**Original Article**

# Cyclist Safety in Malta: A Review

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**Abstract**

The promotion of safe cycling is a way to address physical inactivity, one of the risk factors for non-communicable diseases (NCDs). In the report Road safety in the European Union: Trends, statistics and main challenges (March 2015), 8% of all fatalities are cyclists.

Bicycle helmets can reduce the risk of head and brain injuries and death. Most EU Member states have no requirement in legislation for bicycle helmets. Consequences of mandatory helmet legislation include decreases in head injuries and death, decreases cycling as a mode of transport, and increases helmet use. Other considerations, which influence bicycle accidents, need to be considered.

In Malta there were three deaths due to cycling between 2006 and 2015. The number of Accident & Emergency (A&E) attendances with cycling related injuries increased between 2009 and 2015. The number of A&E attendances in the 0-19 age group decreased whereas the 20-39 and 40-59 year age groups increased. In 2013, there were 173 registered injuries in cyclists, with head, upper extremity and lower extremity involvement in 28%, 40% and 21% respectively.

Recommendations include improving data collection, education campaigns, strong recommendation for helmet use in adults, to consider the introduction of mandatory helmet legislation in children and implementation of infrastructure measures to make roads more cycling friendly.

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**Key words**

Head injuries, bicycle helmet and legislation.

## Introduction

The promotion of safe cycling is a way to address physical inactivity, which is one of the common risk factors for non-communicable diseases (NCDs). NCDs are responsible for a large part of the disease burden in Europe. The World Health Organisations' (WHO) "Global Report on Diabetes" claims that "the physical or built environment plays an important role in facilitating physical activity for many people" and that "urban planning and active transport policies can ensure that walking, cycling and other forms of non-motorized transport are accessible and safe for all".[1] However cyclists fall under the category of "vulnerable road users" together with pedestrians, as they are less protected in traffic from a collision than car drivers or passengers and are at a greater risk of injury or fatalities.

In the report "Road safety in the European Union: Trends, statistics and main challenges",[2] 8% of all fatalities are cyclists. Whilst there has been a low decrease of fatalities over time, there are big differences between countries. Serious head and neck injuries were the most common. The DaCoTA research project (Road safety Data Collection, Transfer and Analysis) found that bicycle helmets can reduce the risk of head and brain injuries between 63% and 88% in the case of a serious crash.[3]

The main legislation regulating cycling in Malta is Subsidiary Legislation 26 of Chapter 65, which is a set of regulations that is known as "Low-Powered Vehicles and Pedal Cycles Regulations". A "pedal cycle" is defined as "a two or three-wheeled vehicle that is propelled solely by human power by means of pedals". The use of helmets is not required for pedal cyclists. However, children under ten travelling on someone else's pedal cycle or power assisted pedal cycle, which was adapted to do so, shall be seated in a safety seat and shall wear a bicycle helmet. Best practice guidelines in Part 3 article 55 of The Highway Code states that cyclists

should wear a cycle helmet, which conforms to current regulations. However, this is not supported by the law.

In the European Union, there is no universal mandate on the use of bicycle helmets. Whilst some countries have partial rules, others have none.[4] Bicycle helmet laws vary across the world. Only Australia and New Zealand currently require and enforce universal use of helmets by cyclists.[5-6]

## Background

### *Demographics*

In a recent systematic review, there were more male cyclists and they had a higher incidence rate (IR) of bicycle accidents than women. The IR increased with age especially in single bicycle accidents. The fatality rates and hospital admissions per million hours of cycling was higher for male cyclists younger than 17 and older than 50, with an incremental increase for those over 70 years of age. Female cyclists had lower fatality and hospital admission rates per million hours of cycling in all ages except between 17 and 20 years.[7]

## The evidence for the protective effects of bicycle helmets

### *Empirical evidence*

A retrospective case-control study showed that helmeted cyclists were less likely to have a skull fracture ($p$=0.01) and a scalp laceration ($p$=0.01) when compared to non-helmeted riders. However there was no difference between the two groups for the development of intracranial haemorrhage ($p$=0.1).[8] However a retrospective case-control study showed that non-helmeted cyclists were more likely to have severe traumatic brain injury on computed tomography scan ($p$=0.004), longer length of stays in an intensive care unit ($p$=0.001) and more neurosurgical interventions ($p$=0.04).[9] Helmeted cyclists injured in collisions with motor vehicles have a 72-74% reduced risk of head injuries.[10-11] Helmeted cyclists had a 44% reduced odds of mortality ($p$= <0.01) and a reduced odds of facial fractures by 31% ($p$= <0.001).[12] In summary, bicycle helmets reduced the risk of head and brain injuries; this is in keeping with previous case-control studies.[13-16]

### *Systematic reviews and meta-analysis*

The largest and most recent systematic review and meta-analysis to date concluded that for cyclists involved in a crash or fall, helmet use was associated with an odds reduction (OR) for head (OR=0.49, 95% confidence interval (CI) 0.42-0.57), serious head (OR=0.31, 95% CI 0.25-0.37), face (OR=0.67, 95% CI 0.56-0.81), and fatal head injury (OR=0.35, 95% CI 0.14-0.88). Neck injury was rare and not associated with helmet use (OR=0.96, 95% CI 0.74-1.12).[17] This is keeping with an older meta-analysis which was later reviewed, which found that bicycle helmets reduce the risk of head injury (OR=0.51, 95% CI 0.47-0.56) and offer slight protection against facial injury (OR=0.74, 95% CI 0.67-0.81).[18]

## Consequences of mandatory helmet legislation

### *Effects on head injuries or deaths among cyclists*

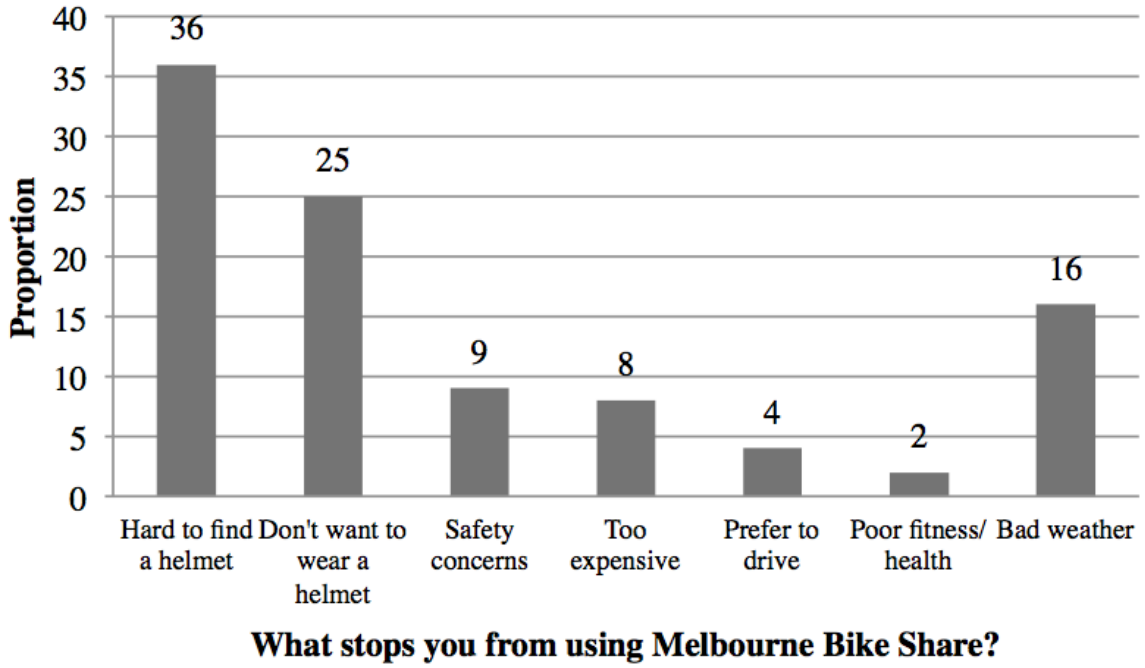
A systematic review demonstrated that mandatory helmet legislation (MHL) resulted in a decrease in head injury rates in the populations for which it was implemented.[19] Following the introduction of MHL in Alberta, Canada there were significant declines in the proportion of child cyclists under 13 years of age to the Emergency Department with head injuries.[20] Similar results were seen in New South Wales, Australia where there was a 46% drop in head injuries compared to arm injuries up to 2006 and a 51% drop by 2010 following MHL in 1991.[21-22]

In Ontario, Canada deaths decreased for children under 16 years by 52% (mortality rate per 100 000 person years decreased by 55%) with time series analysis indicating significant reductions following the introduction of MHL.[23]

### *Effects on the amount of cycling*

In Australia, the decline in cycling varied between 20 and 40% across States following the introduction of MHL.[24] Usage rates for bike sharing schemes in Brisbane and Melbourne were reported to be abysmal with only 5-10% of what was expected.[25] Melbourne Bike Share survey results showed that helmet use was cited as the most common reason for not using the bike sharing scheme with 36% saying it was hard to find a helmet and 25% not wanting to wear a helmet (see Figure 1).

***Figure 1:*** *Barriers to using Melbourne Bike Share.*[27]




***Other considerations***

Factors influencing bicycle accidents and collisions are key to development and implementation of policy measures to improve safety in cyclists.[22] According to a recent systematic review, there are four factors which influence bicycle accidents:[7]

1. Demographic parameters
2. Built environment
3. Weather
4. Behaviour

Demographic parameters were described previously.

Built environment:

- Johnson et al. (2010) reported that cyclists generally have high situational awareness on the roads whereas drivers of collisions were not aware of the cyclists travelling alongside or behind them.[28]
- Hoffman et al. (2010) reported that a dedicated infrastructure for cyclists was important.[29]
- de Geus et al. (2012) reported that the safety of cyclists was not ensured by solely ensuring a good bicycle infrastructure especially if it was not well kept.[30]

Weather:

- There is an increased incidence of bicycle accidents when the roads were snowy or icy and in the months of December and January.[29-30]

Behaviour:

- Wearing visible clothing, having greater bicycling experience or helmet use were not shown to reduce the relative risk of being involved in an accident.[29,31]
- Protective clothing reduces accident severity (described previously).[15-16]

**Local Data**

Data from the National Mortality Register showed that fatalities from cycling are rare occurences with three deaths due to cycling between 2006 and 2015 (Table 1).

Cycling-related morbidity statistics in terms of Accident & Emergency (A&E) attendances and Discharges from Mater Dei Hospital (MDH) was obtained from the Clinical Performance Unit of MDH. Permission to use the data was obtained from the Clinical Chairperson of A&E and the Data Protection Officer of MDH.

A textual search of the registration notes and triage notes of A&E attendances in the Clinical Patient Administration System (CPAS) including "bicycle" and "bike" (motorbike and quadbike excluded) was performed. The number of A&E attendances at MDH with bicycle related accidents has steadily increased between 2009 and 2015

(Figure 2). The age group with the most A&E attendances at MDH was 10-14 years (Figure 3). This was closely followed by the 15-19 year age group. However time trend analysis shows that the number of A&E attendances in the 0-19 age group is decreasing over time in contrast to the 20-39 and 40-59 year age groups (Figure 4).

Discharge data was obtained from the Hospital Activity Analysis using ICD-10 code V19 as well as using a textual search. The number of discharges from MDH with bicycle related accidents varied between 2009 and 2015. The three-year moving average for the total number and the number of males discharged from MDH appears to be decreasing, whereas the three-year moving average for the number of female discharges appears to be increasing (Figure 5).

The age group with the most discharges from MDH was 10-14 years (Figure 6). This was closely followed by the 15-19 year age group. This mirrors the distribution evident in the number people attending A&E. Other studies noted a similar age distribution.[7,20] Time trend analysis for discharges was not performed in view of the small numbers.

Registered injuries in cyclists in 2013 from the Malta Injury Database showed that two in five registered injuries occurred in children 15 years of age or less (Table 2). Overall, just over one in four registered injuries involved the head (Table 3).

**Table 1:** *Deaths due to cycling over the past 10 years in residents and tourists dying in Malta*

| **Transport Fatalities** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|
| pedal cyclist (V10-V19) | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |

**Figure 2:** *Number of cyclists attending A&E for males, females and total between 2009 and 2015*

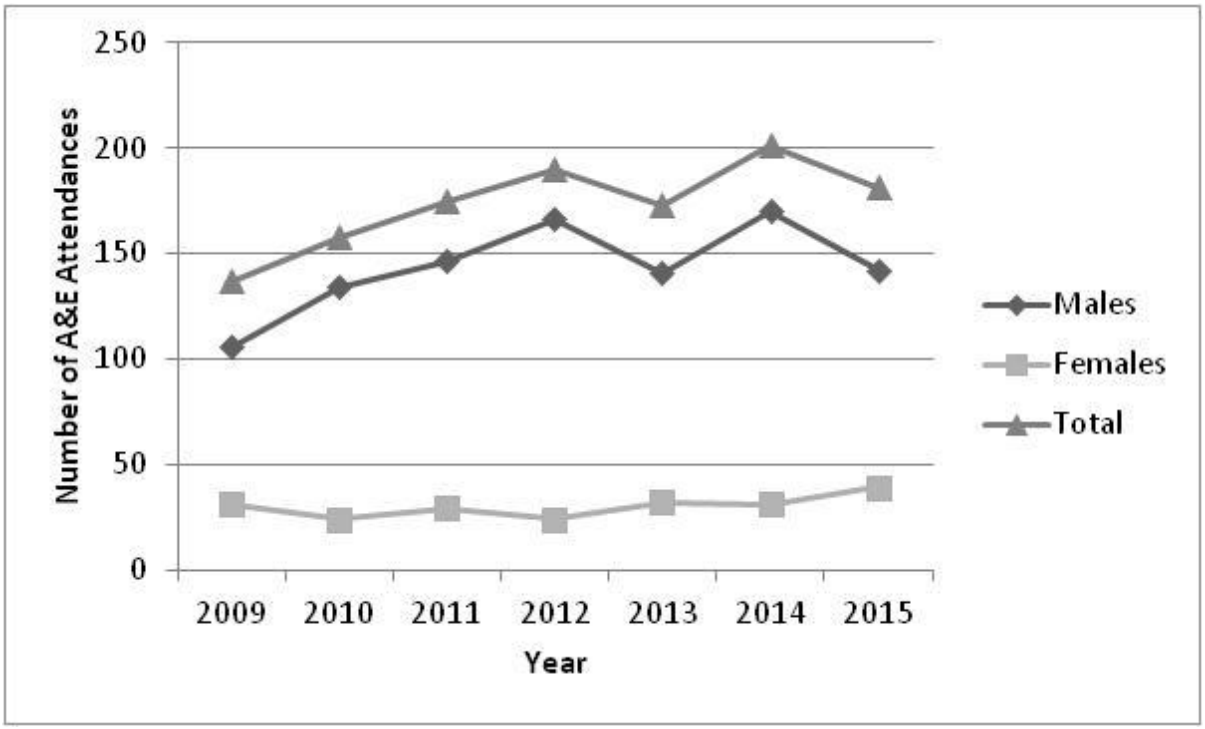


**Figure 3:** *Number of cyclists attending A&E in 2009 and 2015 by age groups*

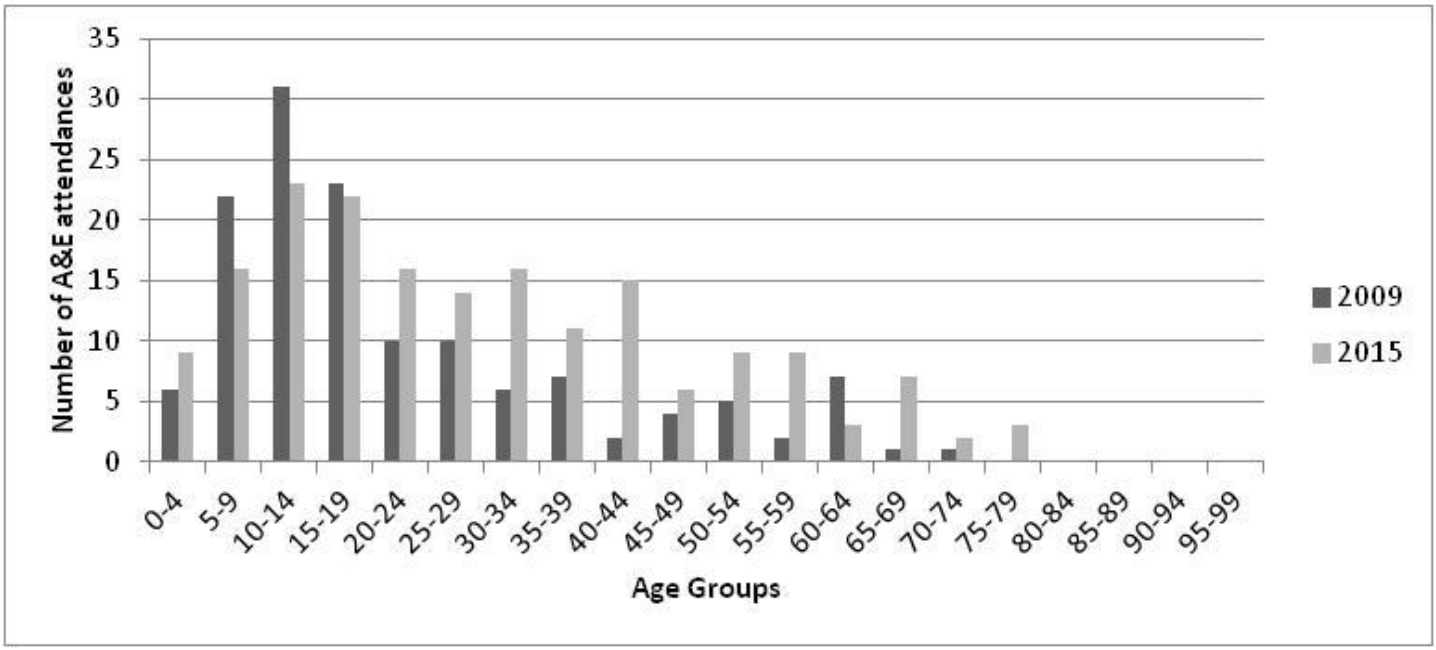



**Figure 4:** *Number of cyclists attending A&E between 2009 and 2015 by broad age groups*

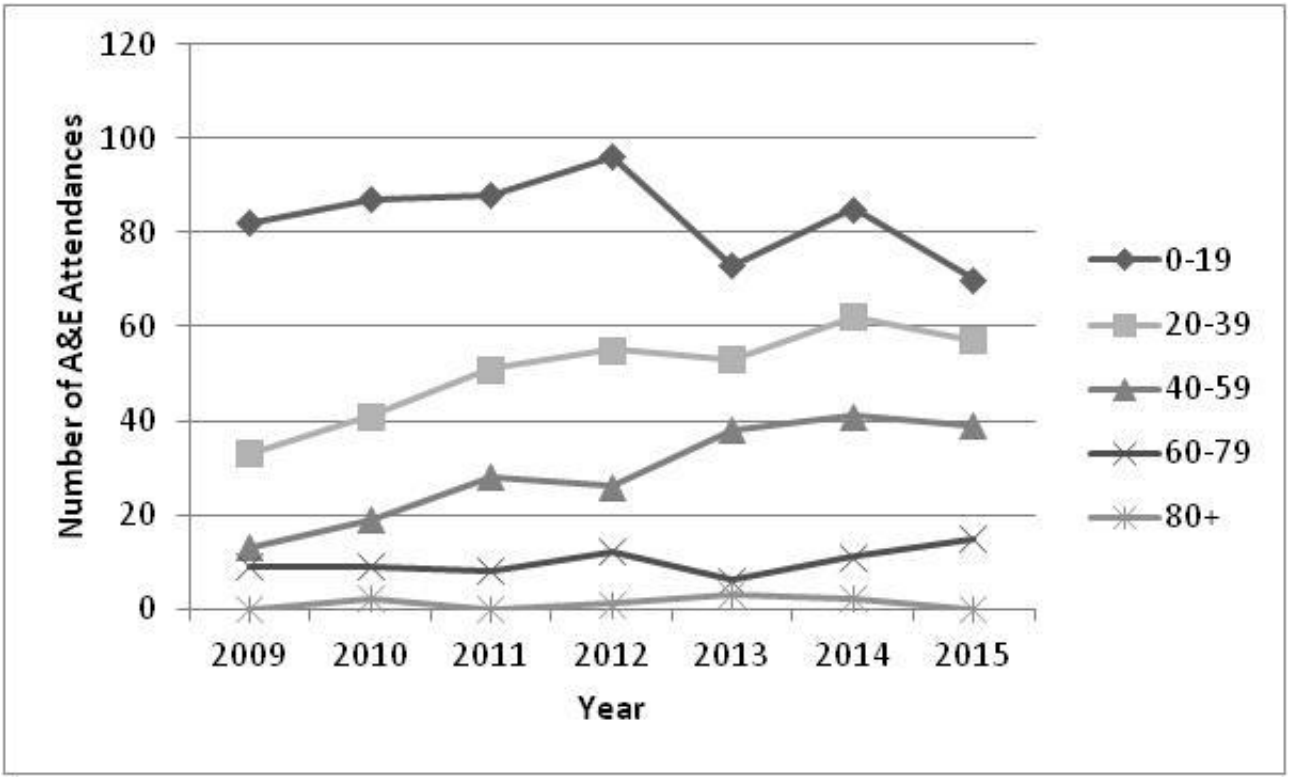


**Figure 5:** *Number of patients discharged from MDH following cycling related injuries for males, females and total between 2009 and 2015*

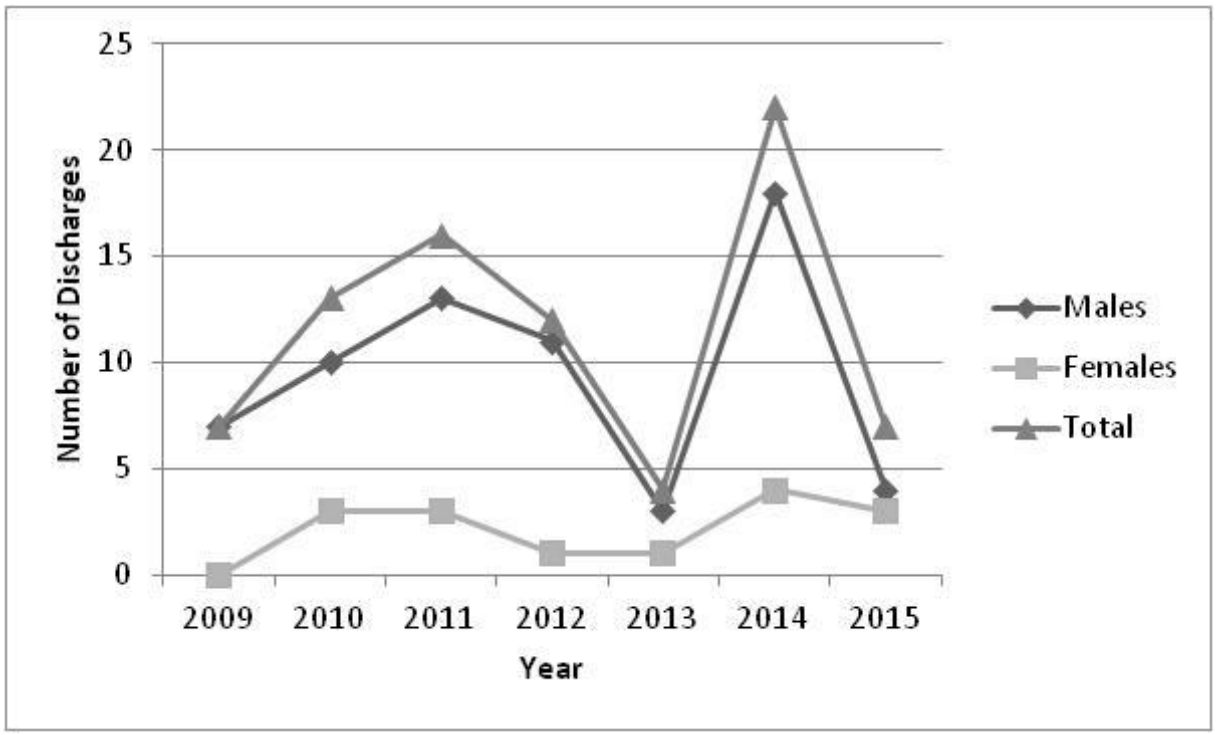



**Figure 6:** *Number of patients discharged from MDH following cycling related injuries in 2009 and 2015 by age groups*

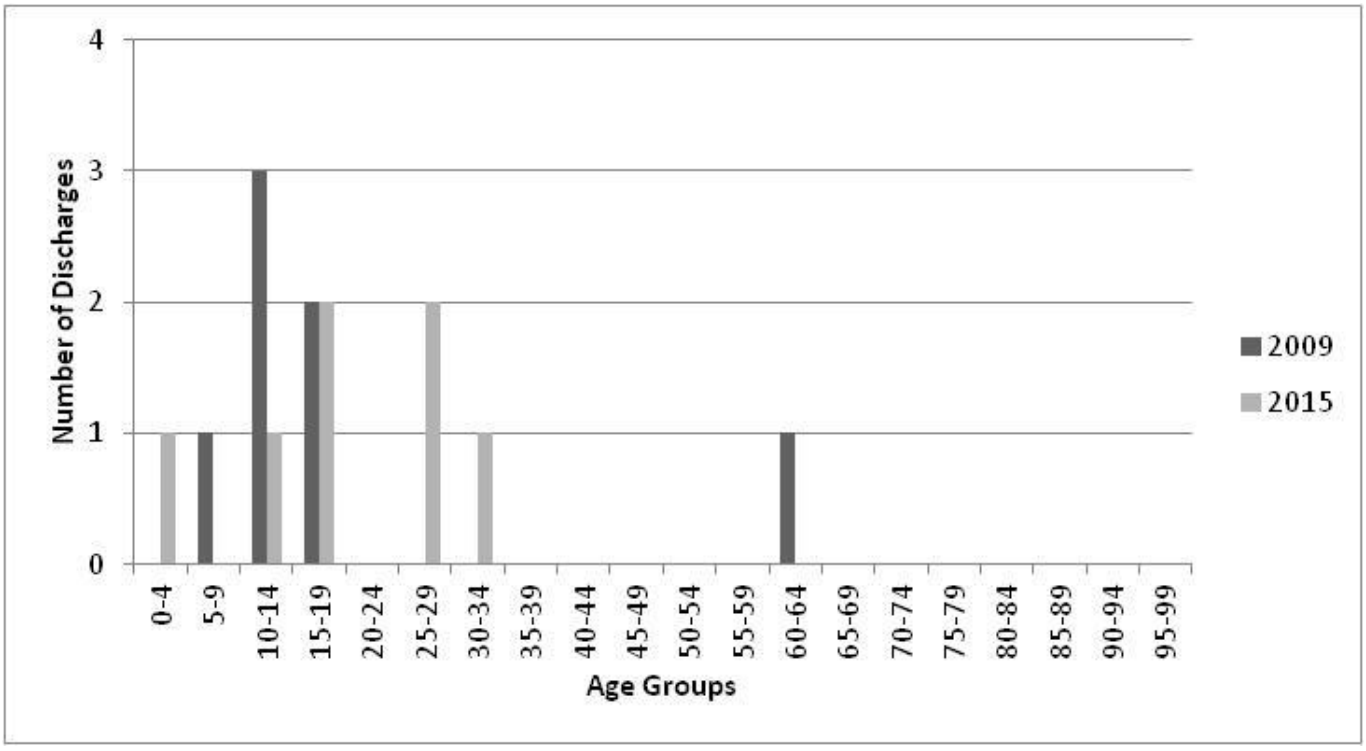


**Table 2:** *Registered injuries in cyclists by age and sex in 2013 in Malta*

| Injuries registered | <15 | 16-25 | 26-34 | 35-44 | 45-54 | 55-64 | >65 | Total |
|---|---|---|---|---|---|---|---|---|
| Male | 58 | 20 | 19 | 18 | 13 | 9 | 6 | 143 |
| Female | 14 | 4 | 5 | 3 | 3 | 0 | 1 | 30 |
| Total | 72 | 24 | 24 | 21 | 16 | 9 | 7 | 173 |

**Table 3:** *Registered injuries in cyclists by injury type and site in 2013 in Malta*[4]

| Injury type registered | Head | Neck, throat | Trunk | Upper extremities | Lower extremities | Multiple body parts | Total |
|---|---|---|---|---|---|---|---|
| Contusion, bruise | 6 | 0 | 2 | 1 | 3 | 0 | 12 |
| Abrasion | 6 | 0 | 1 | 5 | 5 | 2 | 19 |
| Open wound | 19 | 0 | 0 | 1 | 7 | 1 | 28 |
| Fracture | 1 | 0 | 0 | 13 | 4 | 0 | 18 |
| Luxation, dislocation | 0 | 0 | 0 | 4 | 0 | 0 | 4 |
| Distorsion, sprain | 0 | 0 | 0 | 1 | 3 | 0 | 4 |
| Crushing injury | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| Concussion | 7 | 0 | 0 | 0 | 0 | 0 | 7 |
| Injury to blood vessels | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Other specified type of injury | 8 | 1 | 8 | 44 | 14 | 1 | 76 |
| Unspecified type of injury | 1 | 0 | 1 | 0 | 0 | 0 | 2 |
| **Total** | **49** | **1** | **12** | **70** | **37** | **4** | **173** |

**Discussion**

Following the literature review and a look at the local data a number of recommendations can be made:

1. **Improve the data collection**: Data from the National Injuries Database collects data on all accidents and injuries attended to at the A&E Department of Mater Dei Hospital and Gozo General Hospital.[32] However it does not capture data from health centres or the private primary or secondary care and thus it may both underestimate and misrepresent the results. The introduction of an emergency medical text classifier of A&E records with triage notes could help to capture more accurate and complete data of A&E attendances. Helmet use was not recorded in either the National Mortality Register or

Injuries Database. Also geographical, temporal and situational data of the fatalities and injuries were not recorded. The chapter on Road Transport published by the National Statistics Office in the annual Transport Statistics report does not include any information on cyclists involved in road traffic accidents.[33] Also exposure data for cyclists is unknown. To be able to measure risk exposure and compare rates over time and between countries, it is important to know how many deaths and injuries there were and the distance-time exposure. Otherwise a decrease in the total number of fatalities and injuries could be due to a decrease in bicycle use. A survey is recommended.

2. **Education campaigns:** for safe cycling including training for cyclists, educating motorists to be have greater situational awareness, and instill road safety skills and habits in children. This is in keeping with the Road Safety Strategy Malta 2014 – 2024.[34]
3. **Strong recommendation for helmet use in adults**: The protective effect of bicycle helmet use is clear. Bicycle helmet use saves lives. However mandatory helmet legislation may deter adults from cycling altogether forgoing beneficial personal health gains.
4. **Consider the introduction of mandatory helmet legislation (MHL) in children**: The introduction of MHL in children is already in effect in seven European Union Member States. Children are more likely to attend A&E and be admitted to hospital with bicycle-related injuries than adults. This may be due to a higher use of bicycles and less bicycling experience when compared to adults. Also children who grow up cycling with a helmet are probably likely to becomes adults who spontaneously use bicycle helmets.
5. **Implement infrastructure measures**: to separate cyclists and motor vehicles, including cycling lanes, where it is possible. New road design needs to be cycling friendly. This is in keeping with the Road Safety Strategy Malta 2014 – 2024.[34]

## References


1. World Health Organisation. Global Report on Diabetes [Internet]. Vol. 978, ISBN 978 92 4 156525 7 (NLM classification: WK 810). France; 2016 [cited 2016 Oct 5]. Available from: http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf.
2. Road safety in the European Union. 2015.
3. Thomas P, Muhlrad N, Hill J, Yannis G, Dupont E, Martensen H, et al. Final Project Report, Deliverable 0,1 of the EC FP7 project DaCoTa. 2013.
4. European Commission. Going abroad [Internet]. 2016 [cited 2016 Oct 5]. Available from: http://ec.europa.eu/transport/road_safety/going_abroad/index_en.htm#
5. Australian Transport Council. Australian Road Rules. 2012.
6. Land Transport (Road User) Rule 2004 (SR 2004/427) (as at 01 November 2014) 11.8 Safety helmets for cyclists – New Zealand Legislation [Internet]. [cited 2016 Oct 4]. Available from: http://www.legislation.govt.nz/regulation/public/2004/0427/latest/DLM303675.html#DLM303675.
7. Vanparijs J, Int L, Meeusen R, Geus B De. Exposure measurement in bicycle safety analysis : A review of the literature. Accid Anal Prev [Internet]. Elsevier Ltd; 2015;84:9–19. Available from: http://dx.doi.org/10.1016/j.aap.2015.08.007.
8. Joseph B, Pandit V, Zangbar B, Amman M, Khalil M, Orouji T, et al. Rethinking bicycle helmets as a preventive tool : a 4-year review of bicycle injuries. 2014;729–32.
9. Dagher JH, Costa C, Lamoureux J, Guise E De, Feyz M. Comparative Outcomes of Traumatic Brain Injury from Biking Accidents With or Without Helmet Use. 2015;56–64.
10. Bambach MR, Mitchell RJ, Grzebieta RH, Olivier J. The effectiveness of helmets in bicycle collisions with motor vehicles : A case – control study. Accid Anal Prev [Internet]. Elsevier Ltd; 2013;53:78–88. Available from: http://dx.doi.org/10.1016/j.aap.2013.01.005.
11. Sethi M, Heidenberg J, Wall SP, Ayoung-chee P, Slaughter D, Levine DA, et al. Bicycle helmets are highly protective against traumatic brain injury within a dense urban setting. Injury [Internet]. Elsevier Ltd; 2015;46(12):2483–90. Available from: http://dx.doi.org/10.1016/j.injury.2015.07.030.
12. Joseph B, Azim A, Haider AA, Kulvatunyou N, Keeffe TO, Hassan A, et al. Bicycle helmets work when it matters the most. Am J Surg [Internet]. Elsevier Inc; 2016; Available from: http://dx.doi.org/10.1016/j.amjsurg.2016.05.021.
13. Thompson RS, Rivara FP, Thompson DC. A case-control study of the effectiveness of bicycle safety helmets. N Engl J Med. 1989;320(21):1361–7.
14. Thompson D, Rivara F, Thompson R. Effectiveness of bicycle safety helmets in preventing head injuries. A case-control study. JAMA. 1996;276(24):1968–73.
15. Persaud N, Ba EC, Ba DZ, Lauwers B, Cass D. a proportional mortality , case – control study. 2012;184(17):921–3.

16. Amoros E, Chiron M, Martin J-L, Thélot B, Laumon B. Bicycle helmet wearing and the risk of head, face, and neck injury: a French case--control study based on a road trauma registry. Inj Prev [Internet]. 2012 Feb [cited 2016 Sep 28];18(1):27–32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21606469.
17. Olivier J, Creighton P. Original article Bicycle injuries and helmet use : a systematic review and meta-analysis. 2016;1–15.
18. Elvik R. Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy : A re-analysis of Attewell , Glase and McFadden , 2001. Accid Anal Prev [Internet]. Elsevier Ltd; 2011;43(3):1245–51. Available from: http://dx.doi.org/10.1016/j.aap.2011.01.007.
19. Macpherson A, Spinks A. Bicycle helmet legislation for the uptake of helmet use and prevention of head injuries. Cochrane Database Syst Rev. 2008;(3).
20. Karkhaneh M, Rowe BH, Saunders LD, Voaklander DC, Hagel BE. Trends in head injuries associated with mandatory bicycle helmet legislation targeting children and adolescents. Accid Anal Prev [Internet]. Elsevier Ltd; 2013;59:206–12. Available from: http://dx.doi.org/10.1016/j.aap.2013.05.027.
21. Wales S, Walter SR, Olivier J, Churches T, Grzebieta R. The impact of compulsory cycle helmet legislation on cyclist head injuries in New. Accid Anal Prev [Internet]. Elsevier Ltd; 2011;43(6):2064–71. Available from: http://dx.doi.org/10.1016/j.aap.2011.05.029.
22. Olivier J, Walter SR, Grzebieta RH. Long term bicycle related head injury trends for New South Wales , Australia following mandatory helmet legislation. Accid Anal Prev [Internet]. Elsevier Ltd; 2013;50:1128–34. Available from: http://dx.doi.org/10.1016/j.aap.2012.09.003.
23. Wesson DE, Stephens D, Lam K, Parsons D, Spence L, Parkin PC. Trends in pediatric and adult bicycling deaths before and after passage of a bicycle helmet law. Pediatrics [Internet]. 2008 Sep [cited 2016 Sep 29];122(3):605–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18762532.
24. Robinson DL. Public health Do enforced bicycle helmet laws improve public health ? No clear evidence from countries that have enforced the wearing of helmets. 2006;332(March):722–5.
25. Fishman E, Washington S, Haworth N. Barriers and facilitators to public bicycle scheme use: A qualitative approach. Transp Res Part F Traffic Psychol Behav [Internet]. Elsevier Ltd; 2012;15(6):686–98. Available from: http://dx.doi.org/10.1016/j.trf.2012.08.002.
26. Melbourne Bike Share | Melbourne Bike Share survey resutls [Internet]. Available from: http://www.melbournebikeshare.com.au/survey-results.
27. Alta Bike Share. Melbourne Bike Share | Melbourne Bike Share survey resutls [Internet]. 2011 [cited 2016 Oct 5]. Available from: http://www.melbournebikeshare.com.au/survey-results.
28. Johnson M, Charlton J, Oxley J, Newstead S. Naturalistic cycling study: identifying risk factors for on-road commuter cyclists. Ann Adv Automot Med [Internet]. Association for the Advancement of Automotive Medicine; 2010 [cited 2016 Oct 5];54:275–83. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21050610.
29. Hoffman MR, Lambert WE, Peck EG, Mayberry JC. Bicycle commuter injury prevention: it is time to focus on the environment. J Trauma [Internet]. 2010 Nov [cited 2016 Oct 5];69(5):1112–7; discussion 1117–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21068616.
30. de Geus B, Vandenbulcke G, Int Panis L, Thomas I, Degraeuwe B, Cumps E, et al. A prospective cohort study on minor accidents involving commuter cyclists in Belgium. Accid Anal Prev [Internet]. 2012 Mar [cited 2016 Oct 5];45:683–93. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22269558.
31. Bacchieri G, Barros AJD, Dos Santos J V, Gigante DP. Cycling to work in Brazil: Users profile, risk behaviors, and traffic accident occurrence. Accid Anal Prev. 2010;42:1025–30.
32. DHIR. Injury Database - 2013 annual report. Annual Injury Database Report. 2013.
33. National Statistics Office M. Transport Statistics 2015. 2015.
34. Transport Malta. Road Safety Strategy Malta 2014 - 2024.