

# XJENZA

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THE UNIVERSITY OF MALTA  
RESEARCH, INNOVATION  
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MALTA CHAMBER OF SCIENTISTS

Science Journal of the Malta Chamber of Scientists

Editor-in-Chief: Cristiana Sebu

## Chronological List of Past and Present Editors of Xjenza

### The Journal of the Malta Chamber of Scientists

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#### 2023–

**Editor:** Cristiana Sebu

**Associate Editors:** *Ian Cassar, Alexandra Bonnici, Joseph Galea, Lourdes Farrugia, Godfrey Baldacchino, Liberato Camilleri*  
Xjenza Online Vol. 11 Iss. 1 and 2 (2023)

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#### 2018–2022

**Editor:** Cristiana Sebu

**Senior Editors:** *Sebastiano D'Amico, David Magri*

**Associate Editors:** *Sandro Lanfranco, Ian Thornton, Gianluca Valentino, Ian Cassar, Alexandra Bonnici, Joseph Galea, Pierre Vella, Lourdes Farrugia, Godfrey Baldacchino, Liberato Camilleri*

Xjenza Online Vol. 10 Iss. 2 (2022)

Xjenza Online Vol. 10 Iss. 1 (2022)

Xjenza Online Vol. 10 Special Iss. MNS Proceedings (2022)

Xjenza Online Vol. 9 Special Iss. (2021)

Xjenza Online Vol. 9 Iss. 2 (2021)

Xjenza Online Vol. 9 Iss. 1 (2021)

Xjenza Online Vol. 8 Iss. 2 (2020)

Xjenza Online Vol. 8 Iss. 1 (2020)

Xjenza Online Vol. 7 Iss. 2 (2019)

Xjenza Online Vol. 7 Iss. 1 (2019)

Xjenza Online Vol. 6 Iss. 2 (2018)

Xjenza Online Vol. 6 Iss. 1 (2018)

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#### 2013–2017

**Editor:** Giuseppe Di Giovanni

**Associate Editors:** *David Magri, Ian Thornton, Ian Cassar, Philip Farrugia, Sebastiano D'Amico, Nicholas Sammut, David Mifsud, Godfrey Baldacchino, Liberato Camilleri, Carmel Cefai*

Xjenza Online Vol. 5 Iss. 2 (2017)

Xjenza Online Vol. 5 SI MNS Proceedings (2017)

Xjenza Online Vol. 5 Iss. 1 (2017)

Xjenza Online Vol. 5 Virtual Issue COST (2017)

Xjenza Online Vol. 4 Iss. 2 (2016)

Xjenza Online Vol. 4 Iss. 1 (2016)

Xjenza Online Vol. 3 Iss. 2 (2015)

**Associate Editors:** *David Magri, Ian Thornton, Ian Cassar, Philip Farrugia, Sebastiano D'Amico, Nicholas Sammut, Joseph Galea, David Mifsud, Sandro Lanfranco, Mario Valentino, Godfrey Baldacchino, Liberato Camilleri*

Xjenza Online Vol. 3 Iss. 1 (2015)

Xjenza Online Vol. 2 Iss. 2 (2014)

Xjenza Online Vol. 2 Iss. 1 (2014)

Xjenza Online Vol. 1 Iss. 2 (2013)

Xjenza Online Vol. 1 Iss. 1 (2013)

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#### 2003–2007

**Editors:** Joseph N. Grima and Richard Muscat

Xjenza Vol. 12 (2007)

Xjenza Vol. 11 (2006)

Xjenza Vol. 10 (2005)

Xjenza Vol. 9 (2004)

Xjenza Vol. 8 (2003)

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#### 1996–2002

**Editor:** Angela Xuereb

**Associate Editor:** *Richard Muscat*

Xjenza Vol. 7 (2002)

Xjenza Vol. 6 (2001)

**Associate Editors:** *Martin Ebejer and Richard Muscat*

Xjenza Vol. 5 (2000)

Xjenza Vol. 4 Iss. 2 (1999)

Xjenza Vol. 4 Iss. 1 (1999)



**Associate Editors:** *Martin Ebejer, Richard Muscat, and Christian A. Scerri*

Xjenja Vol. 3 Iss. 2 (1998)

Xjenja Vol. 3 Iss. 1 (1998)

**Associate Editors:** *Martin Ebejer, Richard Muscat, Christian A. Scerri and Emmanuel Sinagra*

Xjenja Vol. 2 Iss. 2 (1997)

Xjenja Vol. 2 Iss. 1 (1997)

Xjenja Vol. 1 Iss. 2 (1996)

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## Scope of Journal

Xjenza Online is the Science Journal of the Malta Chamber of Scientists and is published in an electronic format. Xjenza Online is a peer-reviewed, open access international journal. The scope of the journal encompasses research articles, original research reports, reviews, short communications and scientific commentaries in the fields of: mathematics, statistics, geology, engineering, computer science, social sciences, natural and earth sciences, technological sciences, linguistics, industrial, nanotechnology, biology, chemistry, physics, zoology, medical studies, electronics and all other applied and theoretical aspect of science.

The first printed issue of the journal was published in 1996 and the last (Vol. 12) in 2007. The publication of Xjenza was then ceased until 2013 when a new editorial board was formed with internationally recognised scientists, and Xjenza was relaunched as an online journal, with two issues being produced every year. One of the aims of Xjenza, besides highlighting the exciting research being performed nationally and internationally by Maltese scholars, is to provide a launching platform into scientific publishing for a wide scope of potential authors, including students and young researchers, into scientific publishing in a peer-reviewed environment.

## Instructions for Authors

Xjenza is the Science Journal of the Malta Chamber of Scientists and is published by the Chamber in electronic format on the website: <https://www.xjenza.org/>. Xjenza will consider manuscripts for publication on a wide variety of scientific topics in the following categories

1. Research Articles
2. Communications
3. Review Articles
4. Notes
5. Research Reports
6. Commentaries
7. News and Views
8. Invited Articles and Special Issues
9. Errata

**Research Articles** form the main category of scientific papers submitted to Xjenza. The same standards of scientific content and quality that applies to Communications also apply to Research Articles.

**Communications** are short peer-reviewed research articles (limited to three journal pages) that describe new important results meriting urgent publication. These are often followed by a full Research Article.

**Review Articles** describe work of interest to the wide community of readers of Xjenza. They should provide an in-depth understanding of significant topics in the sciences and a critical discussion of the existing state of knowledge on a topic based on primary literature sources. Review Articles should not normally exceed 6000 words. Authors are strongly advised to contact the Editorial Board before writing a Review.

**Notes** are fully referenced, peer-reviewed short articles limited to three journal pages that describe new theories, concepts and developments made by the authors in any branch of science and technology. Notes need not contain results from experimental or simulation work.

**Research Reports** are extended reports describing research of interest to a wide scientific audience characteristic of Xjenza. Please contact the editor to discuss the suitability of topics for Research Reports.

**Commentaries** Upon Editor's invitation, commentaries discuss a paper published in a specific issue and should set the problems addressed by the paper in the wider context of the field. Proposals for Commentaries may be submitted; however, in this case authors should only send an outline of the proposed paper for initial consideration. The contents of the commentaries should follow the following set of rules: 3000 words maximum, title 20 words maximum, references 10 maximum (including the article discussed) and figures/tables 2 maximum.

**News and Views** The News section provides a space for articles up to three journal pages in length describing leading developments in any field of science and technology or for reporting items such as conference reports. The Editor reserves the right to modify or reject articles for consideration as News.

**Invited Articles and Special Issues** Xjenza regularly publishes Invited Articles and Special Issues that consist of articles written at the invitation of the Editor or another member of the editorial board.

**Errata** Xjenza also publishes errata, in which authors correct significant errors of substance in their published manuscripts. The title should read: Erratum: "Original title" by \*\*\*, Xjenza, vol. \*\*\* (year). Errata should be short and consistent for clarity.

## Submission of Manuscripts

Manuscripts should be sent according to the guidelines given hereafter to [xjenza@mcs.org.mt](mailto:xjenza@mcs.org.mt).

**Referees** All manuscripts submitted to Xjenza are peer reviewed. Authors are requested to submit with their manuscript the names and addresses of three referees, preferably from overseas. Every effort will be made to use the recommended reviewers; however the editor reserves the right to also consult other competent reviewers.

**Conflict of Interest** Authors are expected to disclose any commercial or other types of associations that may pose a conflict of interest in connection to with the submitted manuscript. All funding sources supporting the work, and institutional or corporate affiliations of the authors, should be acknowledged on the title page or at the end of the article.

**Policy and Ethics** The work presented in the submitted manuscript must have been carried out in compliance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans (<https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>); EU Directive 2010/63/EU for animal experiments ([http://ec.europa.eu/environment/chemicals/lab\\_animals/legislation\\_en.htm](http://ec.europa.eu/environment/chemicals/lab_animals/legislation_en.htm)); Uniform Requirements for manuscripts submitted to Biomedical journals (<http://www.icmje.org>). This must be stated at an appropriate point in the article.

**Submission, Declaration and Verification** Author(s) must only submit work that has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that is not under consideration for publication elsewhere, that has been approved for publication by all authors, and tacitly or explicitly, by the responsible authorities where the work was carried out, and that, if accepted, will not be published elsewhere in the same form, in English or in any other language, including electronically, without the written consent of the copyright-holder.

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## Preparation of Manuscripts

Xjenza accepts submissions in MS Word, Libre Office Writer and L<sup>A</sup>T<sub>E</sub>X, the latter being the preferred option. Anyone submitting in L<sup>A</sup>T<sub>E</sub>X should use the journal template, the latest version of which can be found at <https://www.overleaf.com/latex/templates/xjenza-article/ktbfsjgqqcpw>. All the necessary files to run the L<sup>A</sup>T<sub>E</sub>X document should be supplied together with the rendered PDF.

If a word processor is used the styling should be kept to a minimum. Bold face and italic fonts, as well as subscript and superscript text may be used as required by the context. Text should be in single-column format and the word processor options should not be used in order to justify text or hyphenate words. Alongside the native format of the word processor, a PDF file, generated by the word processor, must be provided. Furthermore, artwork should be in accordance with the artwork guidelines given below and must be submitted separately from the word processor file. Similarly, the bibliographic data of the cited material should be submitted separately as an Endnote (\*.xml), Research Information Systems (\*.ris), Zotero Library (zotero.splite) or a B<sup>I</sup>B<sub>T</sub><sub>E</sub>X (\*.bib) file.

## Article Structure

A manuscript for publication in Xjenza will typically have the following components: Title page, Abstract, Keywords, Abbreviations, Introduction, Materials and Methods, Results, Discussion, Conclusions, Appendices and References.

The manuscript will be divided into clearly defined and numbered sections. Each numbered subsection should have a brief heading. Each heading should appear on its own separate line. Subsections should be used as much as possible when cross-referencing text, i.e. refer to the subsection by the section number.

### Title page

- The title should be concise yet informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
- Author names and affiliations. Indicate the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript number immediately after each author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address.
- Corresponding author. Clearly indicate who will handle correspondence at all stages of refereeing and publication, including post-publication. Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and complete postal address. Contact details must be kept up to date by the corresponding author.
- Present/permanent address. If an author has changed the address since the work described, this can be indicated as a footnote to the author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

**Abstract** A concise and factual abstract is required of up to about 250 words. The abstract should state briefly the background and purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so

it must be able to stand alone. For this reason, references and non-standard abbreviations should be avoided. If essential, these must be defined at first mention in the abstract itself.

**Abbreviations** Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention as well as in the footnote and should be used consistently throughout the text.

**Introduction** State the objectives of the work and provide an adequate background, avoid a detailed literature survey or a summary of the results.

**Materials and Methods** Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

**Results** Results should be clear and concise. Numbered/tabulated information and/or figures should also be included.

**Discussion** This should explore the significance of the results of the work, yet not repeat them. Avoid extensive citations and discussion of published literature. A combined section of Results and Discussion is often appropriate.

**Conclusions** The main conclusions based on results of the study may be presented in a short Conclusions section. This may stand alone or form a subsection of a Discussion or Results and Discussion section.

**Appendices** Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

**Acknowledgements** Collate acknowledgements in a separate section at the end of the article before the references. Do not include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided assistance during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

**Units** Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI. Anyone using L<sup>A</sup>T<sub>E</sub>X should use the package `siunitx` in all cases.

**Footnotes** Footnotes should be used sparingly. Number them consecutively throughout the article, using superscript Arabic numbers. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes by a superscript number in the text and list the footnotes separately at the end of the article. Do not include footnotes in the Reference list.

**Table Footnotes** Indicate each footnote in a table with a superscript lower case letter.

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- Make sure you use uniform lettering and sizing of your original artwork.
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- Number the illustrations according to their sequence in the text.
- Name your artwork files as 'figx' or 'tabx' where x corresponds to the sequence number in your document.



- Provide captions to illustrations separately.
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- JPEG or PNG: Color or grayscale photographs (halftones): always use a minimum of 300 dpi.
- JPEG or PNG: Bitmapped line drawings: use a minimum of 1000 dpi.
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**Citations and References** Reference and citation styles for manuscripts submitted to Xjenja should be in accordance to the [APA v6](#) style.

**Citation in text** References to cited literature in the text should be given in the form of an author's surname and the year of publication of the paper with the addition of a letter for references to several publications of the author in the same year. For further information regarding multiple authors consult the [APA v6](#) guidelines. Citations may be made directly

Kramer et al. (2010) have recently shown . . .  
or parenthetically

as demonstrated (Allan, 2000a, 2000b, 1999; Allan and Jones, 1999).

Groups of references should be listed first alphabetically, then chronologically. When writing in L<sup>A</sup>T<sub>E</sub>X use `\textcite{}` and `\parencite{}` for the respective cases mentioned.

**The reference section** Every reference cited in the text should also be present in the reference list (and vice versa). The reference list should also be supplied as an Endnote (\*.xml), Research Information Systems (\*.ris), Zotero Library (zotero.splite) or a BiB<sub>T</sub>E<sub>X</sub> (\*.bib) file. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication. Consult the [APA v6](#) guidelines for multiple authors. Below are some examples of referencing different bibliographic material.

#### Reference to a Journal Publication

Agree, E. M. and Freedman, V. A. (2011). A Quality-of-Life Scale for Assistive Technology: Results of a Pilot Study of Aging and Technology. *Phys. Ther.*, 91(12):1780–1788.

McCreadie, C. and Tinker, A. (2005). The acceptability of assistive technology to older people. *Ageing Soc.*, 25(1):91–110.

#### Reference to a Book

Brownsell, B. (2003). *Assistive Technology and Telecare: Forging Solutions for Independent Living*. Policy Press, Bristol.

Fisk, M. J. (2003). *Social Alarms to Telecare: Older People's Services in Transition*. Policy Press, Bristol, 1st edition.

#### Reference to a Chapter in an Edited Book

Brownsell, S. and Bradley, D. (2003). New Generations of Tele-care Equipment. In *Assist. Technol. Telecare Forg. Solut. Indep. Living*, pages 39–50.

**Web references** The full URL should be given together with the date the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately or can be included in the reference list.

**References in a Special Issue** Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

**Journal Abbreviations** Journal names should be abbreviated according to:

-Index Medicus journal abbreviations: <https://www.ncbi.nlm.nih.gov/nlmcatalog/journals/>;

-List of title word abbreviations: <http://www.issn.org/2-22661-LTWA-online.php>;

-CAS (Chemical Abstracts Service): <http://www.cas.org/sent.html>.

**Video data** Xjenja accepts video material and animation sequences to support and enhance the presentation of the scientific research. Authors who have video or animation files that they wish to submit with their article should send them as a separate file. Reference to the video material should be clearly made in text. This will be modified into a linked to the paper's supplementary information page. All submitted files should be properly labelled so that they directly relate to the video files content. This should be within a maximum size of 50 MB.

## Submission check list

The following list will be useful during the final checking of a manuscript prior to sending it to the journal for review. Please consult the Author Guidelines for further details of any item.

- One author has been designated as the corresponding author with contact details:
  - E-mail address.
  - Full postal address.
  - Telephone and fax numbers.
- All necessary files have been sent, and contain:
  - All figures are given separately in PDF, SVG, JPEG or PNG format.
  - Caption for figures is included at the end of the text.

- All tables (including title, description, footnotes) are included in the text and large tables have been given separately as CSV.
- The reference list has been given in XML, RIS, zotero.split or BIB file format.
- Further considerations
  - Abstract does not exceed about 250 words.
  - Manuscript has been 'spell-checked' and 'grammar-checked'.
  - References are in the required format.
  - All references mentioned in the reference list are cited in the text, and vice versa.
  - Bibliographic data for all cited material has been provided.
  - Permission has been obtained for use of copyrighted material from other sources (including the Web).
  - A PDF document generated from the word processor used is submitted.

## After Acceptance

**Use of the Digital Object Identifier** The Digital Object Identifier (DOI) may be used to cite and link to electronic documents. The DOI consists of a unique alpha-numeric character string which is assigned to a document by the publisher upon the initial electronic

publication. The assigned DOI never changes. Therefore, it is an ideal medium for citing a document, particularly 'Articles in press' because they have not yet received their full bibliographic information. When you use a DOI to create links to documents on the web, the DOIs are guaranteed never to change.

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*Editorial*

## Raising Awareness for Support of Xjenza Online

**Cristiana Sebu**<sup>\*1</sup>

<sup>1</sup>*Department of Mathematics, University of Malta, Msida, Malta*

Dear readers and authors of Xjenza Online, as Editor-in-Chief, I am pleased to announce the release of the 11th volume of Xjenza Online, both spring and autumn issues together.

On behalf of the Editorial Board, I apologize to our authors and readers for the slight delay in releasing this volume. Our invaluable main Production Editor and Science Officer of Malta Chamber of Scientists, Julia Curmi, has sadly left for greener pastures although still continuing to serve the journal and her work as Copy Editor for this issue has been invaluable. Thank you very much, Julia, for all your assistance, support and work invested in the journal throughout the past two years. I also welcome on board Francesca Busuttill who will gradually take over Julia's responsibilities as Copy Editor for the journal.

In spite of all hardships the journal is passing through at the moment with barely any financial support and based mainly on voluntary manpower, I am excited to share with you the latest free open access publications. I hope readers and funders will appreciate the high standards of both the peer reviewed articles included in the current issue and their production as well as their great relevance to the very understanding of the perceptions, traditions and hazards in Maltese Islands, and thus, the incommensurate service the journal provides to the local community.

The volume opens with a study by Zammit and Baylon on the use of biosensors for monitoring of parameters and diagnosis of vital functional during first medical emergency.

Then, the article by Grech et al. identifies the main reasons and arguments that people put forward to support their stance against vaccines and the COVID-19 vaccination: health, socio-political factors and lack of scientific information on COVID-19 vaccine.

The article by Baldacchino et al. analyses how the house names assigned to about 20,000 homes in ten localities in Malta communicate social identities. The research reveals that Maltese house names act as potent symbols

of identity and provide a readily, freely and publicly available source of information about Maltese society. Behind the name of each and every house there is a sociological narrative which contextualises that particular name within a social, religious, political and linguistic context.

Next, the study by Attard et al. evaluates Malta's different rural localities and ranks them according to evidenced agricultural activities in small farming holdings, which, by their self-sustenance, have retained traditional Maltese rural features in both food production and consumption.

The research report by Thake et al. presents the case of a 17 year old lady diagnosed with immature high grade teratoma and raises awareness on the highest incidence of this disease in young women aged 18 to 39 and on the importance of early-stage diagnosis to fertility sparing and treatment.

Agius et al present then an overview and account of the geological and geographical characteristics of the Maltese islands, with a particular emphasis on the Sliema peninsula.

The following manuscript by De Battista et al. aims to elucidate and standardize C-reactive protein (CRP) blood sampling intervals in neonates with suspected early onset sepsis, and to describe the relationship between CRP results and final blood culture results. The authors' study emphasizes the importance of maintaining adequate timing intervals between serial CRP levels, which should be taken as a baseline on admission and then repeated not before 12 hours to achieve optimal sensitivity. Moreover, the results reveal that the current sampling practice might lead to falsely reassuring negative CRP values, affecting outcomes in sepsis management.

The audit by Gambin et al. reveals that there is inadequate serum prolactin monitoring in patients taking atypical antipsychotics at the Mount Carmel Hospital (MCH) and recommendations for improved clinical practice are made.

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The following article by Galea et al. describes an intense episode of seismic activity at about 23 km south of Malta whose most active phase lasted for around 2 months in September–November 2020, then continued sporadically even to the present day and, thus, provides useful insights onto ongoing geological processes and rep-

resents an important contribution towards assessing the sources of seismic hazard to the islands.

The volume concludes with an overview of the COPCA 2022 Conference in Valletta.

I conclude by wishing you all a fruitful and successful academic year ahead.



Research Article

# Biosensors for Monitoring of Vital Functional Parameters during Medical Emergency

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**Abstract.** The objective of this work concerns the study of biosensors for monitoring of parameters and diagnosis of vital functional during first medical emergency. The study and analysis of vital parameters is extremely important in emergency medicine. The principle is based on the combination of the signals coming from the patient (vital functions), consists of measurement and comparison of the phase of active and reactive components of biologically active points (BAP) the transduction of such acquired signals and the processing of the obtained information. One of the advantages of reflex diagnostic methods is the fact that the response of BAPs to the change in the internal structure of the human body. These signals are proving instantaneous information on the functional state of 20 basic organ and system of the human body. The method will use one input variables (the classic physiological parameters and/or signals detected by using additive sensors) and one output variable which is correlated with the clinical condition of the patient. High information volume, accuracy, reliability, and reproducibility of data are supported in parallel in emergency diagnostics. A model will produce an association between the input variables and the output variable by using a data set established with the medical team. The proposed methodology improves standard systems such as reflex diagnostics, track and trigger and threshold (Early Warning Score). It is shown that good results for the prediction and early diagnosis in first medical emergency, through the adoption of the Fuzzy Set Theory.

**Keywords:** Biosensors, biologically active points (BAP), fuzzy logic, monitoring of medical parameters

## 1 Introduction

Therapy efficiency suffers greatly from limited in-vivo feedback. It is very difficult to obtain an objective picture of the processes occurring in living organisms, organs, tissues, and systems.

Today the study and analysis of vital parameters is extremely important in clinical medicine (Dias et al., 2018). There are various guidelines in “clinical practice” and the effort towards programming and developing of new clinical and scientific research is strong (Mok et al., 2015). It is worth noting that several solutions have been proposed for clinical methods and specific treatments (Burssens et al., 2016; Gueli et al., 2015; Mannino et al., 2011).

The evolution of the patient condition of first medicine emergency is essential in order to ensure early and rapid action in critical and/or traumatological patients that could have an immediate and/or progressive clinical deterioration (Kredo et al., 2016).

In fact, it should be noted that for patients with acute illness (Miller, 2016) (such as acute coronary syndrome, acute heart failure, arrhythmias, hyperkinetic, and hypokinetic disorder), a continuous vital signs monitoring is required (Khan et al., 2016; Mok et al., 2015).

Analysis of the Autonomous Nervous System through heart rate variability is important in health. Analysis of heart rate variability (HRV) is widely used as a standard method for assessing autonomic nervous functions. Alterations in parasympathetic and sympathetic nervous system activity result in beat-to-beat heart rate variation, and hence, this variation (heart rate variability [HRV]) reflects autonomic nervous system activity.

Heart rate variability by measuring the changes in the cardiac rhythm through time, is altered in pathological states, such as ischemic heart disease, and reduced variability is predictive of worse outcomes.

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Hence, the term Pulse Rate Variability (PRV) has been used to refer to HRV information obtained from pulse wave signals, such as the photoplethysmography (PPG).

Patients in emergency care are in fact subjected to a continuous control of the heart rate, blood pressure and, if necessary, they are supported with assisted artificial ventilation, mechanical cardiovascular support, and hemodialysis (Holden et al., 2002).

In order to ensure first medical assistant, it is particularly interesting to perform continuous monitoring and measurement of vital functions (physiological parameters) of the patient, including oxygen saturation, blood pressure, body temperature, respiratory rate, diuresis, and cognitive signals (consciousness state) (Paradiso et al., 2004).

Even more problematic is trying to precisely define the essence of functional disorders (pathologies). In human, besides the five widely known senses, there are three more known independent networks providing information about the functional state of group of organs, single organs, and different parts of organs: the skin, the outer ear or pinna, and the eye.

One possible approach for early detection in medical emergency, as reflex diagnostics.

This approach is based on measuring energetic characteristics of biologically active points (BAPs) (Burssens et al., 2016; Dias et al., 2018; Fratini et al., 2015; Gueli et al., 2015; Holden et al., 2002; Khan et al., 2016; Kredo et al., 2016; Mannino et al., 2011; Miller, 2016; Mok et al., 2015; Paradiso et al., 2004; Reddy et al., 2009). The advantage of reflex diagnostic methods is the fact that the response of BAPs to the change in the internal structure of the human body occurs prior to the clinical presentation of a disease. We do know that there are more than 3000 biologically active point (BAPs) connected (by meridians) and communicating with all organs and systems of the human body (Tabeeva, 1982).

Example, the BAPs pattern associated with an organ or system generates a specific link of certain components of the organism and is designed as meridian in traditional acupuncture.

Typically, such data can be obtained by using sensors and medical instrumentation, such as: the electrocardiograph, which provides the electrocardiogram (the data appear on a video terminal) (Fratini et al., 2015); a sensor that, connected to a patient's finger, is able to measure the level of oxygen in the blood (Reddy et al., 2009); a sensor that measures the level of carbon dioxide of the patient (Cuvelier et al., 2005); a catheter into the artery to continuously measure blood pressure (Krum et al., 2012); sensors for brain activity recording (EEG) (Curran et al., 2003); probe to measure the temperature (Houdas et al.,

2013), etc...

However, it must be noted that the measure of a single vital sign does identify the clinical evolution and the state of the patient in first assistant medical emergency. For this reason, several solutions for the analysis of vital functions by using Early Warning Score (EWS) (Pedersen et al., 2018) have been proposed in literature.

The basic principle of this method is to collect physical parameters (easily to be measured through sensors) and building a score that allows a rapid evaluation of patient status. The numerical values obtained by using this approach provide an indication of the critical status by supporting and assisting the experience of the doctors, thus allowing the evaluation of the patient's condition. This approach is necessary to define the level of urgency indicating an alert condition and the type of clinical response. However, very often, it is interesting to detect the alterations preceding this stage, predicting critical condition for the patient. The work proposed in this paper is related with this context, in particular the study here conducted regards the phase before the observation study of medical intensive care patients. The basic idea concerns the acquisition of the signals coming from the patient (vital functions) during first medical emergency, the transduction of such acquired signals and the combination of the obtained information.

The proposed methodology is based on advanced mathematical techniques in order to study the signals with variable characteristics in the time domain, using standard systems such as "track and trigger", threshold (EWS) and including the use of the theory of fuzzy sets (Fuzzy Set Theory) (Asiain et al., 2018).

The basic principle is to collect the usual physiological parameters, which are easy to be acquired, and use such information as inputs of a mathematical model (fuzzy system) based on the theory of fuzzy sets and fuzzy logic. The system here proposed will use  $n$  input variables (the classic physiological parameters and/or signals detected by using additive sensors) and one output variable which is correlated with the clinical condition of the patient. The fuzzy model will produce an association between the input variables and the output variable by using a data set (rules) established with the medical team. The goal is to get a system capable to process the signals (physiological parameters) not only by using a binary logic (thresholds system), but also by using "if-then" rules. The proposed methodology will warn the medical team about condition of patient's deterioration (also in presence of a not dangerous/warning condition). These approaches will also give standardized results correlated with the evolution of the clinical status of the patient.

The proposed approach will optimize the medical alert,



considering real case of emergencies, predicting acute degeneration conditions, such as cardiac arrest, improving the quality of life and health for all the involved people.

## 2 Method and Algorithm

One of the important tasks connected with generating decision-making rules is informative feature selection and selecting informative BAPs. The aforementioned features of “displaying” information include the transmission of a large volume of data (multiple diagnoses, symptoms, and syndromes) to one BAP. Due to the existing peculiarities of representing information about the condition of the human body on BAPs, various methods and algorithms have been suggested. These methods and algorithms are intended to search for special combinations of BAPs. The analysis of such combinations makes it possible to confirm the diagnosis in question or to refute the diagnosis reflected in BAPs according to reference data when the disease has not affected a person. The combinations described above are called “diagnostically important points” (DIPs) [5]. Special research on prediction, early and differential diagnostics of cardiovascular system damages, of the digestive tract, nervous system, musculoskeletal system, of the respiratory system, etc. has shown that the use of DIPs, in combination with other informative features, enables us to obtain decision rules providing high-quality classification.

According to the recommendations for generating decision rules it is reasonable to apply decision-making based on Early warning scores (EWSs) and Fuzzy Logic (Klir et al., 1997; Korenevsky et al., 2008; L., 1996).

### 2.1 Working principle

Early warning scores (EWSs) are extensively used to identify patients at risk of deterioration in hospital (Asiain et al., 2018; Pedersen et al., 2018). It is worth noting that this method, and several similar approaches, can support clinical decision-making around escalation of care and can provide a clear means of communicating clinical acuity between clinicians and across different healthcare organizations. EWS systems are based on five measurements of physiological parameters normally performed, as shown in table 1: respiratory rate, oxygen saturation, body temperature, systolic blood pressure, pulse rate, with the addition of the level of consciousness.

The last parameter will not be considered in the developed algorithm. Each parameter is graduated in levels, and a numerical value is assigned to each of them.

The sum of the numerical values provides the measure of the deviation from the normal physiology. As it is shown in table 2 the establishes three levels of clinical alert can

be summarized as<sup>1</sup>:

- Low: score from 1 to 4;
- Medium: score from 5 to 6, or a score of 3 for a single parameter;
- High: score 7.

Depending on the score obtained, the patient’s monitoring frequency is determined. As already mentioned, the classic EWS method is often not able to detect physiological degeneration caused by slow alterations of vital parameters. This is because this method is based on threshold criteria.

### 2.2 Algorithm

Fuzzy logic is a computing technique that is based on the degree of truth. A fuzzy logic system uses the input’s degree of truth and linguistic variables to produce a certain output. The state of this input determines the nature of the output. The fuzzy logic allows to associate weights of belonging through the so-called membership functions, that admit values between 0 and 1, unlike Boolean logic which admits only the two above mentioned values.

This helps to create rules that are very similar to human language, by moving away from the purely mathematical one.

It is therefore necessary, as a first step, to create membership functions for each physiological parameter.

The fuzzy system has been implemented through the Fuzzy System Designer included in LabVIEW environment.

Five membership functions, three of them with triangular shape and the other two (the external ones) with trapezoidal shape.

RR1 and RR5, in fact, represent the critical values to which, in the table 1, a score of three is associated.

On the vertical axis the membership grades 1 in the range 0–1 are reported. The output variables are instead represented only by triangular functions. In order to recall the aggregate scores described in table 1, the functions are defined within the range 0–7.

Once the functions have been created for all the physiological parameters, they need to be correlated with each other by means of the if-then rules. Let us call  $p$  the number of physiological parameters and  $f$  the number of functions for each of them. The number of rules  $r$  is given by

$$r = p^f$$

Since, in this case, for each vital parameter several functions equal to five has been chosen, the total number of rules is equal to 3.125. As the implementation of such a high number of rules involves a considerable burden,

<sup>1</sup>[https://www.weahsn.net/wp-content/uploads/NEWS\\_toolkit\\_njd\\_19Apr2016.pdf](https://www.weahsn.net/wp-content/uploads/NEWS_toolkit_njd_19Apr2016.pdf).

Score	3	2	1	0	1	2	3
Systolic BP	≤70	71–80	<b>81–100</b>	101–199	-	≥200	-
Heart rate (HR)	-	≤40	41–50	51–100	101–110	<b>111–129</b>	≥130
Respiratory rate (RR)	-	≤8	-	9–14	<b>15–20</b>	21–29	≥30
Temperature (°C)	-	34.9	-	<b>35.0–38.4</b>	-	≥38.5	-

Table 1: The EWS Scoring System.

NEW SCORE	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low-medium	Urgent ward-based response
Aggregate score 5–6	Medium	Key-threshold for urgent response
Aggregate score 7 or more	High	Urgent or emergency response

**Low:** score from 1 to 4;

**Medium:** score from 5 to 6, or a score of 3 for a single parameter.

**High:** score 7.

Table 2: EWS aggregate scores and responses.

whether at the debug or testing stage, a coupling of up to two physiological parameters at a time was preferred.

According to the opinion of a medical team, following their clinical observation method, the couplings are as follows:

- Systolic blood pressure + Pulse;
- Oxygen saturation + Respiration rate.

Since the temperature is the last parameter to be taken into consideration, it will be coupled with both results of the above said couplings. The final score will be the maximum value between the results coming from the temperature and the previous coupling combination. This method allows to considerably reduce the number of rules without neglecting the desired correlations. The whole algorithm is synthesized in figure 2.

A rule is a relationship between input and output variables. It will take the following syntax:

**If Oxygen Saturation is Sp3 and Respiration rate is RR2 THEN R2 is 5**

The defuzzification method used to convert the output variables into crisp numerical values is the Center of Area, which calculates the centroid under the weighted sum of the results. This method is the best trade-off between multiple output linguistic terms.

To evaluate the algorithm, a Graphical User Interface

in LabVIEW environment has been developed. As it is shown in figure 3, on the left panel it is possible either to set the values for each physiological parameter manually or get them through a data acquisition (DAQ- 6009) board. Moreover, numerical indicators reporting the partial score obtained from the above-described couplings can be found. On the right panel, instead, the scores obtained from the standard and the fuzzy methods are compared.

The system was tested by setting a set of some vital parameters as shown in table 3. In the first row we can observe an alteration of three parameters, namely respiration rate, pressure, and pulse. In this case, the standard EWS method produced a score of 2, differently from the fuzzy method which produced a score equal to 4. Increasing the temperature by 2°C both methods indicate an increase in the score by one point.

In the third and fourth row, instead, the predictivity of the algorithm is appreciated. In the two cases an alteration of oxygen saturation along with a high pulse can be observed. In the first case the traditional method indicates a score of 3, while the fuzzy one gives the score of 4. When increasing the pulse rate, the traditional method does not vary; conversely, with the fuzzy method a clinical degeneration shifting from a score of 4 to a score of five can be noticed.

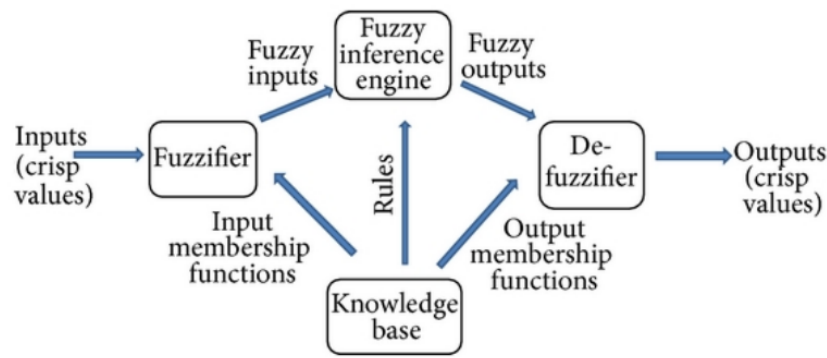


Figure 1: Fuzzy logic.

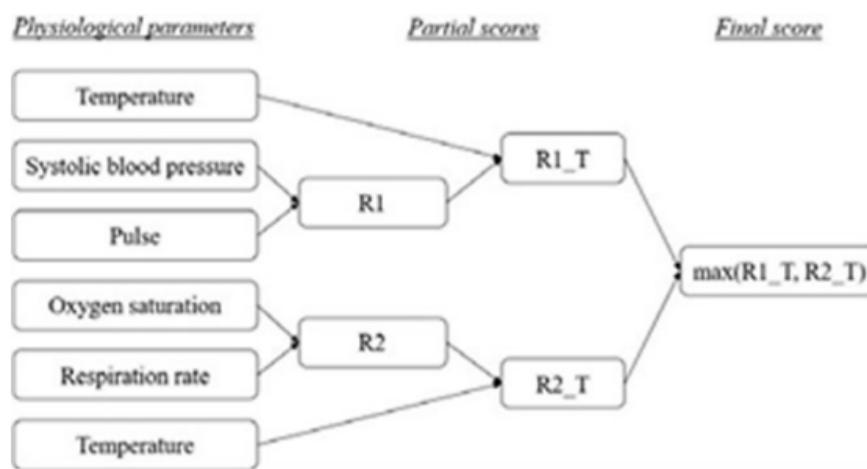


Figure 2: Synthetic scheme of the algorithm.

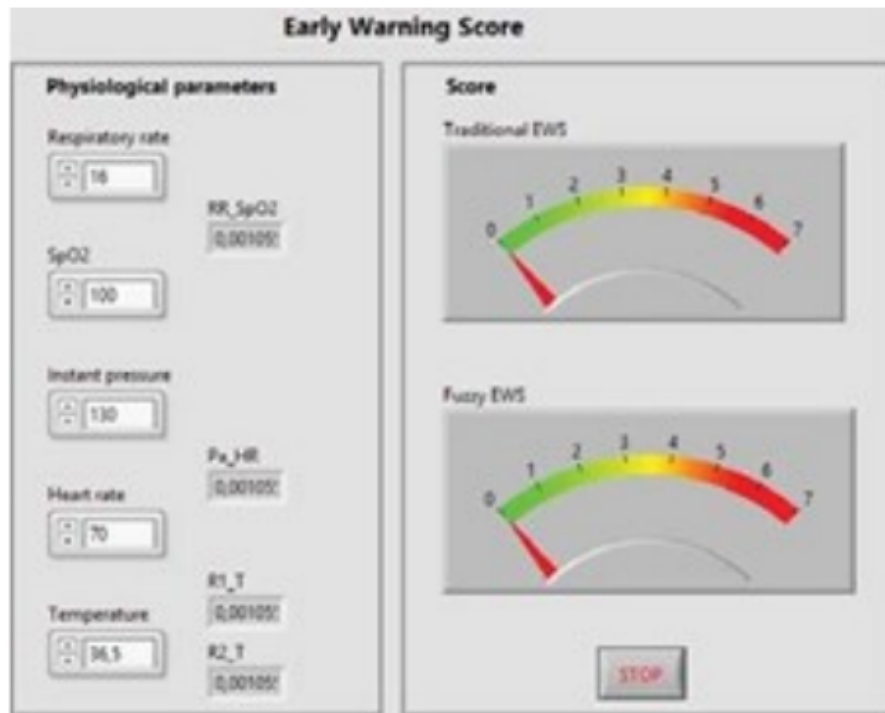
Parameters					Score	
Respiration rate	SpO <sub>2</sub>	Pressure	Pulse	Temperature	Traditional	Fuzzy
20	100	150	124	36.5	2	4
20	100	150	124	38.5	3	5
12	94	130	124	36.5	3	4
12	94	130	126	36.5	3	5
21	97	200	70	37.5	2	4

Table 3: A comparison between the EWS traditional EWS score and the Fuzzy score.

### 3 Conclusion

In this paper biosensors for the estimation of medical precursors have been presented including the model and the implementation through a LabVIEW routine. It is worth noting that the proposed solution improves standard systems such as “track and trigger”, heart rate variability response during stressful event and EWS through the ad-

option of the Fuzzy Set Theory in order to produce an association between the input variables and the output variable by using a data set established with the medical emergency team. The work will be do with a more exhaustive study based on transducers able to measure the physiological parameters of interest in the perspective to perform a clinical validation of the proposed method.



**Figure 3:** Implementation of the biosensors for the valuation of medical parameters: a) Labview routine, b) front panel with aggregate scores and responses

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Research Article

# Playing with Fire—Negative Perceptions towards COVID-19 Vaccination

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**Abstract.** Living during a pandemic has a great impact on a person's health and psychological functioning. While many took the vaccine, others were very sceptical about the intentions and motivations of political and health authorities and the safety of the vaccine. Vaccines may play a role in prevention of disease, however some are against vaccination. This paper will explore the reasons and arguments that people put forward to support their stance against vaccines and the COVID-19 vaccination. This will help in providing a deeper understanding of these participants' points of view, along with their experiences during this challenging period in time. A mixed methods approach was used. Study one was a quantitative study using online survey methodology to determine the degree of vaccine hesitancy and associated reasons. The most frequently cited reason given for not taking the vaccine were about safety issues. Study two was qualitative and involved interviewing six participants recruited through purposive sampling. The transcripts were analysed by using Thematic Analysis. The three main emerging themes were reasons related to health, others to the socio-political context and the third was the perceived lack of scientific information on COVID-19 vaccine. The results concluded that the participants' objections to take the COVID-19 vaccine emerged from personal health factors, and was manifested as a form of protest against authorities.

**Keywords:** Pandemic, vaccination, hesitancy, thematic analysis, lived experience

## 1 Introduction

The SARS-CoV-2 pandemic struck the world suddenly with people desperate for a cure and hoping for a hasty return to normality (World Health Organization, 2020). Once COVID-19 vaccinations were developed, a sense of hope was rekindled within communities. Authorities encouraged people to get vaccinated, with the aim of reaching herd immunity (Randolph et al., 2020). Compared to other countries, Malta achieved high vaccination rates earlier than many other countries (Cuschieri et al., 2021). Immunization programme success could paradoxically, result in complacency and ultimately, hesitancy, as individuals weigh the risks of vaccination against risks of the getting the disease. For some, vaccination was not the way forward. A study by Troiano et al. (2021) indicated that aspects such as ethnicity, working status, religiosity, low educational level, young age, and low income decreased the likelihood of getting vaccinated, whereas positive personal beliefs about vaccination in general promoted COVID-19 vaccination in individuals. Various studies have shown that women have a lower acceptance rate of the COVID-19 vaccine (Borga et al., 2022; Callaghan et al., 2020; Khubchandani et al., 2021). Persons' political beliefs were found to affect the acceptance rate (Trent et al., 2022). Ward et al. (2020) established that individuals who were biased towards radical parties or did not vote had a lower vaccine acceptance rate. On the other hand, Pogue et al. (2020) concluded that political ideology in the United States had no correlation with COVID-19 vaccine opinions and found that vaccine acceptance was higher among those who were highly concerned about being infected. Internet has played an important role in spreading fears

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about the COVID-19 vaccine. Anti-vaccination movements voiced their opinions on online platforms, enabling a vaster reach of people and instigating further vaccine hesitancy (Kim et al., 2020). An analysis of eighty-two international studies reported that vaccine hesitancy was mostly due to uncertainty regarding the vaccine's efficacy and effects, mistrust in authorities, misinformation spread through social media, and reasons pertaining to their religious beliefs (Biswas et al., 2021). There were ethical and legal issues related to COVID-19 vaccination strategies. Every individual has the right to refrain from taking the vaccine (Amin et al., 2012). Some countries enforced restrictions upon the unvaccinated, arguably violating their human rights. In countries, such as in Austria and Greece, during the early months of 2022, people were fined if seen outside of their houses during partial lockdowns when they could not prove that they were vaccinated (Burki, 2022). In Malta, as restrictions for the unvaccinated increased, more people questioned the enforcement of vaccination, claiming that it was against their human rights. This led to protests, such as the one held in Malta on the 24th of July 2021. Conflicts were ignited between the citizens and government authorities. Some of the restrictions imposed on unvaccinated individuals in November 2021 included being barred from attending social events such as parties, no entry to certain restaurants and bars, a longer quarantine period if in contact with persons who tested positive, and no entry into Malta unless spending time in quarantine. These restrictions were enabled in 2021 by means of section 27(b) of the Public Health Act (Chapter 465 of the Laws of Malta). Even though Malta was called out for these practices by the European Commission during a press briefing on the 12th of July regarding unvaccinated travellers wanting to visit Malta, the regulations were not changed (European Commission, 2021; Galea, 2021)). Persons started forming anti-COVID-19 vaccination groups of like-minded people who believed that they were being discriminated against when they were not allowed to attend certain places and to travel unless they were vaccinated. This study will explore why some individuals were against the COVID -19 vaccination using a mixed methods approach.

## 2 Method

This study which follows the sequential exploratory mixed methods design, carries out an analysis on the data collected to compare and corroborate quantitative results with qualitative findings on the same topic of investigation (Creswell, 2003; Tashakkori et al., 2003). Quantitative data was collected through an online questionnaire while qualitative data was collected through interviews. The results from the online questionnaire have already been

published in (Cordina et al., 2021). A short-focused anonymous questionnaire using Google Forms targeted at individuals aged 16 and over was disseminated over social media. The fieldwork took place between the 26th October 2020 and 26th November 2020. The questionnaire gathered demographic data and asked respondents if they were willing to take the COVID-19 vaccines. Those who declared that they were unsure or not willing were asked to give reasons for their choice. Following the questionnaire, qualitative data was collected through semi-structured interviews with a purposive sample of six adult participants from different walks of life who had voiced their opinions against vaccination on the social media. An interview guide was prepared based on literature regarding attitudes towards vaccination. Questions addressed their perceptions on vaccines and reasons why some people were against vaccination. Fieldwork took place May 2022. With the permission of the participants, interviews were recorded and transcribed. Pseudonyms were used to ensure anonymity. The duration of the interviews ranged between 40 to 60 minutes. Participants preferred voice recordings over video recordings. Throughout the recruitment, interviewing and debriefing stages, sensitivity and confidentiality were always assured.

## 3 Results

A total of 843 individuals participated in the survey with a male to female ratio of 1:3. Just over 60% were over 40 years of age and 87% of respondents had received a post-secondary/ tertiary education.

Females were more willing to take the vaccine than males (chi-square=14.63, df=4, p=0.006). Willingness to take the vaccine also varied with age. The cohort of participants between 40 and 49 years were more unsure whether to take the vaccine than those who were 60 years and over who responded that they had the intention to take the vaccine (chi-square= 23.99, df=10, p=0.007). No other significant differences were found except that females cited fear of injections as a reason for not wanting to take the vaccine more than males (chi-square=7.43, df=1, p=006).

From the total sample 16.4% (n = 132) of respondents were unwilling to take the vaccine. Table 2 shows the reasons why they were against vaccination. The most cited reason was related to safety issues.

Participants were asked to cite additional reasons why they were unwilling to take the vaccine and these are summarized in table 3.

The qualitative part of the study used interviews to collect data. Table 4 describes each participant, using a pseudonym so that participants remain anonymous. Identifying details were removed.

<b>Demographic</b>	<b><i>n</i></b>	<b>%</b>
Gender		
Male	220	26.4
Female	609	73.0
Prefer not to say	5	0.6
Age		
Under 19	40	4.7
20–39	277	32.8
40–59	381	45.1
60 and over	126	15.0
Level of education		
Secondary school	96	11.4
Post-secondary	172	20.4
Tertiary/further	562	66.6
Country of residence		
Malta	719	85.2
Other	103	12.3

**Table 1:** Demographics of Survey Respondents (Cordina et al., 2021).

<b>Reason</b>	<b>%</b>
I think COVID-19 vaccine may not be safe	85.2
I am against vaccination in general	16.0
I believe in natural and traditional remedies	16.6
I do not think it will give immunity	35.0
COVID-19 is just like any other flu that will pass	12.8
I have had a bad experience with vaccines	10.6
I am afraid of injections	3.0

**Table 2:** Reasons for Not Wanting to Take the Vaccine (Cordina et al., 2021).

<b>Reason</b>	<b><i>n</i></b>
Short a time for developing & testing vaccine	10
Afraid of long term repercussion	2
Afraid there are harmful substances in vaccine	2
I do not trust the system, money making venture	2
I have a medical condition	2
It is all a political game	1
I am not a guinea pig	1

**Table 3:** Additional Comments For Not Wanting to Take the Vaccine (Cordina et al., 2021).



Participant and age	Educational Level	Employment
Anna, 45	Tertiary	Midwife
Julia, 40s	First Degree	Employed
Rachel, 44	Level 5	Educator
Karen, 44	Diploma	LSE
Tom, 23	Level 4	Customer Care Agent
Ben, 23	Tertiary	Photographer

Table 4: Participants Taking Part in the Interviews.

There was strong overlap between the reasons given by participants answering the questionnaire for not wanting to take the vaccine and those interviewed. Data gathered through the interviews was analysed using thematic analysis (TA) (Braune et al., 2006). TA is a tool used to explore the perspectives of various participants while being able to compare them, allowing for the possible emergence of unexpected insights (Braune et al., 2006). Table 5 gives the three themes which were identified when analysing the transcripts. These were issues related to health, issues related to the socio-political context and issues related to provision of information.

### 3.1 Health Issues

#### 3.1.1 Side Effects

One of the main reasons behind participants not taking the vaccine was because they were afraid of the long- and short-term side effects that they believed were not always being made public. Participants were afraid that since the vaccine had only been tested over a short time frame, the long-term effects or consequences were still unknown. Ben remarked, “no one in reality will ever know the side effects that it can have in the future.” As participants read more about the possible side effects and unofficial information about the vaccine, they became more concerned. They felt that they were not being given the full picture about the different vaccines and their side-effects. Participants mentioned experiences of individuals they knew who experienced side effects that seemed to have appeared after taking the vaccination. “I am personally aware of people who have suffered severe side effects of the vaccine, and they were not mentioned anywhere” (Julia). “...five days after the vaccines, her body was full of psoriasis” (Anna). “My mum has Parkinson’s. After she took the vaccine, it got worse rapidly, not gradually...” (Rachel). These occurrences, according to the participants, were never made public or discussed and participants felt they were not being told all the facts about potential side effects.

*“As soon as my best friend took her booster, she threw up nine times in a span of like six or seven*

*hours” (Rachel)*

In answer to the question “How determined are you that you will refrain from taking the COVID-19 vaccine?”, participants answered “6,000%” (Karen), “200%” (Julia), “no, nothing will change my mind” (Rachel), and “Hundred percent! Why? We have been taken for a ride now for far too long” (Anna). The question regarding the possible long term effect of the vaccine was salient in participants’ minds and they felt that they would rather refrain from taking it rather than live in fear of side effects.

#### 3.1.2 Making Decisions for Others

Making decisions on behalf of another person regarding whether to give the vaccine was considered a great responsibility. While it was very easy to decide for themselves, participants found it difficult to make a decision on behalf of other family members such as minors and the elderly. Participants were afraid that if something had to happen to these relatives they would be blamed however some would still have decided against the vaccine. Ben said “If I had children, I probably won’t allow them, just because I don’t trust” (Ben).

#### 3.1.3 Personal Circumstance

Furthermore, some also communicated that they were hesitant about taking the vaccine for the reason that they suffer from other conditions that that they were afraid could worsen after taking the vaccine. Ben, who had epilepsy, had spent the last few years of his life terrified of having another seizure which would have severe consequences on his life. He feared that if he took this vaccine he would be “playing with fire” and was afraid of the possible repercussions.

*“I did not want to take the vaccine because I suffer from epilepsy. . . . I wasn’t even sure if I had, if I could play with fire and kind of risk, me taking a vaccine, not knowing how it’s going to affect and trigger something that’s in my mind.”*  
(Ben)

Another reason mentioned by participants for not want-

Themes	Sub-Themes	Codes	Codes	Sample Quotes	
Health Issues	Side Effects	Fear	Health aspects	"I don't trust" (Ben)	
	Making Decisions for Others	Trust	Death	"repercussions of the vaccine" (Karen)	
Socio-political	Personal Circumstances	Anxiety	Menstrual cycle	"deep worry down inside of me" (Ben)	
	Natural Immunity	Confidence	Circulatory system	"inconsistent... it gives me anxiety" (Rachel)	
		Certainty	Reproduction	"how is going to affect and trigger something" (Ben)	
		Unknown future	Epilepsy	"damaging our immune system" (Anna)	
		Dependence	Immune system		
		Worry	What if?		
		Playing with fire	Risk		
		Lack of Trust in Politicians and Health Authorities	Leadership	Manipulation	"remove choice for us" (Tom)
		Human Rights	Lack of trust	Prisoners	"they want to make money" (Tom)
		Discrimination	Influence	Abuse	"virus was created in a lab and so was the vaccine" (Julia)
Information		Lack of transparency	Rebellion	"cannot afford to lose my job" (Karen)	
		Hidden Agendas	Threat	"hand in hand with the government" (Ben)	
		Dictatorship	Biases	"I find it abusing" (Anna)	
		Money	Choice	"a subtle dictatorship" (Julia)	
		Intentions	Regulations	"I was forced to take the vaccine" (Ben)	
		Restriction	Inconsistency	"That's a threat. It is blackmail" (Rachel)	
		Forced	Power		
		Complacency	Blackmail		
			Freedom		
		Scientific data	Social media	Pandemic	"some sort of hidden agenda" (Karen)
Information	Social Media	Traditional media	Effectiveness	"Social media played a big part of misinformation" (Anna)	
		News	Protection	"information based on fear" (Anna)	
		Controlled	Statistics	"two sides to a coin" (Ben)	
		Published	Safety	"conflicting decisions" (Anna)	
		Data	Constructive criticism	"no information at all about it" (Karen)	
		Knowledge	Resources	"paying their price for that decision" (Ben)	
		Lack of Information	Fast production		
		Education	One size fits all		
		Opinion	Patient leaflet		
			Open minded		
		Misinformation			

Table 5: Themes and Subthemes Emerging from Interviews.

ing to take the vaccine were issues revolving fertility and the reproductive system. Participants noted that they knew several women who were having irregular periods after taking the booster. Anna said

*"...their menstrual cycle went haywire"* (Anna)

while Rachel said

*"...those who were in their menopause started getting their period again."* (Rachel)

This topic was considered particularly delicate since it concerned women's health and reproduction. The participants pointed out that the effects of COVID-19 vaccination on women in this regard, will only be known as time passes. For this reason some women were not ready to take the risk.

In addition, some participants believed that there were potential risks to the male reproductive system. Tom mentioned that some sperm donors were being paid more if they were unvaccinated, due to the potential unknown risks of these vaccines. He pointed out that

*"... sperm banks around the world they're actually paying 2 to 3 times more for people who are donating sperm without having taken the COVID-19 vaccine."* (Tom)

Another worry discussed by participants regarding side effects were issues related to the circulatory system. Participants said that only time can tell what the long term side-effects of the vaccine were and they were not willing to take the chance. One of the participants reported that

*"...after the second dose of vaccine a friend had three mild MI which means 'heart attack' in simple words."* (Anna)

She also said that

*"...another friend who is a doctor, six days after the booster had myocarditis, which means infection of the heart muscle."* (Anna)

This information, whether true or made up was believed by Anna and was the reason which made Anna start to doubt the safety of the vaccine.

### 3.1.4 Natural Immunity

Another reason given by some of the participants was about one's natural immunity. The participants communicated their lack of awareness about the potential effects of this vaccine on a person's natural immunity. Some thought that the vaccine would be damaging their immune system, whereas others thought that by taking the

vaccine they were weakening their natural immunity to a point where their bodies would eventually become dependent on vaccinations.

*"One of my biggest worries is, whether with these vaccines, are we really improving our immunity or we are damaging our immune system."* (Anna)

Julia said

*"If I get vaccinated, I believe that I am telling my body that it's vulnerable to this virus and that it cannot fight it unless vaccinated. I surely do not want that."*(Julia)

Other participants claimed that our bodies will by time adapt to this virus and that it would become weak enough not to be of danger to one's health. They would rather let the natural process take its course, and eventually do without vaccination. Karen said

*"I know that the immune system of the human being will eventually get used to this kind of virus, and maybe there might not be the need for the vaccine till that time."* (Karen)

## 3.2 Socio-Political Issues

### 3.2.1 Lack of Trust in Political Authorities

The authorities' main aims were to safeguard the public's health. However certain measures which were taken came across as discriminatory and invasive. Some participants believed that the vaccine was a way of making money and that some people were getting rich as a result of promoting the vaccine. This perception impacted participants' trust in politicians and health authorities. Like in many countries, the issue became politicized. Rachel believed that good leadership was lacking.

*"We do not have a reliable leadership...we rely on other countries' decisions."* (Rachel)

*"The reasons are purely political. I admit that I have trust issues. I believe that this virus was created in a lab and so was the vaccine."* (Anna)

Ben spoke of "last minute decisions" that the government took on a day-to-day basis, resulting in inconsistencies.

*"I am being forced for something which Biden and other countries have given exemptions to. Why do those people have a choice? Here they are trying to remove choice for us."* (Tom)

Anna found the directives issued by the health authorities “abusive” while Julia and Karen questioned whether there were hidden agendas.

*“I know that in Malta there are as well, but they are hidden, it’s some sort of hidden agenda.”*  
(Karen)

**Anna** added that

*“...researchers took the world population for a ride.”* (Anna)

Participants said that since Malta is a very small country, people know each other, and it was very easy to find out about people who suffered negative consequences from the vaccine. They believed that the problem was created when the authorities’ messed with data in order to sell a story that everything was fine.

*“I’ve also heard of stories of people who died in hospital, and they’ve told the next of kin that the person died of side effects and symptoms and reasons that had never existed in their body, so they blatantly lied about something that the next of kin knew it could not be possible. So, they are also covering up certain stories of deaths through COVID-19 and the vaccine.”* (Anna)

### 3.2.2 Violation of Human Rights

Participants believed that their human rights were being violated, by indirectly forcing vaccines and restrictions onto people, leading them to get vaccinated against their own will. Anna said

*“I would fight for my right because we have a fundamental human right to choose what we inject in ourself. So, I would definitely go to court for it.”* (Anna)

Another belief was that authorities wanted to achieve herd immunity which made people more angry as they felt they were being forced to conform. Some participants said that in spite of restrictions they were not manipulated into taking the vaccine however others had no choice other than to follow authorities’ regulations

*“...we are the people that are having to conform and miss out on life.”* (Ben)

The element of coercion fuelled the belief that the vaccine was a scam used by authorities to make money, with Tom saying

*“It is shown that they want to make money. Plus, it is not only that, they want to force it on to everyone.”* (Tom)

Anna suggested that they should have provided the public with proper information and not selected what to publish in order to instil fear in people:

*“I think, the authorities practiced dictatorship. It was all about rules and restrictions—not to go out and not to travel... Most importantly was to give the public proper information and not give information based on fear.”* (Anna)

### 3.2.3 Discrimination

Additionally, participants felt discriminated against because they were unable to participate in certain activities which only vaccinated people could do. Rachel said

*“I think a lot of people took it to travel.”*  
(Rachel)

Besides not being able to travel, unvaccinated people could not take on certain jobs, were not allowed in restaurants and clubs, and could not take part in other leisure events. In fact, participants pointed out that some people took the vaccine against their will just to be able to benefit from the rights of vaccinated people. Some were also threatened that they might lose their own employment, leaving them without a choice.

*“...foreign workers will lose their Visa if they don’t get vaccinated. That’s a threat. It is blackmail.”* (Rachel)

### 3.2.4 Lack of information

The third theme that emerged in this study was that of lack of information. They felt that the Maltese were not exposed to enough resources and knowledge about the different vaccinations available.

*“I have all these questions, but I think they don’t have answers for them. So, right now, I don’t think anything would persuade me to take it.”*  
(Rachel)

### 3.2.5 Scientific Data

According to participants, there was a lack of scientific and statistical data regarding whether the vaccine was working the way it was meant to be working. When trying to make an informed decision, participants believed that some information was not being shared and that the public was not privy to all the data and results of research being carried out worldwide. Anna believed that



*“There’s still needs to be statistics looking into, if this vaccine is really protecting people.”*  
(Anna)

Some also felt that *“the production of the vaccine was too fast”* and there could have been shortcuts and oversights (Rachel).

Tom explained that

*“according to the standards of medicine, vaccination testing varies between five to 20 years.”*  
(Tom)

He compared the COVID-19 virus to other diseases such as ‘AIDS’. He said that for AIDS *“the cure came out after a long time”*, insisting that the COVID-19 vaccination testing was done too quickly.

### 3.2.6 Media

Participants believed that people were being manipulated by the media, with excessive fear being instilled in people, especially when there were inconsistent narratives from authorities. According to participants social media played a vital role during the pandemic. They claimed that social media were not carrying scientific information.

*“I think social media was the biggest hindrance of the way the virus and the pandemic were handled. I think authorities in the world should have control on social media. And controlling social media does not mean, taking people’s freedom of speech,...but the media should ensure that they provide proper scientific information for the public’s knowledge.”* (Anna)

Ben also expressed suspicion in Malta’s State broadcaster (PBS). He believed that it was controlled by the government, and therefore it would not publish news that went against the directives of government and health authorities, even though it was the nation’s right to know.

## 4 Discussion

When triangulated, results pointed to three main key findings. The first was the lack of trust in political and medical authorities and big pharma. In Malta, vaccination became politicalized as happened in other countries (Trent et al., 2022). The decision was not linked to the party one voted for but more about whether the Superintendent of Public Health and her team were being autonomous in their decision-making regarding vaccination or whether they were being directed by the Prime minister and the Minister for Health or indeed other international political leaders. The party in opposition did not directly oppose vaccination however it criticized the government on issues

such as the lack of transparency and the question on the infringement of human rights. The European Commission monitored measures which were being taken by most of Europe. Their role was to bring attention to any discriminatory, ineffective, and unethical measures taken by authorities. Mistrust in politicians prevailed even before COVID -19 however conspiracy theories were much more fertile during this period. The belief that the COVID-19 virus was manufactured in a lab in order for big pharma to make money from the vaccines was reported not only on social media but also on mainstream media and international news agencies. Conspiracy theories could have been strengthened when WHO called for further studies following the publication of the report on the origins of SARS-CoV-2 virus published by an international team of experts after a field visit in Wuhan, China. In line with other studies (e.g. Ullah et al. (2021)), some also believed that the vaccine was a part of a money-making venture, and that pharmaceutical companies and politicians were promoting the vaccine because they were going to receive financial gain (Ullah et al., 2021).

The second finding emerging from the study was about herd immunity and the common good. While some participants could accept the idea of herd immunity they were not ready to be ‘part of the herd’ and get vaccinated. The notion of the ‘common good’ was not accepted by some participants. They felt than knowledge about long term side effects was not known and hoped that herd immunity would be reached without them having to take risks by taking the vaccine themselves. Other participants did not believe in herd immunity as a concept while others believed that the body can generate its own defence against the virus. Others still believed that politicians were using the notion of herd immunity as a way of controlling people and controlling the country.

The third issue emerging from the findings was about the availability of information. Social media played a key role in instigating fears about the vaccine and in promoting the anti-vaccination sentiment. Participants often mentioned information they read on social media platforms as a source of evidence. The role played by social media in promoting both news and fake news has been documented by several studies (e.g. Kim et al. (2020), Montagni et al. (2021), Melki et al. (2021)). It seems that participants were aware of fake news circulating in the social media however they were selective in what to believe and were more willing to accept the information being circulated by anti-vaccination groups. Participants were also sure that media, including the state broadcaster, were being manipulated in order to make people take the vaccine. They, however, did not seem to see the other side of the coin which was that social media could be used to convince

people not to take the vaccine.

Many claimed that there was lack of information about the vaccine, about the side effects and about reasons behind the decisions taken by the authorities. The findings from both the qualitative and the quantitative data showed that most participants were misinformed about the vaccine. Some had questions which they could have easily checked but did not, preferring to believe statements which were congruent with what they believed thus avoiding cognitive dissonance.

#### 4.1 Conclusion

Over the past decade, as a nation, people have developed a stronger understanding of their civic rights, duties, and responsibilities. It is being suggested that further research is essential in understanding vaccine hesitancy and negative attitudes towards vaccination as this would prove to be important for policy making. It will also provide Maltese policy makers with the information needed to adapt health campaigns to the Maltese public. It is important to find out whether COVID-19 vaccine hesitancy has given rise to increased hesitancy towards other well established vaccines. The recent resurgence of measles in several countries is one example. Since this survey was carried out with a volunteer sample, it cannot be generalized to the population and neither can the qualitative findings. It is therefore important to repeat such studies and observe patterns. Moreover, giving people a chance to voice their opinion is important even if these opinions may be unpopular. They must be heard. "Throughout history, it has been the inaction of those who could have acted; the indifference of those who should have known better; the silence of the voice of justice when it mattered most; that has made it possible for evil to triumph." (Selassie, 1963)

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Research Article

## Communicating identities: A sociology of house names in Malta

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**Abstract.** 19,683 house names from a convenience sample of ten localities across the island of Malta were collected and analysed in late 2022, with the aim of teasing out how they communicate social identities. Trends in multilingualism and secularisation were particularly explored, from two sets of house names that represent different historical epochs, one dating from 1977 and one from 1977–2022. Results, secured from the ten localities studied, suggest that: (1) English remains by far the preferred language for naming houses, followed by Maltese; (2) house names that involve two or more languages have increased; (3) house names that relate to the religious or sacred have declined (from around 16% to 10%); and (4) in spite of evident secularisation in house-naming practices, the most common house name is 'St Joseph'.

**Keywords:** House names, Identities, Language, Malta, Secularisation, Sociology, St Joseph.

### 1 Introduction

House names are a medium through which people represent and communicate their identities to themselves and others. House names, carved on wood, marble or stone, or made of glass, iron or clay, and occasionally even written on paper as a temporary measure, provide a wealth of visual and linguistic data which is "inextricably interwoven with our personal identities, narratives, lifestyle, culture and society" (Camilleri Grima, 2020).

Names of houses are often sentimental, humorous, historic, or descriptive. Frequently, they were chosen by their owners to make a personalised statement, often about the house but sometimes also about themselves (Batchelor, 2020).

What people do, how they talk and dress, and how they choose to represent themselves and their assets, are active engagements and manifestations of how they wish to be

seen, understood and 'read' by others in their community, and beyond. In this sense, our identities become signifiers of those personae that we wish to convey about ourselves. This lifelong exercise is supported by what we own and demonstrate as ours; and a house is typically our most expensive asset. Thus "naming a house [is] a statement of personal or family identity; [but also] a public statement destined for a particular audience and within a defined context" (Garrioch, 1994).

Sociologically, we can move beyond the individual choices of millions of house dwellers and understand that their personal decisions are influenced by the social and political context in which they live. The choices of house names can thus be examined holistically, with reference to current trends at particular places and times. House names are "an expression not only of individual tastes, but of a collective culture and identity" (Garrioch, 1994).

The very act of naming, and the actual names given to private properties and assets — such as a boat, a car, and of course, one's children — are similarly acts of signification. For those who own their own home, this is likely to be their most valuable material possession in their life course. Moving into or out of a home is one of the most stressful, life-changing (and exciting) events in one's life. Hence, the significance of 'naming' as a declaration of ownership: "naming a house [is] a way of taking possession of it: a statement of power" (Garrioch, 1994). Brincat (2009) observes how the intimacy and character of a house name somehow makes up for and contrasts with the blandness and anonymity of a house number (Pink, 2013).

The practice of naming one's home is not widely disseminated. In most countries of the world, the main signifier and locator of a home is a number and a street name or a civic or rural address, although even these are fairly recent attributions to the urban or rural landscape

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(ASPO, 1950; Tantner, 2009). These are determined by (national, regional or local) state authorities, much more intent in being able to trace residents; for example for the purpose of registering their dwelling for tax, water and electricity consumption purposes, to be able to forward their postal items, or to smoothen the encounter of and with strangers in increasingly cosmopolitan urbanscapes (Tantner, 2015).

Street names and house numbering in Malta are the exclusive purview of government units (Electoral Commission, Malta, 2023a, 2023b). These are then typically complemented by a house name, the choice of which is usually a purely personal one, decided by the original builders, contractors and/or subsequent buyers and occupiers of the home.

House names can be renewed or replaced by their successive owners and tenants; and so they reflect changing times and home-making attitudes (Garrioch, 1994). House names are bound to be more prevalent when people own the homes that they live in (and which they are therefore at liberty to name or re-name); as against living in rented accommodation where the privilege of naming does not belong to the tenant. Hence the popularity of house naming in Malta, where the home ownership rate is around 80% of all households (Sansone, 2018).

It is therefore feasible to examine the preponderance of house names as indicative of social and economic trend[s], such as home ownership, but also of globalisation and secularisation. Recent decades have seen an acceleration of diversity in Malta's demographic profile, with so many returned migrants or foreigners not born in Malta but now living in Malta. There has also been a decline in ecclesiastical power and influence (manifested in the introduction of divorce and the legalisation of same sex unions) and a decline in religiosity and religious practices (such as lower attendance at Sunday mass) (Deguara, 2020; Farugia, 2019; Fenech, 2012). Such and similar trends are bound to find expression in:

1. whether a residence has a name at all
2. whether such a name, where it exists, bears a relationship with the religious, spiritual and/or divine
3. whether the house name is spelt out in English (EN), in Maltese (MT), in a third language or a combination of languages.

## 2 Why House Names?

Garrioch (1994) argues that house names and shop signs started off as markers of status, allegiance, and religious devotion, while they identified the family or profession of the individual who lived in a particular dwelling; the latter was an especially important signpost to would-be visitors or clients.

The oldest house names go back to the European Middle Ages. They primarily spread through oral heritage, although in the Habsburg Empire they were also recorded in official church documents. House names arose from the need to more accurately differentiate between people because social development and advances meant that personal names were no longer sufficient (Geršič et al., 2016). The practice of house naming spread with British colonialism to the western part of North America, South Africa, Australia and other parts of the British Empire, including Malta. Within the United Kingdom itself, according to its Land Registry, just 1.4 million homes in towns and villages (out of 26 million) had a house name in 2011 (Batchelor, 2020).

In the Maltese context, the most compelling reason for house naming, argues Camilleri Grima (2020), was that, until the late 20<sup>th</sup> century, houses were not assigned numbers. Therefore, residents would identify newly built houses by assigning them a name. The vast majority of new buildings have continued to be named, even after a door numbering exercise was completed throughout the Maltese Islands, and is now updated on an ongoing basis. Houses which already had a name often affixed a peel-on version of the number given to them on, or near, the plaque with their house name (*ibid.*). Writing fairly recently, Falzon (2020) argues: "It is common practice in Malta for even the humblest house to be given a name, which is usually displayed on a small ceramic plaque on the facade. Naming is typically inspired by local patron saints, places visited by the owners, and so on, but also by bird names in the case of hunter's homes. 'Turtle Dove', 'Honey Buzzard' and 'Skylark' are not uncommon house names..."

The earliest locale in Malta to have official house numbers (and official street names) introduced was Valletta, the capital city. In 1813, the British authorities assigned a permanent number to every door in the city, and which had to be prominently displayed; most have remained unchanged ever since (Denaro, 1967). This permitted the straightforward identification of every address in the capital, considered as a measure to help control the spread of the plague (Bonello, 2018). This early introduction, plus the extensive rental housing stock in Valletta, snuffed out the resort to house names in the city: as an example, there are only six named houses in the whole of Merchants' Street. In the even older city of Mdina, the former capital, only nine houses have names.

## 3 This study

This study looks at the names assigned to homes in ten localities in Malta, the main island of the Maltese archipelago. It explores:



1. the popularity of such names
2. the language used in house naming, identifying the distribution of houses named in Maltese and in English — the two official languages — as well as a variety of other languages (Italian, French, Spanish, Latin, Hebrew ...), and linguistic combinations thereof
3. the rationale behind the choice of house names, with special attention to the recent secularisation dynamic that is also manifest in such options.

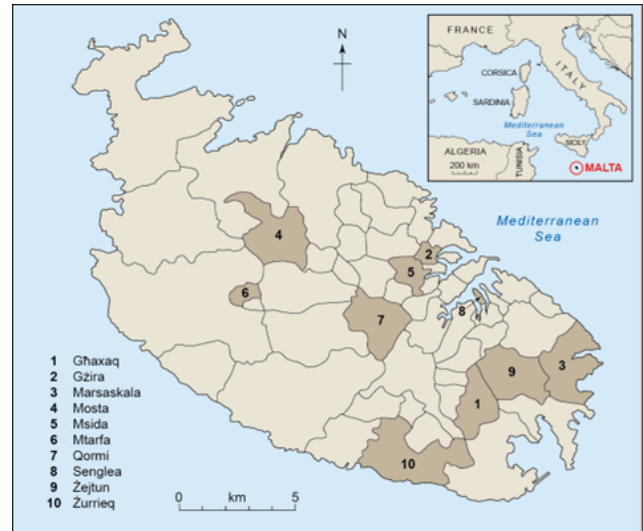
Attempts will also be made to compare house name practices in urban and village cores with those of the same town or village suburbs, where the housing stock is likely to be more recent.

A similar focus on house names, but using a different research methodology, has been used in earlier studies. Camilleri Grima (2020) focused on house names to explore the Maltese linguistic landscape. In her case, ten of her students from the Faculty of Education at the University of Malta each photographed a minimum of 50 house names in the vicinity of where they lived and carried out incidental interviews with their (Maltese) residents during 2017–8. Meanwhile, Brincat (2009) undertook a study of all the house names in the sister island of Gozo: 7,144 houses had names, out of a stock of 10,744 dwellings, at the time of that study. This, mainly qualitative, research identified some of the same house name categories proposed in this study: including composite names, nicknames, names associated with trades, and religious names: 1,817 house names involved the names of saints or the Holy Virgin; and 41 others had biblical names.

This study uses a different approach. It resorts to the Local Council Electoral Register of April 2022 as its base document and population frame: the register is publicly available from the website of the Malta Electoral Commission (MEC, 2022). This offers a comprehensive official and up-to-date directory of those eligible to vote in local council elections, comprising Maltese and other European Union citizens with a registered residence in the Maltese islands. The register includes the names, identity card numbers, address, and the name of the house or apartment block (where this exists and is registered).

The research design involves a desk review of ten select localities, these being *either* the localities that the students following the study unit *Sociology of Space and Place* (code: SOC 2079) at the University of Malta during the first semester of 2022–23 called home; *or* an adjacent locality, if more than one student lived in the same locality<sup>1</sup>. The localities chosen, represent a fair cross-section

<sup>1</sup>Three students resided in Marsaskala, so two of these opted to study Qormi and Żejtun instead.



**Figure 1:** The ten localities featured in this study. (Map work courtesy of Sandra Mather and Ritienne Gauci).

of Maltese towns and villages, and involve localities from all six regions except Gozo and Comino<sup>2</sup>. These localities are: Għaxaq, Gżira, Marsaskala, Msida (including Swatar), Mosta, Mtarfa, Qormi, Żejtun and Żurrieq (including Bubaqra). The study-unit professor added Senglea (L-Isla, in Maltese), so as to include a locality from the inner harbour region, still completely hemmed in by practically intact outer walls and thus unable to expand, and where therefore no additional streets — and houses — have been laid out since 1977. This contrasts with the town of Mtarfa, where all streets — and therefore all homes — have seen the light of day since 1977. All the eight other localities have sets of squares, streets and alleys — and therefore houses and their names — that both pre-date and post-date 1977 (figure 1).

The research method involved first looking at all the streets of each chosen locality, and for each street identifying:

1. the total number of households;
2. the proportion of households with house names
3. the actual house name

Next, the older streets of the locality were identified — as explained below — separate from the more recent streets, so that a comparison of house names could then be made between these two clusters of streets of the same

<sup>2</sup>These regions are: Southern Harbour (in our convenience sample: Senglea); Northern Harbour (Gżira, Msida, Qormi); South Eastern (Għaxaq, Marsaskala, Żejtun, Żurrieq); Western (Mtarfa) and Northern (Mosta). With Gozo-Comino, these six 'regions' correspond to what Eurostat, the statistical agency of the European Commission, calls 'Local Administrative Units' (LAUs). See NSO (2021).

locality. Renaming house names can happen everywhere, even in old houses, of course. But house names can be 'sticky': they can persist, even though owners can and do change. Sometimes, it is simply too much of a hassle (and an expense) to change a house name and the ceramic tile to which it may be affixed.

It is thus hypothesised that house names in the older street sets would have a heavier dose of religious and sacred terms than those in more recently built areas, where personal, sport, trade, hobby and terms associated with particular professions and pastimes are more likely to proliferate. It could also be postulated that more recently built homes are more likely to have house names that appear in other languages (apart from EN and MT); and these homes were also more likely to have house names that express a combination of different languages.

A research ethics self-assessment (minimal risk) was undertaken in September 2022 and registered with the Faculty of Arts Research Ethics Committee at the University of Malta.

House names come in an abundance of diversity (figure 2); but most can be organised inductively according to a number of categories, following a review of the rich database, as well as in light of the insights from previous research (Brincat, 2009; Camilleri Grima, 2020). A tentative classification would break down house names as follows below. (Note that names can overlap more than one category.):

- Religion and the Sacred: pertaining to particular saints or holy persons, including the patron saint/s and/or feast day of the town or village where the house is located, or from where the homeowner(s) originated. E.g. Cova da Iria [valley near Fatima, Portugal, where the Virgin Mary allegedly appeared to three children in 1917], Dar l-Għammied [Home of the Baptist, patron saint of Xewkija, Gozo], Santa Katerina, Holy Family, Madonnina, 8 ta' Settembru [8th September, a national day], Immakulata [The Immaculate Conception, feast celebrated in the city of Cospicua], Salvajtni Mulej [You saved me, Lord]... The references here are mainly to Christianity, but there are also house names that align with other religions (e.g. Shalom, Shiva).
- Hobbies and Professions: pertaining to particular artefacts involved with trades, professions or activities that presumably are associated with the owners—current or previous—of the house. E.g. Synapse (medicine), Il-Karettun [the cart] (farming), Sirius (astronomy), Woodcock (hunting and trapping), The Art Studio ...
- Home Dwellers: related to the persons who own the building, live in the house and/or their family, in-

cluding nickname (laqam) and other references to those residing inside the home, such as the zodiac sign of one or more of the dwellers. This category also includes homes with a reference to the personal, with the usage of words like 'My' or 'Our'. E.g. L-Għekiereb [The Scorpios], Pisces, Micallef Home, Ta' Pawlu Farmhouse [Paul's Farmhouse], My Burrow, Our Nest, Vella Flats ...

- First Name Sets: A sub-set of the above is a curious practice which involves naming the house with a selection of letters from the names of the partners (or children) living there. This exercise has the character of a pub quiz. Guess why these homes are called: ChaRit, MarTrev, CarAnt and NaJoPetAn? (figure 3).
- Links beyond Malta: a practice usually associated with households where one or more family members may have spent their honeymoon or lived abroad, and then returned to Malta. Australia, Canada, the United Kingdom and the United States, and towns and cities therein, would be the main reference points, since these are the countries to which the Maltese migrated en masse in the difficult years after the Second World War (e.g. Jones, 1973). E.g. City of Melbourne, God Bless America; Kangaroo House, Maple Leaf ...
- Locality and Topography: names that refer to natural features, possibly with a connection to a local and neighbouring topographical feature on land or sea or a natural phenomenon, usually associated with the sun, the wind or a flower/garden. E.g. Il-Qolla [The Hillock], Seaside, Blue Sky, Għabex [Sunset], Tramonto [Sunrise], Il-Ponta [The Point], Bay View, Mistral, Dahlia, Poinsettia, Rainbow ...
- Sports: names here bear a direct connection to the name of a sport, a sport team, a famous player, or to the stadium or home of a (local or foreign) sport (usually football/soccer) team. E.g. La Vecchia Signora [The Old Lady: Juventus FC], Old Trafford [Manchester United FC], Casa Del Piero [legendary player with Juventus FC], San Siro [Stadium for both AC Milan and Inter Milan], Toronto Blue Jays, Hibernians House, White Hart Lane [Stadium for Tottenham Hotspur]...
- Politics: here we come across names of political personalities or events from Maltese politics. E.g. Dom [short version for Dominic, the first name of Mintoff, Maltese Prime Minister, 1955–58; 1971–84], Dar il-Helsien [Freedom House], Villa Indipendenza [Villa Independence], 31 ta' Marzu [31st March: one of Malta's national days]...

Other house names turn up and which do not fit com-



Figure 2: A collage of house names. (Source: the authors).



Figure 3: JoeGrace and ErnMar: Double evidence of the practice of naming houses with the combination of parts of the names of persons: typically, their owners and occupiers. (Source: the authors).

fortably in any of the above categories. E.g. Boronia, Dolce Vita, Kitty Hawk, Mirage, Saratoga, Shangri La, Touch and Go ... And one in particular is symptomatic of a touch of creativity and humour, including a pun on the Maltese word 'dar' which, apart from being the noun 'home', also stands for the verb 'he turned' (figure 4). This is a practice also in the United Kingdom, where the names assigned recently to some homes come in the joining together of words in new and witty combinations, also in jest (Wright, 2020). Initially lumped together as 'miscellaneous', various new categories may be teased out from a study of these names. This is a task for future research, and may require a researcher asking the home dweller to explain their choice.

From the ensuing corpus of house names, the language used in the naming of the house will be identified. A separate area of attention in this exploratory study is the actual language in which the name of the house is established. Maltese is the national language of Malta but is more commonly used orally than in the written form; in contrast, English has tended to be the language of correspondence, documentation and officialdom (Brincat, 2019, 2021; Vella, 2013). Indeed, from the sample of 642 house names in a study by Camilleri Grima (2020), around 19% were in English and 15% were in Maltese. We can thus hypothesise that house names are most likely to be spelt out in the English language (and followed by the Maltese language).

Which takes us to 'third languages'. We also postulate that a large proportion of house names are now being written in other languages beyond EN and MT. More than one in five of those who live in Malta today were not born in Malta (NSO, 2023; Sammut et al., 2022). The diversity of citizenships of Maltese residents (including dual citizenships); the variety of languages now spoken in Malta; and the large variety of countries in which Maltese residents have lived, worked and/or studied; means that we can reasonably expect a colourful range of languages used in the naming of houses, even beyond EN and MT. Sciriha et al. (2015) report on the results of a quantitative study of languages used in public signs, notices and house names in Malta, identifying 23 languages. This suggests that "Malta's linguistic landscape is far from insular", and that "the Maltese are linguistically quite versatile ... and draw from a considerable linguistic repertoire when giving names to their home" (*ibid.*).

Thirdly, and following directly from the arguments above, we propose that there is an increasing tendency towards — or the Maltese are increasingly adventurous in — mixing languages when determining a house name; such that, if a house name consists of two or more words, we should not be surprised if these relate to different lan-

guages (figure 5). And so, some house names are bilingual, for example 'Monte Carmelo Flats' [IT/EN] 'Dar ta' Déjà Vue' [literally: 'House of Déjà Vue', MT/FR] as reported by Camilleri Grima (2020).

Finally, a reference was earlier made to 1977. This is the year that Joseph G. Borg published his first edition of 'A to Z of Malta and Gozo', the first published collection of 130 maps comprising all the streets and alleys of the Maltese archipelago. This 167-page book includes a thorough and indispensable 'street guide': an index of street names by locality (Borg, 1977). All information in this book is based on survey maps provided by the then Public Works Department.

A cost-effective and timely but valid and reliable method had to be found to compare house names across time. Borg's 1977 index provides this convenient time marker. While the Local Council Electoral Register included all streets and alleys — and the names of the houses therein — of all localities at the time of writing (December 2022), consulting Borg (1977) would identify which streets and alleys already existed in 1977, 45 years before. In this way, the data of each locality was divided into two sets: that pertaining to house names drawn from streets and alleys that already existed in 1977; and that pertaining to streets and alleys that did not feature in Borg (1977) and are therefore deemed to have been developed and laid out after that date.

We are fully aware that this is not a perfect and error-proof technique: some old streets would have been extended or had empty plots and now contain new housing; some old homes would have been demolished and rebuilt, or renamed, since 1977. But, *grosso modo*, we believe that it is fair to argue that the two datasets represent largely old (pre-1977) houses and largely new (post-1977) houses. And, bar the odd farmhouse, there would only be new housing on new streets<sup>3</sup>. We also had to resort to at least one local expert to identify a number of streets which have changed their name in the interim.

We started the analysis by sourcing the number of persons entitled to vote in local council elections in each of the ten localities, according to the April 2022 electoral register. We also elicited the population count per locality from the demographic statistical database of the National Statistics Office (as at December 2020)<sup>4</sup>.

<sup>3</sup>Indeed, the names of streets in Malta are themselves worthy of study and echo house naming trends: from a naming practice that was largely dedicated to religious names, we have more recently moved on to celebrating local personalities and events. Borg (1977) confirms that there is a 'St Joseph Street' in most localities in the Maltese Islands.

<sup>4</sup>Total population by region, district and locality. Available at: <https://statdb.nso.gov.mt>





Figure 4: Seen in Marsaskala: Having fun with your house name. (Source: the authors).



Figure 5: Seen at the limits of Rabat: English and Maltese words together in a dwelling's name. (Source: the authors).



## 4 Contextual Demographic Data

Table 1 provides descriptive statistics of the populations of the ten localities under study. Their resident populations amount to 115,959, which is 22.3% of the resident population of the Maltese Islands: 519,562, according to the 2021 Census (NSO, 2023). The total number of voters for local council elections from these ten localities is 97,583: Mtarfa and Senglea are by far the smallest, with resident populations of around 2,700 each; while Mosta is one of the most populous localities in the Maltese Islands, with almost 21,500 residents. Mtarfa has the highest proportion of local youth aged 16–18 with voting rights in the sample (2.5%). In contrast, Gżira and Msida have the lowest proportion of local youth aged 16–18 with voting rights in the sample (0.7% and 0.9% respectively) and followed by Senglea (1.5%), suggesting a relatively ageing population. Għaxaq, Qormi and Żejtun are localities where non-Maltese voters who are EU nationals constitute less than 4% of the total voting population; this is in sharp contrast with the North Harbour areas of Gżira and Msida where the proportion is a staggering 51.8 and 46.1 percent respectively. Higher proportions of non-Maltese nationals is likely to mean a higher proportion of rental accommodation, which in turn is bound to suggest a lower resort to house names per capita.

These 115,959 adults lived in 29,764 distinct addresses: a mean of four adults per address. This is a consequence not just of the number of persons per household, but also of the preponderance of apartment blocks, old people's homes and other large social residences which are counted as one address. Thus, in Għaxaq, where homeowner occupied housing prevails, there are 1,596 addresses for a population of 4,989: one address for just over three persons; while in Gżira, with its rental housing stock and apartment blocks, there are 1,672 addresses for a population of 13,021: a ratio of one address for almost eight residents.

## 5 Analysis

Out of 29,764 distinct addresses in the ten localities under study, 19,683 have a house name: that amounts to a sample mean of 66.1%, or almost two out of every three addresses. Localities which have seen relatively large recent increases in population, and where homes are mainly owner owned and occupied — such as Għaxaq, Marsaskala and Mosta — have the highest proportion of named dwellings: 76.6%, 82.1% and 75.2% respectively. At the other extreme, there are only 109 named dwellings in Senglea, where there is a considerable stock of social housing: that is only 8.2% of the total number of distinct addresses (Table 2), (Table 3), and (Table 4).

The choice of a house name with a religious reference has gone down, from around one in six to around one in ten: 15.8% in 1977; 9.9% since 1977 (Table 5). In all ten localities except Gżira and Msida, the proportion of house names that express a religious or spiritual sentiment has decreased between 1977 and 2022; while in Gżira and Msida—two localities that have seen sharp increases in new apartment buildings — there is a marginal increase (from 12.9 to 13.8% and from 10.4 to 11.2% respectively), which may appear to be bucking the trend. The locality with the largest proportion of religious house names in 1977 was Żurriq (35.7%) followed by Senglea (26.6%). In Żurriq, the most common house names in 1977 were Sacred Heart and Ave Maria (6 times each); by 2022, these had been replaced by Madonnina (18 times), followed by Ave Maria (15 times). Meanwhile, in Senglea, Maria Bambina - the titular saint of the town - was used 6 times as a house name; followed closely by Redeemer/Redentur (5 times): the Senglea parish church vaunts a statue of Christ the Redeemer that is visited by pilgrims and devotees (Farrugia, 2019). Since Senglea has reached the maximum footprint permitted within its walls, it has no new streets and probably carries over most of the house names that had been chosen decades ago, when religiosity was a keener and more mainstream concern in Maltese society. Today, Senglea's house names can be considered an anachronism when compared to the more secular house naming practices of other localities in Malta (though not perhaps in Gozo: a topic for future research). In other localities, the patron saint of the town or village was the typically most common house name in 1977, and this position may not have changed by 2022: for example, St Catherine remains the most common house name in Żejtun (19 times pre-1977; 17 times post-1977); same with Mosta (St Mary/Santa Marija: 13 times pre-1977; 40 times post-1977) and Msida (St Joseph/San Ġuzepp: 9 times pre-1977; 8 times post-1977). Finally, Qormi is the only locality in the sample to boast two parishes, devotions and rivalries: one dedicated to St George, and one to St Sebastian. The name 'St George' (and derivatives) appears on 67 houses in Qormi (39 pre-1977; 28 post-1977); while the name 'St Sebastian' (and derivatives) appears on 34 houses (17 pre-1977; another 17 after 1977). There is also a diasporic devotionality, whereby those born or bred in a town (say, Żejtun) would go and live elsewhere (say, Qormi) but fondly name their home 'St Catherine' as a nod to the patron saint of their locality of provenance.

Locality	Resident Population (National Statistics Office: December 2020)	No. of Registered Voters of Maltese Nationality (April 2022 Local Council Electoral Register): 18+	No. of Registered Voters of Maltese Nationality (April 2022 Local Council Electoral Register): 16-18	No. of Registered Voters of Other Nationalities (April 2022 Local Council Electoral Register)	Total No. of Registered Voters for Local Council Elections (April 2022)
GHAXAQ	4989	4210	83	155	4448
GŻIRA	13021	4599	70	5012	9681
MARSASKALA	15579	10034	263	4022	14319
MSIDA (including Swatar)	15566	5465	101	4756	10322
MOSTA	21495	17019	347	1946	19312
MTARFA	2612	2146	56	44	2246
QORMI	17240	13542	297	496	14335
SENGLEA	2732	1907	34	255	2196
ŻEJTUN	11516	9899	209	336	10444
ŻURRIEQ (including Bubaqra)	11209	9490	227	559	10280

**Table 1:** Descriptive statistics of the populations of the ten localities under study.

	No. of Streets as at 1977	No. of Streets in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
Għaxxaq	33	604	430	71.2%	St. Joseph (10)	St. Mary (7)	75	355	17.4%	English	Maltese
	No. of Streets added (1977–2022)	No. of Addresses in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	81	992	792	79.8%	St. Joseph (13)	Redemeer (6)	101	691	12.8%	English	Maltese
Gżira	No. of Streets as at 1977	No. of Addresses in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	46	841	433	51.5%	St. Joseph (5)	St. Mary (4)	56	377	12.9%	English	Maltese
	No. of Streets added (1977–2022)	No. of Addresses in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	39	831	414	49.8%	St. Joseph (4), St. Rita (4), Tony (4)	Angel (3)	57	357	13.8%	English	Maltese
Marsaskala	No. of Streets as at 1977	No. of Addresses in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	32	418	273	65.3%	St. Joseph (4)	St. Anna (3)	29	244	10.6%	English (84)	Maltese (24)
	No. of Streets added (1977–2022)	No. of Addresses in Street	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	145	3219	2713	84.3%	St. Joseph (18)	Sea Breeze (14)	219	2494	8.1%	English (710)	Maltese (219)

**Table 2: House names in Għaxxaq, Gżira and Marsaskala**

	No. of Streets as at 1977	No. of Streets in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
Msida (including Swatar)	56	1,007	583	57.9%	St. Joseph (9)	St. Rita (4), George (4)	61	522	10.4%	English (420)	Maltese (21)
	No. of Streets added (1977-2022)	No. of Addresses in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	53	751	604	80.4%	St. Joseph (8)	Aurora, St. John, St. Mary, St. Rita, Massabielle, Redeemer, Sunrise (3 each)	68	536	11.2%	English (385)	Italian (32)
Mosta	93	1,867	1,281	68.6%	St. Mary (13)	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	No. of Streets added (1977-2022)	No. of Addresses in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	249	4,473	3,486	77.9%	Santa Marja/St. Mary (40)	St. Anthony (7)	155	1,126	12.1%	English	Maltese
Mtarfa	0	0	0	0	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	No. of Streets added (1977-2022)	No. of Addresses in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	51	868	399	46.0%	Redentur	Anfield (16)	302	3,184	8.7%	English	Maltese

Table 3: House names in Msida (including Swatar), Mosta and Mtarfa

	No. of Streets as at 1977	No. of Streets in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
Qormi	86	1289	689	53%	Refecemer	St Rita	55	628	8%	English	Maltese
		No. of Streets added (1977-2022)	No. of Addresses in Streets	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	136	2609	1902	72%	St Mary	St George	73	1827	3%	English	Maltese
Senglea		No. of Streets in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	41	1327	109	8.2%	Maria Bambina (6)	Redentur (5)	29	80	26.6%	English (35)	Maltese (17)
		No. of Streets added (1977-2022)	No. of Addresses in Streets	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	0	0	0	0		0	0	0	0		0
Żejtun		No. of Streets in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	114	2399	1193	49.7%	St Catherine (19)	St Anthony (17), St Joseph (16), St Mary (15), St Rita (14), Dar il-Hena (10)	274	919	23%	English	Maltese, Italian and French
		No. of Streets added (1977-2022)	No. of Addresses in Streets	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	169	2233	1377	61.7%	St Catherine (17)	Shalom (16), Redentur (13), St Joseph (12)	204	1173	14.8%	English	Maltese, Italian and French
Żurrieq (including Bubaqra)		No. of Streets in Streets	No. of Addresses with a House Name	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	53	795	536	67.4	Sacred Heart (6), Ave Maria (6)	Sunset (4), St Catherine (4)	141	395	35.7	English (440)	Maltese (57)
		No. of Streets added (1977-2022)	No. of Addresses in Streets	Addresses with a House Name (%)	Most Common House Name	Followed by	No. of Religious House Names	No. of Secular House Names	Religious House Names (%)	Most Common Language of House Names	Followed by
	218	3241	2360	72.8	Maddonna (18)	Ave Maria (15)	296	2064	14.3	English (1845)	Maltese (306)

Table 4: House names in Qormi, Senglea, Żejtun and Żurrieq (including Bubaqra)



Fast forward to 2022, and the increased diversity in the range of house names is also evident in the most common house names in each locality. Secular house names have become more popular; and some of these appear on the facades of many homes. 'Sea Breeze', a naturalistic house name, is the second most common choice for a house name in post-1977 Marsaskala, a coastal community (14 times); 'Aurora' and 'Sunrise' come in joint second place among house names in post-1977 Msida, which mainly consists of the Swatar neighbourhood (3 times each). Anfield is the second most popular house name in post-1977 Mosta (16 times): there seems to be a cluster of Liverpool Football Club supporters living there.

Otherwise, in spite of the decline in religiosity, the religious category of house names remains the most prevalent choice: perhaps an indication that, in a more individualistic society, a house name with religious connotations is redolent of a sense of community and collective identity (Vassallo, 1974). In relatively younger communities, where allegiance and association with the local patron saint may not be as strong, house names can still bear relationships with other religious symbols or personages. In Mtarfa, a young community which celebrates the feast of St Lucy as a parish since 2004, the most common house name is Redeemer, followed by St Joseph. In Marsaskala, which became a parish in 1949, the most common house name is St Joseph, both pre-1977 (4 times) and post-1977 (18 times); and not St Anne, the local patron saint. In Gżira, St Joseph is the most popular house name, both pre-1977 (5 times) and post-1977 (4 times) even though the local patron saint is Our Lady of Mount Carmel. In Għaxaq, the main village feast is the Assumption of Our Lady; but it is the secondary feast and patron saint of the locality, St Joseph, that scores highest amongst house names, both pre-1977 (10 times) and again post-1977 (13 times). In post-1977 Żejtun, St Joseph is the third most popular choice as a house name (12 times), bested only by Shalom (16 times) and Redentur [Redeemer] (13 times).

There are at least 240 houses named 'St Joseph' in the ten localities under study: one out of every 82 house names (see Figure 4). The pervasiveness of 'St Joseph' — and its linguistic derivatives, such as San Ġużepp (MT) or San Giuseppe (IT) — as a house name throughout the ten localities under scrutiny may come as a surprise. Boissevain (1994) and Boissevain (2004) describe the origins of the devotion to St Joseph and his installation as the secondary saint in many Maltese towns and villages, tracing this to a "ritualised conflict between established and opposition interests" and a tangible outflow of a pent up frustration by a new pro-British Maltese middle class, un-

able to break into the ranks of an entrenched pro-Italian conservative elite, starting in the late nineteenth century. St Joseph became the rallying point for the development of most secondary feasts in Malta; he is the patron saint of workers, and so a fairly good fit with the ideology of the Malta Labour Party which historically prided itself as being a socialist, workers' party. (In tacking to the political centre, the Partit Laburista now calls itself the champion of 'families and businesses'). Is this a legacy of a naming tradition from the past, not likely to be maintained in the future?<sup>5</sup>

Finally, in terms of linguistic diversity, English remains the preferred language used in naming one's house throughout all ten localities studied, thus confirming the findings of Camilleri Grima (2020). Maltese is the second most common language for assigning house names throughout, but with one exception: it is Italian that comes in as the (distant) second most common language for house names in Msida post-1977 (32 times) after English (385 times). With so many immigrants moving to Malta in recent years, and at least some of these buying their own home, we can expect a greater number of houses named in other languages in the coming years.

The resort to 'mixed languages' in house names remains steady since 1977, having increased in some localities and decreased in others. The largest increase in this disposition is in Marsaskala, which had at least three mixed-language house names pre-1977 (Razzett Bella Vista (razzett means farmhouse, MT/IT; Dar Frate Jacoba, MT/IT; and Aqua Gem, IT/EN) and since 1977 has had at least 11 more (El Kantaoui Flats, Tal-Bidni Farmhouse, Monte Carmelo Flats, Quċċa Garage, Farmhouse Sqaq il-Hrejba, Casa Abela, Gandoffla Court, Carina Tower Estate, Tal-Farmhouse and Sea La Vie). Żejtun is the locality reporting the largest number of such mixed language house names: 30 pre-1977 (e.g. Mamma Mia Lodge, IT/EN) and 38 post-1977 (e.g. Mater Grazzja Latin/MT).

## 6 Conclusion

Maltese house names act as potent symbols of identity: they provide a readily, freely and publicly available source

<sup>5</sup>The same observation could be made about the naming of males as Joseph in Malta. Joseph is still the most common name for males in Malta, followed by John, Mark and Mario: one out of every 47 Maltese-born children is called Joseph (Forbears, 2022). Writing on the occasion of the feast of St Joseph celebrated in Cospicua, Bonello (2003) reminds readers that there are four parishes dedicated to St Joseph in Malta (Birkirkara, Kalkara, Manikata and Msida) and one in Gozo (Qala). He adds that 'Joseph' was (at the time of writing) the first name of 63 diocesan priests in Malta (him included) and another 35 in Gozo, along with the Archbishop of the time. Note, however, that this situation is bound to change, since the practice of naming boys with this name has waned.

Locality	Percentage of Religious House Names		Total
	Pre-1977	1977-2022	
GHAXAQ	17.4	12.8	14.4
GŻIRA	12.9	13.8	13.3
MARSASKALA	10.6	8.1	8.3
MSIDA (including Swatar)	10.4	11.2	10.9
MOSTA	12.1	8.7	9.6
MTARFA	not applicable	12.0	12.0
QORMI	8.0	3.0	4.9
SENGLEA	26.6	26.6	26.6
ŻEJTUN	23.0	14.8	18.6
ŻURRIEQ (including Bubaqra)	35.7	14.3	15.1
Total	15.5% (875 out of 5,527 named homes)	9.9% (1,397 out of 14,156 named homes)	11.5% (2,272 out of 19,683 named houses)

**Table 5:** Prevalence of Religious House Names (by %): pre-1977 and post-1977.

of information about Maltese society. Behind the name of each and every house there is a sociological narrative which contextualises that particular name within a social, religious, political and linguistic context. Compared to house names in 1977, we have noticed a trend across most localities in Malta where house naming is less about the divine, religious and supernatural and more about the human, natural and immediate.

Nevertheless, many Maltese collectively still use house names as a way to express, maintain and affirm traditional local parochial allegiances, as manifest in other cultural practices such as festas and fireworks. The recourse to religious house names has declined (from around 16% to 10%); but the choice of 'St Joseph' as the most common house name may be redolent of a 19<sup>th</sup> and 20<sup>th</sup> century class struggle. Perhaps some Maltese are perpetuating traditional parochial patronal and secondary saint house names as counterfoil to secularization and globalisation?

House naming as practice has persisted even during the construction spree of recent decades when "large tracts of the island, far from existing urban areas, were made available for real-estate development", resulting in housing units and estates "lacking either a sense of community or place... divorced from the identity of the place and its history" (Bianco, 2006).

For the students of sociology at the University of Malta, this exercise was conceived as an insightful and original experience of seeing social science 'come alive' and serve as a powerful source of information about Malta, its recent social transitions and its collective identities. The process of going to press is also part of the students' learning experience.

The rich databases that have made this research and its analysis possible are available in open access format, rendering themselves freely amenable to further research.

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The datasets from the 10 localities that form the basis of this article have been deposited in the data repository of the University of Malta (drUM) and are available (in open access format) at: [https://drum.um.edu.mt/articles/dataset/House\\_names\\_in\\_ten\\_Maltese\\_localities/24331825](https://drum.um.edu.mt/articles/dataset/House_names_in_ten_Maltese_localities/24331825).

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Research Article

## Ranking of rural localities in Malta and Gozo according to their degree of exposure to traditional locally produced fare

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**Abstract.** Mediterranean fare originated from regional ethnic groups living in the region, and, other than from external cultural influences, the ingredients used mostly originated from local production. In evaluating the role of tradition in Maltese food culture, three factors, namely part-time farmers, kitchen gardens, and small livestock numbers, appear to have characterised food production within a Mediterranean island agricultural landscape that was dominated by small holdings. This study evaluates Malta's different rural localities, ranked according to evidenced agricultural activities in small farming holdings, which, by their self-sustenance, appear to have retained traditional Maltese rural features. This paper is a first attempt to provide a guideline for selecting locations to evaluate production and consumption patterns of traditional Maltese food in rural areas. The research is not intended as a farm structural or policy analysis as it ultimately focuses on production factors linked to rural fare.

**Keywords:** Malta, locations, rural food, surveys, food.

### 1 Introduction

The 'Mediterranean diet' was first studied by Keys et al. (1957) as the typical food consumption pattern prevalent in olive-growing areas of Crete, Greece and Southern Italy in the late 1950s and early 1960s (Trichopoulou et al., 1997). With slight modifications, the same is found in regions of Italy, Albany, Spain, France, Lebanon, Morocco, Portugal, Syria, Tunisia and Turkey (Willett et al., 1995). The Maltese food consumption culture has been historically attributed to several aspects of the Mediterranean 'model' that originated from the various ethnic groups living in regions along the shores of the Mediterranean Basin and this permeated in different ways. Apart from normal relations between the different cultures, the region also

has a long history of conquests whereby other than seizing power, dominating forces also imposed their cultural practices and associated food preferences. Through time boats, carriages, merchandise and civilisations, as well as creative ideas and religion converged. Trade and migration within the region led to the inevitable exchanges in cultural influences and gradually modified the components of different recipes. Mediterranean gastronomy is not just based on the crops and livestock that were grown, but it also incorporates aspects of the way of cooking, family and social dimensions, encompassing landscapes, and accumulated culture, art, and traditions—including religion.

Perhaps an appropriate starting point as to what the rural Maltese food consumption patterns were in the early 19th Century, is found in *The Royal Military Chronicle: Or, the British Officer's Monthly Register, Chronicle, and Military Mentor* ("The Royal military chronicle", 1811). This document describes that the staple Maltese diet consisted of oil on bread, with some salted anchovies, herrings, or dried fish, especially on those days when religion did not allow the consumption of meat, which is not just limited to the whole period of Lent, but also included every Wednesday, Friday, and Saturday. At the time, the Maltese consumed many artichokes, celery, onions, hog beans, lupins, chickpeas, pickled olives, green figs, prickly pears, raw or with bread, or chestnuts, apart from consuming other various grown vegetables. This, together with some wine and bread formed the basis of nutritional consumption (Buttigieg et al., 2019; Cassar, 2013) frequently comprised the whole nourishment for the day. In Cassar (2016), Maltese food habits, the author remarks that while "Bread has always taken first place in the Maltese kitchen" the type of bread consumed by an individual reflected his status within society. Hence the upper classes customary consumed the refined white bread type kneaded with wheat flour, whereas the bread consumed by

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the lower social strata was a rather coarse, brown based meslin bread kneaded from a mix consisting of wheat and barley flour mix.

Vegetables were in abundance and grown throughout the year. These included: aubergine, tomatoes, turnips, carrots, potatoes, cauliflower, broccoli, artichokes, green peas, French beans, several salads, celery, and long marrows. Some of these vegetables were used in soups, sauces, boiled, or with meat nearly the whole year round. In the early 1800s potatoes were still a recent introduction and were not a popular ingredient. Fruits such as figs, citrus, watermelons, pears, nectarines, apricots, peaches, grapes, pomegranates, strawberries, plums, dry figs, dates, and almonds, were also consumed in great quantity. Bread was made from whole wheat flour, sprinkled the sesame seed on the crust. Sesame seed was frequently used in dishes and soups. The Maltese used olive oil, which was imported from Sicily and North Africa. Salted butter was imported from Ireland primarily to satisfy the palate of the English inhabitants. Sheep's milk was transformed into traditional cheeslets (gbejniet) whilst other cheese was imported from Sicily. Fresh milk was supplied chiefly by goats, which were milked just outside houses, to ensure freshness.

Pork was of high quality and readily available, though mutton and veal were rather scarce. Kids and rabbits afforded frequent nourishment and were not only sold in the market, but, every family in towns and villages reared them for their consumption. The role of rabbit meat in Maltese culture and as a food item for consumption is well documented (Buttigieg et al., 2020; Cassar, 1994, 2016). Turkeys, ducks, hens, capons, chickens, guinea hens, and plump types of pigeon squab were all available and were complimented with seasonal migratory birds of passage—mostly quail, snipe, and ducks. Although these food items were directly available to the rural inhabitants, emphasizing the population and territory's intimate link due to their proximity to rural areas, the urban population could also attain of in-season vegetables and fruits sold in different village shops or bought from hawkers in the streets. The largest market was that found in Valletta and was well stocked with provisions of all kinds of animal products, vegetables, fruits, and fish which, for the convenience of the buyers, were sold at the same place. A large fish market was also located by the quayside in Valletta, and here fish was to be found in abundance.

More recently, Maltese gastronomy was described by Caruana (1998) as being made up of a blend of different traditions improvised over time using locally available ingredients, and that gave a specific identity to Malta and the Maltese, a definition that matched the description given in 1811. The diet contained a direct contribution

of seasonal (Caruana, 1998; L. Sammut, 1977) cultivated fruit and vegetables, and non-cultivated ingredients such as fennel and carob amongst others. Crops were generally complimented with limited diversity and supply of animal products from raised livestock that included milk, cheeslets, eggs, and meat from spent hens, capons, rabbits, squab, and pork. Most of these animals complemented the frugal way of life of our ancestors in their small holdings. The limited resources obliged the minimizing of waste, and livestock was used to varying extents as scavengers and recycling vehicles of kitchen scraps and other edible garbage thus eliminating any waste of food. In this way, the diet and cuisine in rural Maltese localities have been inherited from their ancestors who primarily attained their food through backyard farming with a relative degree of self-sufficiency—barring crop failure. Beef did not form part of the diet in rural Malta and was but a recent addition following the arrival of the British forces.

The Roman Catholic faith also played a huge contribution in shaping the Maltese culture and heritage. Devotion led to various dwellings for worship, but it also had an impact on civilian lifestyle and habits including many culinary traditions. While many traditional Maltese sweets are baked during certain religious holidays or festivals, such as Lent, Easter, or Christmas, there was also the custom of restricted consumption of meat Wednesdays and Fridays, which was more observed in the past (S. Zammit, 2011), and the consumption of particular food on certain days, such as qubbajt (nougat) normally associated with the village festas, qagħaq tal-Appostli a bread ring eaten on Maundy Thursday and Good Friday, figolli for Easter and the consumption of vegetables such as globe artichokes during Good Friday (Wirth, 1991). Thus, religion would likely influence the consumption habits of the elderly who were found to have a high attendance rate to Sunday mass (Inguanez et al., 2018).

As with any other custom and tradition, food preparation has also been passed on from one generation to another. Both Tessier et al. (2005) and Piscopo (2004) emphasized the important role of mothers and grandmothers in transferring recipes and in promoting and exposing their children and grandchildren to rural fare. Hence, the findings of Inguanez et al. (2018) tend to complement those of Tessier et al. (2005) and Piscopo (2004). Data on the dietary habits of the Maltese population are limited (Pace et al., 2004). Mizzi (1994) reviewed the food consumption patterns in Malta for the 1960–1990 period. His observations trends tally with those expressed by Helsing (1991) citing Vuksan et al. (1982), who highlights that “the Maltese diet has for historical reasons many traits in common with that of Northern Europe”. Mizzi (1994) indicates that the one hundred and fifty years of British



colonial rule, the impact of tourism—both inbound and outbound—and the media, as possible factors contributing to this food consumption model. Malta joined the DAFNE V project in 2003. This project provided an opportunity to use the Household Budget Surveys (HBS) for providing information on the dietary habits of the Maltese population. Pace et al. (2004) and M. Sammut (2006) presented their HBS observations and results indicated a general increase in the daily availability of most food groups, that could have reflected:

1. an increase in the variation of food stuffs available,
2. an increase in the national production of most commodities,
3. the 'all year round' availability of previously seasonal food items and
4. the action plans of the Health Promotion Department to promote the value of the Mediterranean diet together with the 'five-a-day' campaign to consume at least five portions of fruits and vegetables daily, implemented at the end of the nineties.

The results suggested that the highest availability of most food groups was associated with retired people as head of households. The fact that retired people may have more time available to dedicate to preparing homemade meals than workers is reflected as a higher quantity of foods purchased to supply for their children's families, especially since more women chose to re-enter the workforce. However, decreases in the purchasing capacity reflected a decrease trend in food availability for most food groups between 1994 and 2000. The results relate solely to purchased food and do not include any household availability of family produced food products that are the basis for the preparation of typical foods and the conservation of consumption culture with a Maltese identity. Although contributions from own production are systematically recorded in the national HBS, the Maltese Statistical Office did not collect this information as own production was considered as negligible.

In 2015, the European Commission stated that because of globalisation and urbanisation, the food consumption habits of the Maltese had evolved partly due to the increasing availability of greater variety of food with dietary patterns that no longer corresponded to the traditional Mediterranean diet. However, the same report stated that in Malta "food is seen as a cultural signifier that embodies tradition and identity: eating traditional dishes at certain time of the year is considered as a food ritual and fosters a sense of cultural belonging".

Recently, two studies (Cuschieri et al. (2021) and Treki et al. (2021)) were published on the adherence of specific groups within the Maltese social strata to the Mediter-

anean diet. In evaluating the food habits of the adult dietary habits, Cuschieri et al. (2021) remark that while the Maltese food culture have never been portrayed as matching the Mediterranean diet due to the British influences, their results indicate a progressing scenario in which the Maltese adult population, similarly to what is being recorded in other Mediterranean islands, is shifting away from the cultural diet and promoting a more Westernized diet. Similar trends were observed by Treki et al. (2021) when studying the dietary patterns of students at the University of Malta. This scenario has prompted the emergence of a movement to revalorise and facilitate the typical Mediterranean diet.

Observations of agriculture in the Maltese Islands suggest that farming systems changed at varying rates over time in response not only to natural conditions that determined what crops would grow or not, but also to a wide range of production factors related to availability and cost of land, labour, input materials and the prevailing market situation (Food and Agriculture Organisation of the United Nations, 1988)[p. 32–34]. During May 1991–January 1992, an FAO/TCP mission assisted the Government of Malta in the preparation of an in-depth policy analysis and review of the agricultural sector aimed at the implications of new international and domestic policy changes necessary for eventual membership to the European Union. At this point, the mission confirmed that while the economic role of agricultural sector had decreased to less than 3% of the Gross Domestic Product, and that farming in the Maltese islands had become a part-time business as less than 10% of farmers were full-timers. The 10,700 hectares of agricultural land gave an average farm size of 0.7 ha for the 15,000 farmers and, furthermore, about 45% of the farms were between 0.01 and 0.5 ha (Food and Agriculture Organisation of the United Nations, 1992)[p. 4].

The 2020 NSO Census of Agriculture, indicates that, as from 2010 to 2020, the number of agricultural holdings decreased by 14.8% from 12,268 in 2010 to 10,449 in 2020. Of these, there were 4,327 agricultural holdings or 41.4% whose produce was solely for their own consumption, while the remaining 6,122 holdings or 58.6% sold all or part of their produce. The amount of utilised agricultural area decreased by 6.2%, from 11,445 hectares in 2010 to 10,730 hectares in 2020. Furthermore, the agricultural labour force declined by 25.8% per cent, from 18,212 persons in 2010 to 13,511 persons in 2020 (National Statistics Office, 2022). The prevailing situation, is that, with an ever-increasing population on an island with few natural resources, the agricultural base has suffered continuous infringements to meet other priorities.

Malta's accession to the European Union in 2004 fur-

ther contributed to the transformation of food consumption patterns. Mizzi (1994) highlights that sociocultural features, demographic patterns, and consumers' attitudes and perceptions of different foods play an important role in moulding consumption patterns. Since accession to the European Union, Maltese demography experienced an influx of non-Maltese settling in Malta. The dynamics of these newcomers are not homogenous and can broadly speaking be classified as:

1. EU citizens entitled to free movement,
2. Non-EU citizens that reside based on a worker's visa,
3. Irregular immigrants.

These new settlers have brought along their particular cultural identity, the bulk of which form part of the national labour force originate from Eastern Europe, Near East, Middle East and central African countries. The residential clusters where these newcomers settle are experiencing a gradual shift from what was perceived as a typical Maltese lifestyle, including food consumption habits that were tweaked to accommodate and adopt the imported customs and tastes. This implies a new identity of changing communities that is bound to influence Maltese gastronomic development.

The island's food consumption patterns have always been in a continuous state of flux. The ongoing cultural and social changes are leading to busy lifestyles with a greater prevalence of foreign products and influences. This is also affecting the traditional Maltese cuisine, possibly inducing the loss of some of its important aspects, if not completely replacing it in some instances. The potato story is a case in point. While the farmers and people were conservative and somewhat sceptical of the newly introduced potatoes, it now ranks at par with bread and pasta, so much so that Buttigieg (2014) felt it pertinent to ask: 'And which is the 'authentic' fenkata, the one served with potatoes?'. This suggests possible issues which students and academics in the fields of agricultural sciences, marketing, food science, and nutrition will face when selecting locations and parameters on which to base their research when they are seeking to evaluate consumption patterns of traditional Maltese food. It, therefore, appears pertinent to compile all available data and provide guidelines on location selection about research on cultural food consumption. The aim of this study is to identify and rank the locations that have a greater probability of having inhabitants that still retain a local production and food consumption culture synonymous with the identity of the Maltese rural society.

## 2 Methodology

Initially, the following data was considered to contain the key indicators directly connected with localities that maintain a style of food preparation and consumption linked to traditional rural food culture: agricultural area, population density, number of foreign inhabitants, kitchen gardens, and backyard farming as characterised by the number of small flocks of sheep, goats, and poultry, full-time farmers, part-time farmers, and total farmer population—whereby the NSO distinguishes farmers by as to who works more, or less, than 1800 hours. It was assumed that kitchen gardens and the backyard livestock holdings were not managed on a commercial basis but served to provide a supply of staple food to the family and extended members of the family and possibly neighbours. Data on these indicators was obtained from the National Statistics Office (NSO). In the case of livestock numbers, this refers to the number of heads on small holdings that have less than 10 sheep and goats, plus chickens and laying hens that are exempt from a commercial licence.

The indicators were analysed to identify which parameters are closely correlated. The CORREL function in Excel was used to find the correlation coefficient between the various parameters. The correlation coefficient (a value between -1 and +1) gives an indication of how strongly two variables are related to each other. Based on values of the correlation coefficients a group of the most relevant parameters were selected. A final ranking of the rural localities most likely having a high percentage of its population that still retained the rural food preparation and consumption habits were consequently calculated for each location as follows:

$$\frac{\left( \frac{\sum \text{of parameters having strong correlation greater than 0.8}}{\text{total population of the location}} \right)}{\text{highest value}} \times 100 \quad (1)$$

This ranking was based on the degree of exposure per inhabitant of that particular locality to the selected indicators.

## 3 Results and Discussion

### 3.1 The Maltese urban-rural dichotomy

The Maltese urban-rural dichotomy was studied to some extent by A. Zammit (1986, 1990). The main factors that generally shape settlement patterns are issues of economic, social, cultural, environmental, and other factors. In the not-so-distant past, when the strategic importance of the Maltese islands was still had to affirm itself, their whole economy depended on agriculture. The quality and

quantity of Maltese agriculture has always been dictated by enlarge by the geophysical characters of the territory. Often described a semi-arid territory with shallow soils, land production was governed by the availability of irrigation water. Land that had access to water, through natural springs or otherwise, was generally used for the production of vegetables and food crops, whilst the other areas that were dedicated to cash crops such as cotton and cumin in the past now have potatoes and tomatoes, in areas supported with drip irrigation. Remaining e areas have been utilised for fodder production. Up to the 1950's the main livestock were the sheep and goats. While goat's milk was predominantly dedicated towards fresh consumption as liquid milk, sheep's milk was transformed into a soft curd cheese known locally as gbejniet. Other courtyard animals included rabbits, poultry and pigeons. With the coming of the British era, a new agro-industrial sector evolved based on the importation of live bulls to be fed on imported feed to be finished off to supply the British forces as well as the resident population with beef. This economic activity provided opportunities of prosperity and contributed towards making available larger quantities of manure to apply to soil. The goat population that suffered a significant shrinkage to provides meat during the second world war., The scheme introduced in 1956 to substitute goats for dairy cows to curtail the spread *pf brucellosis*, also known as Malta Fever, further decimated the goat population (Rizzo Naudi, 2005).

Meli (1994) noted that observations of agriculture in the Maltese Islands suggested that farming systems changed at varying rates over time in response not only to natural conditions that determined what crops would grow or not, but also to a wide range of production factors related to availability and cost of land, labour, input materials and the prevailing market situation. While other natural factors, geology, topography, climate and soil types provided the basis for land utilisation, the cumulative results of long continued action plus the interaction of historical, political, economic and technological factors, not only influenced the changing patterns of land use, but dominated over factors of production. The conceptual framework of size has dominated as well on the behavioural activity of farmers in their outlook towards crop patterns or methods of livestock production by increasing the possibility of minimization of inputs or effort. Through time, a system of hamlets, villages, towns and cities evolved with distinct urban and rural identities where one is a boundary condition of the other. Within this context, the Maltese rural spaces were the main source of food and at the same time provided for employment and income for many people. However, although Maltese farming was productive, it is a well-known fact

that Malta, that even since the late Middle Ages, did not produce enough wheat to meet the island's needs and hence wheat, cereals and pulses were imported regularly from Sicily (Wettinger, 1981).

Meli (1994) observed that throughout Malta's history, the progress of society was affected by the agricultural base in that an always increasing population required food to survive. During the country's evolution, transition of agricultural land and workers also met other development needs, and planning policy, directly or indirectly, always reserved a role for the agricultural sector. Initially the practice of farming was based more on necessity than choice as this job involved incessant toil. Updated managerial and technical inputs improved the situation though ultimately land use and agricultural productivity resulted in regional differentiation.

Generally speaking, rural and urban areas are often conceptualised as two separate entities, and their main connection in term of land use are via flows of agriculture products from rural areas to urban centres (Seto et al., 2012). However, urban expansion has given rise to a dichotomy, that can be simplified if the rural and urban areas are considered as extremes of a gradient with many landscapes being a mosaic that combine rural and urban land (Kroll et al., 2012; Radford et al., 2013).

With the gradual evolution and modernisation of lifestyles characterised by complex economies, technological progress, socio-cultural aspirations, increased affluence, and leisure, the challenges and problems in the planning process escalated—often compounded by long periods of laissez-faire attitudes and wrong decisions. Ideally the hierarchy of settlement should reflect a pyramidal structure, with the urban centre at the vertex. The author noted that the physical demarcation lines of some settlements have disappeared, thereby giving rise to three clusters of conurbations namely: Valletta-Hamrun-Sliema, Paola-Cottonera, and Birkirkara-Lija-Balzan-Attard agglomerations. In most cases, urban expansion in Malta has happened at the expense of agricultural land, yet any remaining agricultural land parcels enclosed by urban sites and any other land that has been subjected to fragmentation mostly due to inheritance practices are increasingly being used for recreational purposes and hobby farming to supply the household with fresh locally grown produce.

### 3.2 Rural areas and population

Before 2004, when Malta's first Rural Development Plan was being engineered, one of the issues of concern was the designation of rural areas as defined by the Organisation for Economic Co-operation and Development (OECD), which essentially stated that at Nomenclature of ter-

territorial units for statistics (NUTS) 5 level, rural areas were those that had a population level below 150 inhabitants per square kilometre. This would have automatically excluded all of Malta as being rural. However, given that such a definition would have also created limitations on the Benelux countries, the Committee on Agricultural Structures and Rural Development (STAR Committee), through the OECD, allowed for the adoption of more nuanced rural definitions that incorporate differentiation from functional urban areas and reflect their specific needs. (A. Meli, Malta former STAR Committee representative—personal communication, June 2021) Malta's rural areas were first defined in the Rural Development Programme for Malta 2004–2006. For the purposes of agricultural and rural development planning, it was determined that a rural locality will be defined as a NUTS 5 level, with a population density lower than 5,000 persons per square kilometre. Based on this definition of rurality being adopted, 54 localities were classified as rural—40 in Malta and 14 in Gozo. These rural localities covered 96% of the islands' territory and 74% of the total population. The additional definitions that were adopted for the 2007–2013 period where more than 10% of the locality had to be agricultural land, and not less than 35% of the locality had to be outside the development zone, resulted in 5% less of the rural area and 10% less of the total population. At this point, local rural areas covered some 288 km<sup>2</sup> of the total islands' area with a population of 257,606, and an average population density of 896 persons per km<sup>2</sup>. On the application of this definition of rurality, 47 localities were classified as rural, 33 in Malta, and 14 in Gozo. These 47 localities accounted for 91% of the islands' territory and 64% of the total population. [Tables 1 and 2](#) presents the profile of the rural localities as established with these parameters and includes the key indicators selected for analysis.

### 3.3 Correlations between the key indicators

Indicators that showed correlation coefficients larger than +0.5 and lower than -0.5 were Agriculture area, Full-time farmers, Part-time farmers, Total farmer population, % Farmers, Population density, Sheep, Goats, Layers, and Kitchen gardens. Indicators that fell within the range of +0.5 and -0.5 were deemed to have too small a coefficient to be assumed as having an impact on rural food consumption patterns. To this effect, the multiple correlation analysis revealed that three chosen indicators, namely % non-Maltese persons, population density, and broilers follow an independent pattern and show no correlation with the rest of the indicators.

### 3.4 % Non-Maltese People

While prima facie review of [tables 1 and 2](#) does not provide much in terms of conclusions, one notes that with regards to the infiltration of non-Maltese in localities classified as rural, their greatest presence is in coastal localities, i.e., 29.8% in Birżebbuġa, followed by 21.01% in Saint Paul's Bay and 11.1% in Mellieħa, with a total number of inhabitants of 8397, 14054, and 7935 respectively. Most probably, since the bulk of non-Maltese are members of the workforce, they are presumably opting to settle in urban rather than rural localities due to easier logistics to and from the place of employment, however Birżebbuġa and Saint Paul's Bay are also renowned as being dormitories of the foreign working class, most probably due to lower rents in these localities as compared to the more central urban centres. The next cluster of localities having a non-Maltese population of 8%–11% all fall in Gozo: Għarb, Għasri, San Lawrenz, Munxar, and Żebbuġ (Gozo)—with a total number of inhabitants of 1150, 383, 571, 986, 1732 respectively. The infiltration of foreigners involves a wide range of drivers other than strictly economic ones (Milbourne, 2007), as some individuals may be seeking a connection with the rural environment so much so that Għarb, Għasri, San Lawrenz and Munxar are renowned for their rustic farmhouses and houses of character. This study indicates that when all these aspects are taken into consideration together with the fact that the numbers in rural areas are overall very small, shows that this parameter is not relevant to the scope of this study.

### 3.5 Agriculture Area

Since arable land is the main fabric that will allow for the evolution of agriculture and hence rural communities, it is of no surprise that this indicator showed strong positive correlations at over +0.8 with farmers' population. Farmers that till the land, sheep that feed on roughage, and kitchen gardens all require the land base to exist. While the correlation coefficient of sheep stands at 0.77, goats and poultry have a coefficient below the 0.5 cut-off point suggesting that these indicators are not dependent on agricultural land.

### 3.6 Population Density

Results show a strong negative correlation (-0.709) between population density and % of farmers. High population density is synonymous with the presence of concentrated habitation. High-density pockets are not typical of rural community areas although they may infringe. though with limited exposure and interaction with rural aspects.

Locality	<sup>a</sup> % Non-Maltese People	<sup>b</sup> Surface Area in Km <sup>2</sup>	<sup>b</sup> Agriculture Area in ha	<sup>b</sup> % of Agriculture Land	<sup>b</sup> % ODZ	<sup>b</sup> Total Population	<sup>b</sup> Population Density	<sup>c</sup> Full-time farmers	<sup>c</sup> Part-time farmers	<sup>d</sup> Sheep	<sup>d</sup> Goat	<sup>d</sup> Broilers	<sup>d</sup> Layers	<sup>d</sup> Kitchen Gardens in ha
Rabat (Malta)	2.08	26	1702.1	63	95.6	10943	422	180	1168	250	81	50	556	110.9
Mosta	2.69	7	368.9	54	70.3	19273	2914	90	713	54	6	0	1324	115.8
Siggiewi	1.41	20	926.5	46	95.3	8210	413	52	729	209	69	18	313	125.7
Żebbuġ (Malta)	1.29	9	410.6	47	82.7	11468	1337	68	592	139	98	50	383	76.4
Żurrieq	1.27	8	344.1	40	84.8	10286	1216	31	654	159	73	18	282	99.1
Żabbar	0.75	5	286.6	54	72.5	14709	2788	67	411	85	54	20	520	48.8
Qormi	2.19	5	174.4	34	58	15958	3259	78	266	65	94	20	618	52.1
Qala	7.19	6	80.3	14	90.5	1703	309	1	139	46	21	665	228	20.4
Xewkija	1.72	4	135.6	30	73.9	3089	694	29	306	167	81	103	372	42.6
Mellieħa	11.1	21	562.9	24	91.2	7935	382	62	554	118	36	0	100	103.1
Żejtun	0.7	5	334.9	62	63.6	11147	2112	48	548	128	88	0	100	51.3
Xagħira	4.99	7	246.3	32	98.5	3770	520	20	444	103	44	147	104	59.6
Mġarr	2.62	16	742.6	46	97.2	3450	216	160	356	118	10	0	224	44.7
Luġa	1.63	6	101.8	15	83.5	5621	879	14	260	34	11	66	359	37.6
Ta' Kerċem	3.94	5	249.4	45	93.2	1681	313	30	200	55	18	20	415	39.9
Nadur	3.1	7	283.4	40	87.5	3851	554	35	449	139	57	12	12	65.9
Qrendi	1.82	5	226.4	46	91.7	2641	544	13	270	22	11	262	143	34
Victoria	2.41	3	172.2	59	52.5	6075	2157	34	284	76	55	74	174	37.2
San Pawil il-Baħar	21.01	12	628.5	43	83.5	14054	1129	107	302	49	16	0	100	85.3
Birżebbuġa	29.81	7	328.7	35	58.8	8397	1130	9	354	81	45	25	12	54.4
Xgħajra	2.02	1	16.3	16	74.8	1601	1627	0	3	0	0	0	525	3.7
Dingli	1.06	6	366.3	64	94.7	3561	620	36	314	81	11	0	29	54
Ta' Sannat	4.56	11	259.9	27	88.8	12766	1113	30	248	107	45	0	10	80.2
Lija	4.89	3	40.6	16	51.4	11809	4643	25	99	4	3	46	252	18.5
Kirkop	0.91	1	41	37	76.3	2297.0	2001	4	160	67	21	36	142	13.6
Għaxaq	0.86	4	122.2	31	86.2	4606	1188	15	222	88	44	0	40	33
Żebbuġ (Gozo)	8.31	7	230.3	30	78.8	1732	244	7	184	25	10	39	127	41.5

Table 1: Profile of rural localities as of 2006 together with the key indicators.

Source: (a) NSO 2016, Demographic Review 2014; (b) Rural Development Programme for Malta 2004–2006; (c) Census of Agriculture 2001; (d) NSO unpublished data.

Locality	<sup>a</sup> % Non-Maltese People	<sup>b</sup> Surface Area in Km <sup>2</sup>	<sup>b</sup> Agriculture Area in ha	<sup>b</sup> % of Agriculture Land	<sup>b</sup> % ODZ	<sup>b</sup> Total Population	<sup>b</sup> Population Density	<sup>c</sup> Full-time farmers	<sup>c</sup> Part-time farmers	<sup>d</sup> Sheep	<sup>d</sup> Goat	<sup>d</sup> Broilers	<sup>d</sup> Layers	<sup>d</sup> Kitchen Gardens in ha
Mqabba	0.95	3	68.7	26	85.5	3236	1238	16	149	44	30	100	22	33.2
Għajnsielem and Comino	4.47	7	129	17	89.4	2563.0	369	15	133	43	11	2	113	24.6
Safi	2.64	2	132.5	57	86.3	2066	908	3	165	30	18	0	99	21.3
Għarb	10.38	4	127.9	27	91	1150	258	8	114	50	15	0	76	18.6
Gudja	1.38	2	165.6	72	83.6	3007	1331	3	219	36	0	0	0	13.4
Naxxar	4.56	4	319.1	68	82.2	1779	477	13	132	63	42	0	0	20.2
Għargħur	4.91	2	100.5	50	86.2	2557	1292	13	170	35	11	0	0	21.9
San Lawrenz	9.37	3	89.8	25	95.1	571	171	2	83	7	0	12	134	11.8
Marsascla	7.34	5	152.4	28	75.1	10812	2057	20	79	41	12	60	20	13.5
Attard	2.27	7	140.5	21	75.2	10517	1590	34	111	3	13	0	29	26.3
Munxar	9.29	3	87.4	16	87.5	986	378	2	74	21	7	24	40	8.7
San Gwann	4.89	1	44	36	39.0	2920.0	2718	23	47	20	6	0	54	8.4
Marsaxlokk	2.28	5	206.8	43	85.3	3344	714	7	86	26	23	0	0	12.5
Fontana	1.8	0	7.7	16	78.7	871	1862	17	19	8	9	0	66	5
Għasri	9.67	4	127.2	25	92.4	383	86	4	63	22	6	0	0	7.5
Mtarfa	0.85	1	56.6	80	99.3	2560	3560	0	11	10	10	0	0	25.8
Kalkara	1.69	2	34.1	18	65.3	2904	1675	1	36	6	1	0	0	6.7
Iklin	1.87	2	22.5	13	71.5	3145	1836	1	6	0	0	0	20	8.8
Santa Lucija	0.74	1	20.2	28	58.5	2947	4112	0	16	0	0	0	0	2.6
Mdina	6.44	1	14.2	15	61.1	218	270	1	10	0	0	0	0	0.436

**Table 2:** Profile of rural localities as of 2006 together with the key indicators.

Source: (a) NSO 2016, Demographic Review 2014 (b) Rural Development Programme for Malta 2004–2006 (c) Census of Agriculture 2001 (d) NSO unpublished data.





Locality	Part-time farmers	Sheep	Kitchen Gardens	Total Population	Ranking
Rabat (Malta)	1168	250	110.9	10943	100.00
Siggiewi	729	209	125.7	8210	66.15
Żurrieq	654	159	99.1	10286	57.33
Mosta	713	54	115.8	19273	54.09
Żebbug (Malta)	592	139	76.4	11468	51.55
Żejtun	548	128	51.3	11147	47.67
Mellieħa	554	118	103.1	7935	47.39
Nadur	449	139	65.9	3851	41.47
Xagħra	444	103	59.6	3770	38.58
Żabbar	411	85	48.8	14709	34.98
Mgarr	356	118	44.7	3450	33.43
Xewkija	306	167	42.6	3089	33.36
Birżebbuġa	354	81	54.4	8397	30.68
Dingli	314	81	54	3561	27.86
Victoria	284	76	37.2	6075	25.39
Ta' Sannat	248	107	80.2	12766	25.04
San Pawl il-Baħar	302	49	85.3	14054	24.75
Qormi	266	65	52.1	15958	23.34
Għaxaq	222	88	33	4606	21.86
Luqa	260	34	37.6	5621	20.73
Qrendi	270	22	34	2641	20.59
Ta' Kerċem	200	55	39.9	1681	17.98
Gudja	219	36	13.4	3007	17.98
Kirkop	160	67	13.6	2297	16.01
Żebbug (Gozo)	184	25	41.5	1732	14.74
Għargħur	170	35	21.9	2557	14.46
Naxxar	132	63	20.2	1779	13.75
Safi	165	30	21.3	2066	13.75
Mqabba	149	44	33.2	3236	13.61
Qala	139	46	20.4	1703	13.05
Għajnsielem and Comino	133	43	24.6	2563	12.41
Għarb	114	50	18.6	1150	11.57
Marsascalea	79	41	13.5	10812	8.46
Attard	111	3	26.3	10517	8.04
Marsaxlokk	86	26	12.5	3344	7.90
Lija	99	4	18.5	11809	7.26
Munxar	74	21	8.7	986	6.70
San Lawrenz	83	7	11.8	571	6.35
Għasri	63	22	7.5	383	6.00
San Gwann	47	20	8.4	2920	4.73
Kalkara	36	6	6.7	2904	2.96
Fontana	19	8	5	871	1.90
Mtarfa	11	10	25.8	2560	1.48
Santa Luċija	16	0	2.6	2947	1.13
Mdina	10	0	0.436	218	0.71
Iklin	6	0	8.8	3145	0.42
Xgħajra	3	0	3.7	1601	0.21

Table 4: Ranking of localities.

### 3.7 Full-time farmers

Full-time farmers are significantly fewer in numbers than part-timers and are commercially oriented to deliver produce to markets. Their focus may not permit them in terms of time and effort to take up pluriactivity as this would deviate them from crop production. This indicator has a moderate coefficient of correlation with sheep, layers, and kitchen gardens all of which are strongly associated with the provision of basic materials used in rural home cooking.

### 3.8 Part-time farmers

Part-time farmers have a stronger positive correlation than full-time farmers with the number of sheep, goats, layers, and kitchen gardens. This is quite a relevant outcome, given that the number of part-time farms far outnumbers that of full-timers and hence has a greater influencing potential on the rural food culture. While major advances in crop production were confined by the unavailability of water and lack of improved management and technology, the not so constrained but intensive livestock sector fared better but remained dependent on feed imports. Fragmentation has also led to a predominance of tiny rural holdings. This combination of factors could thus have led to the predominance of part-timers, representing 90% of total farmers, by 1991. As of 2020, 11,713 part-timers represented 87% of total farmers. Apart from constraints imposed by climatic and geophysical factors, human activity in the Maltese Islands has played a central role in the shaping of agriculture, and the prevailing situation is not indicative of an evolving process synonymous with change, but of essentially traditional agriculture which, while reflecting certain changes because of socioeconomic interaction, has not undergone many radical transformations (Meli, 1994). The results indicate that this group of farmers is strongly correlated with kitchen gardens—hence the provision of seasonal fruit and vegetables for consumption at home and by the extended family. The fact that they are also correlated to sheep, goats, and layers may also infer that apart from horticultural production, they may also indulge in livestock production to be more self-sufficient. Although backyard rabbit production is not captured in the national statistics, one could safely assume that this segment includes small rabbit units comprised of up to 10 does kept for home consumption. The rabbit is well entrenched into Maltese cuisine, culture, and traditions, so much so, that the Maltese national dish is cooked rabbit known as ‘Stuffat tal Fenek’ (Cassar, 1994, 2016; De Battista, 1985).

### 3.9 Small Ruminants: Sheep and Goats

Malta’s indigenous breeds of sheep and goats has always constituted a backyard industry since the production of sheep and goats’ milk is for the production of cheeselets (Ġbejna) eaten fresh, dried or peppered. Additionally, culled animals, lambs, and kids also contribute to the food culture as mutton, lamb, and kid meat. The products of this industry are usually intended for home consumption on an ‘extended’ family basis or sold within the neighbourhood if in surplus. The ġbejna is an important element in several traditional dishes and is popular in various cheeselet-based dishes such as ravioli, qassatat, pastizzi, and torta tal-ġbejniet. The consumption of lamb and mutton dishes prevails during the Easter period. The significant discrepancy in the coefficient of correlation between sheep and goats with part-time farmers needs addressing. Historically, sheep have always outnumbered goats, a situation that is also relevant today (Tables 1 and 2), with a sheep population that is roughly three-fold that of goats. However, this fact alone does not explain why sheep correlate with a coefficient of 0.87 with part-time farmers while goats feature at 0.68. This discrepancy between the two populations is probably because the current goat population includes a significant group of recently introduced goats, such as the pygmy goat, that are not kept for their milk, but rather are kept as pets.

### 3.10 Poultry: Layers and Broilers

Eggs and poultry meat also formed part of the local gastronomy, so much so that Cesareo (1950) states that the Maltese Black, an indigenous breed of chicken served as a rustic, dual-purpose breed capable of producing adequate egg and chicken for consumption. While eggs find their way into local cuisine in standalone dishes such as balbul-jata, which is made with beaten eggs and tomatoes, they are also frequently incorporated as a binder for recipes based on flour, and cheese, while poultry meat was served on special occasions or used to make broth to be given to the sick. MacGill (1839) captures both in his description of the Maltese weddings, stating on pages 29–30:

‘The families of the peasantry invited to one of these weddings bring in their horgia, a fowl or capon, prepared for the pot with a distinguishing sign, attached to it; a large loaf, and one or more bottles of wine: a kettle or boiler is provided, into which the whole of the volatiles are thrown, and at the appropriate time a quantity of paste or vermicelli, (provided by the father of the bridegroom,) with other condiments, is put into the pot; which forms an excellent soup or minestra. Now comes a scene of enjoyment hurry-scurry and excitement; a friend of the

bridegroom presides over the boiling cauldron, dives a large fork into it, and holds up the produce to the excited party; each knowing his distinguishing mark, claims it as his property, and carries it off.'

Although poultry occupies a role in local cuisine, results indicate very poor correlation coefficients. The fact that broilers do not feature in the correlation analysis, and that layers are only just correlated with part-time farmers and kitchen gardens suggests that these indicators have moved away from the pure rural context. A potential interpretation could be that small flocks need minimal housing requirements and can easily be bred by people who are not part-time farmers or have access to kitchen gardens. Feed, the one element that would link poultry with kitchen gardens are easily purchased from the two major feed mills and other outlets, abolishing the need to resort to kitchen gardens. Additionally, it has been observed that broiler production typically follows a cobweb cycle with new entrants after a year of high prices and fewer producers after a bad year by part-time amateurs.

### 3.11 Kitchen Gardens

According to the survey on kitchen gardens in Malta (National Statistics Office, 2005), the large majority of agricultural holdings are a family concern that directly supports the farmer's household without producing a significant surplus for trade. The produce from these holdings is not sold at the official markets, as is normal practice with commercial agricultural holdings. Since traditions are passed on from one generation to the next, one would expect that the aspect of home cooking would also follow the same form of transmission. Piscopo (2004) further identified that grandparents have an important role in promoting and exposing their grandchildren to traditional food. Hence, as far as food is concerned, one can venture to say that it is usually mothers who transfer recipes to their children and grandchildren, from one generation to the next.

### 3.12 Ranking

Since results indicate that part-time farmers contribute most towards retaining rural food production and consumption habits, the indicators having a high coefficient of correlation with part-time farmers were used to formulate the ranking of the rural localities most likely having a high percentage of its population that still resorted to rural food preparation. In this context, references to food consumption relate to the rural fare provided by market gardeners and small livestock producers. The calculation for each location is as follows:

$$\frac{\left( \frac{\sum \text{of Part-time farmers, Sheep and Kitchen Gardens}}{\text{total population of the location}} \right)}{\text{highest value}} \times 100 \quad (2)$$

This ranking is based on the degree of exposure per inhabitant of that particular locality to the selected indicators. The results presented in table 4, indicate that the Rabat (Malta), Siggiewi, Żurrieq, Mosta, and Żebbug (Malta) cluster of the top five locations that have a population that is most likely still exposed to the traditional way of cooking and food habits, while Mtarfa, Santa Luċija, Mdina, Iklin and Xgħajra are at the bottom of the rank. This ranking clearly supports the concept that the rural and urban areas need to be considered as extremes of a gradient with various landscapes being a mosaic that combine rural and urban land.

## 4 Conclusion

A very comprehensive definition of traditional food is given by Guerrero et al. (2009): 'A product frequently consumed or associated with specific celebrations and/or seasons, normally transmitted from one generation to another, made accurately in a specific way according to the gastronomic heritage, with little or no processing/manipulation, distinguished and known because of its sensory properties and associated with a certain local area, region or country.' This definition indicates that cuisine and food production forms part of a country's cultural identity and traditions. In this day and age of globalization, the rediscovery of "tradition foods" is a response to the deep-rooted desire for reassurance and story-telling (Geyzen et al., 2012). It is also important to note that the concept of traditional food within modern lifestyles is particularly diffused and fluid (Amilien et al., 2013) and is being adopted in a loosely manner by food writers, chefs, food marketers, and policy makers. The complexities of the "tradition" concept can be presented on four underlying axes, i.e.

1. geographical origin,
2. historical use,
3. specificities of artisan production and culinary skills, and a more longwinded aspect of,
4. overall story-telling.

In agreement with this, Buttigieg (2014) argues that Malta's regional characteristics should be seriously taken into consideration when conducting food culture surveys. In support of this argument, this study has showed that rather than conceptualising the Maltese rural and urban

areas as two separate entities, they should be characterised along a gradient with the pure rural and urban at the extremities at opposite ends.

This study indicates that rural affinity is best evaluated by the parameters part-time farmers, the number of sheep in small holdings, and kitchen gardens. Future studies on Maltese typical culinary culture should include these parameters for consideration in the identification and selection of locations to include in their research. A ranking across a gradient of the Maltese rural location has been accordingly tabled. These results can serve as a guideline in selecting appropriate locations on which to conduct surveys to evaluate the consumption patterns of traditional Maltese rural fare. Furthermore, in line with the findings of Inguanez et al. (2018) and those of Tessier et al. (2005) and Piscopo (2004), surveys could be conducted by focusing on the adult population attending Sunday mass.

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*Research Report*

## Immature High Grade Teratoma in A 17-Year-Old Lady—a case report

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**Abstract.** Immature teratomas are uncommon, malignant ovarian neoplasms that make up less than 1% of ovarian germ cell tumours. Immature teratomas are often larger and occur in younger women (in the first three decades of life). This case report discusses a 17-year-old lady who was admitted to the emergency department in view of dyspnea, severe abdominal pain, abdominal distension and loss of appetite. On CTPA she had a large pelvic mass, and was referred to gynaecology. She underwent an elective right salpingo oophorectomy and cystectomy. Histology report indicated ovarian immature teratoma (high grade, grade 3) showing extensive neuroectodermal differentiation. The incidence of immature teratoma is highest in young adults. Most patients present with early-stage disease, are managed with fertility sparing surgery and chemotherapy with an excellent prognosis. Diagnosis requires a combination of clinical, radiological and laboratory findings.

**Keywords:** Ovarian neoplasms, immature teratoma, biomarkers, younger women.

### 1 Introduction

Immature teratomas are uncommon, malignant ovarian neoplasms that make up less than 1% of ovarian germ cell tumours. Immature and embryonic tissue from all three cell lines may be present within immature teratomas, and primitive neuroectodermal tissue is the most common malignant tissue subtype. Compared with mature teratomas, immature teratomas on average are larger, occur in younger women (in the first three decades of life), and show more solid components on imaging. The presence of small amounts of fat within an aggressive ovarian mass can suggest the diagnosis of malignant immature teratoma (Siegelman, 2005).

### 2 Case presentation

A 17-year-old lady presented to the emergency department with dyspnea, severe abdominal pain, abdominal distension and loss of appetite. Patient had no previous medical or surgical history, and was not taking any treatment. On admission she had a CT pulmonary angiogram (CTPA) done in view of dyspnea which showed no evidence of pulmonary embolism, however this showed large heterogeneous pelvic mass likely ovarian in origin causing right obstructive uropathy.

The CTPA report commented on a large mixed solid cystic mass (as seen in figure 1) arising from the pelvis measuring 32.4 cm (cc) × 13.3 cm (ap) × 25 cm (trans) with interspersed globules of fat and calcific components. The CT also noted that the ovaries were not distinguishable and fat plane with the uterus was also not respected. Due to the mass effect, there was resultant delayed nephrogram of the right kidneys with mild hydronephrosis in keeping with obstructive uropathy. The CT report noted that moderate ascites together with the size of the lesion suggest malignant nature and high risk of torsion. No aggressive bone lesions noted. Patient was referred urgently to gynecology. On examination patient had striae on her abdomen, soft abdominal distention otherwise unremarkable examination.

Tumour markers and routine blood tests were taken. She had elevated cancer antigen (CA125), Alpha-fetoprotein (AFP) and lactate dehydrogenase (LDH).

In view of the mild hydronephrosis present and the high blood pressure readings throughout the admission, the case was discussed with urologists and endocrinologists. She was started on amlodipine 5 mg daily and was referred to medical outpatients for further endocrinological tests. Urologists deemed necessary a bilateral Pollock catheter insertion, which was done during surgery. Urgent stent-

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ing was not needed in view of normal creatinine, stable parameters, as well as lack of pain and urinary symptoms.

She underwent an elective right salpingo oophorectomy and cystectomy.

Histology report indicated ovarian immature teratoma (high grade, grade 3) showing extensive neuroectodermal differentiation, 275 mm in the greatest dimension (pT1c pNx TNM classification of malignant tumours, 8th edition).

Post-operatively she was admitted to a high dependency unit (HDU) for further observation. She had sluggish bowel sounds thus remained nil by mouth and the Pollock catheter was kept in situ. She was prescribed ciprofloxacin 200 mg twice daily and Gentamycin 400 mg daily for a total of 9 days. Post-operatively the patient complained of right sided chest pain, and on CTPA there was bilateral features of pulmonary embolism involving the lower lobar segment of pulmonary arteries. Pneumoperitoneum was also noted on the report, in view of recent surgery. She was thus started on a therapeutic dose of clexane 80 mg twice daily.

She was transferred to the gynecology ward, started on a light diet and the catheters were removed. Her case was discussed with the oncologist and CT brain was suggested.

Non-contrast and contrast enhanced CT scan of the brain report showed preserved grey-white matter differentiation. No intra or extra axial haemorrhage or collections. No space occupying lesions, mass effect or midline shift. No aggressive bone lesions. In conclusion there were no acute intra-cranial pathology demonstrated and no evidence of metastatic disease.

Her discharge plan was a renal DTPA scan in 6 weeks (to assess kidney function), gynecology outpatients follow up in 6 weeks with ultrasound. She was discharged on Rivaroxaban 15 mg twice daily for 21 days and 20 mg daily for 6 months.

Renal scintigraphy commented on good percentage uptake of both kidneys and no significant tracer retention, in conclusion there was no scan evidence of complete obstruction as seen in [figure 2](#).

She was followed up by oncology with chemotherapy and monitoring of tumour markers. CT liver was done to exclude metastasis. The report commented on a left adnexal cystic lesion measuring 4.8 (TR) × 4.4 (CC) × 4.1 (AP) cm with a tubular appearance, possibly dilated fluid-filled fallopian tube (hydrosalpinx). Note was also made of mild fat-stranding in the omentum anterior to ascending colon and adjacent to umbilicus likely omental infarction secondary to recent surgery.

Note was also made of a collection in the posterior pelvis (approx. 8 cm × 3 cm) which appeared mildly com-

plex with areas of higher density represent a postop pelvic haematoma or residual disease. A repeat scan 4-6 weeks postop was advised for follow-up and reassessment, and to allow time for postop changes to resolve. Review of the images in bone window settings revealed no abnormalities. The report commented on minor atelectasis right lower lobe. Otherwise, the lung bases show normal appearances. In conclusion no hepatic metastasis demonstrated.

A repeat scan was done which commented on enlarge axillary lymph nodes on the left up to 1.6 cm. There was a small amount of residual pelvic fluid. There was fat stranding in the area of surgery compatible with postop changes.

Ultrasound-guided biopsy was performed using an 18-G core biopsy system, in view of multiple enlarged left axillary lymph nodes described on CT. The core biopsies showed well preserved lymph node parenchyma exhibiting reactive follicular hyperplasia in places. The Ki67 index was in keeping with a reactive lymph node. There was no expression of pancytokeratins (AE1/AE3) or of synaptophysin (performed on both tissue blocks) and there was no evidence of metastatic tumour in these biopsies. In conclusion there is lymph node parenchyma with no evidence of metastatic tumour.

### 3 Discussion

Immature teratoma is a germ cell tumour composed of tissues that can be traced to the three embryonic germ layers, with at least one of the them lacking full differentiation (Medeiros et al., 2018). Immature teratoma is a rare tumour and is of unknown aetiology (Busca et al., 2020). It makes up 1% of all teratomas, 1% of all ovarian cancers, and 35.6% of malignant ovarian germ cell tumours (Busca et al., 2020; Medeiros et al., 2018). Immature teratoma is the second most common type of ovarian malignant germ cell tumor. In the ovary, mature teratomas are considered benign, and immature teratomas are considered malignant (Medeiros et al., 2018). Immature teratoma of the ovary is almost always unilateral (Alwazzan et al., 2015).

Occurring primarily during the first 2 decades of life, with 26 years of age being the mean age of presentation (Alwazzan et al., 2015; Busca et al., 2020). The most common presenting symptom is abdominal distention (81%) (Alwazzan et al., 2015). Often associated with a rapidly growing painful abdominal mass. Torsion can also be part of the presentation (Busca et al., 2020).

Diagnosis requires a combination of clinical, radiological and laboratory findings. If a young female presents with rapidly enlarging adnexal mass, with mildly elevated AFP and typical radiological findings, this raises high suspicion

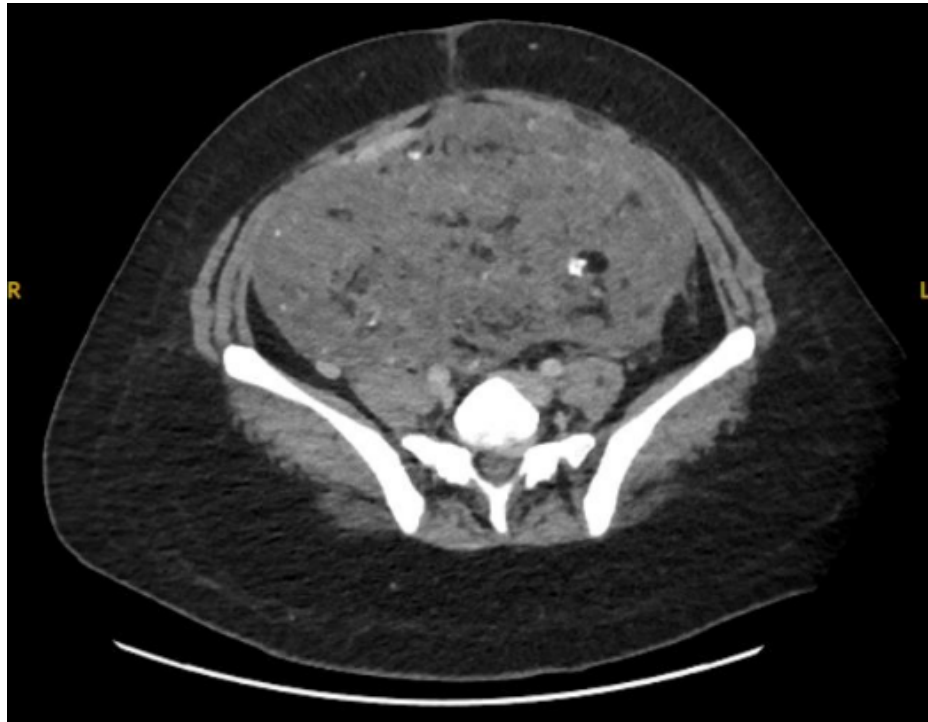


Figure 1: CT scan showing large mixed solid cystic mass within the abdomen.

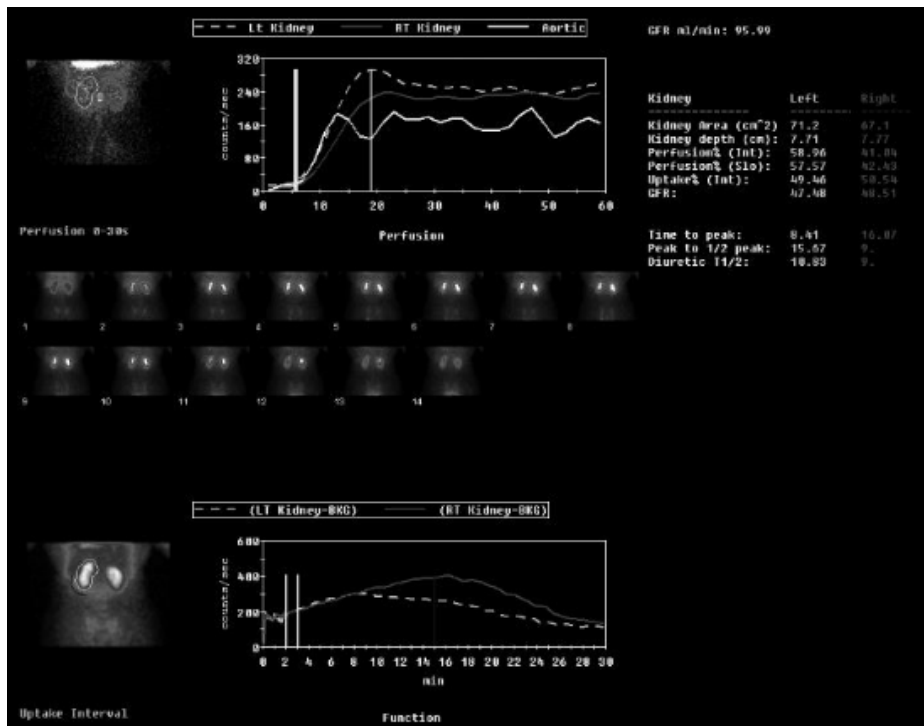


Figure 2: Renal scintigraphy of right and left kidney showing good percentage uptake of both kidneys and no significant tracer retention.

of immature teratoma. To confirm the diagnosis as well as for grading, histological examination is required (Busca et al., 2020). On CT imaging, the solid component appears large and irregular, with coarse calcifications and small foci of fat scattered throughout (Choudhary et al., 2009).

Different tumor markers are elevated depending on the component tissues. Elevated serum tumor markers, can aid in initial diagnosis, therapy monitoring, and post-treatment surveillance. For the screening of malignant germ cell tumors, CA125 is useful. CA19-9 is high in immature teratoma, and mature cystic teratoma with malignant transformation. Dysgerminoma and yolk sac tumor have high levels of LDH (Kawai et al., 1992; Shaaban et al., 2014).

Elevated  $\alpha$ -fetoprotein or  $\beta$ -hCG levels are diagnostic of ovarian malignant germ cell tumors and should be measured in all young women who present with a pelvic mass (Kawai et al., 1992; Shaaban et al., 2014). Alpha-fetoprotein is found in all patients with a tumor that contains components of a yolk sac tumor. Serum  $\alpha$ -fetoprotein concentrations are significantly elevated at diagnosis in most ovarian immature teratomas with foci of yolk sac tumor. Mixed germ cell tumors may secrete  $\beta$ -hCG,  $\alpha$ -fetoprotein, or both, depending on the components (Kawai et al., 1992; Shaaban et al., 2014).

Prognosis improves overall after chemotherapy. Older age at diagnosis, advanced stage and high grade histology confers worse prognosis (Jorge et al., 2016). Adjuvant chemotherapy has improved overall survival after surgery (Alwazzan et al., 2015). Grade is the most important risk factor for relapse (Busca et al., 2020).

Patients with stage I, grade 1 tumor may be treated through surveillance, whilst for grade 2 or 3 lesions, surgery and chemotherapy is done (Busca et al., 2020). Most of the patients present with early-stage disease, and are managed with fertility sparing surgery and chemotherapy. These have an excellent prognosis (Jorge et al., 2016).

## 4 Conclusion

The incidence of immature teratoma is highest in young adults aged 18 to 39. Most patients present with early-stage disease, are managed with fertility sparing surgery and chemotherapy and have an excellent prognosis. Later age at diagnosis, advanced stage, and high-grade histology confer a worse prognosis. Diagnosis requires a combination of clinical, radiological and laboratory findings (Jorge et al., 2016).

## 5 Acknowledgement

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Research Article

## A Geological overview of the Maltese Archipelago with reference to the Area of Sliema

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**Abstract.** This study offers an overview and account of the geological and geographical characteristics of the Maltese islands, with a particular emphasis on the Sliema peninsula. The stratigraphic sequence of the geology on the islands, including the lithostratigraphy and sedimentary structure dating back to the Oligo-Miocene Epoch, is described starting from the oldest layer, the Lower Coralline Limestone, up to the most recent rock deposition in the newly discovered quaternary rock deposition. Additionally, the report delves into the general seismic activity on the island that has contributed to the unique geomorphology, hydrology, and hydrogeology that exist on Malta and Gozo. The interrelationship between these geological components is evident on the islands, particularly in the tectonic activity that has resulted in the formation of cliffs and bays throughout. After providing a general geological overview of the islands, the report focuses more specifically on the Sliema area, a town located in the east of the main island of Malta known for its numerous rocky beaches and heavy urbanization.

**Keywords:** Geology, Maltese archipelago, geomorphology, tectonics, hydrogeology.

### 1 Introduction

The Maltese archipelago is situated in the middle of the Mediterranean Sea with latitude between  $35^\circ \wedge 36^\circ$  and longitude between  $14^\circ \wedge 15^\circ$ . It consists of three main islands: Malta, Gozo, Comino and other smaller islands like Cominotto and Filfla (Figure 1). The areal coverage of the islands is about  $316 \text{ km}^2$ . Their strategic location has led to colonization by various groups over the years, including the Phoenicians, Greeks, Romans, and other European countries. It is likely that each of these groups

contributed to the anthropogenic causes of soil erosion on exposed limestone surfaces (Bonnici et al., 1993).

The Maltese archipelago is unique because it emerges from the Pelagian Platform, which is mostly submerged under the sea. The islands are composed of sedimentary rocks formed during the Oligo-Miocene epochs and consist of five main stratigraphic formations (Pedley et al., 1976) (Figure 2).

The islands are primarily structured by two fault systems: The Great Fault and Magħlaq Fault. The fault systems contribute to the northeast tilt of the island (Alexander, 1988; Micallef et al., 2019b), have a significant impact on the subaerial geomorphology of the archipelago (Alexander, 1988) and are closely associated with the development of the Malta Graben (Illies, 1981; Reuther et al., 1985). The Great or Victoria Fault is the more extensive system, consisting of ENE-WSW trending normal faults with a dip of  $55\text{--}75^\circ$ . These faults mainly occur between Malta and Gozo, creating a horst and graben structure approximately 15 km wide. The second system, the Magħlaq Fault, is the youngest and consists of NW-SE trending, oblique flank-rift faults. These faults mainly affect the southern coastline of Malta (Bonson et al., 2007; Reuther et al., 1985).

*Sliema:* The exposed limestone surfaces are very evident in the study area of Sliema, a town located in the north-eastern coast of island.

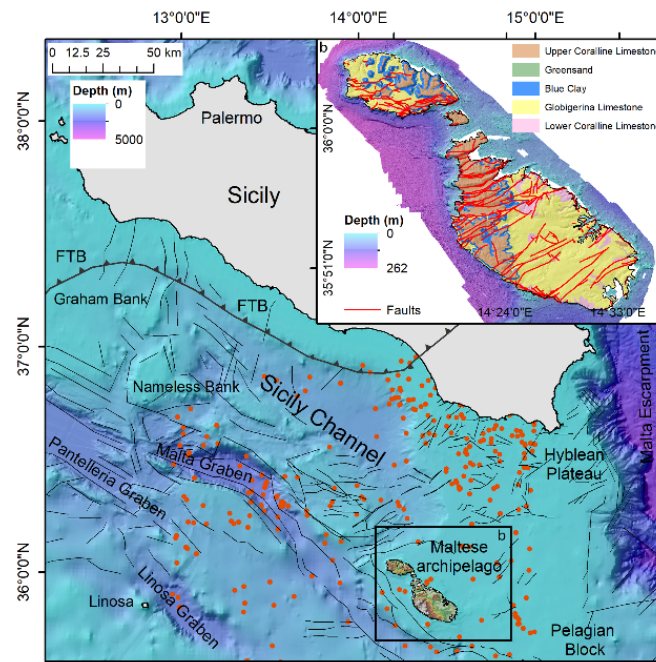
*Aim:* The aim of this study is to present a general overview of the geology of the Maltese Archipelago, with special reference to the urban area of Sliema. This can be useful for tourism purposes.

### 2 Geographic and Geological Setting

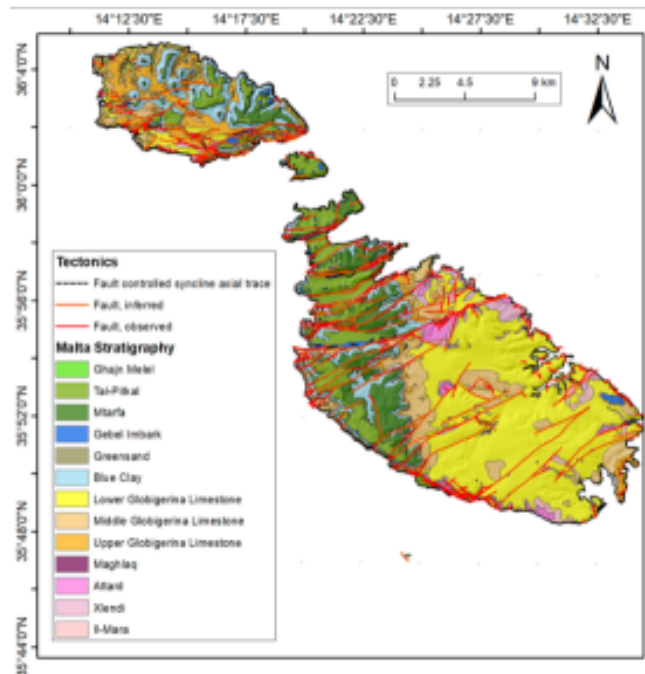
The Maltese archipelago is linked by a shallow submarine ridge, consisting of a 25–30 km thick continental crust,

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**Figure 1:** Bathymetric map of the Pelagian Platform (central Mediterranean Sea), showing the principal morphological and structural features (faults in black). Background bathymetry from EMODnet bathymetry (<http://www.emodnet-bathymetry.eu>). FTB: Fold and Thrust Belt.



**Figure 2:** Stratigraphic and tectonic Map of the Maltese Archipelago.



known as the Pelagian Platform or Pelagian Block (Spatola et al., 2018; Todaro et al., 2021) to Sicily and Africa. The islands emerge from the central eastern part of the Pelagian Platform, which served as a land bridge during the Pleistocene and allowed for the migration of exotic fauna (e.g. dwarf elephants) both northwards and southwards.

The upper sedimentary units of the Pelagian Block contain Plio-Pleistocene units of terrigenous, pelagic and hemipelagic sediments, together forming layers that are up to 300 m thick (Max et al., 1993; Osler et al., 1999; Todaro et al., 2021). Underlying these units are the sedimentary sequences of the Miocene to Cretaceous shelf edge carbonate buildups, with thickness greater than 4 km and the Cretaceous to Triassic shallow platform carbonates. These carbonate sequences are accentuated by extensive depositional hiatus, together with tufts and pillow lavas that were deposited during numerous volcanic episodes. In the northern section of the Pelagian Block lies the Sicily Channel, or Sicilian Strait, consisting of shallow waters typically less than 400 m in depth, except in the Pantelleria, Linosa and Malta grabens, which range from 1300 to 1700 m in depth (Civile et al., 2010; Spatola et al., 2018). In the north-eastern boundary of the Pelagian Block, lies the Malta Escarpment, a steep submarine cliff consisting of limestone and dolomite. It is 290 km long with a relief of more than 3 km and stretches from the eastern margin of Sicily southwards towards the Medina Seamounts. Numerous submarine canyons are present across the escarpment, which were most likely driven by subaerial fluvial erosion during the Messina Salinity Crisis (Micallef et al., 2019a; Spatola et al., 2020).

### 3 Data and Methods

The baseline information presented in this study was collected from:

1. Published literature,
2. LiDAR data and aerial photographs acquired during project ERDF 156 (Environment and Resources Authority),
3. Google Earth imagery,
4. Field surveys were also undertaken in May 2021.

Thematic maps of this study were generated using ArcGIS (<http://www.esri.com>).

## 4 Geology of The Maltese Islands

### 4.1 Lithostratigraphy

The geology of the Maltese islands is young considering the geological time frame. The Maltese Islands include five main formations which are, from bottom to top (oldest to youngest): Lower Coralline Limestone, Globiger-

ina Limestone, Blue clay, Greensand and lastly the Upper Coralline Limestone Formation (Figures 1 and 2). These formations are composed mostly of mid-Tertiary rocks and took around 21 million years to form (Alexander, 1988). The table below (Table 1) shows the epochs for each of these formations.

Lower Coralline Limestone (LCL): locally referred to as Żonqor, it is the oldest exposed layer lying at the bottom of the stratigraphic sequence. It was formed during the late Oligocene and is visible in vertical cliff faces such as the base of the Dingli Cliff section and Mtaħleb. The LCL, characterized by a hard and grey limestone, contains numerous fossils such as the *Conus* species and coral (Figure 3). It is subdivided into four geological members, named after the locations where they occur: the Magħlaq member, Attard member, Xlendi member, and il-Mara member, with Magħlaq being the oldest.

*Globigerina Limestone*: this formation overlies the LCL and is locally referred to as Franka. It is mainly composed of fine granite rocks with a yellow to pale grey colour (Figure 4). The *Globigerina Limestone* outcrops approximately 70% of the island forming gentle slopes such as those located at the lower cliffs at Dingli, as well as outcrops in the Marsaxlokk area. Two distinctive fossils, the Sea urchin and Sand Urchin, dating back 30–25 million years ago, are commonly found embedded in the formation. The formation is subdivided by two beds of phosphorite pebbles into three members, from oldest to youngest being the Lower, Middle and Upper *Globigerina Limestone*.

*Blue Clay*: this formation is characterized by alternating shades of grey ranging from dark to pale and a low to high carbonate content percentage, was formed during the middle Miocene period. The formation is primarily located in the northwestern regions of the Maltese islands, with its maximum thickness found in the North of the Gozo Island (as depicted in figure 2). According to Alexander (1988), the carbonate calcium content in the Blue Clay can range from a minimum of 2% to a maximum of 30%. The Blue Clay strata are composed of soft fine clay, easily erodible and prone to slope formation. Furthermore, the Blue Clay being impermeable acts as a collection point for groundwater, leading to the creation of the perched aquifer (Stuart et al., 2010).

*Greensand*: it outcrops locally and attains its greenish colour in unweathered areas, whilst its orange colour is a result of oxidation and exposure to air (Figure 6). The Greensand layer also contains fossils such as the Domed Sand-Dollar, dating back 15 million years ago. It is less than 1 m thick in the Maltese islands, except for sections in il-Gelmus hill in Gozo, where the formation can be found to be as thick as 12 m.



Figure 3: The lower Coralline Limestone Formation located on the Dingli Cliffs.



Figure 4: Cliffs of Upper Globigerina Limestone Formation at Il-Hofra l-Kbira near Marsaxlokk.



**Figure 5:** The Blue Clay Formation at Gnejna Bay.



**Figure 6:** Greensand layer at Il-Gelmus hill in Gozo.



*Upper Coralline Limestone*: it is the youngest formation containing coralline algal content, similar to the LCL Formation (Figure 7) (Pedley et al., 1976). It is composed of four different members which are in the order from oldest to youngest: the Malal member, Mtarfa member, tal-Pitkal member and the Ġebel Imbark member.

*Quaternary Deposits*: the most recently laid geological strata are the Quaternary deposits, formed almost 2.5 million years ago, after the emergence of the Maltese islands. The Quaternary deposits are not thick enough to be classified as a formation, but they are easily identifiable by their reddish-brown colour, which can be mistaken for soil (as shown in figure 8). These deposits are primarily composed of terrestrial, aeolian, and alluvial sediments, and they can be found in a wide variety of locations such as valleys, plains, seashores, and even on seafloors like in Wied Magħlaq, Pembroke, and Sliema.

## 4.2 Tectonics

The Maltese rocks are characterized by gentle folds and several faults of different sizes, greatly affecting the topography of the Maltese Islands. The two main extensional fault systems of the Maltese Islands are the NE-SW Victoria Fault and the Magħlaq Fault (Figure 2). In the northern part, the Victoria Fault crossing from Fomm ir-Riħbay to Madliena likely forms alternatively horst and graben features that are not visible in the southern part.

Numerous normal faults are present in Malta, with a dominant trend in the northeast direction, rapidly decreasing eastwards. In the southern part of Malta, a second movement with a northwesterly trend is observed. At Ġħar Lapsi, the Magħlaq Fault can be seen, which has a smooth, sliced fault plane facing the sea, running parallel to the coast. The fault has displaced the Upper Coralline Limestone at least 230 m to the south, with the downward sloping fault layers inclined at a high angle. The Magħlaq Fault consists of two spaced parallel faults, as is common with many larger faults in Malta. Consequently, pieces of Globigerina Limestone and Blue Clay are trapped between the two fault walls at various points throughout the fault complex. To the east of the dramatic cliffs formed by the Magħlaq Fault, a series of side fractures occur, which increase in the southeast direction (Pedley et al., 1976).

The third region is Gozo Island, slightly inclined to the NE. The southern west coast is characterized by cliffs reaching heights over 120 m. However, the northern coast is beyond 20 m below the sea level. The two largest faults in Gozo, the Sannat and Qala Faults, are centered around the locality of Mġarr ix-Xini. The Sannat fault extends in the W-NW whilst the Qala fault extends in the NE. The latter fault has a maximum throw of approximately 120 m to the south of Nadur, decreasing in height to-

ward the east and west. Numerous smaller faults intersect the southern coast south of both fault systems, as documented by Pedley et al. (1976).

## 4.3 Seismicity

The Maltese islands lie on a relatively stable plateau within the pelagian platform (Figure 1). They are located at 200 km southwards from the Euro-African plate collision margin, which runs across Sicily, and 100 km west from the seismically active Malta Escarpment. The latter, together with the Pantelleria Graben and the Linosa Graben, form part of the Sicily Channel Rift Zone (SCRZ), a system which characterizes these three grabens from the Miocene-Pliocene age (Civile et al., 2010). The grabens are governed by a fault system that runs across the Sicily Channel from Southern Sicily to Tunisia and is responsible for the major tectonic and geomorphological development of the Maltese Islands. Knowledge regarding the seismicity that takes place on the Sicily Channel Rift Zone has always suffered from a degree of accuracy in locating the epicentre of the earthquakes (Agius et al., 2011) (Figure 1). This is partially due to the inadequate network coverage but also due to the generally small magnitude of the events, which peak at about 3.0 on the Richter scale. The largest earthquakes are potentially generated by the more dangerous area of the northern end of the Malta escarpment, which is believed to have generated the earthquake that caused maximum damage on the Maltese Islands during the 11 January 1693 event. Despite Malta's location near seismically active zones, the Maltese Islands rarely suffered from strong earthquakes that brought about severe damages. The earthquakes which occur on the islands are mild and infrequent (Figure 1). As a result of this, there is culturally no public awareness about seismic activity, as safety is an automatic assumption (Galea, 2007).

## 4.4 Geomorphology

Tectonic activity plays a key role in the land formation of the island and relates to the faulting, up-arching, and subsidence.

The formation of the island's landscape is significantly influenced by tectonic activity, which involves faulting, up-arching, and subsidence. According to House et al. (1961), the primary physical geomorphological landscape of the Maltese Islands can be categorized as follows:

*Coralline Plateaus*: these are uplands composed of coralline limestone which can be found in a variety of sizes. Large plateaus are located towards the west of Malta, with heights reaching 245 m, whilst smaller mesas can be found in Gozo.

*Blue clay slopes*: mainly present on coastal areas and in valleys that divide the plateau uplands from the sur-



Figure 7: Cliffs of Upper Coralline Limestone Formation on islands at the western end of Comino.



Figure 8: Quaternary deposits found in Pembroke.

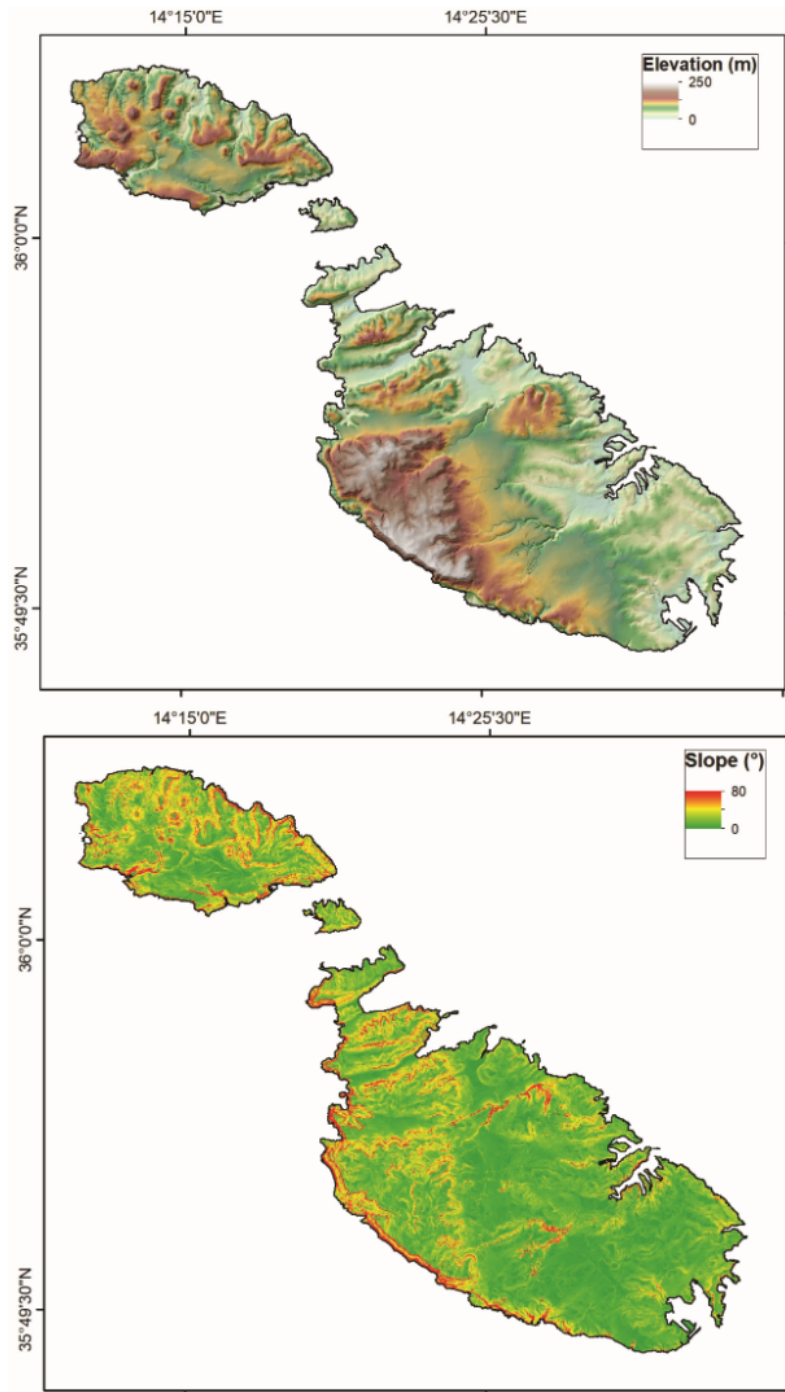


Figure 9: a) Topographic map showing the general elevation of the Maltese Islands. b) Slope Map of Malta.



Epoch	Stage (Years BP)	Formation	Maximum Thickness (m)
U.Miocene	Tortonian (12–7.5 MA)	Upper coralline Limestone	104–175
M.Miocene		Greensand	0–16
M.Miocene	Serravallian (13–12 MA)	Blue Clay	0–75
M.Miocene	Langhian (15–13 MA)	Upper Globigerina Limestone	5–20
L. Miocene	Burdigalian	Middle Globigerina Limestone	0–110
L. Miocene		Lower Globigerina Limestone	5–110
U. Oligocene	Chattian	Lower Coralline Limestone	140 (visible)
			236 (boreholes)

**Table 1:** Summary description of the general stratigraphy of Maltese archipelago.

rounding areas. Along the Maltese coastline, these slopes are situated at the base of the UCL plateau. Moving inland, Blue Clay can be found in dry valleys that feature seasonal watercourses (only during the wet season) and in some areas with perennial springs that flow throughout the year (Schembri, 1993), owing to the permeability of Blue Clay. In Gozo, it is present in coastal and valley slopes and floors that cut through Coralline plateaus and Globigerina Limestone plains.

*Undercliffs:* cliffs, locally known as ‘Rdum’ where steep blue clay slopes form. They are characterized by rockfalls of the UCL onto the Blue Clay slopes. Most undercliffs are situated on the western coast of Malta and on the Eastern coast in Gozo.

*Flat-floored basins:* these geomorphological formations are typically formed as a result of faulting and erosion (Magri, 2006). Examples of flat floored valleys include Pwales valley, Binġemma Basin and Wied il-Għasel.

*Globigerina limestone hills:* these are vast regions of gently sloping land. In Malta, these areas are linked to a sequence of low ridges and shallow valleys, with minimal flat land available, mainly found in places like the Marsa Creek in the east, Ta’ Qali in the center, and the Luqa airfield in the south. In contrast, the Globigerina Limestone hills and plains in Gozo display more diverse topography.

#### 4.5 Hydrology and Hydrogeology

On the Maltese islands, precipitation is primarily lost through water runoff and evapotranspiration. The remaining water is collected in underground freshwater reservoirs, as it flows through fissures in the rock layers. The Miżieb and Binġemma basins are sealed off by a soft blue clay layer and function as perched synclines, allowing for water collection. The top layer of water, which has

the lowest salinity, is extracted and utilized for irrigation and public water supply, as noted by Stuart et al. (2010).

The geological features of the Maltese Islands give rise to two distinct types of aquifers: sea-level aquifers (fresh-water lenses within the LCL) and perched aquifers. The most significant aquifer in Malta is the Mean Sea-Level Aquifer (MSLA), which covers an area of 216 km<sup>2</sup> south of the Victoria fault. The MSLA is in contact with seawater and has an outflow gradient towards the sea, with galleries excavated in the saturated zone serving as a crucial source of drinking water. Conversely, perched aquifers are smaller aquifers located in the UCL with a low permeability and porosity ranging between 41% and 45%. These aquifers discharge through springs, but due to heavy pollution, they are only suitable for irrigation purposes. The aquifers are primarily recharged through fissures, cracks, rock porosity, and a thin soil coverage, with the MSLA being approximately 50–100 m thick, while perched aquifers range between 20–50 m in thickness (Bakalowicz et al., 2003).

### 5 The Area of Influence

The study area considered for this report is the urban area of Sliema (Figure 11). Sliema, one of the largest towns in the north-eastern section of Malta, offers a diverse lifestyle and is a main tourist attraction in the summertime with its numerous rocky beaches. It is a peninsula characterized by a low rocky coast, surrounded by the Mediterranean. The geomorphology, geology and structure of the area reflects its dense population and urbanization it underwent during the past few years. The area’s geomorphology, hydrology, lithostratigraphy and structure are reviewed in greater detail.

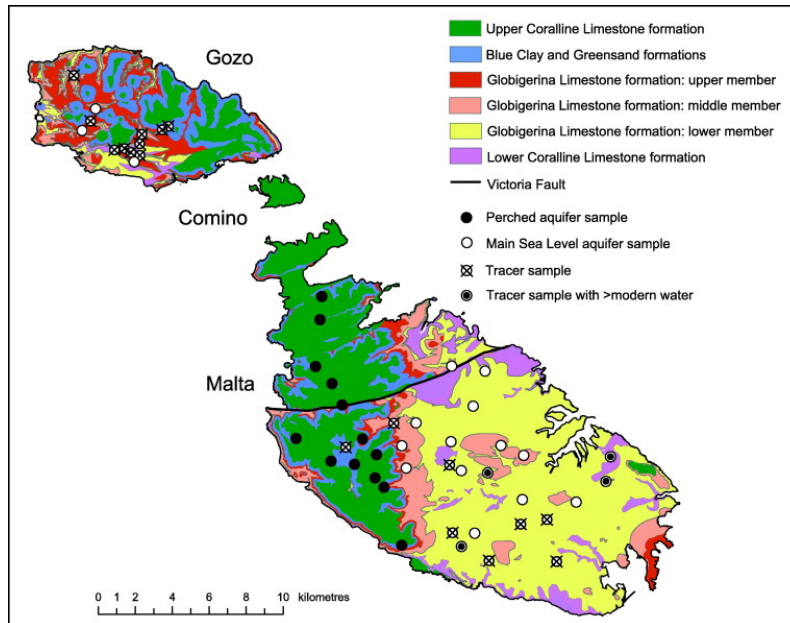


Figure 10: a) Map showing locations of the mean sea level aquifers and perched aquifers taken from (modified from Stuart et al. (2010)).



Figure 11: Aerial image of the area of Sliema taken from Google Earth.

## 5.1 Stratigraphy

Sliema is mainly composed of two rock members which can be found at the surface. The majority of surface is covered by the lower member of the Globigerina Limestone Formation. This Globigerina rock outcrop varies from an elevation of around 33 m all the way towards the coast at sea level. Globigerina limestone can be seen as pale-yellow rock and contains great amounts of planktonic foraminifera. The second rock member found in Sliema is the older Xlendi member which makes part of the LCL formation. The Xlendi member is a harder and more resistant rock in comparison to the overlying Globigerina Limestone member and has a greyish colour. This member is found mostly towards the upper part of Sliema (near St. Julians) and is the third oldest member of the formation from the total of four. This indicated a zone of unconformity as the uppermost, youngest member of the LCL formation which formed between the Xlendi member and the Lower globigerina member is not present. This is possibly due to erosion and weathering as result of the heavy wind and wave action present in the coast of Sliema.

Another geological feature present in the study area of Sliema are Quaternary Rocks (Figure 12). Quaternary rocks are discontinuous rocks containing high amounts of fossils such as land shells and extinct marine quaternary gasteropoda. This rock type can be found at Surfside, a known location along the Siema Coast.

## 5.2 Structures

The Sliema shore platform's distinctive structure is characterized by numerous fault and joint systems that vary in both size and orientation (see figure 13). Most of the faults are situated on the western side of the coast, with fewer on the eastern side, resulting in an uneven platform surface. The faults present in the rocks contribute to the alteration and erosion of the shoreline by weakening the bedrock and making certain parts of the shoreline more vulnerable to wave quarrying.

Joints have been identified throughout the study area and are depicted in figure 16. The mapped joints generally trend in an ENE-WSE and NW-SE direction, and it is suggested that their genesis and evolution are linked to the main fault systems, namely the Victoria and Magħlaq Faults. Some of the observed faults on the ground were also found to contain infill material, likely due to their large-scale size and width. This infill material typically consists of silt, sand, and gravel, although some were found to be filled with sea water, algae, and fauna.

## 5.3 Geomorphology

The geomorphology of Sliema includes landforms and coastal geomorphology features such as potholes, pools

which exist within the rocky coast as well as depositional material. The geomorphology of area, being an urban and densely populated city, is highly affected by human activities, such as tourism, therefore displays a number of human impacts (Figure 13).

The area contains many geomorphological features, such as bays and valleys (Figures 13 and 17). Examples of such bays include Balluta Bay, St. Julian's Bay as well as St. George's. The valleys located in the Sliema area include Wied Mejxu and Wied il-Kbir.

Since the area is mainly characterized by the presence of Lower Globigerina Limestone, it is easily eroded by wave action due to its soft nature, resulting in the formation of a number of features. The wind forces which vary throughout the year give rise to the formation of potholes distributed along the coast, which are then normally filled with infill material which acts as an abrasive tool. This gives the potholes a characteristic circular shape with steep sides and are found in the same areas that are also occupied by pools. Pools are formed by solution and characterized by pitted beds and can extend for distances ranging 5 to 30 m in length. The depth of the pools increases moving towards the shoreline and can reach depths that range 20–25 cm deep.

The topographic profiles along three linear locations in Sliema were generated and analysed for a better understanding of the geomorphological components. Topographic profiles help visualise the topography as seen from a cross-sectional perspective and hence help describe and observe the geomorphology, elevations and inclinations present along the area (Figure 16). The three lines are labelled as AB, CD and EF, where AB is the longest. The lines CD and EF are slightly shorter of a different orientation. This is shown in figures 16 to 18.

AB profile: This is the longest topographic profile out of all three topographic profiles considered. The topographic profile was plotted along a line with an NNW-SSE orientation. A number of highs and lows are observed within the topography along line AB. This is an indication of ridges and valleys. The valleys have a V-shape suggesting that water is transported along these valleys and results in erosion of the rock.

The elevation decreases from a maximum elevation of 45 m at Point A, which is the maximum elevation, to 0 m at Point B, which is the point closer to the coast and 500 m away from Point A (Figure 16).

CD profile: This topographic profile depicts the area of St. Julians, with a SW to NE orientation. The flat surface is seen to reach a maximum of 45 m above the sea level and a rather steep inclination towards the coast with a dip, down to 15 m height before a slight increase to 20 m above sea level. This is followed by another decrease.



Figure 12: Quaternary deposit mapped in the study area.

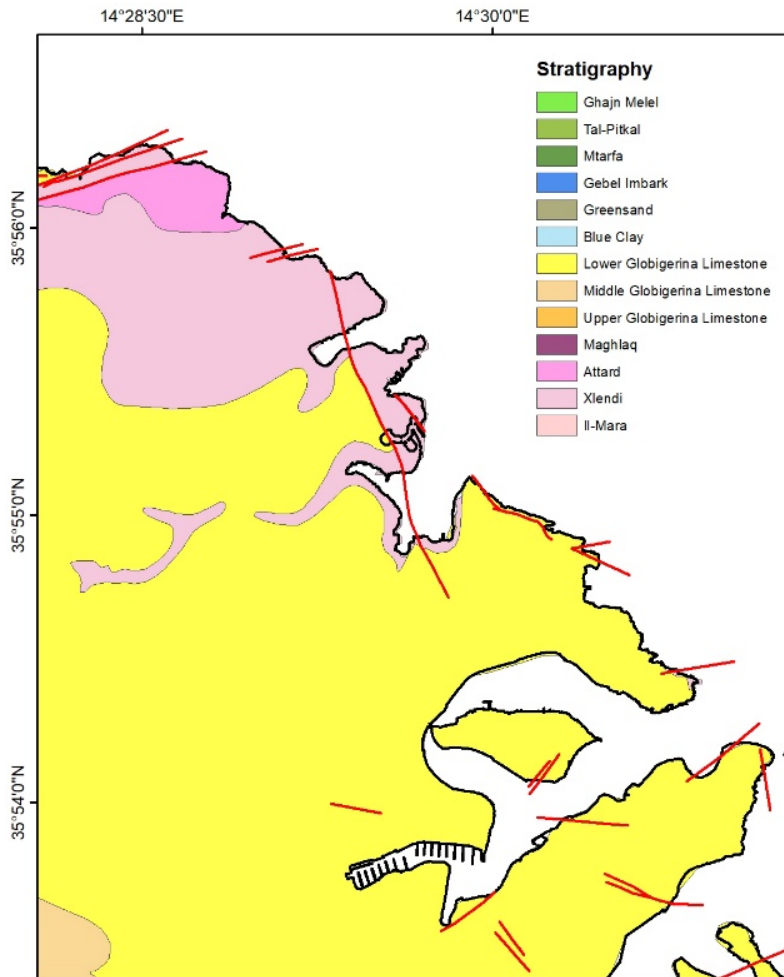


Figure 13: Geological map of the area of Sliema showing the lithostratigraphy and the main faults affecting the study area.



**Figure 14:** Aerial image of the area of Sliema taken from Google Earth showing several fractures affecting the study area.

The topographic map indicates a V shaped water course (Figure 17).

EF profile: The two points form a line 1,800 m long across the SW-NE direction. The initial elevation at point E is around 26 m, shown to initially increase to around 45 m. This is followed by a dip to 25 m and a sharp rise back to an elevation of around 45 m, displaying a V-shaped valley. At the distance of 1600 m, the topographic profile shows the presence of slope break forming an escarpment whose genesis is linked to the occurrence of a small normal fault (Figure 18). The final elevation at point F is of 0 m, as once again this point is located very close to the coast.

#### 5.4 Hydrology

The hydrological characteristics of the Maltese Islands are influenced by various factors, including climate, geology, soils, and vegetation cover. The semi-arid climate of Malta, characterized by high-intensity rainfall over short periods of time, has resulted in minimal vegetation and soil in the area of Sliema. However, surrounding areas have xerorendsina soils that develop in semi-arid climates, with varying structures and textures. The absence of soil and vegetation in Sliema today does not necessarily indicate that the area was always barren. It is possible that farming or agriculture may have taken place in the past when the area had more favorable conditions.

Sliema is also characterized by watercourses that collect inland water and transport it as runoff to the coast and into the sea (Figure 19). Although Sliema currently does not have any rivers, the presence of watercourses suggests a different, more humid climate in the past that could have supported the formation of rivers about 10,000 years ago.

## 6 Conclusion

Small islands such as Maltese Islands are suited for geological investigations. This study has shown that the geology of the islands, including that in Sliema is quite young. This is evident through the simple lithostratigraphy and the effect of lateral movements. With close reference to the densely populated and urbanized study area of Sliema, the geology of the area consists mainly of the Lower Globigerina Limestone and ix-Xlendi member of the LCL. Sections of quaternary rock were also visible in the area close to Surfside, Sliema. Along the study area, multiple fractures in the rocks are likely linked to the main fault systems affecting the Maltese islands. Moreover, the rocks closer to the coast are seen to be heavily eroded and discoloured by the sea.



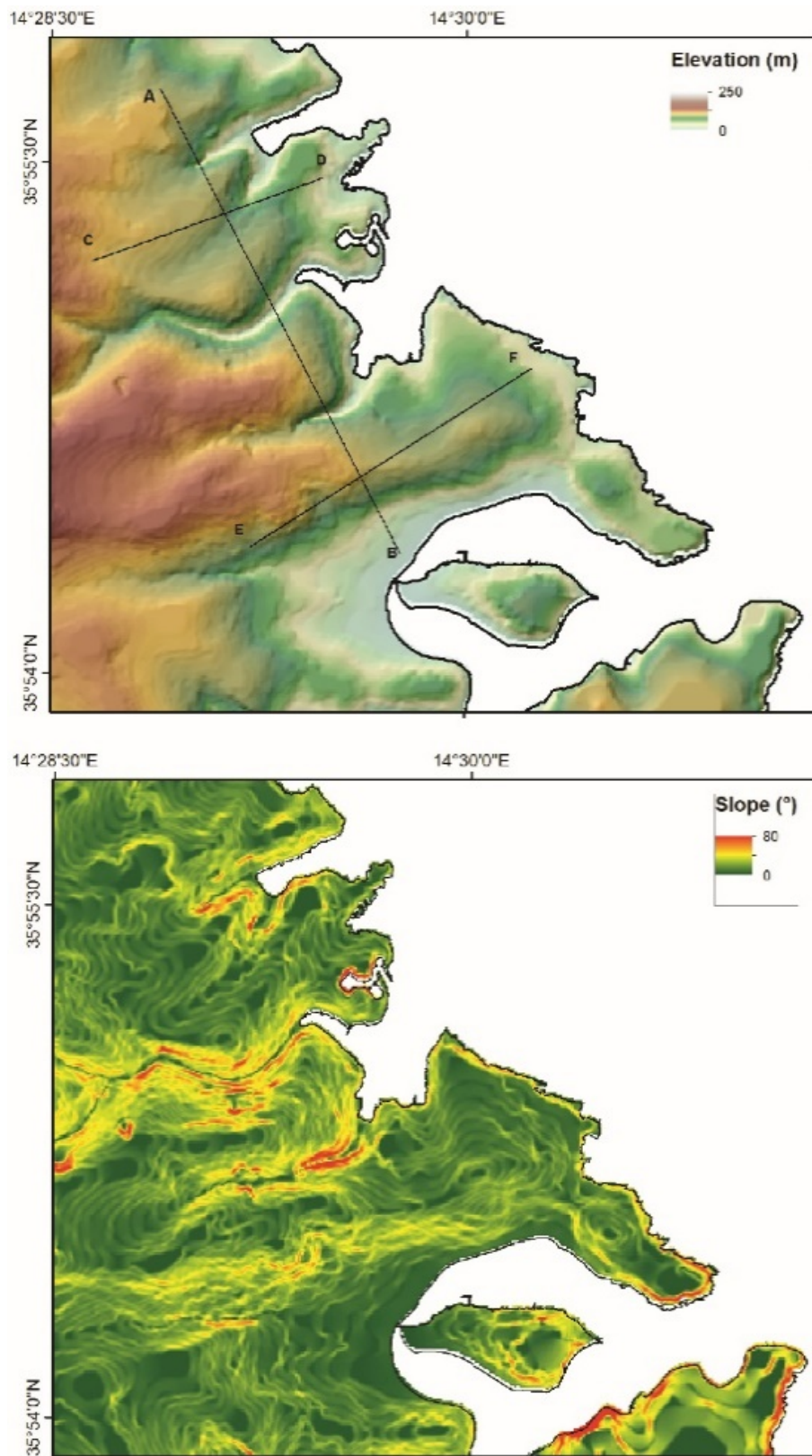


Figure 15: a) Topographic map showing the general elevation of the Maltese Islands. B) Slope Map of the area of interest.



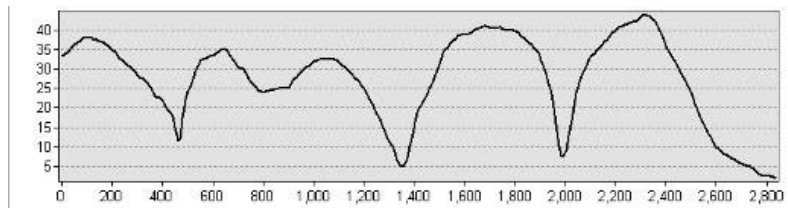


Figure 16: Topographic profile depiction from point A to B.

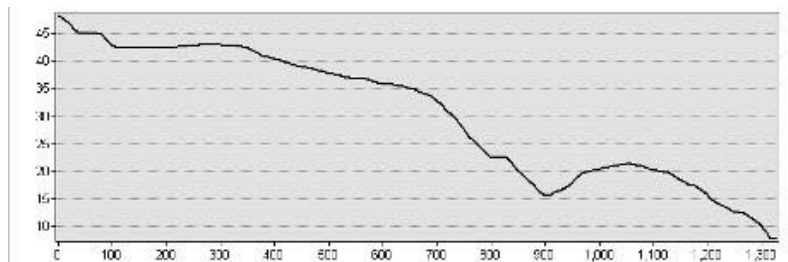


Figure 17: Topographic profile depiction from point C to D.

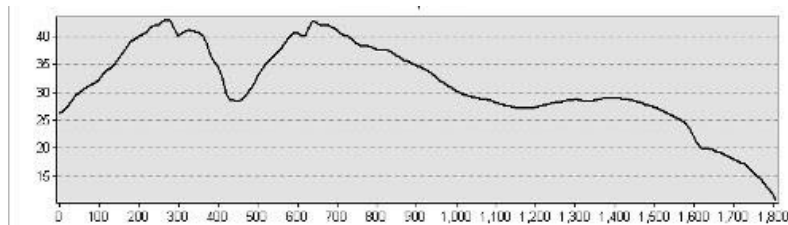
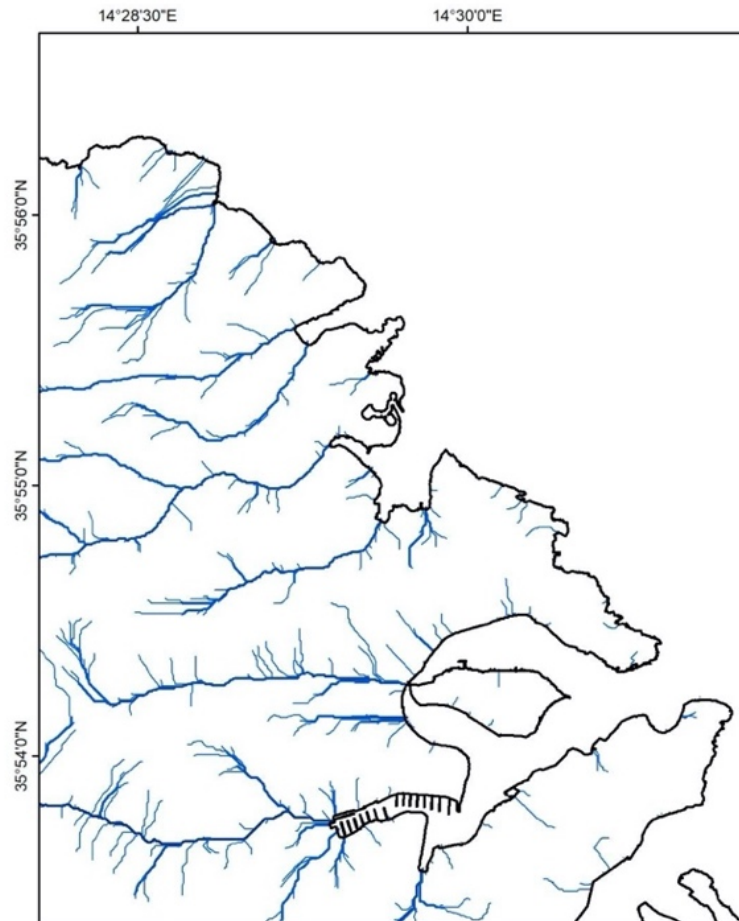


Figure 18: Topographic profile depiction from point E to F.



**Figure 19:** Reconstruction of the hydrology of the area using the digital elevation model coming from continental shelf website and using a specific tool with ARCGIS.

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Research Article

# Assessing Current C-reactive Protein Sampling Practices within the Neonatal Intensive Care Unit for Neonates with Suspected Early Onset Sepsis

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**Abstract. Background:** C-reactive protein is synthesized in the liver as part of the acute phase response activated in reaction to acute injury. It has been well established that CRP levels can be used as an acute marker of inflammation making it a useful aid in the diagnosis and management of sepsis. However, its use within the immediate postnatal period presents unique challenges.

**Aim:** This study aimed to elucidate and standardise CRP blood sampling intervals in neonates with suspected early onset sepsis, and to describe the relationship between CRP results and final blood culture results, with the aim of implementing NICE recommendations within the local setting.

**Results:** 316 infants were included in the study. 26.2% of neonates had at least 1 positive CRP value (>10 mg/dl) during the first 72 hours of life, with 12.7% resulting in a detectable bacterial growth on blood cultures. The largest percentage of positive CRP levels was obtained when blood was sampled within 18 to 24 hours post birth (30.3%). 40.7% of CRP samples were repeated between 24-48 hours of life. For 27.7% of neonates, a first positive CRP level of more than 10 mg/dl was noted after 24 hours of life.

**Conclusion:** The results show the importance of maintaining adequate timing intervals between serial CRP levels, which should be taken as a baseline on admission and then repeated not before 12 hours of age, to achieve optimal sensitivity. Our current sampling practice might lead to falsely reassuring negative CRP values, affecting outcomes in sepsis management.

## Abbreviations

CRP	C-reactive Protein
CSF	Cerebrospinal Fluid
EOS	Early Onset Sepsis
NICE	The National Institute for Health and Care Excellence
NICU	Neonatal Intensive Care Unit

## 1 Introduction

C-reactive protein (CRP) is a protein synthesized in the liver as part of the acute phase response activated in reaction to acute tissue injury including trauma, surgery, infection and inflammation. (Jaye et al., 1997) CRP levels start to rise 6 to 8 hours after activation of the acute phase response but may take up to 24 to 48 hours to peak. Levels remain high for at least 24 to 48 hours after commencing treatment, and then rapidly decline 5 days later (Chiesa et al., 1998). Given its functional role within the inflammatory process, it has now been well established that CRP levels can be used as an acute marker of inflammation making it a useful aid in the diagnosis and management of infection including sepsis. Despite this, use of CRP levels within the immediate postnatal period to guide management of neonatal sepsis presents challenges. Although a level of >10 mg/dl is considered abnormal and is the most widely reported reliable cut-off used to date to indicate possible sepsis (Benitz et al., 1998), CRP level taken on initial presentation is often negative, with initial CRP levels being within the normal range in 60% of cases of subsequently proven sepsis (Franz et al., 1999). Similar findings have been reported for 2 CRP levels taken within the first 24 hours of presentation (Krediet et al., 1992). In view of this, various efforts have been made to try devise a standardised practice for CRP sampling. Various studies have shown increased sensitivity of CRP levels

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when taken at least 24 hours post presentation (Gerdes et al., 1987; NICE Guideline 195, 2021). Moreover, likelihood ratios indicated that positive CRP levels at initial sampling pointed towards a moderate increase in probability of neonatal sepsis. However, a negative result taken 24 to 48 hours later indicated a moderate decrease in infection risk, thus increasing its reliability in guiding clinicians re further management. Given these findings, NICE guidelines recommend taking a CRP level at the time of initial blood culture sampling (baseline), with a subsequent level taken not before 18 to 24 hours later. Locally, there is no standardised practice for the timing of CRP sampling in neonates with suspected early onset sepsis, with sampling intervals varying for each neonate admitted to the unit. The role of this study was to assess such sampling intervals, together with the relationship of CRP results with final blood and CSF culture results, to elucidate whether the NICE recommendations can be implemented within the local setting.

## 2 Material and Methods

### Aim and Objectives

The objectives of this study were:

1. To describe the population of neonates admitted to the NICU with the suspicion of possible early onset neonatal sepsis.
2. To evaluate time intervals and results of CRP sampling in relation to time post birth.
3. To assess CRP sampling time intervals and CRP level results in relation to final blood and CSF culture results.

### Guidelines

The guideline referred to within this study against which parts of the results were analysed and recommendations made accordingly, was the NICE Guideline 195: Neonatal Infection: antibiotics for infection and treatment published April 2021.

### Data Collection

Permission to perform this study was obtained from the hospital administration, data protection office and the chairperson for the Department of Child and Adolescent Health at Mater Dei Hospital.

Data was collected from intradepartmental censuses, handover sheets and via the online hospital clinical manager system. The study period spanned over 13 months from 1<sup>st</sup> February 2019 to 29<sup>th</sup> February 2020.

### Inclusion Criteria

- All term and preterm neonates admitted to the NPICU within the first 72 hours of life with clinical

signs of suspected sepsis.

- Signs of suspected sepsis were taken to include lethargy, irritability, poor feeding, vomiting, tachypnoea, apnoea, temperature instability, hypoglycaemia or hyperbilirubinemia.
- A level of >10 mg/dl was considered as a positive CRP reading.

### Exclusion Criteria

- Neonates presenting with clinical signs of sepsis after 72 hours of age.
- Preterm and term neonates with no clinical signs of sepsis.

### Data collected

- CRP levels taken on admission to the unit
- CRP levels taken within the following 48 to 72 hours after birth
- gestational age (GA)
- date and time of birth
- time post birth of first, second  $\pm$  third CRP sample
- blood and CSF culture results
- reason for NICU admission—presenting signs of possible sepsis

## 3 Results

### 3.1 General Demographics

A total of 316 infants were originally identified with signs of possible sepsis and were included in the study. 144 infants (45.6%) were less or equal to 37 weeks of gestation at time of sampling whilst 172 infants (54.4%) were above 37 weeks of gestation. The commonest reason for admission and CRP sampling was that of respiratory distress (54.7%). 83 neonates (26.2%) had at least 1 positive CRP value (>10 mg/dl) during the first 72 hours of life. For these 83 neonates with positive CRP results, blood cultures were only taken in 95% (79 neonates). Subsequently out of these, only 10 blood cultures (12.7%) resulted in a detectable bacterial growth. There was only one case in our cohort with a positive CSF culture, in addition to a detectable growth on blood culture, hence why our results focus on relationship between CRP levels and final blood culture results.

### 3.2 CRP results vs time of sampling post delivery

Data on CRP level results in relation to hours post delivery for neonates presenting with possible EOS was plotted for better graphical understanding of data as shown in figures 1 and 2 below.

Table 1 below shows the total number of CRP samples taken together with the resultant total number of positive





CRP levels obtained at different time intervals after birth.

The data in [table 1](#) shows that out of a total of 849 CRP samples, 270 samples were taken between 24–48 hours of age followed by 199 samples taken on admission. Despite this, the largest percentage of positive CRP levels was obtained when blood was sampled within 18 to 24 hours post birth (30.3%). This was followed by the 12–18 hour group (26.2%).

For neonates presenting with possible sepsis at less than 24 hours of life, a CRP taken within the first 6 hours resulted to be positive in only 11% of cases. Meanwhile a CRP level taken at 6–12 hours of age increased yield of a positive value to 23.5%.

A total of 200 samples were taken in the first 0–6 hours of life, with one sample being a repeat sample within 6 hours of admission. Of these, 6 (3%) were repeated within 12 hours of life, 42 (21.1%) within 12–18 hours, 42 (21.1%) between 18–24 hours of life, 81 (40.7%) between 24–48 hours and 20 (10%) beyond 48 hours of age.

[Figure 3](#) below shows the number of first positive CRP levels recorded in relation to time post birth. Interesting to note is the fact that for the majority of neonates studied, a positive CRP level of more than 10 mg/dl was first noted after 24 hours of life (27.7%). This was followed closely by the less-than-6-hours and 18–24 hours categories (21.8% each respective category). A first positive CRP level was on the other hand least noted during the 6–18 hour time range (27.7%).

### 3.3 CRP sampling results vs blood culture results

Bacterial growth on blood cultures was detected in 11 cases. Out of these, only 4 samples were considered to be significant growth (Group B Streptococcus and Staphylococcus aureus), with the rest being considered as contaminants. A CRP rise was noted in 3 out of the 11 positive culture results. First positive CRP values were obtained between 12–18 hours of age in 1 case, and between 18–24 hours of age in 2 cases. Out of the 4 significant blood culture growths, 2 were associated with a rise in CRP levels.

## 4 Discussion

### 4.1 Neonatal sepsis

Despite advances in neonatal care, neonatal sepsis remains an important cause of morbidity and mortality. Neonatal sepsis is defined as early-onset sepsis (EOS) when it occurs at  $\leq 72$  hours after birth. In EOS, transmission of pathogens occurs vertically from the mother to the infant before or during delivery (Hornik et al., 2012). Although the gold standard for confirmation of neonatal sepsis remains positive blood cultures, many cases of sus-

pected neonatal sepsis are managed empirically with antibiotics on admission to the neonatal intensive care unit (NICU) despite having no pathogen isolated from blood cultures.

The burden of sepsis on the NICU in terms of incidence and mortality, remains high, with a mortality up to 40% in EOS. The incidence of culture-proven neonatal sepsis is estimated between 0.77 and 1 per 1000 live births (Cohen-Wolkowicz et al., n.d.). Presenting signs and symptoms vary according to the gestational age and the severity of infection. These may include fever, hypothermia, lethargy, poor feeding, or vomiting (Lim et al., 2012). Most term neonates will develop respiratory distress as an early sign of sepsis as demonstrated in our study, and 80–90% of all cases of EOS will present in the first 24 to 48 hours of life (Polin et al., 2012). Although neonatal sepsis is potentially curable if diagnosed and treated early, it is important to realise that early clinical signs of sepsis are non-specific and may be easily missed.

### 4.2 Role of CRP in guiding sepsis management

All neonates admitted to the NICU with clinical signs of sepsis should have a thorough review of antenatal risk factors and a workup that includes a blood culture sampling. However, as demonstrated in the results section, even when taking the required blood volume using proper aseptic technique, a positive growth on blood culture was obtained in only a small percentage of cases of suspected sepsis, possibly due to a low colony count bacteraemia ( $\leq 4$  CFU/ml) in 12.7% of cases. In addition, a positive blood culture result with identification of the pathogen is usually not possible before 48 to 72 hours.

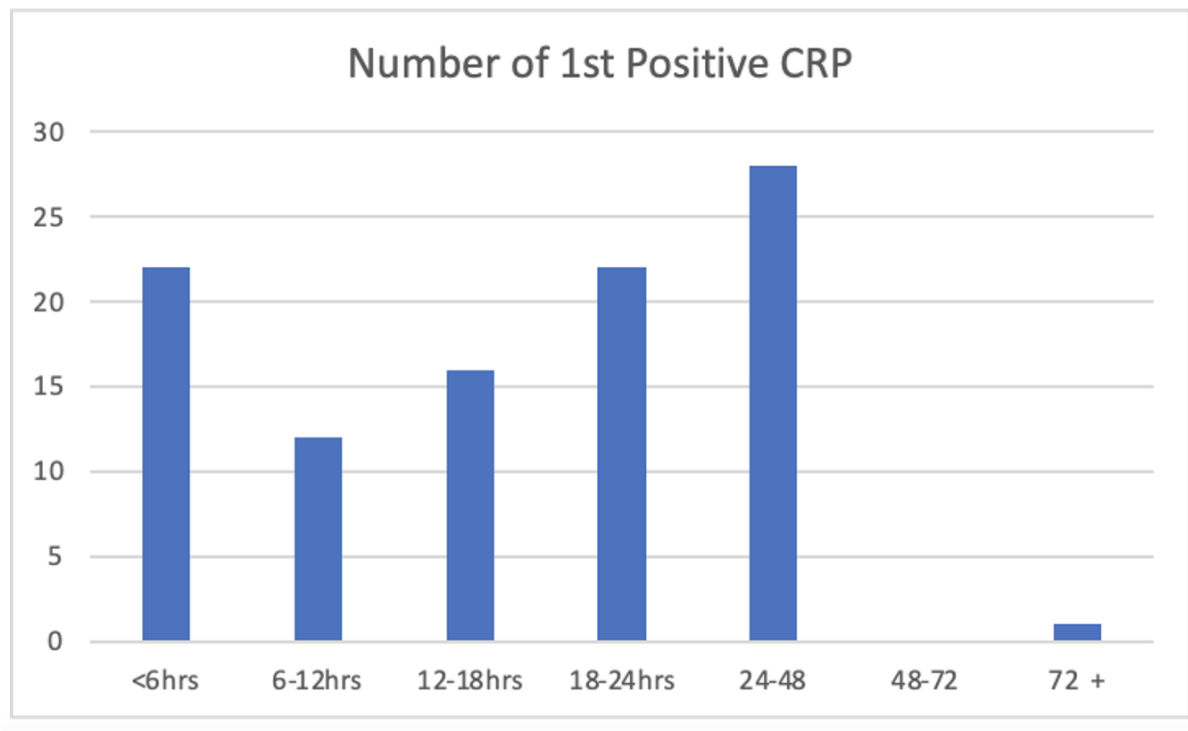
It is therefore necessary to have a rapid diagnostic test and adjuncts such as C-reactive protein that can aid clinical assessment in reliably confirming or excluding neonatal sepsis at its early stages (Mishra et al., 2006). Not only will this allow prompt treatment of infection but will also avoid judicious use of antibiotics in sepsis negative patients. CRP remains the most widely used infection marker due to it being a simple, fast, cost effective and widely available test (Chirico et al., 2011).

The positive predictive value of CRP increases with higher CRP levels. In addition, the magnitude of the CRP response varies according to the underlying pathogen with a greater CRP response seen in gram negative sepsis as opposed to gram positive sepsis (Rønnestad et al., 1999). CRP has a negative predictive value of 93% and is considered to be a useful tool to aid in the duration of antibiotic therapy and to assess response to treatment (Hofer et al., 2012).

The results of this study show that the largest percent-

Time after birth (hours)	CRP 1 (n)	CRP 2 (n)	CRP 3 (n)	Positive CRPs (>10mg/dl) n (%)	Total num. of CRPs taken (n)
<b>0-6</b>	199	1	0	22 (11)	<b>200</b>
<b>6-12</b>	55	13	0	16 (23.5)	<b>68</b>
<b>12-18</b>	33	47	0	21(26.2)	<b>80</b>
<b>18-24</b>	26	51	2	24 (30.3)	<b>79</b>
<b>24-48</b>	0	144	126	65 (24)	<b>270</b>
<b>48-72</b>	0	32	63	12 (12.6)	<b>95</b>
<b>72+ (max 6 days of age)</b>	0	20	37	3 (5.3)	<b>57</b>
<b>Total</b>	<b>313</b>	<b>308</b>	<b>228</b>	<b>163</b>	<b>849</b>

**Table 1:** Total number of CRP samples taken in relation to the total number of positive CRP levels obtained at different time intervals post birth.



**Figure 3:** Timing post birth of first positive CRP levels obtained.

age of positive CRP levels was obtained when neonates were sampled between 12 to 24 hours post birth. Meanwhile a CRP level taken within the first 6 hours of life was only positive in 11% of cases and for the majority of neonate studied, a positive CRP level was first noted after 24 hours of life. This highlights the importance of not solely using a single negative CRP value taken on admission to rule out sepsis. Serial CRP measurements, together with rate of rise, should always be used, ideally allowing at least 12 hours post admission before repeating samples.

Meanwhile bacterial growth on blood cultures was only detected in 11 cases, with only 4 growths being considered as being significant. A CRP rise (first noted within 12–24 hours of age) was associated with only 2 of these significant growths, further emphasising the fact that CRP levels cannot be reliably used to predict positivity or negativity of blood culture results.

In light of this, the timing of the sample, the presence of other sepsis related clinical symptoms, the presence of positive sepsis related blood results including use of early sensitive markers such as procalcitonin, should all be considered in the decision-making process. The combination of CRP with procalcitonin was shown to increase sensitivity to values between 90 and 100% in most studies (Hofer et al., 2012).

#### 4.3 Developing alternative diagnostic techniques

Molecular testing such as PCR and DNA microarray-based methods are increasingly being used in the diagnosis of neonatal sepsis since they are able to detect bacterial DNA at much lower concentrations that would be required for bacterial culture (Peters et al., 2004). In addition, a result may be achieved in as quickly as 30 minutes. However, the lack of bacterial culture means no information can be given regarding antimicrobial resistance (Jordan et al., 2005; Jordan et al., 2006). Their main use is potentially in cases where antibiotic exposure has already occurred, with a low-density bacteraemia or nonviable pathogen resulting in culture-negative sepsis.

#### 4.4 Study Limitations

The results presented within this study were based on absolute CRP values in relationship to a specific threshold (10 mg/dl). Trend and rate of change (rise/decline) in CRP levels over time which can also be used to guide infection risk and management of possible sepsis, were not assessed.

### 5 Conclusion

The fact that CRP takes 10–12 hours to significantly change is its most significant limitation. An initial CRP

taken on admission in a neonate <12 hours of age should not influence the clinical decision on whether to start antibiotic treatment or not. This decision should be taken based on the presence or otherwise of risk factors for sepsis and on the clinical picture.

The results in this study show the importance of maintaining adequate timing intervals between serial CRP levels, which should be taken as a baseline on admission and then repeated not before 12 hours of age, to achieve optimal sensitivity. Our current practice of repeating CRPs too early after initial sampling might lead to early positive CRPs being missed apart from increased cost burden on the hospital labs.

It is therefore being recommended that timing of CRP sampling is standardised for all neonates admitted to the NICU with signs of suspected sepsis, especially given the low rate of culture proven sepsis within this population.

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Research Article

## Serum Prolactin Monitoring in Patients on Risperidone admitted to the acute wards at Mount Carmel Hospital

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**Abstract.** First-generation antipsychotics have been shown to increase prolactin levels in the body. Atypical antipsychotics have a lower tendency to produce hyperprolactinaemia due to a weaker and transient dopamine antagonistic effect. Despite being an atypical antipsychotic, Risperidone, tends to cause a higher increase in prolactin due to a stronger and more prolonged blockade on dopamine receptors.

The purpose of this audit is to assess current practices at Mount Carmel Hospital (MCH) with regards to serum prolactin monitoring in patients taking Risperidone when compared to Maudsley Prescribing Guidelines in Psychiatry, 14th Edition (2021). The audit was based on patients acutely admitted between June and December 2021. Focus was placed on prolactin levels checked during admission in patients previously on Risperidone, prolactin levels checked in the preceding six months if no prolactin level was checked during admission and the appropriate action taken in cases where the serum Prolactin was noted to be high.

From this audit it was concluded that there is inadequate monitoring of serum prolactin levels in patients prescribed Risperidone at MCH. Increased awareness of Risperidone-induced hyperprolactinemia and associated guidelines are required to improve clinical practice.

The recommendations suggested from this audit were to increase awareness of serum prolactin monitoring guidelines amongst all medical and nursing staff at MCH and to create a simple flow-chart outlining the appropriate serum prolactin monitoring guidelines and distribute this to MCH wards.

**Keywords:** Hyperprolactinemia, Risperidone, Antipsychotics.

## 1 Introduction

Hyperprolactinemia is clinically defined as a plasma prolactin level of >424 mIU/L for men and >530 mIU/L for women. Serum prolactin levels may be raised as a result of stress, pregnancy and lactation, seizures, renal impairment and in cases of prolactinoma. The blood sample should be taken first thing in the morning and stress during venipuncture should be kept to a minimum. Levels over 2500 mIU/L are considered to be highly elevated and one must rule out the possibility of a prolactinoma by MRI in these cases. Hyperprolactinaemia (in all cases) is more common in female patients.

High serum prolactin levels are often asymptomatic, however may be associated with symptoms pertaining to disruption of the hypothalamic-pituitary-gonadal axis. The clinical manifestations of chronic hyperprolactinemia include:

- Reproductive dysfunction (anovulation, menstrual irregularity, amenorrhea, reduced fertility, decreased oestrogen and testosterone production).
- Sexual impairment (reduced libido, retrograde or painful ejaculation, erectile dysfunction, impotence)
- Breast pathology (galactorrhoea, breast enlargement, prolactin-sensitive dysplasia with increased potential for breast cancer, gynecomastia).
- Chronic hypogonadism complications (decreased bone mineral density and osteoporosis, increased cardiovascular risk, metabolic syndrome, malignancy).
- Psychological effect (depression, anxiety, hostility, memory deficit, psychosis).

First-generation antipsychotics have been shown to increase prolactin levels in the body. The associated mechanism involves dopamine (D2) blockade in the tuberoinfundibular tract of the hypothalamus, which in turn re-

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verses the dopaminergic inhibition of prolactin in the anterior pituitary gland. The time taken for prolactin levels to increase varies between a few hours to approximately nine days.

Atypical antipsychotics have a lower tendency to produce hyperprolactinaemia due to a weaker and transient dopamine antagonistic effect. Although atypical antipsychotic agents, such as olanzapine, quetiapine, and clozapine, have shown to increase prolactin level, this effect is minimal and short-lived. These varying effects can be attributed to the duration of receptor binding. Atypical antipsychotics tend to dissociate from D2 receptors rapidly, therefore having a transient dopamine antagonistic effect. This in turn leads to a smaller rise in plasma prolactin. Despite being an atypical antipsychotic, Risperidone, tends to cause a higher increase in prolactin due to a stronger and more prolonged blockade on dopamine receptors (Besnard et al., 2014).

Risperidone is one of the most commonly used antipsychotics, due to its safety and efficacy in reducing psychotic symptoms. However, the side effects of Risperidone are the most common cause of non-compliance with therapy, resulting in worsening of psychiatric symptoms and hospitalization. Symptoms associated with hyperprolactinaemia may have a significantly negative effect on quality of life (Stojkovic et al., 2022).

Regular serum prolactin monitoring is recommended in patients taking antipsychotics which are particularly associated with hyperprolactinaemia, i.e. Risperidone, as well as Amisulpiride, Sulpiride, Paliperidone and first-generation antipsychotics. Patients taking Asenapine, Aripiprazole, Clozapine, Olanzapine and Quetiapine do not require regular monitoring but serum prolactin levels are measured if the patient develops symptoms.

Prolactin-elevating drugs should be avoided in patients under the age of 25 (i.e. before peak bone mass), especially females; and in patients with osteoporosis and a history of hormone-dependent breast cancer.

## 2 Aims and Objectives

The purpose of this audit is to assess current practices at Mount Carmel Hospital (MCH) with regards to serum prolactin monitoring in patients taking Risperidone when compared to Taylor et al. (2021). This audit takes into account all acute admissions between June and December 2021. The following parameters were considered in this audit:

- Prolactin levels checked during admission in patients previously on Risperidone.
- Prolactin levels checked in the preceding six months if no prolactin level was checked during admission.
- Appropriate action taken in cases where the serum

Prolactin was noted to be high.

## 3 Standard used

Clinical practices at Mount Carmel Hospital were compared to the Taylor et al. (2021). These guidelines state that serum Prolactin levels should be checked:

- At baseline (prior to commencing antipsychotic),
- then at 6 months,
- then yearly.

Patients should be assessed for symptoms related to hyperprolactinaemia after being started on a high risk antipsychotic, such as Risperidone.

If the serum prolactin is noted to be above normal range, the following action is recommended:

- Assess for symptoms of hyperprolactinaemia.
- MRI Brain if levels over 2500 mIU/L.
- **Symptomatic hyperprolactinaemia:** Change antipsychotic to one with a lesser effect on serum prolactin. If this is not possible, add adjunctive Aripiprazole.
- **Asymptomatic hyperprolactinaemia:** Discuss risks of chronically raised prolactin levels, i.e. increased risk of osteoporosis and breast cancer. Consider continuing current treatment with annual monitoring for complications. If this is not possible, change antipsychotic to one with a lesser effect on serum prolactin. If this is not possible, add adjunctive Aripiprazole.
- If the above courses of action are not successful, consider adding a dopamine agonist, such as Bromocriptine, or metformin.

## 4 Methodology

The audit was based on patients acutely admitted between June and December 2021. Patient data was obtained from the acute admissions list, as well as, electronic case summaries (ECS), physical case files and iSOFT results. Ethical clearance was obtained prior to acquiring patient data, and the approval of the chairman of Psychiatry in Malta was also obtained.

The following information was collected from the aforementioned sources:

- Prolactin levels checked during admission in patients previously on Risperidone.
- Prolactin levels checked in the preceding six months if no prolactin level was checked during admission.
- Appropriate action taken in cases where the serum Prolactin was noted to be high.

The medical files of patients with hyperprolactinaemia were obtained and analyzed for any clinical action taken following recognition of the elevated prolactin level. The data was analyzed and compared to the above-mentioned

guidelines.

## 5 Results

A total of 477 patient records were analyzed; all patients were listed on the acute admissions list between June and December 2021.

RESULTS SUMMARY	
Total Patients: 477	
On Risperidone: 145	
Prolactin Level Taken	
Y	N
15	130
Results	
Elevated	NORMAL
5	10
Appropriate Action Taken	
Y	N
3	2

**Table 1:** Summary of results.

145 patients were noted to be on Risperidone during the acute admission, amounting to 30.40% of the patient sample.

40 patients out of the total had a serum prolactin checked during the admission; 14 of these were taking Risperidone. Therefore, only 9.66% of patients taking Risperidone had a prolactin level recorded during admission.

Two other patients had a serum prolactin checked in the 6 months prior to the admission, one of whom was noted to be taking Risperidone. This amounts to 15 patients out of 145 who fit into the monitoring guidelines described above, i.e. 10.34%.

18 patients had an elevated serum prolactin level and 5 of these were taking Risperidone. This means that out of all prolactin levels taken in patients on Risperidone, 35.71% had hyperprolactinaemia.

Out of these 18 individuals, the high serum prolactin level was acknowledged in the medical notes in 7 instances and some form of clinical action was taken in all of these patients.

## 6 Discussion

A total of 477 patient records were analyzed in this audit, taking into account all acute admissions to MCH between June and December 2021. Initially, there were around 530 admissions recorded in this time frame, however some patient data was discarded as the I.D. card numbers did not match the patient details in the acute admissions list and thus, the data could not be collected from iSOFT and ECS.

30.40% of all patients were taking Risperidone, as confirmed by the patients' discharge letters for the admission being studied. Thus, this audit focused on the monitoring of serum prolactin levels of all patients taking Risperidone, rather than whether baseline levels were being checked in patients being started on Risperidone during the admission. This could be an area of possible future audit as baseline prolactin levels are essential in future monitoring and to distinguish between causes of hyperprolactinaemia.

Out of 477 patients, 40 patients had a serum prolactin checked during the admission in question. Only 14 of these patients were prescribed Risperidone. Therefore, 9.66% of the patients taking Risperidone had a serum prolactin level checked during the admission. This result was increased to 10.34% when taking into consideration another two patients who had serum levels checked in the 6 months prior to the admission, thus deeming another serum prolactin level unnecessary according to guidelines. This result showcases a very poor level of monitoring for hyperprolactinaemia in these patients and highlights the need for improvement in this regard.

Out of the 40 patients who had a serum prolactin level checked, 45% had an elevated result. Five of these were taking Risperidone, therefore 35.71% of prolactin results were elevated in patients taking Risperidone. These results are significant in that they highlight the importance of serum prolactin monitoring in all patients on neuroleptic treatment. Despite being an atypical antipsychotic, Risperidone, tends to cause a higher increase in prolactin due to a stronger and more prolonged blockade on dopamine receptors (Aboraya et al., 2004). Furthermore, it poorly penetrates the blood-brain barrier, thus having a greater presence at the pituitary gland (Tewksbury et al., 2016).

3 out of the 5 patients who had confirmed hyperprolactinaemia on Risperidone in this audit were noted to be on long-acting Risperidone intramuscular depot of doses ranging from 25 to 50mg every 2 weeks. The other two patients were taking a nocte dose of oral treatment; 0.5mg and 2mg respectively. Although a dose-dependent relationship of Risperidone and serum prolactin can be observed, a study by Kinon et al. (2003) showed that even at a low-dose of around 2 mg daily, the serum prolactin level

begins to rise, reaching the upper-limit of normal range.

There were 13 other patients noted to have an elevated serum prolactin whilst not being prescribed Risperidone. The treatment prescribed to these patients was not documented as it was beyond the scope of this audit. However, it is known that hyperprolactinaemia can be induced by other neuroleptic treatment, especially first-generation antipsychotics. Other drug classes that induce sustained hyperprolactinaemia include (La Torre et al., 2007):

- Antidepressants;
  - Tricyclics, ex. Clomipramine, Amitriptyline.
  - SSRIs, ex. Fluoxetine, Sertraline
  - MAOIs.
- Prokinetics, ex. Metoclopramide.
- Antihypertensive, ex. Verapamil, alpha-methyldopa.
- Opiates, ex. Morphine.
- H2 Antagonists, ex. Ranitidine.
- Chemotherapy.

The medical records of patients with elevated prolactin levels were obtained and the admission notes were reviewed, checking for recognition of hyperprolactinaemia and recording any related clinical action that was taken. Raised prolactin levels were acknowledged in the medical notes in 7 out of 18 cases. The most common action taken was a dose reduction or change in antipsychotic choice. MRI of the pituitary gland was booked in 2 cases. Repeat prolactin levels were planned by the caring teams for all acknowledged cases, however, the plan was lost to follow-up in 5 out of 7 patients.

The above results are in keeping with the established importance of serum prolactin monitoring in these patients. Prolonged hyperprolactinaemia may have serious implications on patient's physical health, namely through distressing sexual side effects, osteoporosis and the resultant increased risk of fractures, as well as the risk of developing breast cancer.

For this reason, the poor results displayed by this audit are concerning and increased awareness of guidelines amongst clinical staff is essential. Furthermore, any acknowledgement of deranged prolactin levels must be documented in the patient's medical notes and any plans to act on the elevated level must be followed through by the caring team.

## 7 Conclusion

There is inadequate monitoring of serum prolactin levels in patients prescribed Risperidone at MCH. Increased awareness of Risperidone-induced hyperprolactinemia and associated guidelines are required to improve clinical practice.

## 8 Recommendations

- To increase awareness of serum prolactin monitoring guidelines amongst all medical and nursing staff at MCH.
- To create a simple flow-chart outlining the appropriate serum prolactin monitoring guidelines and distribute this to MCH wards.

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Research Article

## An earthquake swarm on the Malta Graben, Central Mediterranean, September–November 2020

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**Abstract.** The seafloor of the Sicily Channel is characterised by an extensional regime, governed by a network of normal and strike-slip fault systems. These faults generate a background level of seismicity that rarely exceeds magnitude 5.0. A number of these faults pass close to the Maltese islands. In particular the Malta graben lies less than 15 km to the south of Malta at its closest point, and the islands have been shaken a number of times by earthquakes originating on this, and other fault systems. In this study we describe the occurrence of a seismic sequence, that started in September 2020 and lasted for several weeks, the largest event having a local magnitude of 4.5 and being strongly felt throughout the archipelago. The sequence was located at a distance of around 23 km south of the eastern tip of Malta. We have used single-station polarization analysis at seismic station WDD to estimate epicentral location for all events, down to magnitude 1.2. For the largest events, we have also used conventional network location, utilising phase picks at stations of the Malta Seismic Network and in Southern Sicily. We describe the time evolution of the sequence, felt effects, the public response and the implications for seismic hazard.

**Keywords:** Sicily Channel, earthquake swarm, Malta graben, felt reports.

### 1 Introduction and geological background

The Sicily Channel Rift Zone (SCRZ) appears as the main bathymetric feature on the shallow platform joining Sicily to Tunisia in the Central Mediterranean Sea (Figure 1). It features three main grabens that interrupt the seabed in a NW–SE trend. The Pantelleria graben, an approximately 100 km long trough that contains the volcanic island of Pantelleria, branches out into two other parallel troughs—

the Linosa graben to the south and the Malta graben to the north. The latter runs for about 180 km, passing less than 15 km south of the Maltese coastline at the nearest point. The whole graben system spans a distance of about 300 km, and the sea depth exceeds 1500 m at the deepest point within the Malta graben (Dart et al., 1993; Pedley et al., 2002). Since the Pliocene, the SCRZ has been undergoing NE–SW directed extension, a process superposed on the general NW directed compressional regime of Africa converging on to Europe. Details of the tectonic history and proposed models of present behaviour are given in, for example, Agius et al. (2022), Civile et al. (2010), Corti et al. (2006) and Faccenna et al. (2001).

Geophysical studies confirm that extension across the grabens, themselves bounded by normal faults and interlinked by a network of strike-slip faults (Catalano et al., 2008; Grasso et al., 1986; Reuther et al., 1993), has been recently active, and GPS measurements reveal that it is still ongoing (Agius et al., 2022; Serpelloni et al., 2007). Such processes are expected to be accompanied by seismicity, which, however, is only observed as sparse and ill-defined on most maps, owing primarily to difficulties in instrumental coverage of the region. Agius et al. (2020) have recently compiled an earthquake catalogue spanning the period 1994–2014 for the offshore region around the Maltese islands. The earthquakes in this catalogue were located using a single-station, WDD, in the south of Malta. The map indicates a clear clustering of seismicity along a lineament at 35°N, as well as at the southeastern end of the Malta graben (Figure 1).

Since 2014, seismic monitoring in Malta has gradually developed into the Malta Seismic Network (MSN, FDSN code ML), currently consisting of eight broadband stations covering the whole archipelago of Malta, Gozo and Comino (Galea et al., 2021). The MSN (Figure 1), inset) is managed by the Seismic Monitoring and Research Group (SMRG) within the Department of Geosciences,

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University of Malta. The network represents an important development in the assessment of seismic activity occurring all around the islands, especially at close distances, or even on land. The situation still exists, however, where a considerable number of small magnitude events, particularly to the south of Malta, are well recorded on only one or two of the closest stations. In these cases, the use of conventional hypocentral location, using network first arrivals, may be limited, and the single-station polarisation algorithm LESSLA (Local Earthquake Single Station Location Analyser) developed locally (Agius et al., 2011) presents a valuable alternative, allowing a quantitative assessment of seismicity and approximate source location of events. For local and regional earthquakes, LESSLA computes event distance and origin time from measured S-P times against a calibrated regional travel time graph, while event azimuth is measured from the 3-component polarisation at the first P-wave arrival, using the algorithm of Roberts et al. (1989).

In this paper we present a first description of an intense episode of seismic activity whose most active phase lasted for around 2 months. The activity occurred at around 23 km south of Malta during September–November 2020, then continued sporadically even to the present day. Most of the events were of magnitude below 3.0, but the largest event reached a local magnitude of 4.5 and was strongly felt on the islands. The earthquake swarm is important not only because it provides insight onto ongoing geological processes, and the SCRZ in general, but also because it represents an important contribution towards assessing the sources of seismic hazard to the islands. To this end, further studies will concentrate more deeply on its seismological characteristics and geodynamical interpretation.

## 2 The Seismic Sequence

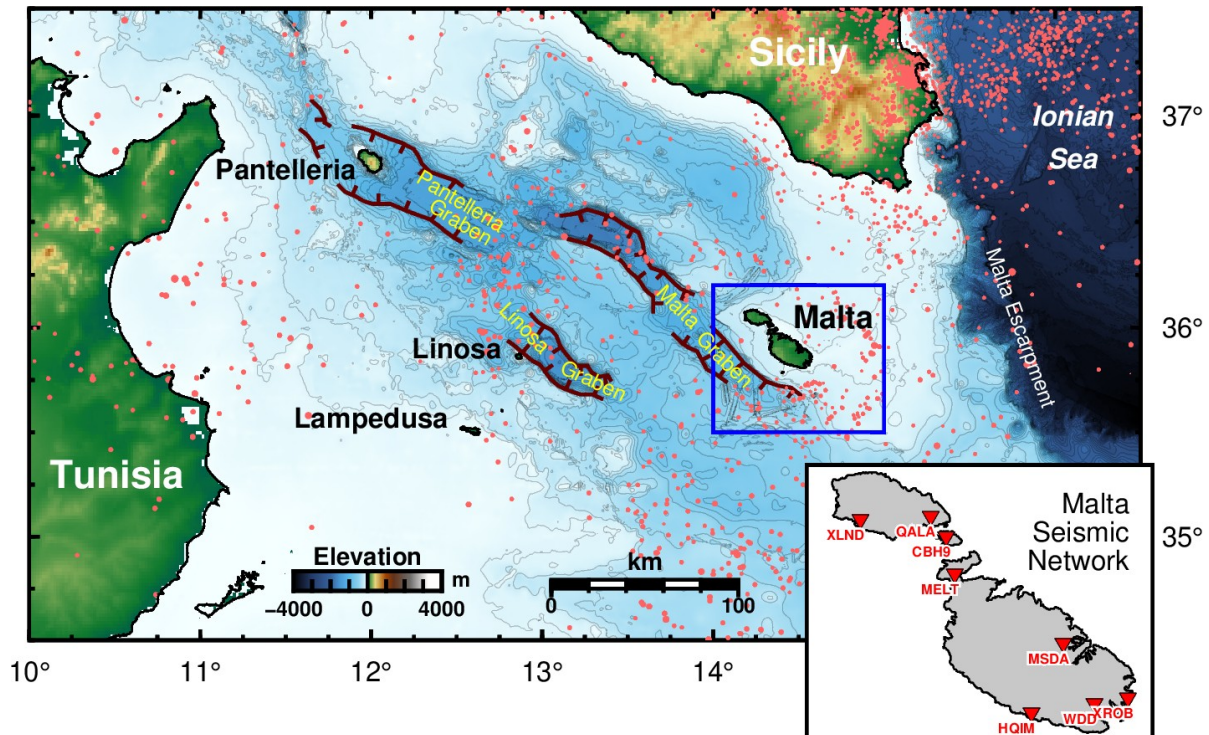
Except for a few larger events, as described later in this section, this work reports the earthquake locations as obtained by the use of single station location, using broadband station WDD. The first identified earthquake of the sequence occurred on the 8<sup>th</sup> September 2020 at 04:49 UTC, at a distance of 22.7 km from station WDD, and having a local magnitude of 2.3. This was followed in the next days by a number of similar events during September, most of them with magnitudes smaller than 2.0. Then on the 30<sup>th</sup> September 2020, a magnitude 4.5 event, at 22.9 km from WDD, occurred at 01:01 UTC (03:01 local time), producing strong shaking on the Maltese islands and waking up most of the residents of the southeastern region of Malta. This event was preceded by a magnitude 3.4 event on the previous day, 29<sup>th</sup> September, at 18:24 UTC (20:24 local time) which was also felt by residents. The magnitude 4.5 event was followed by more than 15

events on the same day, 30<sup>th</sup> September (Figure 2). The inset of figure 2 shows the 3-component recording of the magnitude 4.5 event on station WDD.

Figure 3 shows the magnitude–time development of the sequence over a 70-day period. We clarify here that the local magnitudes shown in this figure are the ones estimated by the single station algorithm, however when referring to the largest event, we choose to assign the magnitude computed by SeisComP (see later in this Section). The whole sequence continued till the middle of November 2020, with some events also being felt, notably the ones on the 1<sup>st</sup> October at 09:00 UTC with magnitude 3.1 and on the 20<sup>th</sup> October, at 07:36 UTC with magnitude 3.4. In all, the SMRG located 116 swarm events during this period. Figure 3 shows the sequence to be composed of 2 phases, lasting between 8<sup>th</sup> September–4<sup>th</sup> October, and 19<sup>th</sup> October–11<sup>th</sup> November respectively. The largest event was the one of 30<sup>th</sup> September. After this swarm, other sporadic events from the same source region, were recorded, up till the time of writing. The smallest detectable event of the sequence had a local magnitude of 1.2. Figure 4 shows the location of those events which had a good enough signal quality to allow reliable location by the single-station method, applied at station WDD.

All events in the sequence had an S-P time of around 3.0 s. The local/regional distance calibration used in LESSLA translates this to a distance of 23 km, while the polarization analysis of all events gave a mean back-azimuth of 177° with a standard deviation of 24°. The back-azimuth calculation in LESSLA represents the largest uncertainty in the location, especially when the signal-to-noise ratio at the P-onset is low, as in the weakest events. It is observed in Figure 4 that the events are located along a circular arc centred at WDD. This reflects the constant epicentral distance coupled with the uncertainty in the back-azimuth calculation inherent in the single-station location.

The mainshock of the swarm was large enough to be recorded on all operating stations of the Malta Seismic Network at the time, and on a number of stations in Southern Sicily. This triggered an earthquake location by SeisComP (Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences and gempa GmbH, 2008) which is used at SMRG for routine seismic monitoring. SeisComP employs Hypo71PC (Lee et al., 1985) for earthquake location. The first epicentre calculation was automatically communicated one minute after the earthquake origin time, and after manual verification, a standard report was sent to the Civil Protection Department (CPD) after 9 minutes. Using 24 stations, with the furthest at a distance of around 400 km, a manual relocation using SeisComP placed the hypocentre at 35.63°N,



**Figure 1:** Location of the Maltese islands (blue box), bathymetry of the Sicily Channel and the three main grabens, and the seismicity of the region between 1995 and 2014, with maximum magnitude of 5.4 from Agius et al. (2020) (scaled red dots). Inset shows the stations of the Malta Seismic Network.

14.56°E, 4 km depth and magnitude 4.5. The SeisComP location is shown as a large black star on figure 4. The smaller stars represent the SeisComP location, using all available recordings, of three smaller events on the 29<sup>th</sup> and 30<sup>th</sup> September, and 1st October, having magnitudes 3.3, 3.7 and 3.4 respectively. SeisComP locates these events at depths ranging between 1 km and 6 km.

Figure 5 shows a number of filtered P-waveforms all recorded on station WDD from events taking place during the 30<sup>th</sup> September, including the M4.5 event, showing the first 3 seconds after the P-onset. The strong waveform similarity is evident and implies an origin on the same fault.

### 3 Felt Reports

The magnitude 4.5 event of the 30<sup>th</sup> September was felt all over the archipelago, and especially in the eastern half of Malta. Close to 2000 felt reports were submitted to the “Did you Feel It?” form on the SMRG website (<https://seismic.research.um.edu.mt/>) (Figure 6). 282 reports were also submitted on the website of the Euro-Mediterranean Seismological Centre (EMSC) (<https://www.emsc-csem.org/>) (Figure 7). For this event, the absolute majority of reports were from the island of Malta. In total, only five reports were received from the island of

Gozo. In addition, around 30 reports were submitted for each of the felt events on the 29<sup>th</sup> September and 20<sup>th</sup> October. Figure 6a shows the geographical distribution of the felt reports over the islands while figure 6b shows the timeline of website hits and questionnaire submissions on the 29<sup>th</sup>–30<sup>th</sup> September, including the preceding event at 20:24 local time on 29<sup>th</sup> September. Around 1000 website hits were registered during the first few minutes following the largest event, right after 3am local time, with another peak of reporting during the following morning. Close to the epicentre, the reports indicate strong shaking with 78% of respondents being woken from their sleep by the shaking. Approximately half the respondents reported rattling doors and windows, and a minority reported falling small objects. 74% of respondents reported that some kind of sound (mostly a roaring sound) accompanied the shaking. Overall, the distribution and intensity reported through SMRG and EMSC websites show very similar patterns (figure 6a, and figure 7). These reports allow us to assign an intensity of IV–V on the European Macroseismic Scale (EMS-98) (Grünthal et al., 2001) over the island of Malta. The short form of the EMS-98 scale describes intensity IV as “Felt indoors by many people, outdoors by very few. A few people are awakened. Windows, doors and dishes rattle.”, whereas intensity V is described as

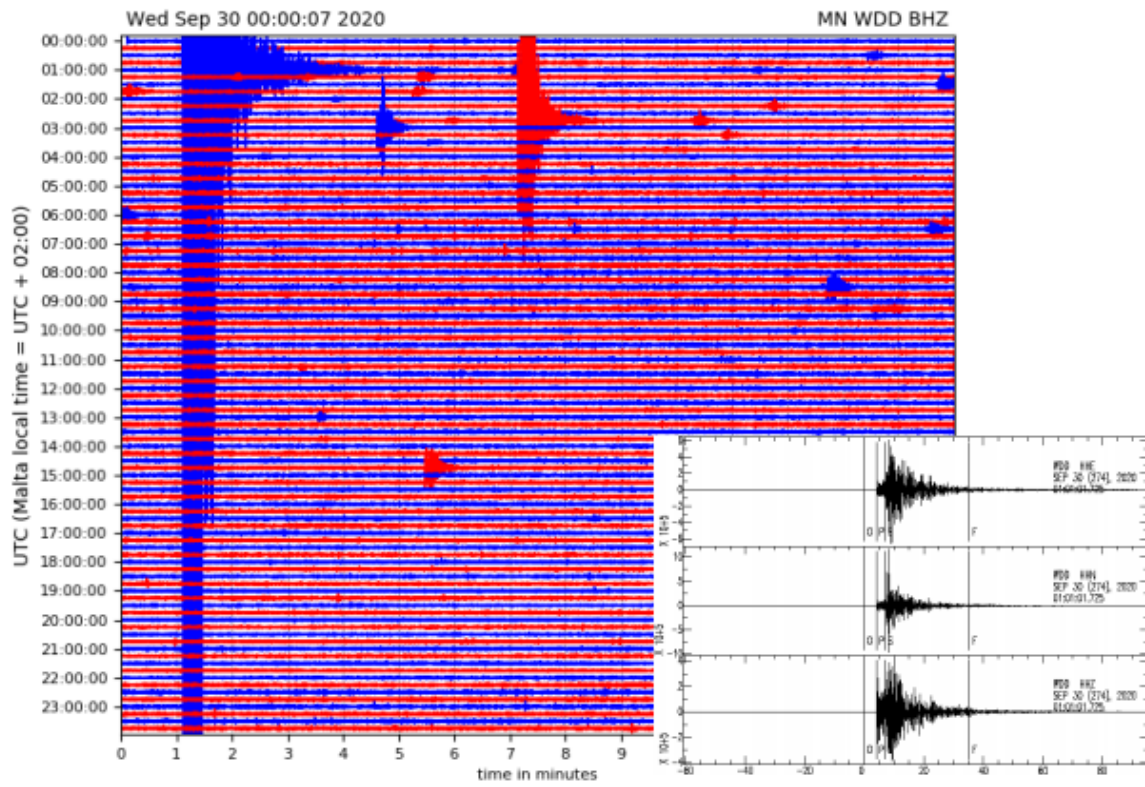


Figure 2: 24-hour plot from station WDD on the 30th September 2020. Inset shows the 3-component trace of the largest event record on broadband station WDD. O, P, S, F mark the origin time, P and S picks, and *fini* of the event, respectively.

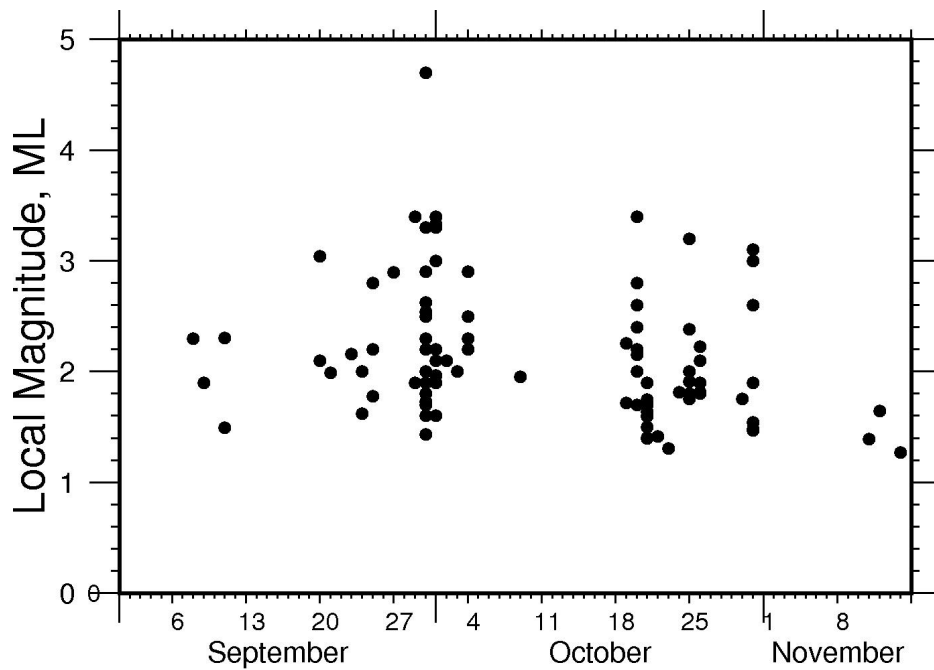
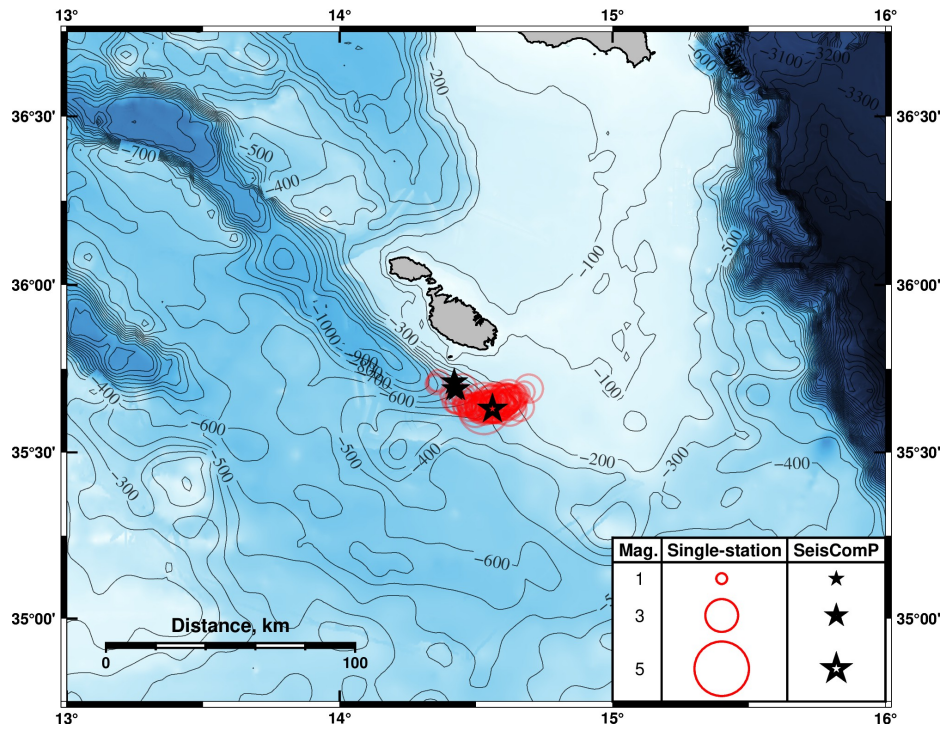
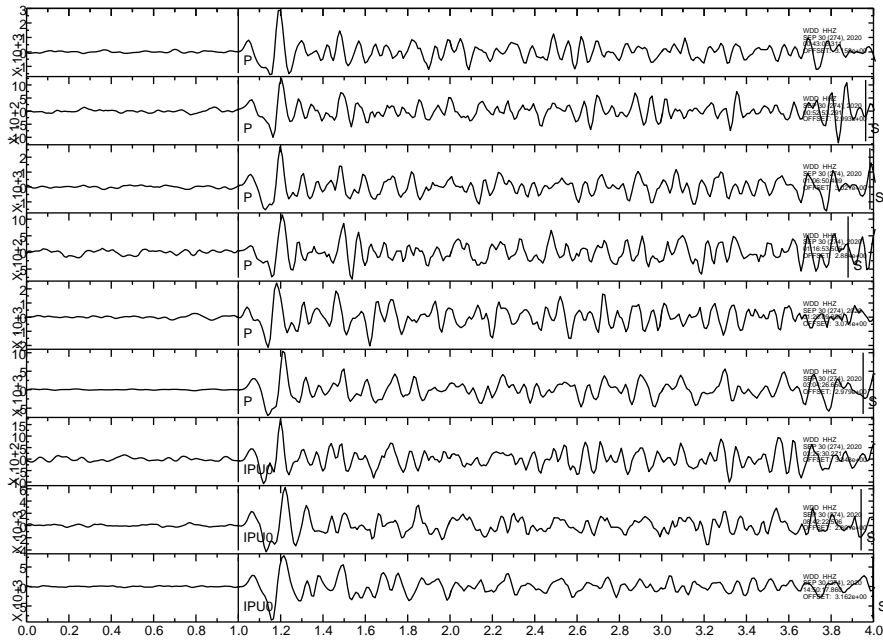


Figure 3: Magnitude-time plot of the earthquake sequence September–November 2020.

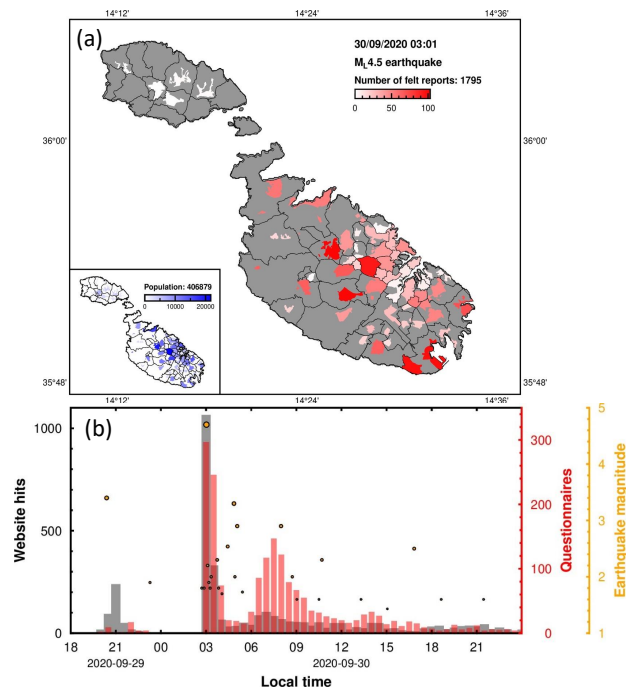




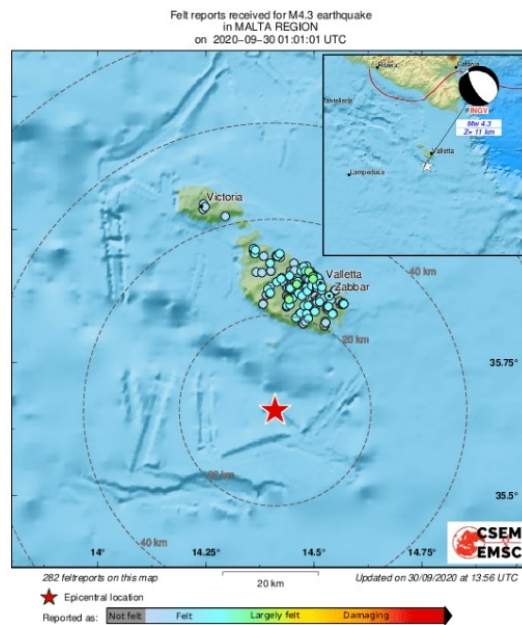
**Figure 4:** Epicentre locations of the earthquake swarm from 08/09/2020 to 14/11/2020. Red circles are epicentres using single-station location at station WDD. The black stars indicate SeisComP locations.



**Figure 5:** Seismograms showing an example of the similar P phase arrivals of 9 different events from the swarm sequence recorded on station WDD on the 30<sup>th</sup> September.



**Figure 6:** (a) Geographical distribution of felt reports on Malta (red shade). Internal boundaries delineate local council areas. Inset shows the population distribution across the Maltese islands based on the national census (National Statistics Office 2011). (b) Website hits (grey bars) and number of questionnaires (red bars) submitted between the 29<sup>th</sup> and 30<sup>th</sup> September 2020, binned every thirty minutes. Orange circles represent the earthquakes time and magnitude.



**Figure 7:** Felt reports and earthquake solution reported by the Euro-Mediterranean Seismological Centre (EMSC). Coloured dots represent the felt/damaging intensity reported. Red star shows the epicentre solution by EMSC. Inset shows the earthquake focal mechanism as reported by INGV.



"Felt indoors by most, outdoors by few. Many sleeping people awake. A few are frightened. Buildings tremble throughout. Hanging objects swing considerably. Small objects are shifted. Doors and windows swing open or shut."

#### 4 Discussion and Concluding Remarks

An earthquake sequence whose main activity lasted close to 3 months has been successfully identified and monitored to the south of the Maltese islands. The sequence consisted of more than 100 events, the largest one having a local magnitude of 4.5. The majority of the events had a magnitude smaller than 3.0, and were consequently reliably recorded on only a few stations of the Malta Seismic Network. The use of a single-station location algorithm, LESSLA, was therefore employed in this study, using the recordings from station WDD, approximately 23 km away. For the magnitude 4.5 event, on the 30th September, as well as three other events, sufficient recordings were available from Sicilian stations, together with four available stations of the MSN, to allow us to carry out conventional location using SeisComP, which is routinely used at the University of Malta for earthquake monitoring. The SeisComP location of the main event, with a location error of  $\pm 4$  km, is very close to the single station location for this event, giving us confidence about the LESSLA location at the southern extremity of the Malta graben. The azimuthal uncertainty from single-station location results in an arc-like distribution of epicentres, which therefore has no geological significance related to the causative structure or the spatio-temporal evolution of the sequence. Nonetheless, a more thorough analysis of the earthquake recordings from all available stations shall be carried out to investigate whether a conventional least squares epicentral location methodology will yield different results. This, possibly together with a moment tensor inversion of the mainshock, will enable us to give a better geodynamical interpretation of these events. At the time of writing, the only moment tensor solution available is one by the Istituto Nazionale di Geofisica e Vulcanologia (INGV), reported on the EMSC website (Figure 7), which shows a normal faulting mechanism, with strike oriented parallel to the Malta graben, possibly implying that the events occurred on the graben bounding faults.

Seismicity around the Maltese islands has often been observed to occur in swarm episodes (Agius et al., 2020), although the swarm reported here is one of the largest to be recorded instrumentally, both in terms of duration as well as in the number of events. A swarm of around 15 events, lasting 4 days was experienced on 24<sup>th</sup> April 2011 and located around 40 km east of Malta (Agius et

al., 2016). The largest event in that swarm, having magnitude 4.1, was also strongly felt on the islands. Other, less significant, swarms were also recorded on WDD in previous years, originating south of Malta (Agius et al., 2020). Historical documents contain several reports of episodes of felt tremors lasting several days (Galea, 2007). One such example occurred between the 14<sup>th</sup> and 27<sup>th</sup> August 1886, when no less than 15 tremors were reported in local newspapers to have been felt by the population, 6 of them on the same day, Sunday 15<sup>th</sup> August. Of these, the largest event, at 03:45am (local time) on Sunday, was large enough to cause most of the residents of Valletta and nearby cities to flee outside, and was accompanied by rumbling sounds. These events were reported not to have been felt in any nearby countries. It is therefore likely that such historical earthquake sequences had similar origins and characteristics as the 2020 sequence.

Finally, the close proximity of this swarm to the southern Maltese coastline makes it important to understand as well as the possible characteristics of this fault system and its contribution to the seismic hazard assessment of the Maltese islands, especially considering the ongoing rapid increase in the urban and population densities of the archipelago, particularly in the southeastern region of Malta.

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News Article

## The 2022 COPCA Conference in Valletta

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Collisions represent a fundamental conduit of energy leading to physical and chemical changes in various systems. Ranging from the cosmic scale (e.g., cometary or asteroidal impacts with planetary bodies in the Solar System) to the nanoscale (e.g., the lithographic preparation of nanostructures on surfaces during focused electron beam induced deposition), the physics and chemistry of collisions underpin many important processes of inherent interest to both academic and industrial research. Indeed, collisions are routinely studied in several disciplines, including: molecular physics, nuclear fusion science, astrochemistry, planetary and Solar System science, nanotechnology, battery technology, and materials engineering.

It is likely that the investigative methodologies and techniques used in one field of research are applicable to solving problems in other fields, and thus cross-disciplinary collaborations in collisions science research are necessary and should be developed. Furthering such cross-disciplinary collaboration and exchange was the primary motivation behind the organisation of a *Collisions Physics and Chemistry and their Applications (COPCA) Conference*: bringing together researchers from apparently disparate fields whose work relates to collisions on the nano, micro, and macroscales to provide new insights into ongoing research projects, engender the formation of new cross-border and cross-disciplinary collaborative efforts, and stimulate or renew old collaborations whose progress had been stymied by the Covid-19 pandemic.

The mass cancellation of in-person conferences, congresses, and symposia and their replacement by online, virtual meetings proved to be one of the greatest challenges posed to scientific research by the pandemic, as the reduced ability for free conversation beyond the scope of scheduled presentations undoubtedly hindered the dis-

cussion of ideas and the formation of new collaborations between colleagues. Indeed, the organisation of the COPCA Conference itself was waylaid by problems associated with the epidemiological evolution of the pandemic. Thus, although initially planned to be held in October 2020, the Conference had to be postponed several times due to the emergence of different variants of the virus.

However, it was recognised that, in order to achieve the primary goals of the COPCA Conference, an in-person conference was necessary and thus the conference was repeatedly postponed until it was possible to hold the meeting as an in-person event, as originally planned. The inaugural COPCA Conference (the logo of which is depicted in [figure 1](#)) was successfully held between October 31<sup>st</sup> and November 4<sup>th</sup> 2022 at the Grand Hotel Excelsior in Valletta, Malta. The Conference was officially opened by Prof. Nigel J. Mason (President of the Europlanet Soci-

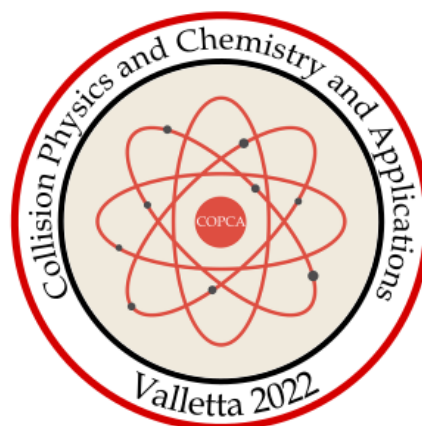


Figure 1: The 2022 COPCA Conference logo.

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**Figure 2:** The 2022 COPCA Conference picture, taken at the Trattoria AD1530 restaurant in Mdina.

ety) in his capacity as a co-organiser of the Conference, together with Prof. Alfred J. Vella (Rector of the University of Malta) and Ms. Ruth DeBrincat (Senior Director for Strategy, Research, and Technical Affairs at the Malta Council for Science and Technology).

The first session of the Conference was dedicated to research either conducted at the University of Malta, or by Maltese researchers based abroad. Indeed, the inclusion of and promotion of scientific research carried out by Maltese nationals was a fundamental theme of the Conference, and such research was presented in almost every session held throughout the Conference. The programme contained a number of sessions on varied fields of research linked to the central principle of collisions physics and chemistry, such as: the interaction of radiation and electromagnetic fields with biological matter, battery technology, astrochemistry and the origins of life, electron-molecule interactions, nanotechnology, plasma science, multiscale modelling, materials science and engineering, and shock processes. A poster presentation session was also held towards the end of the first day of the Conference, in which early career researchers were given the opportunity to present their work to fellow delegates.

The Conference also included an invited plenary lecture by Dr Sotirios Kiokias of the European Research Executive Agency, who provided an overview of the Marie Skłodowska-Curie Actions in Horizon Europe, with a particular focus on the Staff Exchanges Action. Overall, the Conference was attended by nearly 60 delegates from research institutions spread across 15 countries: Belgium, Colombia, Czechia, Estonia, France, Germany, Hungary, Italy, Latvia, Malta, Slovakia, Slovenia, Spain, Switzerland, and the United Kingdom.

The Conference also included social events, such as a walking tour of Valletta beginning at the Grand Hotel Excelsior, pausing for a visit to St John's Co-Cathedral, and culminating with a viewing of the 4pm saluting battery at the Upper Barakka Gardens. The conference dinner was held on November 3<sup>rd</sup> at the Trattoria AD1530 restaurant in Mdina (figure 2), during which prizes for best poster presentations were presented to early career researchers. The winners, Mr Matthew Dickers (University of Kent, United Kingdom), Ms Rebekah Attard-Trevisan (University of Kent, United Kingdom), and Dr João Ameixa (University of Potsdam, Germany), were presented their awards by Prof. Nigel J. Mason (figure 3).



**Figure 3:** Poster presentation prize winners receiving their awards. *Top panel:* Mr Matthew Dickers (centre) of the University of Kent flanked by Prof. Andrey V. Solov'yov (left) and Prof. Nigel J. Mason (right). *Middle panel:* Ms Rebekah Attard-Trevisan (centre) of the University of Kent flanked by Dr Maria Alfredsson (left) and Prof. Nigel J. Mason (right). *Bottom panel:* Dr João Ameixa of the University of Potsdam being awarded his prize by Prof. Nigel J. Mason (right).



The Conference itself proved to be a resounding success, with a number of new collaborations having been formed between researchers who had not previously met. The success of the Conference was also evidenced by the responses gained through post-meeting evaluation forms that were disseminated to the delegates. A total of 46% of delegates anonymously provided feedback through these forms, with 100% of those who responded indicating that they were either satisfied or very satisfied with the Conference as a whole as well as the choice of Malta as the host country; while 96% were either satisfied or very satisfied with the scientific content of the Conference. When asked whether the COPCA Conference should be continued as a biennial conference series, 100% of delegates who responded to the evaluation forms were supportive of this motion with 62% indicating that Malta should remain the host country for future editions of the Conference.

As such, consensus was reached among the organising committee for the next COPCA Conference to be held in October 2024 in Malta. This next edition of the Conference will seek to build upon the successes of the 2022 edition, but will aim to improve upon three aspects in particular. Firstly, the greater participation of female scientists and researchers should be encouraged: only 16% of speakers at the 2022 COPCA Conference were female. Although it is to be recognised that such a gender imbalance reverberates across science in general and physical sciences in particular, more effort will be made to further include female researchers as presenters and session chairs in future editions of COPCA. The increased participation of early career researchers will also be sought, with only 20% of speakers at the 2022 COPCA Conference being PhD students or post-doctoral research associates.

Secondly, future editions of the COPCA Conference should pursue further internationalisation by seeking contributions and presentations from beyond Europe. With the exception of one, all delegates attending the 2022

COPCA Conference represented research institutions and universities based in Europe. In an age of increased globalisation, greater discussions with scientific researchers based in Asia, Oceania, the Middle East, Africa, and North and Latin America could allow for yet further insights to be gleaned in collisions science research and fruitful collaborations to be established.

Finally, an increased participation of researchers based at the University of Malta as well as Maltese researchers based abroad is desired. As previously stated, one of the key goals of the COPCA Conference was to highlight and promote Maltese scientific research among the international community. In total, eight academic members of staff from the University of Malta were in attendance at the 2022 COPCA Conference, representing the Departments of Chemistry, Physics, Systems and Control Engineering, and Applied Biomedical Science, as well as the Institute of Aerospace Technologies. Three postgraduate students, from the University of Malta, also participated in the poster presentation session. Further efforts to increase these numbers will thus be a priority of the 2024 edition of the COPCA Conference.

*If you believe that your research is relevant to the themes covered by the COPCA Conference and would like to participate in future editions, please do not hesitate to contact the corresponding author for more information.*

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