

## Mouthguards reduce dental injuries and associated costs in Ladies Gaelic football

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### Abstract

#### *Aim*

To investigate whether the implementation of mandatory mouthguard use in Ladies Gaelic football has successfully reduced dental injuries and associated costs.

#### *Methods*

The dental injury incidence and associated costs in Ladies Gaelic football were examined from 2011-2019 using the LGFA Injury Fund. Comparisons were made for adults pre (2014-2016) and post (2017-2019) and juveniles pre (2011-2013) and post (2014-2016) introduction of mandatory mouthguard use. The frequency and cost of injury claims were calculated for the overall sample, and for adults and juveniles individually. Claim rates per 1000 players, per 1000 adults and per 1000 juveniles were calculated.

#### *Results*

From 2011-2019, 177 claims were made for dental injuries in the LGFA across all age groups. These claims had a sum cost of €169,791.84, with a mean cost of €968.54 per claim. Overall dental claim costs fell by 51.7% in the three years post-mandatory mouthguard introduction, when compared to the three years prior. Adult costs reduced by 53.8%, while juvenile costs reduced by 44%. IRR (95% CI) was calculated as 0.43 (0.29-0.64) overall, 0.38 (0.23-0.65) in adults, and 0.51 (0.28-0.93) in juveniles.

#### *Discussion*

Mandatory mouthguard use is a cost-effective method to reduce dental injuries and associated costs in community sports.

### Introduction

Ladies Gaelic football is a women's national sport in Ireland and governed by the Ladies Gaelic Football Association (LGFA)<sup>1</sup>. It is the most popular women's sport to play and watch in Ireland<sup>1</sup>. Ladies Gaelic football is a high-intensity, multi-directional sport which requires an array of physical demands from its players, such as the ability to accelerate/decelerate, sprint at maximal velocity, jump, land, catch, kick and hand pass, turn, and solo with the ball while running<sup>2</sup>. These demands, as well as the possibility of contact can lead to a significant risk of injury in Ladies Gaelic football. Injuries are common in Ladies Gaelic football, with match and training injury rates recorded at 42.28 and 7.93 injuries per 1000 hours, respectively<sup>1</sup>.

Dental injuries can carry a significant financial burden, combined with time and aesthetic issues<sup>3</sup>. In Ladies Gaelic football, 2% of all claims from 2012-2020 were due to dental injuries<sup>4</sup> and these accounted for 2.9% of all associated claim costs<sup>4</sup>. Dental injuries are also a major cause for concern in men's Gaelic football, with 2,677 insurance claims related to dental injuries between 2007-2015<sup>5</sup>, and they accounted for roughly 3% of injuries that presented to primary care in a single season<sup>6</sup>. When dental injuries occur in childhood, they are often associated with extensive dental treatments which may result in poorer oral health-related quality of life outcomes, especially in more severe injuries<sup>3,7</sup>. Thus, efforts to mitigate these injuries are essential. Mandatory mouthguard use has been suggested as a method to reduce dental injuries and the high costs associated with them<sup>8</sup>. Mouthguards increase the surface area over which impact forces are applied, resulting in a more equal distribution of forces across the mouth and reducing the stress on a singular tooth<sup>9</sup>. A previous meta-analysis on multiple field and court sports demonstrated that those who wear mouthguards are significantly less likely to suffer an impact related traumatic dental injury than those who do not<sup>10</sup>.

The LGFA Injury Fund is an injury scheme implemented by the LGFA which aims to reduce the financial burden of injuries on players, coaching staff, and officials through reimbursement of medical expenses associated with injury sustained during training or match play in Ireland or Britain<sup>11</sup>. The LGFA Injury Fund is financed via registration fees of LGFA members. If a member has their own private medical insurance, the LGFA Injury Fund covers excess expenses. Injured members must submit an injury claim form to the LGFA for evaluation. If approved, the LGFA Injury Fund reimburses dental expenses up to €3000 and loss of income up to €200 per week for a maximum of 20 weeks<sup>4</sup>. Thus, the LGFA Injury Fund is a useful resource to examine the impact of any injury prevention strategies that aim to reduce injury risk in Ladies Gaelic football. Mouthguards were made mandatory for adult Ladies Gaelic football players on the 1<sup>st</sup> of January 2017, and for juveniles on the 1<sup>st</sup> of January 2014. However to date, no published research has examined the effectiveness of implementing mandatory mouthguards in the community sport of Ladies Gaelic football. Thus, this study aims to investigate whether the implementation of mandatory mouthguard use in juvenile and adult Ladies Gaelic

footballers has led to a reduction of dental injuries and their associated costs in Ladies Gaelic football.

## Methods

Dental injuries from the LGFA Injury Fund between 2011 and 2019 were examined. Ethical approval was granted by Dublin City University's research ethics committee. The LGFA Injury Fund records all injuries which resulted in a claim in Ladies Gaelic football. LGFA Injury Fund data are reported every year in October and include all approved injury claims from the previous 12 months. This information allows us to compare the data pre- and post-mandatory introduction of mouthguard use. Dental injuries and associated costs were compared for adults pre- (2014-2016) and post- (2017-2019) and juveniles pre- (2011-2013) and post- (2014-2016) mandatory implementation of mouthguards. All approved dental injury claims contained in the LGFA's internal annual reports from 2014 to 2019 for adults and 2011-2016 for juveniles were included in this study. Anonymised claim data was extracted from the LGFA's database and delivered to the research team in a Microsoft Excel spreadsheet. Data included information on age group (adult/juvenile), total cost of injury, and the specific medical expenses incurred in the treatment of that injury.

Analysis of the data was performed in Microsoft Excel (version 2016; Microsoft Corp, Redmond, WA) and IBM SPSS version 27 (IBM Corp., Armonk, N.Y.). Age groups were classified as juvenile (<18 years) or adult (≥18 years). Claim year data were used over report year data to ensure claims were not incorrectly categorised in a year with different mouthguard rules. One claim (0.01% of claims) contained missing data, with the injured party's age group being absent. This claim was excluded from the age group analysis but included in all other analyses.

The total and annual frequency of dental injury claims and costs to the LGFA Injury Fund were calculated for the full sample, as well as for the adult and juvenile age groups to allow for comparison. Mean claim cost ± standard deviation (SD) was calculated for each year and overall, for both groups and for all dental claims. Overall, annual, and mean costs have been adjusted for inflation and reported in 2019-euro values. Ireland's Consumer Price Index<sup>12</sup>, the official inflation measure in Ireland was employed to calculate inflation for each individual year. Dental claim rates were calculated per 1000 players, per 1000 adults and per 1000 juveniles. This was done using the following method, for the whole sample, and for adults and juveniles separately:

$$\text{Claim Rate} = \frac{\text{number of injury claims}}{\text{number of players}} \times 1000$$

The 95% confidence interval (CI) for each claim rate was calculated using Poisson distribution. The overall, annual, and mean costs and the claim rates for both groups and the total sample were then evaluated pre- and post-mouthguard rulings to determine the percentage difference. For the claim rates, the incidence rate ratio (IRR), percentage change ( $100 \times [IRR - 1]$ ) and odds ratio (OR) were also presented.

## Results

Between 2011 and 2019, 177 dental injury claims were made in the LGFA across all age groups, with a total cost of €169,791.84, and mean cost of €968.54 per claim. Overall, Ladies Gaelic footballer's odds were 2.34 times higher to suffer dental injuries prior to the introduction of the mandatory mouthguard rule, while adult and juvenile players odds were 2.61 times and 1.96 higher respectively. The IRR was calculated as 0.43 for total players, 0.38 for adults, and 0.51 for juveniles. Combined, there was an overall reduction in total dental claim costs of 51.7% in the three years after mandatory mouthguard introduction, when compared to the three years prior (**Table 1**).

**Table 1 – Claim rates pre- and post-rule introduction per 1000 players in Ladies Gaelic football**

Total Claim Rates	OR	Claim Rate	IRR (95% CI)	Percentage Change (%)
Claim rate per 1000 players (pre)		0.37	0.43	
Claim rate per 1000 players (post)	2.34	0.16	(0.29-0.64)	57.2
Claim rate per 1000 adult players (pre)		1.10	0.38	
Claim rate per 1000 adult players (post)	2.61	0.42	(0.23-0.65)	61.7
Claim rate per 1000 juvenile players (pre)		0.18	0.51	
Claim rate per 1000 juvenile players (post)	1.96	0.09	(0.28-0.93)	49.0

Note: IRR = Incidence rate ratio, CI = Confidence Interval.

In the three years prior to mandatory mouthguard introduction (2014-2016) in adults there were 45 dental injury claims with associated costs of €67,368.48, compared to the three years post-rule introduction (2017-2019) where there were 20 claims costing €31,100.98 (53.8% reduction) (**Table 2**).

**Table 2 – Annual claims and costs of dental injuries in adult Ladies Gaelic Football players pre- and post-rule introduction**

	Total claims (N)	Sum (€)	Average (Mean ± SD) (€)
<b><u>Pre-rule change</u></b>			
2014	14	19023.28	1358.81 ± 1226.23
2015	13	14927.24	1148.25 ± 812.33
2016	18	33417.96	1856.55 ± 1381.83
TOTAL	45	67,368.48	
<b><u>Post-rule change</u></b>			
2017	8	10388.12	1298.52 ± 1214.78
2018	6	11746.47	1957.74 ± 2687.80
2019	6	8966.39	1494.40 ± 1682.79
TOTAL	20	31,100.98	1519.05 ± 1500.96

Note: N = number of claims, SD = standard deviation.

In the three years prior to mandatory mouthguard introduction (2011-2013) in juveniles there were 28 dental injury claims with associated costs of €18,948.50, compared to the three years post-rule introduction (2014-2016) where there were 17 claims costing €10,603.65 (44% reduction) (Table 3).

**Table 3 – Annual claims and costs of dental injuries in juvenile Ladies Gaelic football players pre- and post-rule introduction**

	Total claims (N)	Sum (€)	Average (Mean ± SD) (€)
<b><u>Pre-rule change</u></b>			
2011	4	3,041.12	760.28 ± 831.60
2012	4	3,236.90	809.23 ± 904.20
2013	20	12,670.48	633.52 ± 687.12
TOTAL	28	18,948.50	
<b><u>Post-rule change</u></b>			
2014	6	4,138.51	689.75 ± 523.59
2015	6	3,839.12	639.85 ± 792.53
2016	5	2,626.02	525.20 ± 558.55
TOTAL	17	10,603.65	676.31 ± 716.27

Note: N = number of claims, SD = standard deviation.

## Discussion

The introduction of a rule on mandatory mouthguard use in the community sport of Ladies Gaelic football has been effective in reducing dental injury claim rates and associated costs. This finding supports previous research in handball<sup>13</sup>, hockey<sup>10,14</sup>, basketball<sup>15</sup> and rugby

union<sup>16</sup>. Similar to the findings of the current study, a meta-analysis published in 2007 found that athletes across multiple sports wearing mouthguards were 1.6-1.9 times less likely to suffer dental injuries<sup>17</sup>.

However, while a reduction in dental injuries was observed, dental injuries do still occur with dental injuries accounting for 1.2% of all injuries and costs of €14326.39 in 2019. Thus, adherence to mouthguard use across all Ladies Gaelic football activities may be an issue. Despite athletes across multiple sports such as water polo, karate, taekwondo and handball understanding the importance and benefits of mouthguards<sup>8</sup>, adherence in wearing mouthguards consistently in all training and games was identified as a substantial issue in the community sport setting with only 41% of study participants using them<sup>8</sup>. Anecdotally, when working with Ladies Gaelic football and athletes in general, it is commonly noted that many athletes don't wear their mouthguards in training, or wear mouthguards which they have personally modified. No research to date has examined mouthguard use adherence and perceptions and attitudes towards mouthguard use in Ladies Gaelic football and this is recommended.

The type of mouthguards worn may also impact dental injury rates and may impact their effectiveness in reducing dental injuries<sup>14</sup>. Among the 106 children playing Gaelic Football in one study, 81.1% of their mouthguards had inadequate retention, meaning they could be easily dislodged<sup>18</sup>. Mouthguards vary in terms of design, costs, and level of protection<sup>14</sup>. There are three main types of mouthguards; pre-fabricated, mouth-formed, and custom-made (14). The custom-made mouthguard is the most effective<sup>19</sup> and should be recommended for use in sporting activity. Mouthguards which are not custom-made are less effective due to potential looseness<sup>19,20</sup>, reduced length<sup>21</sup> and reduced thickness<sup>19,22</sup>. Thus, Ladies Gaelic footballers should be advised to purchase custom-made mouthguards where possible and educated on their benefits over generic mouthguards. Further awareness in the juvenile population in particular may be needed as a recent Irish study noted that only 3.8% of Irish children partaking in contact sport wore custom mouthguards<sup>18</sup>. To accommodate for rapid growth of the mouth and jaw, it is recommended juvenile players replace their mouthguard annually<sup>23</sup>. Thus, education on regular mouthguard replacement is required for juvenile parents, coaches and parents.

As mouthguards are mandatory in all Ladies Gaelic football activities, if a player does not wear a mouthguard or wears a modified mouthguard, they are not covered by the LGFA Injury Fund<sup>11</sup>. If a dental injury occurs, the player is consequentially liable to cover the financial implications of this injury. Thus, it is essential that education on the importance of wearing mouthguards during all Ladies Gaelic football activities, not solely just games but also training and individual sessions is undertaken. Increasing player awareness on the importance of not

modifying mouthguards, and the potential additional dental injury risk and financial implications of this is also essential.

Despite being the first study to look at the effectiveness of mandatory mouthguard use in Ladies Gaelic football, this study has limitations. The study is retrospective in design, so causality can't be directly applied to mouthguards. Due to the nature of injury claim databases, injuries which are more expensive or more severe are more likely to be reported, which may lead to some athletes who may have had minor dental injuries not reporting them, and thus a misrepresentation of overall injuries and costs<sup>24</sup>. Also, claims are only made to the LGFA Injury Fund after a claim has been made with the insurer. Therefore, if the injured athlete has private medical insurance, the actual number of injuries and associated costs may be higher than presented in the current study. Information such as injury severity and injury mechanism are not available through the LGFA Injury Fund. This would have allowed for a more in-depth analysis.

In conclusion, mandatory mouthguard use is effective in reducing dental injuries and associated costs in Ladies Gaelic football and should be recommended in other community sports where dental injuries occur. Further research on athlete's adherence to wearing mouthguards, their attitudes towards mouthguard use and mouthguard modification is recommended. An education campaign is necessary to increase awareness for players, coaches and parents of juvenile players on the importance of wearing properly fitted, non-modified mouthguards during both training and match play.

**Declarations of Conflicts of Interest:**

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