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An awareness and prevalence study of Irish cold-water athletes and external auditory canal exostoses

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Main Article

Dr S Boyle takes responsibility for the integrity of the content of the paper

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Abstract

Objective. This study aimed to determine the awareness, otological symptoms and prevalence of external auditory canal exostoses in Irish cold-water athletes.
Method. An online and in person cross-sectional survey was undertaken with Irish cold-water athletes to explore athletes' awareness, known prevalence of external auditory canal exostoses and attitudes towards preventive measures.
Results. Of the 926 participants surveyed, 67.5 per cent were aware of external auditory canal exostoses. Triathletes reported the lowest awareness (39.9 per cent) among water athletes. A total of 9.7 per cent ($n = 90$) had previously been diagnosed with external auditory canal exostoses and 46.7 per cent ($n = 42$) were non-surfers. Ear symptoms were reported in 76 per cent of athletes. Otoscopic examinations showed that 23.7 per cent had external auditory canal exostoses, 3.6 per cent of whom were aware of their diagnosis.
Conclusion. The majority of Irish surfing athletes are aware of external auditory canal exostoses. There is less awareness with regard to Ireland's newly emerging sports such as open water swimming and triathlons. Over 90 per cent of athletes surveyed had no idea they had external auditory canal exostoses, which highlights the need to increase public awareness.

Introduction

Rationale for study

External auditory canal exostoses are broad-based benign bone growths of the bony ear canal that can develop in response to cold-water and wind exposure. They are often bilateral and frequently asymptomatic until they cause significant obstruction.[1] There is a latency of several years before the development of external auditory canal exostoses and symptoms.[2]

Recently, the popularity of cold-water sports in Ireland has risen. Between 2013 and 2018, Swim Ireland reported a 71 per cent increase in competitors attending the Leinster Open Sea Race Series, and the number of Triathlon Ireland memberships has increased by 33 per cent to 135 000.[3,4] Additionally, Canoeing Ireland noted a membership increase of 15 per cent in 5 years to 3432, and Surfing Ireland estimated there has been a 5-fold increase in regular surfers in the last 20 years to 50 000.[5,6] In 2018, there were over 50 clubs registered with Surfing Ireland, compared with just one in 1997. In a previous Irish study, Lennon *et al.* found that 88 per cent of surfers diagnosed with external auditory canal exostoses were unaware they had the condition.[7]

Awareness of external auditory canal exostoses

Previous research indicated there was 59–86.1 per cent awareness of external auditory canal exostoses among surfers.[8–10] However, previous studies have yet to document the awareness of external auditory canal exostoses among other cold-water athletes, such as open water swimmers, kayakers, triathletes and divers.

Prevalence of external auditory canal exostoses

Several studies have examined the ear canals of surfers, reporting a prevalence rate of 38–80 per cent.[7,11–18] Unlike awareness levels, several studies have investigated the prevalence of external auditory canal exostoses among non-surfers. Two studies demonstrated a prevalence of 69.5–79 per cent among the kayaking community.[19,1] Divers have a reported prevalence of 26–87 per cent.[20–22] Amongst open water swimmers, Hurst *et al.*[13] reported a 21 per cent prevalence rate of severe exostosis. However, there is no English language study published that examines external auditory canal exostoses among triathletes.

The primary aim of this study was to determine the awareness, otological symptoms, community known previous diagnosis and actual prevalence of external auditory canal exostoses in Irish cold-water athletes. The secondary aim was to launch a public awareness campaign.

Materials and methods

Participants

Inclusion criteria included cold-water athletes aged 18 years or over. Informed consent was obtained from all eligible participants prior to participation in this study. Information was provided on the study's aims, format and data protection issues (Appendix 1).

The majority of participants were recruited through the national sporting bodies (Canoeing Ireland, Swim Ireland, Surf Ireland, Irish Underwater Council, Sailing Ireland and Triathlon Ireland), who promoted the study via website and social media forums. Additionally, a link to the questionnaire was distributed among water athletes who were known to the authors, local clubs and outdoor retail outlets.

Phase 1: questionnaire

Irish water athletes were invited to complete an online questionnaire. The questionnaire was shared nationwide through national and local sporting bodies over a three-month period and assessed demographic factors such as age and gender as well as geographical location, water-sport discipline, sporting level, self-reported symptoms and previous diagnosis of external auditory canal exostoses.

Participants' awareness, knowledge and source of information of external auditory canal exostoses were examined using 10 factual questions and a 5-point Likert scale, based on a study from Morris *et al.* (Appendix 1).[8] Awareness was defined as having heard of surfer's ear or external auditory canal exostoses. Scores were assigned categorical values (for knowledge: poor, 10–35; good, 36–42; excellent, 43–50). A further category of 'knowledgeable' (good and excellent scores) and 'not knowledgeable' (poor scores and unaware) was defined. Univariant and multi–variant regression analysis were performed, using a Hosmer and Lemeshow test. The $X^2 = 8.12$ ($p = 0.42$), suggesting that the model can accurately predict knowledge about external auditory canal exostoses. The concordance index for this model was 0.74 indicating a good predictive model.

Participants were questioned regarding ear symptoms, such as decreased hearing, ear pain, infection, water trapping or ear blockage. Asymptomatic was defined as no symptoms. Scores were assigned categorical values (one symptom was scored as mild and four or more symptoms were scored as severe symptoms). Univariant and multi–variant regression analysis were performed to determine predictors of symptoms. Using a Hosmer and Lemeshow test, the $X^2 = 3.52$ ($p = 0.9$), suggesting that the model can accurately predict the occurrence of symptoms in external auditory canal exostoses. The concordance index for this model was 0.76 indicating it a good predictive model.

Participants' attitudes towards wearing ear plugs as a preventive measure for external auditory canal exostoses were assessed across nine questions and measured using a five-point Likert scale coded from one (strongly disagree) to five (strongly agree). Scores were assigned categorical values (for attitudes: less than 27, positive; 27, neutral; more than 27, negative). This model was based on the study by Morris *et al.*[8] This information was used to determine what factors might contribute to or limit the compliance of ear plug use. Lastly, participants' level of concern with external auditory canal exostoses, desire to know more information and preferred source of information were assessed.

Phase 2: otoscopic examinations

Three 'surfer's ear clinics' were held in a regional hospital outpatient department, and a further three were held at sporting or off site events (farmers market, registration stand at Open Swim and Triathlon Race). An ENT consultant was present at each event and categorised the severity of external auditory canal exostoses. Ethical approval was granted by the Ethics Board of Sligo University Hospital. Otoscopic examinations were performed after wax removal, if necessary, using a Firefly Wired Otoscope DE500 (Belmont, USA) and 4 mm specula.

Statistical analyses

Statistical analysis was performed using SPSS® statistical software (version 26) and GraphPad Prism (version 6; San Diego, USA). Patients were not invited to comment on the study design and were not consulted to develop patient-relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

Results

Phase 1: online questionnaire

Participant characteristics

A total of 1143 online questionnaires were completed, and 217 were excluded based on inclusion criteria. Data from the remaining 926 questionnaires were examined. Table 1 presents the characteristic breakdown of participants. The average age of respondents was 41.2 years (standard deviation (SD) = 12.04 years) and they were involved in their sport for a mean (SD) of 11.07 (10.79) years. Participation in sporting disciplines is illustrated in Figure 1.

Awareness and knowledge of exostosis

Results from the questionnaire demonstrated that 67.5 per cent (625) of respondents were previously aware of external auditory canal exostoses. Surfers were found to have the most awareness (92.3 per cent) compared with triathletes who had the least awareness (39.9 per cent) of all water athletes. Table 2 outlines the breakdown of awareness of external auditory canal exostoses among different sporting disciplines.

Those individuals with a 'good' and 'excellent' response were reclassified as being 'knowledgeable'. Those with 'no awareness' and 'poor knowledge' were reclassified as 'not knowledgeable'. The majority of surfers were knowledgeable (85.5 per cent) compared with triathletes (30.3 per cent). Those participating in multiple sports were most interested to learn more (92.3 per cent) and were also most concerned about developing external auditory canal exostoses (73.1 per cent).

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Table 1. Participant characteristics*

Parameter	Overall	Kayaker	Open water swimmer	Sub-aqua	Surfer	Triathlete	Multiple sports	Other
Total (*n* (%))	926	196 (21.2)	263 (28.4)	30 (3.2)	207 (22.4)	178 (19.2)	26 (2.8)	26 (2.8)
Gender (*n* (%))								
– Male	525 (56.9)	141(71.9)	85 (32.6)	20 (66.7)	157 (75.8)	90 (50.8)	15 (57.7)	17 (65.4)
– Female	398 (43.1)	55 (28.1)	176 (67.4)	10 (33.3)	50 (24.2)	87 (49.4)	11 (42.3)	9 (34.6)
Participation in sport (mean (SD); years)	11.07 (10.79)	9.72 (9.03)	9.63 (11.65)	18.1 (12.34)	16.78 (11.2)	5.65 (5.48)	15.23 (10.34)	15.12 (10.76)
Standard of participation in sport n(%)								
– Beginner	116 (12.6)	25 (12.7)	29 (11.1)	1 (3.5)	12 (5.8)	47 (26.4)	2 (7.7)	0 (0)
– Advanced	338 (36.7)	87 (44.4)	85 (32.4)	23 (79.3)	91 (44.4)	27 (15.2)	9 (34.6)	16 (61.5)
Time of year for participation in sport (*n* (%))								
– All year round	610 (66.0)	183 (94.3)	129 (49)	24 (80)	193 (94.1)	37 (20.8)	20 (76.9)	24 (92.3)
– Summer only	312 (33.8)	11 (5.7)	134 (51)	6 (20)	12 (5.9)	141 (79.2)	6 (23.1)	2 (7.7)
Frequency of participation in sport (*n* (%))								
– Daily	123 (13.3)	22 (11.2)	51 (19.5)	2 (6.7)	29 (14)	12 (6.8)	4 (15.4)	3 (11.5)
– Weekly	633 (68.5)	126 (64.3)	178 (67.9)	19 (63.3)	134 (64.8)	140 (79.1)	18 (69.2)	18 (69.2)
– Monthly	119 (12.9)	33 (16.8)	20 (7.6)	8 (26.7)	35 (16.9)	17 (9.6)	2 (7.7)	4 (15.4)
Knew someone with EACE: yes (*n* (%))	390 (42.1)	93 (47.4)	86 (32.3)	10 (33.3)	150 (72.5)	24 (13.5)	16 (61.5)	12 (46.2)
Desire to know more about EACE: yes (*n* (%))	781 (84.3)	166 (84.7)	263 (81.7)	25 (83.3)	180 (87.0)	149 (83.7)	24 (92.3)	22 (84.6)

*$n = 926$. SD = standard deviation; EACE = external auditory canal exostoses

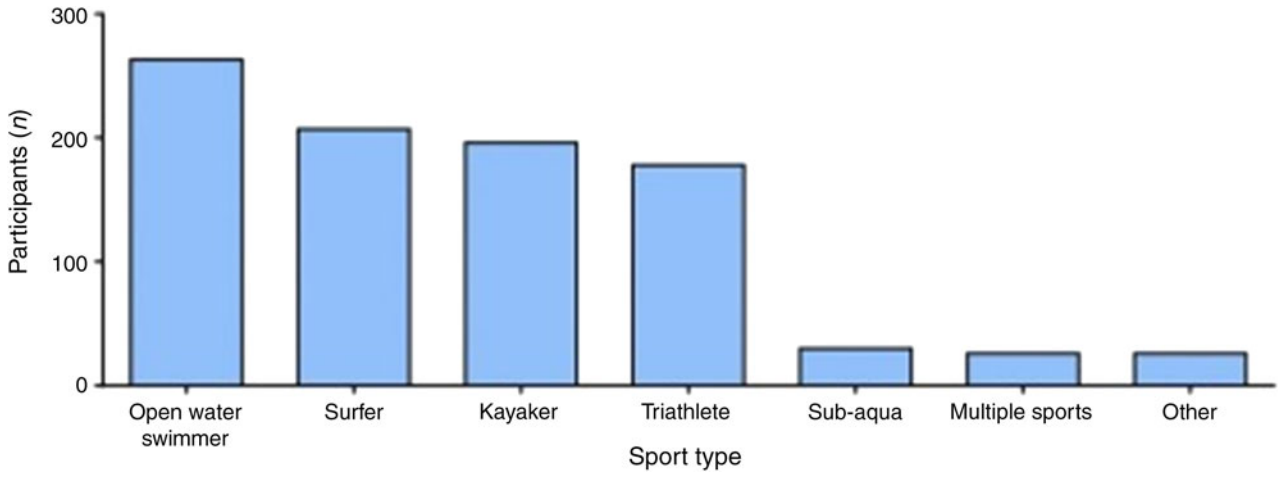

Fig. 1. Graph showing number of participants in different sporting disciplines.

Table 2. Breakdown of participants' awareness of external auditory canal exostoses

Sport	Aware (*n* (%))	Knowledgeable (*n* (%))
Overall	625 (67.5)	526 (56.8)
Kayaker ($n = 196$)	155 (79.1)	122 (62.2)
Triathlete ($n = 178$)	71 (39.9)	54 (30.3)
Surfer ($n = 207$)	191 (92.3)	177 (85.5)
Sub-aqua ($n = 30$)	16 (53.3)	11 (36.7)
Open water swimmer ($n = 263$)	154 (58.5)	129 (49.0)
Multiple sports ($n = 26$)	22 (84.6)	20 (76.9)
Other ($n = 26$)	16 (61.5)	13 (50)

Multivariate binary logistic regression analysis was performed to assess the relationship between cold-water athletes and prior knowledge of external auditory canal exostoses. Sport type ($p < 0.001$) and knowing someone with external auditory canal exostoses ($p < 0.001$) were significant predictors of having prior knowledge about external auditory canal exostoses. A further breakdown of univariate and multivariate results are outlined in Table 3.

Of the cold-water athletes surveyed, the community known prevalence of external auditory canal exostoses (participants who were previously diagnosed with external auditory canal exostoses) was 9.7 per cent ($n = 90$). The results also highlighted that 46.7 per cent ($n = 42$) of reported external auditory canal exostoses cases in our study were among non-surfers. Of those surveyed, the prevalence of external

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Table 3. Results of the univariate and multivariate analysis for predictors of knowledge

	Univariate analysis			Multivariate analysis		
Independent variable	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Age	1.001	0.990–1.012	0.883	1.013	0.997–1.030	0.101
Gender	1.713	1.315–2.231	<0.0001	1.077	0.77–1.505	0.665
Sport type	–	–	–	–	–	<0.001
– Kayaker	1.649	0.725–3.748	0.233	1.891	0.748–4.777	0.178
– Triathlete	0.435	0.189–1.001	0.05	0.714	0.268–1.905	0.502
– Surfer	5.9	2.495–13.952	<0.001	4.802	1.826–12.625	0.001
– Sub-aqua	0.579	0.199–1.686	0.316	0.544	0.161–1.831	0.325
– Open water swimmer	0.963	0.43–2.155	0.926	1.165	0.45–3.019	0.752
– Multiple sports	3.333	1.011–10.99	0.048	2.557	0.688–9.502	0.161
– Other sports	–	–	–	–	–	–
Standard	–	–	–	–	–	0.458
– Beginner	–	–	–	–	–	–
– Intermediate	2.134	1.4–3.354	<0.001	1.3	0.802–2.106	0.287
– Advanced	4.004	2.567–6.246	<0.001	1.427	0.809–2.516	0.219
Years of participation	1.058	1.042–1.074	<0.001	1.013	0.993–1.033	0.2
Symptoms	1.337	0.987–1.81	0.06	0.981	0.682–1.411	0.917
Know someone with exostoses				–	–	<0.001
– Yes	8.304	6.009–11.474	<0.001	5.152	3.579–7.418	<0.001
– Maybe	2.028	1.286–3.196	0.002	1.76	1.084–2.860	0.022
– No	–	–	–	–	–	–
Attitude to ear plugs	–	–	–	–	–	0.044
– Positive	1.058	0.746–1.5	0.753	1.271	0.885–1.826	0.194
– Neutral	0.724	0.394–1.333	0.3	0.638	0.341–1.19	0.158
– Negative	–	–	–	–	–	–

OR = odds ratio; CI = confidence interval

auditory canal exostoses amongst triathletes was 2.8 per cent and for open water swimmers was 4.9 per cent. 'Other' cold-water athletes affected included a coast guard volunteer. Surgery had previously been performed on 1.7 per cent (16) of athletes surveyed, including a triathlete and 3 open water swimmers. The breakdown of community known prevalence of external auditory canal exostoses among different sporting disciplines is outlined in Table 4.

Overall, otological symptoms were experienced by 75.8 per cent ($n = 704$) of participants, with 76.3 per cent ($n = 611$) of this cohort experiencing mild symptoms and 23.7 per cent ($n = 93$) experiencing severe symptoms. The symptoms described include: water trapping (60.5 per cent), ear infection (16.1 per cent), pain (23.1 per cent), reduced hearing (29.5 per cent) and ear blockage (25.5 per cent). Table 4 outlines the breakdown of symptoms by sporting discipline.

Regression analysis shows that age (odds ratio = 0.98; $p = 0.003$), female gender (odds ratio = 0.7; $p = 0.04$), years of exposure (odds ratio = 1.04; $p = 0.002$), ear plug use (odds ratio = 0.79; $p = 0.03$) and diagnosis of external auditory canal exostoses (odds ratio = 3.35; $p = 0.008$) were all significant predictors of having symptoms of external auditory canal exostoses, whereas sport type, standard, time of year, frequency of participation, skull cap use, and living near the sea, river or lakes were not significant predictors of having symptoms of external auditory canal exostoses (Table 5).

Ear protection

Within this study, the use of two forms of ear protection were examined: ear plugs and skull caps or hoods. Of those surveyed, just over half (50.4 per cent) of cold-water athletes used a skull cap or hood whereas 37.1 per cent used ear plugs.

The highest compliance with skull cap or hood use was among sub-aqua (66.7 per cent) and surfing (67.5 per cent) participants, whereas multiple sport participants had the highest use of ear plugs (61.6 per cent). Appendix 2 outlines the breakdown of skull cap and ear plug use in sporting disciplines.

A total of 63.9 per cent ($n = 592$) of participants reported a 'positive attitude' towards ear plug use with triathletes (74.7 per cent; $n = 133$) having the highest level compared with all other sporting disciplines. However, actual use of ear plugs among triathletes was only 28.7 per cent ($n = 51$). Hearing loss associated with wearing ear plugs was identified as the main deterrent for athletes across all sporting disciplines.

Phase 2: clinical otoscopic exams

A total of 180 cold-water athletes were examined during the 6 'surfer's ear clinics', with 29.4 per cent ($n = 53$) of athletes diagnosed with external auditory canal exostoses. There was no significant difference between the percentage of right and

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Table 4. Community known prevalence, surgical breakdown and symptoms among sporting disciplines

Sport	Previous diagnosis of EACE: yes (*n* (%))	Previous surgery: yes (*n* (%))	Otological symptoms: yes (*n* (%))	Severe symptoms (>4 symptoms) (*n* (%))
Overall	90 (9.7)	16 (1.7)	704 (76)	93 (13.2)
Kayaker	18 (9.2)	3 (1.5)	162 (83.5)	22 (13.6)
Multiple	5 (19.2)	1 (4)	21 (80.8)	4 (19)
Open water swimmer	13 (4.9)	3 (1.1)	187 (71.1)	16 (8.6)
Other	1 (3.8)	0 (0)	18 (69.2)	3 (16.7)
Sub-aqua	0 (0)	0 (0)	18 (60)	2 (11.2)
Surfer	48 (53.3)	8 (3.9)	166 (80.2)	36 (21.7)
Triathlete	5 (2.8)	1 (0.5)	132 (74.2)	10 (7.6)

EACE = external auditory canal exostoses

Table 5. The univariate and multivariate odds ratios for independent variable predictors of 'symptom' over 'no symptom'

	Univariate analysis			Multivariate analysis		
Independent variable	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Age	0.959	0.707–1.301	0.959	0.975	0.958–0.001	0.003
Gender (female)	0.984	0.972–0.996	0.012	0.696	0.489–0.99	0.044
Sport type	–	–	–	–	–	0.169
– Kayaker	2.118	0.851–5.267	0.107	2.534	0.991–6.48	0.052
– Triathlete	1.275	0.52–3.13	0.595	2.106	0.758–5.855	0.153
– Surfer	1.799	0.731–4.427	0.201	1.655	0.651–4.207	0.29
– Sub-aqua	0.667	0.22–2.018	0.473	0.92	0.28–2.978	0.889
– Open water swimmer	1.094	0.456–2.622	0.841	1.529	0.578–4.046	0.393
– Multiple sports	1.867	0.518–6.731	0.34	1.947	0.509–7.456	0.331
– Other sports	–	–	–	–	–	–
Standard	–	–	–	–	–	0.476
– Beginner	–	–	–	–	–	–
– Intermediate	1.083	0.68–1.726	0.737	0.996	0.601–1.649	0.98
– Advanced	1.182	0.726–1.925	0.5	0.781	0.431–1.416	0.416
Years of participation	1.02	1.005–1.036	0.011	1.035	1.013–1.058	0.002
Time of year	0.747	0.546–1.022	0.068	1.06	0.693–1.621	0.789
Frequency	–	–	–	–	–	0.322
– Daily	1.503	0.728–3.104	0.271	1.615	0.740–3.526	0.229
– Weekly	1.575	0.843–2.941	0.157	1.81	0.932–3.514	0.08
– Monthly	1.652	0.792–3.446	0.181	1.967	0.899–4.301	0.09
– Other	–	–	–	–	–	–
Ear plug use	0.788	0.649–0.956	0.016	0.794	0.641–0.983	0.034
Skull cap use	1.079	0.903–1.29	0.401	0.995	0.814–1.217	0.962
Living <5 miles from beach	0.676	0.446–1.025	0.065	0.735	0.473–1.142	0.17
Diagnosis of EACE	4.877	2.1–11.327	<0.001	3.348	1.372–8.174	0.008

OR = odds ratio; CI = confidence interval; EACE = external auditory canal exostoses

left ear occlusion (39.6 ± 26.9 per cent *vs* 41.4 ± 27.5 per cent; $p = 0.76$).

Otoscopic features correlated to questionnaire

The completed questionnaires and findings from the otoscopic examination were complete for 139 participants (see Appendix 3 for external auditory canal exostoses prevalence by sport). The overall prevalence of external auditory canal exostoses was 23.7 per cent ($n = 33$). Only 3.6 per cent knew of this diagnosis prior to examination. Those that developed external auditory canal exostoses participated in cold-water sport for a greater number of years (mean = 15.3, SD = 12.2) compared to those without external auditory canal exostoses (mean = 7.44, SD = 7.5). Multivariant analysis failed to determine any

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predictors of external auditory canal exostoses including years in sport, standard, frequency, time of year involved in sport, ear protection and sport discipline.

Discussion

Why we did it?

The study was based in County Sligo on the West Coast of Ireland, an area renowned for surfing and open water sports. Several of the authors have an interest in open water sports, and awareness and knowledge of external auditory canal exostoses was anecdotally variable across different sports. This formal study emanated from local and national sporting body discussions.

The rise of open water sports

Open water sports such as open water swimming, triathlon and surfing in Ireland have seen a rise in popularity from 15 to 71 per cent.[3–6] Awareness of external auditory canal exostoses varies between different water sports. Surfers in particular have a greater knowledge of external auditory canal exostoses. We report 92.3 per cent of Irish surfers were aware of external auditory canal exostoses, but 11 per cent had 'poor knowledge'. Among Australian surfers awareness ranged from 88.2 to 100 per cent.[9] This compares to a UK based paper by Morris *et al.* with 86.1 per cent awareness and 'poor knowledge' in 23.4 per cent.[8] Our study is the first the authors could find to document awareness and knowledge among non-surfers, specifically triathletes and swimmers. These cohorts have an awareness of 39.9 and 58.5 per cent, respectively. We have yet to determine whether increased media awareness campaigns will increase awareness, diagnosis and possible prevention with ear plugs.

Strengths and limitations

This is one of the largest national studies of external auditory canal exostoses in open water athletes. The study's initial online questionnaire phase had responses from across the entire country of Ireland. Building on this information, open clinics were established where athletes could view their own external auditory canal exostoses and the team could correlate the otoscopic findings to their questionnaire. As a result of our findings, a significant local, regional and national media awareness campaign was conceived.

- Awareness of external auditory canal exostoses among emerging sports such as triathlon is low (39.9 per cent)
- Sub-aqua divers were the least knowledgeable of external auditory canal exostoses at 36.7 per cent
- Overall otological symptoms were experienced by 75.8 per cent, but ear plug use reduced ear symptoms
- Eighty-four per cent wished for further external auditory canal exostoses health advice, predominantly through social media
- Increasing cold-water activities have the potential to increase the workload of general practitioners and ENT surgeons
- Awareness of ear protective equipment such as ear plugs may reduce the morbidity of external auditory canal exostoses

Authors of this study promoted awareness at two competitive kayaking events. Articles detailing the hazards of cold-water exposure were reported in many local and national newspapers. Furthermore, two specific magazine articles were created for kayakers (Flowstate) and general practitioners (Forum). A scientific poster (information slide) detailing the study's findings was created and displayed alongside a digital illustration to raise awareness in hospital out-patient departments (Appendix 1).

A television interview with authors and open water swimmers was broadcast as a news article on national television (Raidió Teilifís Éireann (RTÉ) followed by a regional radio interview (Ocean FM). A webpage detailing information on external auditory canal exostoses and study findings was published on the national health website (Saolta). Additionally, a series of videos were produced for social media platforms (YouTube, San Bruno, USA, and Facebook, Menlo Park, USA).

One of the limitations of the questionnaire was regarding the question of date of birth. Many found scrolling through the year selection onerous and led to many inputting their date of birth as 2019. This resulted in the athlete's exclusion in phase 1 (217 respondents) and phase 2 (41 respondents) of the study. The design of the clinics was contrasting: three clinics were in a hospital setting and three were at competition registrations. There was potential selection bias in those who attended the clinics, with perhaps only the most symptomatic attending.

Further study

Areas of further research in the non-surfing cohort are required. For example, there are high risk groups such as 'ice water swimmers' (who swim in water of temperatures of 5°C and lower) who are yet to be studied. Two of the clinics in this study were held at race events registration open water and swimming events. Further studies of kayakers and divers at similar race or meeting events would be useful to document. A follow-up national awareness study should be performed to determine if increased awareness and fewer symptoms have been achieved.

Surfer's ear: a misnomer?

The online questionnaire aspect of this project demonstrates two points: 9.7 per cent of participants ($n = 90$) were previously diagnosed with external auditory canal exostoses, of whom 46.7 per cent were non-surfers, and surfers are no more symptomatic than other cold-water athletes. Therefore, the term surfer's ear is not an appropriate term, and it may thwart the efforts to bring awareness to other cold-water athletes. The authors suggest a more accurate patient friendly title such as cold-water athletes' ear because one of the aims of this project is to highlight non-surfing cohort awareness, prevalence and attitudes to ear protection. Several papers have documented the prevalence of external auditory canal exostoses among kayakers and divers.[1,19,20] The implications of not raising awareness is that a greater number of cold-water athletes will gradually develop external auditory canal exostoses and become symptomatic. Inevitably, this leads to increased presentations of otitis externa, ear toileting and ultimately invasive surgery. In Cornwall, an increase of 1.3 per cent of cold-water athletes requiring surgery was observed over a 9-year period.[11] Surgery for external auditory canal exostoses is not without complications, such as hearing loss, facial nerve injury, temporomandibular injury and restenosis.[23–27]

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Data available on request.

Competing interests. None declared

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Appendix 1. Knowledge questions

- Surgery is the only cure for surfer's ear
- Ear wind chill contributes to surfer's ear
- All surfers are at risk of surfer's ear
- Surfer's ear/exostosis can completely close up the ear canal
- Surfer's ear is due to cold-water exposure
- You cannot see surfer's ear/exostosis by looking in a mirror
- Surfer's ear/exostosis can be prevented
- Surfer's ear/exostosis is due to bone growth in ear canal
- Surfer's ear/exostosis features ear infections & hearing loss
- Only long-term water athletes get surfer's ear/exostosis

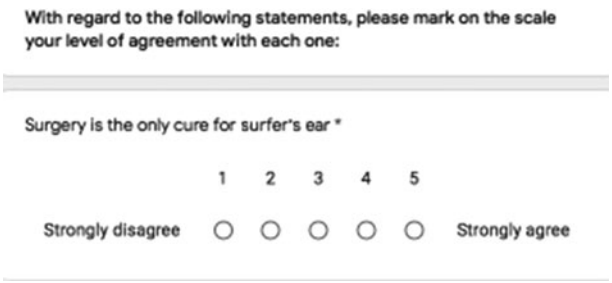

Fig. 1. Likert scale example

Attitude questions

- Ear plugs limit my hearing in the water
- Ear plugs interfere with feeling immersed in the sea
- Ear plugs are uncomfortable
- Ear plugs are anti-social
- Ear plugs cost too much
- Ear plugs will reduce my balance
- Ear plugs affect my performance
- I accept that surfer's ear/exostosis is inevitable if I don't wear ear plugs
- I feel self-conscious wearing ear plugs

Information slide

Title: To determine water athletes' awareness of surfer's ear or exostosis and attitudes to wearing ear plugs

Introduction and study information section

You are invited to take part in a research study undertaken by the Ear, Nose and Throat Department at Sligo University Hospital. It is important for you to understand why this research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. If you would like more information, please email surfersearproject@gmail.com. Take time to decide whether or not you wish to take part. Thank you for reading this.

What is the purpose of this study

Surfer's ear or exostosis are benign bone growths in the ear. It is associated with cold-water exposure particularly seen in surfers. An Irish study determined 66 per cent of surfers in Ireland can have these bone growths, 88 per cent of whom were unaware of their diagnosis (Auditory canal exostoses in Irish surfers, P. Lennon *et al.*). Surfers are not the only water participants potentially at risk – any person exposed to prolonged cold-water exposure may develop surfer's ear.

A previous study in the UK determined 86 per cent of surfers reported awareness of surfer's ear (awareness and attitudes towards external auditory canal exostosis and its preventability in surfers in the UK by S Morris *et al.*). There is paucity in the literature to determine the awareness of surfer's ear in Irish kayakers, triathletes, open water swimmers, sailors and sub-aqua participants and attitudes towards ear plugs. The aim is to answer these questions, as well as raising awareness of surfer's ear and potential preventative measures. This study involves a questionnaire.

You have been chosen as you are either a water or non-water athlete. Those picked as a non-water athlete will be used as a control to determine general baseline information.

The questionnaire takes around 3 minutes to complete. No treatment or intervention will be performed in this study. The aim is to gather information on awareness of surfer's ear and attitudes to ear plug use. All information which is collected about you during the course of the research will be kept strictly confidential.

What are the possible disadvantages and risks of taking part

No intervention will be performed.

What are the possible benefits of taking part

The benefits of this study are to raise awareness of surfer's ear and potential prevention of surfer's ear in water athletes. The information we obtain from this study may help us to provide better outcomes for future patients with surfer's ear.

What happens when the research study stops and what will happen to the results of the study

The results of this study will be analysed. The data may be accepted for publication to a medical journal and may be presented at national medical meetings. This is an observational study. If you are concerned you may have surfer's ear, please contact your GP.

The Research Ethics Committee of Sligo University Hospital have reviewed this study.

For Further Information please contact Seamus Boyle, ENT Spr, Dept. of ENT Sligo University Hospital by email: surfersearproject@gmail.com

Thank you for your time.

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Appendix 2. Breakdown of use and attitudes towards ear protection by sporting disciplines

Sport	Ear plugs (regularly) (*n* (%))	Ear plugs (sometimes) (*n* (%))	Skull cap or hood (regularly) (*n* (%))	Skull cap or hood (sometimes) (*n* (%))	Attitude to ear plug (positive) (*n* (%))
Overall	202 (21.8)	142 (15.3)	245 (26.5)	468 (50.5)	592 (63.9)
Kayaker	21 (10.7)	29 (14.8)	15 (7.7)	53 (27)	114 (58.2)
Multiple	8 (30.8)	8 (30.8)	7 (26.9)	9 (34.6)	16 (61.5)
Open water swimmer	80 (30.8)	34 (12.9)	113 (43.1)	28 (10.7)	183 (69.6)
Other	4 (15.4)	3 (11.5)	3 (11.5)	2 (7.7)	11(42.3)
Sub-aqua	0 (0)	1 (3.3)	18 (60)	2 (6.7)	19 (63.3)
Surfer	54 (26.1)	50 (24.1)	31 (15)	106 (51.5)	116 (56)
Triathlete	35 (19.7)	16 (9.0)	58 (32.6)	21 (11.8)	133 (74.7)

Appendix 3. Breakdown of otoscopic examination and diagnosis of EACE by sporting disciplines

Sport	(*n* (%))	EACE diagnosis (*n* (%))
Overall	139 (100)	33 (23.7)
Kayaker	3 (2.2)	1 (33.3)
Triathlete	32 (23)	2 (6.3)
Surfer	25 (18)	16 (64)
Sub-aqua	4 (2.9)	0 (0)
Open water swimmer	62 (44.6)	3 (4.8)
Multiple sports	12 (8.6)	3 (25)
Other	1 (0.7)	0 (0)

EACE = external auditory canal exostoses

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