}{2}, 2o}\right)}{2e} \times 100$ $Upper\ Limit = \frac{\left(\chi^2_{1-\frac{\alpha}{2}, 2(o+1)}\right)}{2e} \times 100$	χ^2 = Chi-square value at degrees of freedom of $2o / 2(o+1)$