Do Irish Travellers experience similar inequalities as other indigenous minorities? A cross-sectional comparative study of the burden of injuries in an indigenous minority in Europe

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Complete List of Authors:	Abdalla, Safa; University College Dublin, School of Public Health, Physiotherapy and Population Science Kelleher, Cecily; University College Dublin, School of Public Health, Physiotherapy and Population Science Quirke, Brigid; University College Dublin, School of Public Health, Physiotherapy and Population Science Daly, Leslie; University College Dublin, School of Public Health, Physiotherapy and Population Science
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Do Irish Travellers experience similar inequalities as other indigenous minorities? A cross-sectional comparative study of the burden of injuries in an indigenous minority in Europe

Safa Abdalla1, Cecily Kelleher1, Brigid Quirke1, Leslie Daly1 on behalf of the All-Ireland Traveller Health Study team

1 School of Public Health, Physiotherapy and Population Science

University College Dublin

Woodview House

Belfield

Dublin 4

Republic of Ireland

Corresponding author

Dr Safa Abdalla

Email: drsafa@yahoo.com

Phone: +353857146018

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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: cross-sectional population-based comparative study

Setting: Republic of Ireland

Participants: Population census and retrospective mortality data were collected from 7,042 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 5,992 adults in private households aged 18 years or over.

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

Results: injury accounted for 36% of PYLL among Travellers, compared to 13% in the general population. Travellers were more likely to die of unintentional injury than the general population (SMR = 454 (95%CI 279-690) in men and 460 (95%CI 177-905) in women), with a similar pattern for intentional injury (SMR = 637 (95%CI 367-993) in men and 464 (95%CI 107-1,204). They had lower incidence of unintentional injury but those aged 65 years or over were about twice as likely to report an injury. Travellers had higher incidence of intentional injuries (SIR = 181 (95%CI 116-269) in men and 268 (95% CI 187-373) in women). Injury CFR were consistently higher among Travellers.

Conclusions: Irish Travellers experience injury burden mortality differentials similar to other indigenous groups, but have different unintentional injury differentials, which should be considered

when planning injury prevention among a distinct population group as Irish Travellers. Further research should focus on suicide, alcohol misuse and elderly injury among this group.

ARTICLE SUMMARY

Article focus

- Assesssing 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 deaths data from the All-Ireland Traveller Health study, routine population-based statistical reports and population surveys.

Key messsages

- Similar to other indigenous minorities, Irish Travellers continue to bear a disproportionately higher mortality burden of unintentional and intentional injury than the general population in the twenty first century, with higher case fatality rates.
- 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 within a social determinants framework, drawing from experience in other countries.

Strengths and limitations

- 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 underestimation of non-fatal injury incidence due to recall bias
- Limitations include under-reporting of injury events for reasons other than recall limitations, 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.

INTRODUCTION

Injuries are one of the leading causes of mortality and morbidity worldwide, accounting for 5.8 million deaths or 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. (2-8) 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 recognized and systems set up and operated to capture reliable information on their trends. In Europe, Sami men in Sweden, Sami men and women in Finland, (9-11) Roma women in Serbia, (12) and Roma men and women in Bulgaria. (13), 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 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 (14-16), although cultural and contextual differences remain. Injuries are the leading cause of death among young people in Ireland (17), 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 twenty years old record, from a national study, of higher injury mortality than the general population (18), very little is known about the current burden of injuries among Irish Travellers. Recently, the All-Ireland Travellers 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

Data

Traveller data

We used Traveller data from the All-Ireland Traveller Health Study. The methodology of the study was published in a series of technical reports (19, 20), and included as a Traveller a person identified by themselves 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 (21). The study included a census of Irish Travellers conducted over six 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 the there was a child aged 5, 9 or 14 years in the family. Otherwise, a randomly selected adult completed a health status or a health service utilisation interview.

The mortality sub-study 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 with dwelling or occupation characteristics unique to Travellers, not reported by the other sources. 93% of the reported ages for those successfully matched with the official database were within a five years range of the ages in the official death record. The GRO death records were matched next with the Central Statistics Office (CSO) database of ICD-10 coded causes of death to obtain the Traveller deaths 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 current CSO

practice of reporting the former as unintentional injuries. Among the successfully matched deaths, 22 were coded to external causes (V01-Y89) and were also reported as injury deaths by Traveller respondents, out of 26 deaths coded to external causes, and out of 23 deaths reported as injury deaths by Traveller respondents. We thus considered unconfirmed injury deaths to be of acceptable validity and included them in the total injury deaths count.

The adult health status survey (sample size of 1,663; 702 men and 961 women) provided data on the occurrence of any injury serious enough to limit daily activity among Travellers over the two years preceding the survey, and intent of the most recent injury.

General population data

General population injury deaths by age, gender, and intent were obtained from CSO report of 2008 prospectively registered deaths coded to external causes (V01-Y89) and to mental and behavioural disorder (F00-F99). The publicly available national Survey of Lifestyle, Attitude and Nutrition (SLAN) 2002 of adults aged 18 years or over with a sample size of 5,992 provided comparable data on non-fatal injury.

Analysis

Potential Years of Life Lost

We measured the burden of premature mortality due to injury using Potential Years of Life Lost (PYLL) with 100 years as the highest age achievable. The average age at death was 0.1 years for infants, 2.6 years for 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 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 (2001).(22))

Age-specific PYLL rates and directly age-standardized PYLL rate were computed with the general population as reference. Age-standardised PYLL rate ratios were calculated as the ratio of the Traveller estimate to the general population estimate, with 95% confidence intervals computed using the method described by Kuroishi et al (1990) (23).

Standardized Mortality Ratios and Standardized Incidence Ratios

We calculated Standardized Mortality Ratios (SMR) by gender and intent, as the small age specific numbers prohibited intent disaggregation of PYLL. 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 injuries of unspecified intent proportionately over unintentional and intentional injuries where applicable. We also calculated Standardized Incidence Ratios (SIR) by gender and intent for those aged 15-64 years and those aged 65 years and over. Exact 95% Poisson confidence limits were calculated for SMRs and SIRs using the chi-square distribution as proposed by Ulm (1990). (24) Statistical significance was indicated by 95% confidence intervals that did not include 100.

Table 1: Formulas used in calculating Potential Years of Life Lost and Standardized Mortality Ratios with their confidence intervals

Formula	Description of parameters
Potential Years of Life Lost (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 disagreggation; 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 $V = Var(z) = \sum_{j=1}^{2} \left[\frac{\sum a_i^2 N_i^2 \pi_{ji}(1-\pi_{ji})}{n_{ji}} \right] / (r_j^2 N^2)$ $CLl, CLu\ (r_2/r_1) = \exp\left(Z_0 \pm 1.96\sqrt{V}\right) - 1$	*z = age-standardized PYLL ratio* π = r_1 = PYLL rate of the general population r_2 = age-standardized PYLL rate ratio of Irish Travellers CLl = Lower Confidence Limit CLu = Upper Confidence Limit

Formula	Description of parameters
Standardized Mortality Ratios and Standardized Incidence Ratios: $SMR/SIR = 100 \times \frac{o}{e}$ $e = \sum_{i=1}^{k} n_i R_i$	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 ith age group R_i = mortality rate (for SMR) or retrospective incidence rate (for SIR) in the ith age group of the general population. Incidence rate was based on those who responded to the injury question
Confidence intervals for SMR/SIR $Lower\ Limit = \frac{\left(\chi^2_{\frac{\alpha}{2},2o}\right)}{2e} \times 100$ $Upper\ Limit = \frac{\left(\chi^2_{1-\frac{\alpha}{2},2(o+1)}\right)}{2e} \times 100$	X^2 = *Chi-square value at degrees of freedom of 2o /2(o+1)*

Case Fatality Ratios

We estimated injury case fatality ratios as the ratio of injury deaths to the total number of fatal and non-fatal injuries over one year. The number of non-fatal injuries was obtained by correcting the two year recall non-fatal injury rate for under-estimation due to failure to recall injuries far back in the recall period, and then annualizing it by dividing by two. Recall correction factors were based on recall patterns observed in the 2003 World Health Surveys conducted by the World Health Organization. The recall analysis was done 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 month preceding the surveys, three months preceding the survey, six months preceding the surveys and 12 months preceding the surveys were estimated. Logarithmic models were fitted to the change in annualizing 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 two year recall; 2.0 for medically attended injuries and 3.8 for non-medically-attended injuries. We applied the same factors to unintentional and intentional injuries, as the available data did not allow development of intent-specific factors. Using the predicted factor for medically attended injuries to correct the annualized 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 (25), and converted from episode based rate to a person based rate using SLAN 2007 data. 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 (version 18). All other calculations were conducted in Excel 2007 spreadsheets.

Ethical approval for AITHS was obtained from University College Dublin Human Research Ethics Committee, and all participants provided informed written consent.

RESULTS

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

Table 2: Injury deaths among Irish Travellers and the general population, Republic of Ireland 2008[a]

	Men		Women		Total	
	Travellers	General population	Travellers	General population	Travellers	General population
Total deaths	124	14,413	64	13,779	188	28,192
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)[b]	35 (18)	47 (40)	32 (33)	78 (38)	34 (20)	56 (47)
Total PYLL (100) in years[b]	6,124	422,056	2,816	310,168	8,940	732,224
PYLL (100) due to injury (% of total)[b]	2,520 (41%)	71,943 (17%)	710 (25%)	25,702 (8%)	3,230 (36%)	97,645 (13%)

[a] As the mortality study included Traveller deaths that occurred one year before the census interviews (starting in mid-October 2008), some of the deaths would have occurred in October-December 2007.

[b] Excluding 4 male deaths and 2 female deaths with no age information

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, 92% of deaths (12 out of 13 Traveller deaths identified at GRO and 424 out of 463) of the intentional category were suicides and intentional self harm. Of the unintentional category, 71% (12 out of 17) of Traveller deaths were accidental poisoning, half due to alcohol, compared to only 24% (229 out of 974) of general population unintentional deaths that were due to accidental poisoning.

Table 3 displays SMRs and SIRs for those aged 15 years and over, by gender and intent. Men and women were about four times more likely to die of unintentional injury than their general population counterparts. Traveller men were about six times more likely to die of intentional injuries, and Traveller women were about five times more like to die of intentional injuries. Travellers had lower incidence of unintentional injury than the general population (SIR of 42 (95% CI 32-55) in men and 46 (95% CI 34-61) in women). Travellers 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 116-269) in men and 268 (195% CI 187-373) 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 standardized PYLL rate ratio[a] (95% CI)	541 (392-748)	429 (219-841)	490 (368-652)
Overall injury SMR[b] (95% CI)	523 (372-715)	462 (230-826)	496 (368-654)
Unintentional injury SMR (95% CI)	454 (279-690)	460 (177-905)	446 (292-634)
Intentional injury SMR (95% CI)	637 (367-993)	464 (107-1,204)	583 (362-885)
Non-fatal injury			
Overall injury SIR[c] 15+ (95% CI)	57 (46-71)	73 (59-90)	65 (56-75)
15-64	53 (42-66)	67 (53-83)	59 (50-69)
65+	237 (108-450)	191 (102-327)	208 (130-314)
Unintentional injury SIR 15+ (95% CI)	42 (32-55)	46 (34-61)	44 (36-53)
15-64	39 (29-51)	42 (31-57)	40 (33-49)
65+	176 (64-383)	115 (46-238)	137 (73-235)
Intentional injury SIR 15+ (95% CI)	181(116-269)	268 (187-373)	224 (171-289)
15-64	170 (107-258)	258 (176-364)	213 (160-278)
65+	607 (73-2,192)	471 (97-1,375)	517 (168-1206)

a Ratio of Potential Years of Life Lost for Irish Travellers to that of the general population in the Republic of Ireland in 2008

b Standardized Mortality Ratio of Irish Travellers using 2008 age-specific mortality rate of the general population in the Republic of Ireland as standard

c Standardized Incidence Ratio of Irish Travellers using 2002 age-specific incidence rate of the general population in the Republic of Ireland as standard

Overall injury case fatality ratio was 23 per 1000 in Traveller men and 7 per 1000 in Traveller women (Table 4). The ratio was consistently higher in Travellers than the general population, a gap that was more marked for intentional than unintentional injuries and for men than women.

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 per 1000 injured	
		Traveller	General population	Traveller	General population	Traveller	General population
Men	All injuries	38	1,402	1,474	384,778	23	4
	Unintentional	21	998	1,054	351,398	20	3
	Intentional	17	404	420	33,380	39	12
Women	All injuries	10	832	1,319	276,035	7	3
	Unintentional	7	729	766	242,816	9	3
	Intentional	3	103	554	33,219	5	3
Total	All injuries	48	2,234	2,793	660,813	15	3
	Unintentional	28	1,727	1,819	594,214	15	3
	Intentional	20	507	974	66,599	20	8

Some totals do not add up due to rounding

DISCUSSION

Our analysis revealed stark inequalities in the burden of injury affecting one of Europe's indigenous minorities, with higher proportion of deaths and potential years of life lost at younger ages in comparison to the general population contributing to the shape of their population pyramid (online only 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 fare better in terms of non-fatal injuries, this is not the case in older Travellers, nor is it the case for all types of injuries. Intentional injuries occur at a higher rate among Travellers than the general population in both the young and the old and Travellers had a higher case fatality from both intentional and unintentional injuries.

A 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 accounts for underestimation of non-fatal injury incidence due to recall bias. However, before discussing these findings, we note their limitations. Injury events are subject to underreporting in mortality and morbidity surveys for other reasons apart from recall limitations, 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 even higher injury mortality than observed here. Another limitation is that the intent for injury deaths was mainly medico-legally determined, while intent for non-fatal injuries was self-reported, which could have caused some mismatch in the numerator and denominator of the intent-specific case fatality ratios. 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 has 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 differentials findings are generlizable 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 males with no obvious trend in females (26), predicting similarly minimal decline from 2002 onwards for males.

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 reported higher unintentional non-fatal injury in other indigenous groups in comparison to their corresponding general populations. It is likely that the

higher Travellers case fatality ratio 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 lower frequency of alcohol consumption than the general population, they have higher proportions of excessive alcohol consumption than a socio-economically comparable group of the general population (19). 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, 11) are unlikely to affect Travellers. Although "going on the road" is a defining feature of Traveller culture, near 80% of Traveller families haven't 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 (19). The higher unintentional injury rate among older Travellers is not surprising, as older Travellers report higher proportions of poor health and chronic illnesses (27). Those would compound ageing related factors such as gait problems that increase the risk of falls, the commonest cause of elderly injury (27, 28).

Suicide has recently surmounted road traffic injury as the main cause of injury death in Ireland (29), and the finding that it caused the majority of Traveller's intentional injuries indicates that this is even a 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 inter-personal

violence. Fatal and non-fatal self-harm and assault also occur at a higher rate among other disadvantaged indigenous minorities (5, 8). Behind these findings likely 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 (30-32), and alongside other substance misuse, was found to be associated with suicide in other disadvantaged groups (33-37). Despite the lack of exact estimates, illicit drug use too seems to be a substantial and increasing problem among Travellers (19, 38).

Overall, the disparities observed fit well with the circumstances of social exclusion, and deprivation that affect most Travellers, impacting negatively on their mental and physical health, directly and through risky behaviour, particularly in men. Irish Travellers are thus no different in this respect from indigenous minorities in other countries. Such countries have more experience with injury prevention among indigenous people and their tried and tested strategies would thus provide a good starting point for similar efforts targeting Irish Travellers in Ireland. However the different circumstances of Irish Travellers, 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 materialize in existing and future policies, action and research.

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COMPETING INTERESTS

The authors declare that they have no competing interests

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CONTRIBUTORSHIP

Abdalla S participated in the collection of the Traveller data, designed and implemented the analysis strategy and drafted the manuscript. Kelleher C is the Principal Investigator of the All Ireland Traveller Health Study, designed and supervised the implementation of the Traveller studies that provided the data for this paper, and contributed to the writing and revision of the manuscript. Quirke B supervised the field activities, participated in the Traveller data collection and management, and reviewed the manuscript. Daly L designed and supervised the implementation of the Traveller studies, supervised the analysis, and reviewed the manuscript. All authors approved the final manuscript.

DATA SHARING

There is no additional data available.

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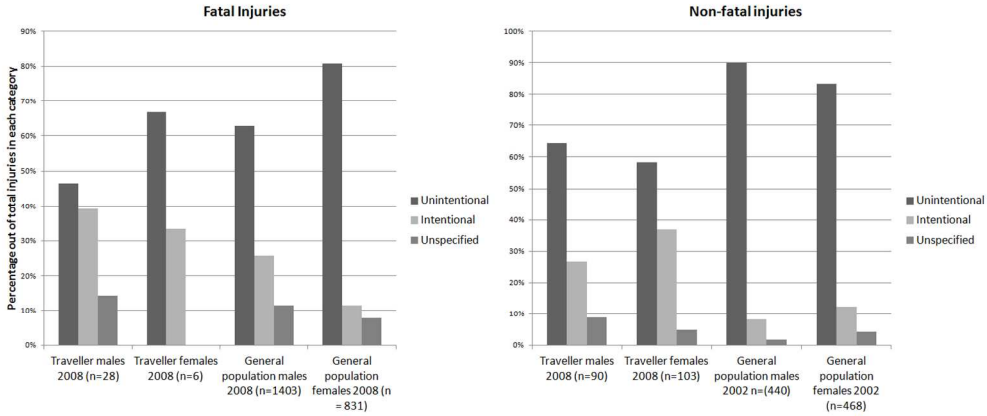
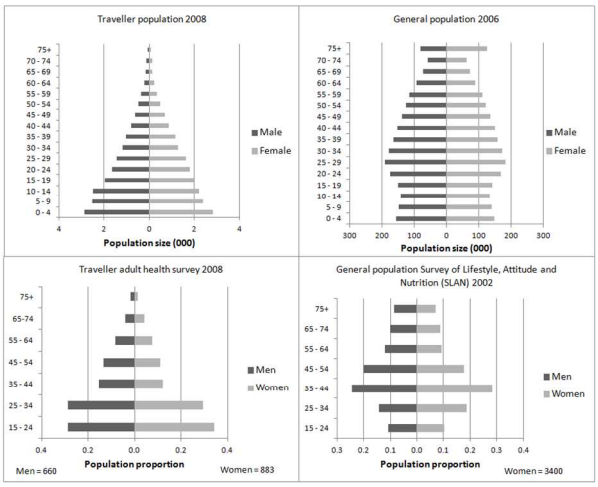


Figure 1: The figure displays bar charts of the distribution of fatal and non-fatal injuries by intent among Irish Travellers and the general population of Ireland. The x-axis represents the categories of male Travellers with 28 injury deaths in 2008, female Travellers with 6 injury deaths in 2008, general population males with 1403 injury deaths in 2008 and general population females with 831 injury deaths in 2008. The y-axis represents the percentage of unintentional, intentional and unspecified intent injuries out of total injury deaths in 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.
404x171mm (96 x 96 DPI)



Appendix figure
402x191mm (96 x 96 DPI)

STROBE Statement— Do Irish Travellers experience similar inequalities as other indigenous minorities? An investigation of the burden of injuries in an indigenous minority in Europe

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any pre-specified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes , [exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable] **NA**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods , including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions **NA**
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy **NA**
		(*e*) Describe any sensitivity analyses **NA**
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **NA**
		(b) Give reasons for non-participation at each stage **NA**
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **NA**
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval) . Make clear which confounders were adjusted for and why they were included **NA**
		(*b*) Report category boundaries when continuous variables were categorized

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **NA**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **NA**
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

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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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

Safa Abdalla1, Cecily Kelleher1, Brigid Quirke1, Leslie Daly1 on behalf of the All-Ireland Traveller Health Study team

1 School of Public Health, Physiotherapy and Population Science

University College Dublin

Woodview House

Belfield

Dublin 4

Republic of Ireland

Corresponding author

Dr Safa Abdalla

Email: drsafa@yahoo.com

Phone: +353857146018

Key words:

Burden of disease, mortality, health disparities, indigenous

Word count: 3,684

Abstract

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

Design: cross-sectional population-based comparative study

Setting: Republic of Ireland

Participants: Population census and retrospective mortality data were collected from 7,042 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 5,992 adults in private households aged 18 years or over.

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

Results: injury accounted for 36% of PYLL among Travellers, compared to 13% in the general population. Travellers were more likely to die of unintentional injury than the general population (SMR = 454 (95%CI 279-690) in men and 460 (95%CI 177-905) in women), with a similar pattern for intentional injury (SMR = 637 (95%CI 367-993) in men and 464 (95%CI 107-1,204). They had lower incidence of unintentional injury but those aged 65 years or over were about twice as likely to report an injury. Travellers had higher incidence of intentional injuries (SIR = 181 (95%CI 116-269) in men and 268 (95% CI 187-373) 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 further research should focus on suicide, alcohol misuse and elderly injury among Irish Travellers.

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 twenty first 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

- 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 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.

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 recognized 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 Serbia, (13) 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 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 twenty years 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-standardized PYLL rate ratios. Standardized Mortality Ratios 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 Standardized Incidence Ratios (SIR). We also calculated overall and gender-specific injury case-fatality ratios for each group.

Data

Traveller mortality and population data

We used Traveller data from the All-Ireland Traveller Health Study. 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 University College Dublin Human Research Ethics Committee, and all participants provided 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 six 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 the 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 sub-interview.

The mortality sub-study 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 . 93% of the reported ages for those successfully matched with the official database were within a five years range of the ages in the official death record. The GRO death records were matched next with the Central Statistics Office (CSO) database of ICD-10 coded causes of death to obtain the Traveller deaths 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 current CSO practice of reporting the former as unintentional injuries. Among the successfully matched deaths, 22 out 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 deaths count. We used Traveller population counts from AITHS census for rate calculations.

Traveller non-fatal injury data

The adult health status survey (sample size of 1,663; 702 men and 961 women) provided retrospective data on the occurrence of any injury serious enough to limit daily activity among Travellers over the two 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 CSO report of 2008 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 5,992 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 socio-economic 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).

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 [ ]

Analysis

Potential Years of Life Lost (PYLL)

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 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 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 (2001).(27))

Age-specific PYLL rates and directly age-standardized PYLL rate for Travellers were computed with the general population as reference. Age-standardised PYLL rate ratios were calculated as the ratio of the Traveller estimate to the general population estimate, with 95% confidence intervals computed using the method described by Kuroishi et al (1990) (28).

Standardized Mortality Ratios

Using indirect standardization, we calculated Standardized Mortality Ratios (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 mortality 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 injuries of unspecified intent proportionately over unintentional and intentional injuries where applicable. Exact 95% Poisson confidence limits were calculated for SMRs using the chi-square distribution as proposed by Ulm (1990). (29) Statistical significance was indicated by 95% confidence intervals that did not include 100.

Standardized Incidence Ratios (SIR)

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. 95% confidence intervals for SIRs were calculated in the same way as those for SMRs.

The online only appendix table details the formulas used in the calculation of the estimates and their confidence intervals.

Case Fatality Ratios

We estimated injury case fatality ratios as the ratio of injury deaths to the total number of fatal and non-fatal injuries over one year. The number of non-fatal injuries was obtained by correcting the two year recall non-fatal injury rate for under-estimation due to failure to recall injuries far back in the recall period, and then annualizing it by dividing by two. Recall correction factors were based on recall patterns observed in the 2003 World Health Surveys conducted by the World Health Organization. The recall analysis was done 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 month preceding the surveys, three months preceding the survey, six months preceding the surveys and 12 months preceding the surveys were estimated. Logarithmic models were fitted to the change in annualizing 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 two year recall; 2.0 for medically attended injuries and 3.8 for non-medically-attended injuries. Using the predicted factor for medically attended injuries to correct the annualized 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 SLAN 2007 survey. We applied the same factors to unintentional and intentional injuries, as the available data did not allow 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 (version 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 one year, 27% of which were due to injury (33% in males and 18% in females), compared to 8% in the general population (10% in males and 6% in females). The median age at death from injuries was 35 years in males and 32 years in females, much lower than that in the general population (47 years in males and 78 years in females). Injuries accounted for 36% of PYLL among Travellers (41% in males and 25% in females), compared to 13% in the general population (17% in males and 8% in females).

Table 2: Injury deaths and burden of premature mortality due to injury among Irish Travellers and the general population, Republic of Ireland 2008[a]

	Men		Women		Total	
	Travellers	General population	Travellers	General population	Travellers	General population
Total deaths	124	14,413	64	13,779	188	28,192
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)[b]	35 (18)	47 (40)	32 (33)	78 (38)	34 (20)	56 (47)
Total PYLL (100) in years[b]	6,124	422,056	2,816	310,168	8,940	732,224
PYLL (100) due to injury (% of total)[b]	2,520 (41%)	71,943 (17%)	710 (25%)	25,702 (8%)	3,230 (36%)	97,645 (13%)

[a] As the mortality study included Traveller deaths that occurred one year before the census interviews that started in mid-October 2008, some of the deaths would have occurred in October-December 2007.

[b] Excluding 4 male deaths and 2 female deaths with missing age data

IQR: Interquartile Range; PYLL(100): Potential Years of Life Lost with reference age of 100 years

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 out of 13 Traveller deaths identified at GRO, and 424 out of 463 (92%) of general population deaths). Of the unintentional category, more than half of Traveller deaths (12 out of 17) were accidental poisoning, half of them due to alcohol, while only 24% (229 out of 974) of 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-standardized 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 368-652 and SMR of 496 (95% CI 368-654)). At 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 like to die of intentional injuries. Travellers had lower incidence of unintentional injury than the general population (SIR of 42 (95% CI 32-55) in men and 46 (95% CI 34-61) 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 116-269) in men and 268 (195% CI 187-373) 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 standardized PYLL rate ratio[a] (95% CI)	541 (392-748)	429 (219-841)	490 (368-652)
Overall injury SMR[b] (95% CI)	523 (372-715)	462 (230-826)	496 (368-654)
Unintentional injury SMR (95% CI)	454 (279-690)	460 (177-905)	446 (292-634)
Intentional injury SMR (95% CI)	637 (367-993)	464 (107-1,204)	583 (362-885)
Non-fatal injury			
Overall injury SIR[c] 15+ (95% CI)	57 (46-71)	73 (59-90)	65 (56-75)
15-64	53 (42-66)	67 (53-83)	59 (50-69)
65+	237 (108-450)	191 (102-327)	208 (130-314)
Unintentional injury SIR 15+ (95% CI)	42 (32-55)	46 (34-61)	44 (36-53)
15-64	39 (29-51)	42 (31-57)	40 (33-49)
65+	176 (64-383)	115 (46-238)	137 (73-235)
Intentional injury SIR 15+ (95% CI)	181(116-269)	268 (187-373)	224 (171-289)
15-64	170 (107-258)	258 (176-364)	213 (160-278)
65+	607 (73-2,192)	471 (97-1,375)	517 (168-1206)

a Ratio of Potential Years of Life Lost for Irish Travellers to that of the general population in the Republic of Ireland in 2008

b Standardized Mortality Ratio of Irish Travellers using 2008 age-specific mortality rate of the general population in the Republic of Ireland as standard

c Standardized Incidence Ratio of Irish Travellers using 2002 age-specific incidence rate of the general population in the Republic of Ireland as standard

Overall injury case fatality ratio was 23 per 1000 in Traveller men and 7 per 1000 in Traveller women, compared to 4 per 1000 in general population men and 3 per 1000 in general population women (Table 4). The case fatality ratio was consistently higher in Travellers than the general population, a gap that was, in its relative form, more marked for unintentional (15 per 1000 among Travellers compared to 3 per 1000 among the general population) than intentional injuries (20 per 1000 among Travellers compared to 8 per 1000 among the general population) and for men (25 per

1000 among Travellers comparted to 4 per 1000 among the general population) than women (8 per 1000 among Travellers compared to 3 per 1000 among the general population).

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 per 1000 injured	
		Traveller	General population	Traveller	General population	Traveller	General population
Men	All injuries	38	1,402	1,474	384,778	25	4
	Unintentional	21	998	1,054	351,398	20	3
	Intentional	17	404	420	33,380	39	12
Women	All injuries	10	832	1,319	276,035	8	3
	Unintentional	7	729	766	242,816	9	3
	Intentional	3	103	554	33,219	5	3
Total	All injuries	48	2,234	2,793	660,813	17	3
	Unintentional	28	1,727	1,819	594,214	15	3
	Intentional	20	507	974	66,599	20	8

Some totals do not add up due to rounding

DISCUSSION

Summary of main findings

Our analysis revealed stark inequalities in the burden of injury affecting one of Europe's indigenous minorities, with 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 (online only 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, nor was it the case for all types of injuries. Intentional injuries occured at a higher rate among Travellers than the general population in both the young and the old and Travellers had a higher case fatality 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 underreporting 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 even higher injury mortality than observed here. Another limitation is that the intent for injury deaths was mainly medico-legally determined, while intent for non-fatal injuries was self-reported, which could have caused some mismatch in the numerator and denominator of the intent-specific case fatality ratios. 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 differentials findings are generalizable 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 males (23% in 1998 and 21% in 2002) with no obvious trend in females (14% in 1998 and 2002) (26), predicting similarly minimal decline from 2002 onwards for males.

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 to 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 to the general population (8). It is likely that the higher Travellers' case fatality ratio 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 lower frequency of alcohol consumption than the general population, they have higher proportions of excessive alcohol consumption than a socio-economically 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, near 80% of Traveller families haven't travelled for more than three 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). Higher unintentional injury rate among older Travellers would not 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 that 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 surmounted road traffic injury as the main cause of injury death in Ireland (33), and the finding that it caused the majority of Traveller's intentional injuries indicates that this is even a 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 inter-personal violence. Fatal and non-fatal self-harm and assault also occur at a higher rate among other disadvantaged indigenous minorities (5, 8). Behind these findings likely 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, 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 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 materialize in existing and future policies, action and research.

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COMPETING INTERESTS

The authors declare that they have no competing interests

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CONTRIBUTORSHIP

Abdalla S participated in the collection of the Traveller data, designed and implemented the analysis strategy and drafted the manuscript. Kelleher C is the Principal Investigator of the All Ireland Traveller Health Study, 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. Quirke B supervised the field activities, participated in the Traveller data collection and management, and reviewed the manuscript. Daly L designed and supervised the implementation of the Traveller studies, supervised the analysis, and reviewed the manuscript. All authors approved the final manuscript.

DATA SHARING

no additional data available.

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Disparities in fatal and non-fatal injuries between Irish Travellers and the Irish general population are similar to those of other indigenous minorities: ~~Do Irish Travellers experience similar inequalities as other indigenous minorities? A cross-sectional comparative~~A cross-sectional population-based comparative study ~~study of the burden of injuries in an indigenous minority in Europe~~

Safa Abdalla1, Cecily Kelleher1, Brigid Quirke1, Leslie Daly1 on behalf of the All-Ireland Traveller Health Study team

1 School of Public Health, Physiotherapy and Population Science

University College Dublin

Woodview House

Belfield

Dublin 4

Republic of Ireland

Corresponding author

Dr Safa Abdalla

Email: drsafa@yahoo.com

Phone: +353857146018

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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: cross-sectional population-based comparative study

Setting: Republic of Ireland

Participants: Population census and retrospective mortality data were collected from 7,042 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 5,992 adults in private households aged 18 years or over.

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

Results: injury accounted for 36% of PYLL among Travellers, compared to 13% in the general population. Travellers were more likely to die of unintentional injury than the general population (SMR = 454 (95%CI 279-690) in men and 460 (95%CI 177-905) in women), with a similar pattern for intentional injury (SMR = 637 (95%CI 367-993) in men and 464 (95%CI 107-1,204). They had lower incidence of unintentional injury but those aged 65 years or over were about twice as likely to report an injury. Travellers had higher incidence of intentional injuries (SIR = 181 (95%CI 116-269) in men and 268 (95% CI 187-373) in women). Injury CFR were consistently higher among Travellers.

Conclusions: Irish Travellers ~~experience injury burden mortality differentials similar to other indigenous groups~~continue to bear a~~-~~ disproportionate burden of injury, ~~but have different unintentional injury differentials, which should be considered when planning injury prevention~~

~~among a distinct population group as Irish Travellers~~which calls for scaling up injury prevention efforts in this group. Prevention and ~~F~~further research should focus on suicide, alcohol misuse and elderly injury among ~~this group~~Irish Travellers.

ARTICLE SUMMARY

Article focus

- ~~Assesssing~~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

- ~~Similar to other indigenous minorities,~~ Irish Travellers continue to bear a disproportionately higher mortality burden of unintentional and intentional injury than the Irish general population in the twenty first century, with higher case fatality ~~rates~~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 ~~within a social determinants framework, drawing from experience in other countries~~.

Strengths and limitations

- 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 underestimation of non-fatal injury incidence due to incomplete recall ~~bias~~.
- Limitations include under-reporting of injury events for reasons other than incomplete recall ~~limitations~~, 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.

INTRODUCTION

Injuries are one of the leading causes of mortality and morbidity worldwide, accounting for 5.8 million deaths ~~or~~(-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)~~(2-8)~~ 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 recognized 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 Serbia, (13) 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 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 twenty years old record, from a national study, of higher injury

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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-standardized PYLL rate ratios. Standardized Mortality Ratios 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 Standardized Incidence Ratios (SIR). We also calculated overall and gender-specific injury case-fatality ratios for each group.

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Data

Traveller mortality and population data

We used Traveller data from the All-Ireland Traveller Health Study. 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 University College Dublin Human Research Ethics Committee, and all participants provided written informed consent.~~, and included as a~~The definition of a Traveller in AITHS was ~~Traveller~~ 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 six 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 the there was a child aged 5, 9 or 14 years in the family. Otherwise, an ~~randomly selected~~ adult aged 15 years or over was selected at random from available adults to complete~~d~~ 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 sub-interview.

The mortality sub-study of AITHS provided the number of deaths, including injury deaths, over the year preceding the census. ~~Travellers~~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 ~~unique to~~that were typical of Travellers~~, not reported by the other sources~~. 93% of the reported ages for those successfully matched with the official database were within a five years range of the ages in the official death record. The GRO death records were matched next with the Central Statistics Office (CSO) database

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of ICD-10 coded causes of death to obtain the Traveller deaths 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 current CSO practice of reporting the former as unintentional injuries. Among the successfully matched deaths, 22 out of 26 deaths ~~were~~ coded to external causes (V01-Y89) ~~and~~ were also reported as injury deaths by Traveller respondents~~, out of 26 deaths coded to external causes,~~. The latter reported a total of~~and out of~~ 23 ~~deaths reported as~~ injury deaths ~~by Traveller respondents~~. We thus considered unconfirmed injury deaths to be of acceptable validity and included them in the total injury deaths count. We used Traveller population counts from AITHS census for rate calculations.

Traveller non-fatal injury data

The adult health status survey (sample size of 1,663; 702 men and 961 women) provided retrospective data on the occurrence of any injury serious enough to limit daily activity among Travellers over the two 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 CSO report of 2008 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 5,992 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 socio-economic 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).

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 [ ]

Analysis

Potential Years of Life Lost (PYLL)

~~We measured the burden of premature mortality due to injury using Potential Years of Life Lost~~ ~~(~~PYLL were calculated~~)~~ with 100 years as the ~~highest age achievable~~reference age. The average age at death was taken as 0.1 years for infants and~~,~~ 2.6 years for 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 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 (2001).(27))

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Age-specific PYLL rates and directly age-standardized PYLL rate for Travellers were computed with the general population as reference. Age-standardised PYLL rate ratios were calculated as the ratio of the Traveller estimate to the general population estimate, with 95% confidence intervals computed using the method described by Kuroishi et al (1990) (28).

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Standardized Mortality Ratios ~~and Standardized Incidence Ratios~~

Using indirect standardization, ~~W~~we calculated Standardized Mortality Ratios (SMR) by gender and intent, as the small age specific number of Traveller deaths~~s~~ 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 mortality 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 injuries of unspecified intent proportionately over unintentional and intentional injuries where applicable. ~~We also calculated Standardized Incidence Ratios (SIR) by gender and intent for those aged 15-64 years and those aged 65 years and over.~~ Exact 95% Poisson confidence limits were calculated for SMRs ~~and SIRs~~ using the chi-square distribution as proposed by Ulm (1990). (29) Statistical significance was indicated by 95% confidence intervals that did not include 100.

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Standardized Incidence Ratios (SIR)

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. 95% confidence intervals for SIRs were calculated in the same way as those for SMRs.

The online only appendix table details the formulas used in the calculation of the estimates and their confidence intervals.

Case Fatality Ratios

We estimated injury case fatality ratios as the ratio of injury deaths to the total number of fatal and non-fatal injuries over one year. The number of non-fatal injuries was obtained by correcting the two year recall non-fatal injury rate for under-estimation due to failure to recall injuries far back in the recall period, and then annualizing it by dividing by two. Recall correction factors were based on recall patterns observed in the 2003 World Health Surveys conducted by the World Health Organization. The recall analysis was done 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 month preceding the surveys, three months preceding the survey, six months preceding the surveys and 12 months preceding the surveys were estimated. Logarithmic models were fitted to the change in annualizing 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 two year recall; 2.0 for medically attended injuries and 3.8 for non-medically-attended injuries. ~~We applied the same factors to unintentional and intentional injuries, as the available data did not allow development of intent-specific factors.~~ Using the predicted factor for medically attended injuries to correct the annualized 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 SLAN 2007 ~~data~~survey. We applied the same factors to unintentional and intentional injuries, as the available data did not allow 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.

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

~~Ethical approval for AITHS was obtained from University College Dublin Human Research Ethics Committee, and all participants provided informed written consent.~~

RESULTS

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

Table 2: Injury deaths and burden of premature mortality due to injury among Irish Travellers and the general population, Republic of Ireland 2008[a]

	Men		Women		Total	
	Travellers	General population	Travellers	General population	Travellers	General population
Total deaths	124	14,413	64	13,779	188	28,192
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)[b]	35 (18)	47 (40)	32 (33)	78 (38)	34 (20)	56 (47)
Total PYLL (100) in years[b]	6,124	422,056	2,816	310,168	8,940	732,224
PYLL (100) due to injury (% of total)[b]	2,520 (41%)	71,943 (17%)	710 (25%)	25,702 (8%)	3,230 (36%)	97,645 (13%)

[a] As the mortality study included Traveller deaths that occurred one year before the census interviews that started in mid-October 2008, some of the deaths would have occurred in October-December 2007.

[b] Excluding 4 male deaths and 2 female deaths with missing age data

IQR: Interquartile Range; PYLL(100): Potential Years of Life Lost with reference age of 100 years

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 out of 13 Traveller deaths identified at GRO, and 424 out of 463 (92%) of general population deaths ~~of deaths (12 out of 13 Traveller deaths identified at GRO and 424 out of 463) of the intentional category were suicides and intentional self harm~~. Of the unintentional category, ~~71%~~more than half ~~(12 out of 17)~~ of Traveller deaths (12 out of 17) were accidental poisoning, half of them due to alcohol, ~~compared to~~while only 24% (229 out of 974) of general population unintentional deaths ~~that~~ 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-standardized PYLL rate ratios, ~~s~~ 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 368-652 and SMR of 496 (95% CI 368-654)). At intent level, ~~M~~men and women were ~~about~~ more than four times more likely to die of unintentional injury than their general population counterparts. Traveller men were ~~about~~ more than six times more likely to die of intentional injuries, and Traveller women were ~~about~~ more than four~~five~~ times more like to die of intentional injuries. Travellers had lower incidence of unintentional injury than the general population (SIR of 42 (95% CI 32-55) in men and 46 (95% CI 34-61) in women) but those~~. Travellers~~ 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 116-269) in men and 268 (195% CI 187-373) 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 standardized PYLL rate ratio[a] (95% CI)	541 (392-748)	429 (219-841)	490 (368-652)
Overall injury SMR[b] (95% CI)	523 (372-715)	462 (230-826)	496 (368-654)
Unintentional injury SMR (95% CI)	454 (279-690)	460 (177-905)	446 (292-634)
Intentional injury SMR (95% CI)	637 (367-993)	464 (107-1,204)	583 (362-885)
Non-fatal injury			
Overall injury SIR[c] 15+ (95% CI)	57 (46-71)	73 (59-90)	65 (56-75)
15-64	53 (42-66)	67 (53-83)	59 (50-69)
65+	237 (108-450)	191 (102-327)	208 (130-314)
Unintentional injury SIR 15+ (95% CI)	42 (32-55)	46 (34-61)	44 (36-53)
15-64	39 (29-51)	42 (31-57)	40 (33-49)
65+	176 (64-383)	115 (46-238)	137 (73-235)
Intentional injury SIR 15+ (95% CI)	181(116-269)	268 (187-373)	224 (171-289)
15-64	170 (107-258)	258 (176-364)	213 (160-278)
65+	607 (73-2,192)	471 (97-1,375)	517 (168-1206)

a Ratio of Potential Years of Life Lost for Irish Travellers to that of the general population in the Republic of Ireland in 2008

b Standardized Mortality Ratio of Irish Travellers using 2008 age-specific mortality rate of the general population in the Republic of Ireland as standard

c Standardized Incidence Ratio of Irish Travellers using 2002 age-specific incidence rate of the general population in the Republic of Ireland as standard

Overall injury case fatality ratio was 23 per 1000 in Traveller men and 7 per 1000 in Traveller ~~women~~ women, compared to 4 per 1000 in general population men and 3 per 1000 in general population women (Table 4). The case fatality ratio was consistently higher in Travellers than the general population, a gap that was, in its relative form, more marked for unintentional (15 per 1000 among Travellers compared to 3 per 1000 among the general population) -than ~~un~~intentional injuries (20 per 1000 among Travellers compared to 8 per 1000 among the general population) and for men (25

per 1000 among Travellers comparted to 4 per 1000 among the general population) than women (8 per 1000 among Travellers compared to 3 per 1000 among the general population).

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 per 1000 injured	
		Traveller	General population	Traveller	General population	Traveller	General population
Men	All injuries	38	1,402	1,474	384,778	253	4
	Unintentional	21	998	1,054	351,398	20	3
	Intentional	17	404	420	33,380	39	12
Women	All injuries	10	832	1,319	276,035	87	3
	Unintentional	7	729	766	242,816	9	3
	Intentional	3	103	554	33,219	5	3
Total	All injuries	48	2,234	2,793	660,813	175	3
	Unintentional	28	1,727	1,819	594,214	15	3
	Intentional	20	507	974	66,599	20	8

Some totals do not add up due to rounding

DISCUSSION

Summary of main findings

Our analysis revealed stark inequalities in the burden of injury affecting one of Europe's indigenous minorities, with 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 (online only 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 ~~is~~ was not the case in older Travellers, nor ~~is~~ was it the case for all types of injuries. Intentional injuries occured at a higher rate among Travellers than the general population in both the young and the old and Travellers had a higher case fatality from both intentional and unintentional injuries.

Strengths and limitations

The~~A~~ 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 ~~accounts~~ accounted for underestimation of non-fatal injury incidence due to recall bias. However, before discussing the~~se~~ findings, we note their limitations. Injury events are subject to underreporting in mortality and morbidity surveys for other reasons apart from ~~recall limitations~~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 even higher injury mortality than observed here. Another limitation is that the intent for injury deaths was mainly medico-legally determined, while intent for non-fatal injuries was self-reported, which could have caused some mismatch in the numerator and denominator of the intent-specific case fatality ratios. 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 ha~~s~~d 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 differentials findings are generalizable 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 males (23% in 1998 and 21% in 2002) with no obvious trend in females (14% in 1998 and 2002) (26), predicting similarly minimal decline from 2002 onwards for males.

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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~~ the~~reported~~ higher unintentional non-fatal injury ~~in~~among ~~other indigenous groups in comparison to their corresponding general populations~~the indigenous people of Australia, who had 1.5 to 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 to the general population (8). It is likely that the higher Travellers' case fatality ratio 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 lower frequency of alcohol consumption than the general population, they have higher proportions of excessive alcohol consumption than a socio-economically comparable group of the general population (20)~~(19)~~. 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.

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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, near 80% of Traveller families haven't travelled for more than ~~3~~ three 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). Higher unintentional injury rate among older Travellers would not 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 that 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 surmounted road traffic injury as the main cause of injury death in Ireland (33), and the finding that it caused the majority of Traveller's intentional injuries indicates that this is even a 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 inter-personal violence. Fatal and non-fatal self-harm and assault also occur at a higher rate among other disadvantaged indigenous minorities (5, 8). Behind these findings likely 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, 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

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Irish Travellers continue to bear a disproportionate burden of injury in patterns that~~Overall, the~~ seem to ~~disparities observed~~ fit well with the circumstances of social exclusion~~,~~ and deprivation that affect most ~~Travellers~~of them, and the expected negative impact of such circumstances ~~impacting negatively on their~~on mental and physical health~~, directly and through risky behaviour, particularly in men~~. ~~Irish Travellers are thus no different in this respect from indigenous minorities in other countries.~~ 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,~~Such countries have more experience with injury prevention among indigenous people and their tried and tested strategies would thus provide a good starting point for similar efforts targeting Irish Travellers in Ireland. However ,~~ the ~~different circumstances~~specificity of Irish Travellers circumstances~~,~~ 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 materialize in existing and future policies, action and research.

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COMPETING INTERESTS

The authors declare that they have no competing interests

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CONTRIBUTORSHIP

Abdalla S participated in the collection of the Traveller data, designed and implemented the analysis strategy and drafted the manuscript. Kelleher C is the Principal Investigator of the All Ireland Traveller Health Study, 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. Quirke B supervised the field activities, participated in the Traveller data collection and management, and reviewed the manuscript. Daly L designed and supervised the implementation of the Traveller studies, supervised the analysis, and reviewed the manuscript. All authors approved the final manuscript.

DATA SHARING

There is no additional data available.

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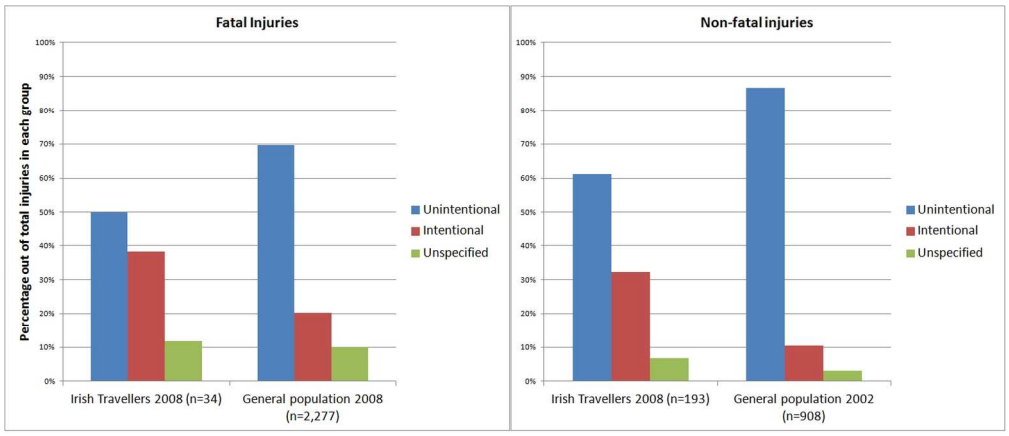

Figure 1: Distribution of fatal and non-fatal injuries by intent for Irish Travellers and the general population, Republic of Ireland.

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 2,277 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.

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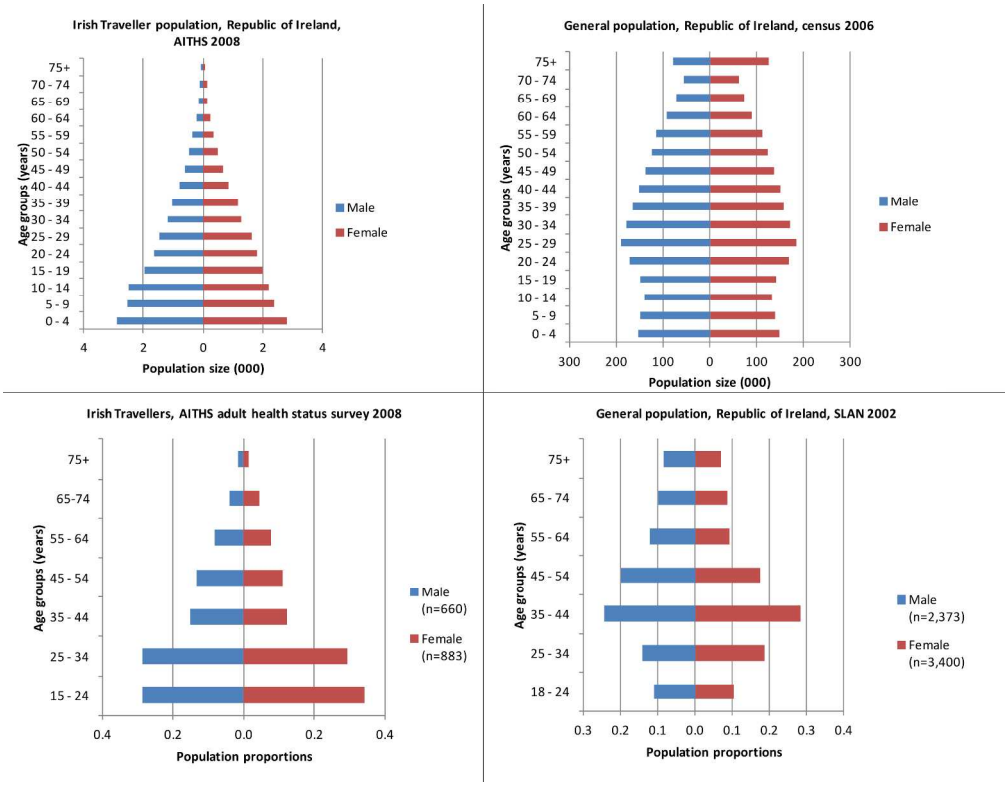

Appendix figure: Age-gender distribution of Irish Travellers and the general population in the population and survey data.

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.

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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 disagreggation; 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): $$V = Var(z) = \sum_{j=1}^{2} \left[\frac{\sum a_i^2 N_i^2 \pi_{ji} (1 - \pi_{ji})}{n_{ji}} \right] / (r_j^2 N^2)$$ $$CLl, CLu\ (r_2/r_1) = \exp\left(Z_0 \pm 1.96\sqrt{V}\right) - 1$$	*z = age-standardized PYLL ratio* π = r_1 = PYLL rate of the general population r_2 = age-standardized PYLL rate ratio of Irish Travellers CLl = 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 15 years or over for SIR) n_i = number of Travellers in the ith age group R_i = mortality rate (for SMR) or retrospective incidence rate (for SIR) in the ith age group of the general population. Incidence rate was based on those who responded to the injury question
Confidence intervals for SMR/SIR (28): $Lower\ Limit = \frac{\left(\chi^2_{\frac{\alpha}{2},2o}\right)}{2e} \times 100$ $Upper\ Limit = \frac{\left(\chi^2_{1-\frac{\alpha}{2},2(o+1)}\right)}{2e} \times 100$	*X^2 = Chi-square value at degrees of freedom of 2o /2(o+1)*

STROBE Statement—~~Do Irish Travellers experience similar inequalities as other indigenous minorities?~~

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 comparative study

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found ✓
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported ✓
Objectives	3	State specific objectives, including any pre-specified hypotheses ✓
Methods		
Study design	4	Present key elements of study design early in the paper ✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection ✓
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants ✓
Variables	7	Clearly define all outcomes ✓, [exposures, predictors, potential confounders, and effect modifiers. *(exposure/predictor was belonging to the Traveller community, potential confounders were age and sex, considered in the stratified, age-standardized analysis)* Give diagnostic criteria, if applicable] (Provided as questionnaire items used)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group ✓
Bias	9	Describe any efforts to address potential sources of bias ✓
Study size	10	Explain how the study size was arrived at ✓
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why ✓
Statistical methods	12	(*a*) Describe all statistical methods ✓, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions **NA***
		(*c*) Explain how missing data were addressed ✓ (*included is how Traveller mortality data missing from General Registrar Office database were addressed)*
		(*d*) If applicable, describe analytical methods taking account of sampling strategy **NA**
		(*e*) Describe any sensitivity analyses **NA**
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **NA**
		(b) Give reasons for non-participation at each stage **NA**
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) □ and information on exposures and potential confounders ✓ (*Demographics of the groups*

		included in the study were provided)
		(b) Indicate number of participants with missing data for each variable of interest ✓
Outcome data	15*	Report numbers of outcome events or summary measures ✓
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval) ✓. Make clear which confounders were adjusted for and why they were included *(Key outcomes were presented with age-adjustment and stratification by gender)*
		(*b*) Report category boundaries when continuous variables were categorized ✓
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **NA**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **NA**
Discussion		
Key results	18	Summarise key results with reference to study objectives ✓
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias ✓
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence ✓
Generalisability	21	Discuss the generalisability (external validity) of the study results ✓ *(Included in the limitations of the study)*
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based ✓

***NA: Not Applicable**