



An Roinn Talmhaíochta,  
Bia agus Mara  
Department of Agriculture,  
Food and the Marine

# 17F264 - Seafood consumption and risk exposure study

## Final Report

This project was funded under the Department of  
Agriculture, Food and the Marine Competitive Funding  
Programme.

## **SUMMARY**

This project provided detailed diet, health, and lifestyle information on a specific but interesting portion of the population to undertake specific risk assessment scenarios. Detailed information on seafood intake was collected. Mean daily total seafood intake in this population was 75g/day, and respective mean daily intakes of oily fish, white fish and shellfish were 46g, 73g and 43g. Using the food intake data in risk analysis, for the first time, this project, gave quantitative evidence to national industry and regulatory stakeholders as to the risk from viruses posed by the consumption of raw oysters. The food consumption data relating to oysters was used to update the previously completed risk assessment of Norovirus in oysters (14 SF 852) which had assumed fixed quantities of oyster consumption (1, 3, 6 oysters) per eating occasion. The updated data acted as further confirmatory evidence for that risk assessment. In addition, a risk assessment of selected marine biotoxins in Irish produced shellfish was undertaken, specifically, Diarrhetic Shellfish Poisoning. The risk assessment considered the likelihood of Diarrhetic Shellfish Poisoning in mussels in a specific mussel producing area (Bantry Bay) and developed a predictive model for the occurrence of the biotoxin depending on time of year.

The risk assessments have underpinned Irish regulators input to the current ongoing consideration by The EU to set a regulatory limit for Norovirus in Oysters. The work has direct relevance to the Marine Institute and the SFPA and discussions are ongoing as to how to further this work to consider other marine biotoxins. This work has facilitated UCD to develop a high level of expertise in the growing area of assessing the risk associated with viruses in foods. This is an emerging area as viruses are being increasingly associated with a range of foods including pork meat, shellfish and berried fruit.

## **KEYWORDS**

Seafood, Fish, Shellfish, Dietary Intake, Portion size, Risk Assessment, Toxins

## **ACRONYM**

SCaRES

## **PROJECT COORDINATOR, INSTITUTION**

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November 2021.

# Section 1 - Research Approach & Results

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## Start Date

01 July 2018

## End Date

30 June 2020

## Research Programme

Food Institutional Research Measure

## TRL Scale

TRL 3: Experimental Proof of Concept

## NRPE Priority area

Food for Health

## Total DAFM Award

€197,193.74

## Total Project Expenditure

€174,397.64

## Rationale for undertaking the Research

This work within this project aimed to generate specific dietary intake data, on seafood, to improve the characterisation of the risk from exposure to biotoxins and other contaminants from consuming shellfish. In doing so, the proposal brought together a unique partnership of expertise relating to collection of food consumption data for different population cohorts as well as risk assessment expertise. In the past nationally representative surveys severely lacked reported eating occasions of seafood, with the most recent survey comprising of 133,050 rows of data with only 12 of these related to Shellfish, not sufficient data for risk exposure assessment in this food group. It is therefore clear that a targeted data collection approach was required. Thus, the proposal aimed to collect reported dietary intake data from seafood consumers, using novel online dietary intake assessment techniques, to determine habitual intakes of seafood for use in risk assessment. This approach represents a significant step forward in terms of public health policy contribution by being able to characterise the likelihood of illness in a population or population sub-group on an annual basis. The project used the seafood consumption data to underpin an exposure assessment of selected marine biotoxins in Irish produced shellfish and developed detailed risk assessments for these marine biotoxins in Irish produced shellfish.

## Methodology

### Dietary Intake Assessment:

Dietary intake was evaluated using Foodbook24. This web-based tool was developed and validated for the purpose of nutritional surveillance in Ireland. Participants were asked to record their dietary intake on Foodbook24, a web-based dietary analysis tool, by completing 3, non-consecutive, 24-hour dietary recalls within a period of 2 weeks in addition to a Food Frequency Questionnaire (FFQ) and a Food Choice Questionnaire (FCQ). Participants also completed a demographic questionnaire to self-report anthropometric data (body weight and height), health status and other lifestyle data. Data from the SCaRES study was combined with data from DietIreland for analysis, to ensure adequate numbers of reported eating occasions for targeted seafood consumers. Fish intake, anthropometric and lifestyle data collected was analysed to examine the number of reported eating occasions, mean and median portion size of fish consumed and the demographic characteristics of seafood consumers.

### Risk Assessment Analysis:

In the first instance, the consumption data for oysters was obtained from the SCaRES study and an estimate was derived for the distribution in portion size arising from a single eating occasion. This data was then used in an existing norovirus exposure model developed from a previous FIRM funded norovirus risk assessment project (14SF852). The results were within the consumption pattern scenarios used in the initial risk assessment and served to act as additional verification of the risk assessment methodology. For the biotoxin risk assessment, it was decided to concentrate on Diarrhetic Shellfish Poisoning in mussels produced in the Bantry Bay production area, given the relatively frequent bay closures in that area arising from phytoplankton blooms at favourable times of the year. In this task, we developed a novel Bayesian Network (BN) model for forecasting the occurrence of DSP toxins in blue mussels (*Mytilus edulis*) from Bantry Bay.

## Project Results

Although seafood is an important part of a balanced diet, many national food consumption surveys suggest that seafood is not consumed in sufficient amounts, and research on what is consumed and why is needed. A detailed systematic review revealed that seafood consumers were more likely to be older, more affluent, more physically active, and were less likely to smoke compared to non-seafood consumers. The most commonly reported barriers to seafood consumption were cost, followed by sensory or physical barriers, health and nutritional beliefs, habits, availability and cooking skills.

Using dietary data collected from participants within this study, reported food intakes of this sample population suggest that seafood consumers met the current recommended weekly intake for fish. Mean daily total seafood intake in this population was 75g/day, and respective mean daily intakes of oily fish, white fish and shellfish were 46g, 73g and 43g.

Consumption Data from the from the SCaRES study was used to update existing norovirus risk assessments. The risk assessments indicated that if the concentration of Norovirus in infected oysters was greater than approximately 500 genome copies per gram, then the likelihood of illness arising from the consumption of three or more oysters was generally approximately 50% and this increased with further consumption or concentration of virus in the oysters. This level of contamination is frequently obtained in Irish oysters during the winter months and demonstrates the urgency in developing a regulatory limit for norovirus in oysters.

In the course of the project, we successfully developed a Bayesian Network (BN) model for forecasting the short-term variations of DSP toxins in blue mussels (*Mytilus edulis*) from Bantry Bay, Southwest Ireland. Model validation showed that the prediction accuracy was higher than 86%. This risk model is useful to allow producers and regulatory agencies to manage production sites and further work is ongoing with the Marine Institute to further develop the model.

## Section 2 - Research Outputs

### Summary of Project Findings

This research has provided insights into the barriers and enablers of seafood consumption and examined current intakes of seafood consumption and their link to food choice considerations. The food intake data is then used within the development of novel risk assessment tools, enabling seafood producers in Ireland to predict the risk of specific biotoxins in specific species. This knowledge will allow precautionary actions to be taken to reduce closures and loss of produce due to biotoxin contamination.

Specific outputs include:

- Report outlining the methods used and the main findings with regards to fish and fish dish consumption, portion size and corresponding fish consumer demographic data from the Seafood Consumption and Risk Exposure Study (SCaRES).
- Final datasets detailing dietary, demographic and food choice data of seafood consumers in Ireland.
- Further development of Foodbook24 dietary intake assessment tool ([www.ucd.ie/foodbook24](http://www.ucd.ie/foodbook24)) demonstrating targeted use to determine dietary intakes in Irish population.
- Further refinement of quantitative risk assessment of norovirus in Irish produced oysters
- Development of a risk model for forecasting the short-term variations of DSP toxins in mussels in Irish production areas.

### Summary of Staff Outputs

Research Output	Male	Female	Total Number
MSc Students	0	2	2
Research Technicians/ Assistants	0	1	1

### Summary of Academic Outputs

Research Outputs	Total Number	Details
Publications in Peer Reviewed Scientific Journals	1	A systematic review of the determinants of seafood consumption. Govzman S, Looby S, Wang X, Butler F, Gibney ER, Timon CM. Br J Nutr. 2021 Jul 14;126(1):6680. doi:10.1017/S0007114520003773. Epub 2020 Sep 24. PMID: 32967738
Peer Reviewed Conference Papers	2	<ol style="list-style-type: none"> <li>1. Systematic Review of the determinants of seafood consumption – Govzman, Gibney, Timon, Butler, Looby &amp; Xiyao - FENS2019</li> <li>2. Examination of Seafood Intake Using Online 24hr Recall Tool for Use in Risk Assessment Analysis' - Govzman, Gibney, Timon, Butler, Looby &amp; Xiyao FENS2019</li> </ol>
Masters Theses	1	MSc Thesis Title: An examination of seafood intake in Irish adults – Sophie Govzman, (Submitted to University College Dublin Sept 2020, Graduated June 2021).
Other	2	<ol style="list-style-type: none"> <li>1. Report outlining the methods used and the main findings with regards to fish and fish dish consumption, portion size and corresponding fish consumer demographic data from the Seafood Consumption and Risk Exposure Study (SCaRES) – available at <a href="https://www.ucd.ie/seafoodstudy/findingsfromthisstudy/">https://www.ucd.ie/seafoodstudy/findingsfromthisstudy/</a></li> <li>2. Wang Xiao, completed a review published in Biosystems and Food Engineering Research Review (25) - UCD School of Biosystems and Food Engineering. Document Number: ISSN 1649-475X May 2020 - Editors: Enda J. Cummins and Thomas P. Curran. T</li> </ol>

## Intellectual Property

Several aspects arising from this project can be further used and exploited including:

- Developments made within foodbook24 have increased the functionality of the tool and will be utilised in future projects.
- Final datasets derived from the project, detailing dietary, demographic and food choice data of seafood consumers in Ireland will be shared and utilised within ongoing projects – e.g., FNS-Cloud (H2020 Project, Eileen Gibney, Principal Investigator).
- The work relating to the risk assessments are by their nature ‘public good’ research and there are no associated IP issues.

## Summary of other Project Outputs

Project Outputs	Details	Total No.
New Technology	Further development of Foodbook24	1

## Potential Impact related to Policy, Practice and Other Impacts

Impact	Details
Other	Use of Seafood Intake data within Food Safety Authority of Ireland (Julia le Jeune, Christina Tlustos and Wayne Anderson) for use in relation to development of species-specific fish consumption advice. Datasets and reports shared October 2020.
Industry	Risk model developed to predict biotoxin concentrations in shellfish in Irish production areas

## Dissemination Activities

Activity	Details
Workshops at which results were presented	Presented at FNS Work Package 4 Workshop – Food consumption data online workshop – n=50 attendees 22/04/2020

## Knowledge Transfer Activities

Identify knowledge outputs generated during this project.	<ul style="list-style-type: none"><li>• Database of food and nutrient intake in Irish Seafood consumers.</li><li>• Database of seafoods portion sizes in Irish consumers.</li><li>• Foodbook24 dietary intake assessment tool.</li></ul>
Identify any knowledge transfer activities executed within the project.	<ul style="list-style-type: none"><li>• Use of Seafood Intake data within Food Safety Authority of Ireland (Julia le Jeune, Christina Tlustos and Wayne Anderson) for use in relation to development of species-specific fish consumption advice. Datasets and reports shared October 2020.</li><li>• Use of ScAREs Food intake Datasets within FNS-Cloud Catalogue, for future and ongoing research and analysis (FNS-Cloud, H2020).</li></ul>
List any impacts resulting from the knowledge transferred during the project.	Further work is ongoing with the Marine Institute to broaden the scope of the marine biotoxins to PSP.

## Section 3 – Leveraging, Future Strategies & Reference

### Leveraging Metrics

Type of Funding Resource	Funding €	Summary
EU R&I programmes	€493,750.00	Involvement as partner in FNS-Cloud FNS-Cloud which aims to use existing FNS resources (data, knowledge, and tools) for health and agri-food sciences which are currently fragmented, lack critical mass, and access by user communities is ‘unevenly’ distributed. FNS-Cloud among other activities aims to integrate existing and emerging FNS datasets, sources, and formats. Value to UCD as partner is €493,750.
Other	€100,000.00	CSC Scholarship for 3 years for Xiyao Wang – transfer from MSc to PhD student at University College Dublin.

## **Future Strategies**

- Foodbook24 tool is being further developed to add additional functionalities including multiple languages (English, Polish, Chinese and Portuguese), built in questionnaire/survey features & interchangeable food / food composition lists. This tool will be used in several ongoing project such as Food for Health Ireland (FHI3), SuHe (Sustainable Healthy Eating part of the FNS-Cloud catalogue for use in future).
- Dietary intake and demographic datasets arising from the project will be made available within the FNS-Cloud catalogue for future use and analysis
- Use of Seafood Intake data within Food Safety Authority of Ireland (Julia le Jeune, Christina Tlustos and Wayne Anderson) for use in relation to development of species-specific fish consumption advice. Datasets and reports shared October 2020. Knowledge and expertise shared with the FSAI as needed to facilitate and support this work.

## **Project Publications**

1. A systematic review of the determinants of seafood consumption. Govzman S, Looby S, Wang X, Butler F, Gibney ER, Timon CM. Br J Nutr. 2021 Jul 14;126(1):66-80. doi:10.1017/S0007114520003773. Epub 2020 Sep 24. PMID: 32967738