XJENZA ONLINE

VOLUME 8 ISSUE 1, 2020

www.xjenza.org

Science Journal of the Malta Chamber of Scientists

Editor-in-Chief: Cristiana Sebu

Xjenza Online - Science Journal of the Malta Chamber of Scientists
http://www.xjenza.org

Editorial Board

Xjenza Online - Science Journal of the Malta Chamber of Scientists
https://www.xjenza.org

Chronological List of Past and Present Editors of Xjenza The Journal of the Malta Chamber of Scientists

2018–
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. 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

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

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

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*
Xjenza Vol. 3 Iss. 2 - 1998
Xjenza Vol. 3 Iss. 1 - 1998
Associate Editors: *Martin Ebejer, Richard Muscat, Christian A. Scerri and Emmanuel Sinagra*
Xjenza Vol. 2 Iss. 2 - 1997
Xjenza Vol. 2 Iss. 1 - 1997
Xjenza Vol. 1 Iss. 2 - 1996
Xjenza Vol. 1 Iss. 1 - 1996

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: http://www.mcs.org.mt/index.php/xjenza. 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.

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 (`http://www.wma.net/en/30publications/10policies/b3/index.html`); EU Directive 2010/63/EU for animal experiments (`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.

Permissions It is the responsibility of the corresponding author of a manuscript to ensure that there is no infringement of copyright when submitting material to Xjenza. In particular, when material is copied from other sources, a written statement is required from both the author and/or publisher giving permission for reproduction. Manuscripts in press, unpublished data and

personal communications are discouraged; however, corresponding authors are expected to obtain permission in writing from at least one author of such materials.

Preparation of Manuscripts

Xjenza accepts submissions in MS Word, Libre Office Writer and LaTeX, the latter being the preferred option. Anyone submitting in LaTeX should use the journal template, the latest version of which can be found at `http://github.com/hicklin/Xjenza-Journal-Template`. All the necessary files to run the LaTeX 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 processer, 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 BibTeX (*.bib) file.

Article Structure

A manuscript for publication in Xjenza will typicall 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 LaTeX 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.

Artwork Electronic artwork general instructions:

- Make sure you use uniform lettering and sizing of your original artwork.
- Save text in illustrations as 'graphics' or enclose the font.
- Only use the following fonts in your illustrations: Arial, Courier, Times, Symbol or Computer Modern Roman, the latter is preferred.
- Number the illustrations according to their sequence in the text.
- Name your artwork files as 'fig$x$' or 'tab$x$' where x corresponds to the sequence number in your document.
- Provide captions to illustrations separately.
- Produce images near to the desired size of the printed version or grater.
- Make sure that the artwork has no margins and borders.

- Submit each figure as a separate file.

Formats Regardless of the application used, when your electronic artwork is finalised its file format should be one of the following (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):

- PDF or SVG: Vector drawings. Embed the font or save the text as 'graphics'.
- 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.
- JPEG or PNG: Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.

Where possible use a vector format for your artwork (PDF or SVG). If this is not possible, supply files that have and adequate resolution.

Colour Artwork Make sure that color artwork files are in an acceptable format (JPEG, PNG, PDF or SVG) and have the correct resolution.

Figure Captions Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum, but explain all symbols and abbreviations used.

Tables Number tables consecutively in accordance with their appearance in the text. Place footnotes to tables below the table body and indicate them with superscript lowercase letters. Avoid vertical rules. Be moderate with the use of tables and ensure that the data presented in tables do not duplicate results described elsewhere in the article. Large tables should be submitted in CSV format.

Citations and References Reference and citation styles for manuscripts submitted to Xjenza 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 LaTeX 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 BiBTeX (*.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 Telecare 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: `http://www.nlm.nih.gov/tsd/serials/lji.html`;

-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 Xjenza 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 the 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 of 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.splite 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.

Proofs, Reprints and Copyright The corresponding author will receive an electronic proof of the article and have an opportunity to review editorial changes and to double-check accuracy of content, tables, and statistics before publication. A list of any necessary corrections should be sent by email to the managing editor within a week of proof receipt to avoid unnecessary delays in the publication of the article. Alterations, other than essential corrections to the text of the article, should not be made at this stage. Manuscripts are accepted for publication on the understanding that exclusive copyright is assigned to Xjenza. However, this does not limit the freedom of the author(s) to use material in the articles in any other published works.

Xjenza Online - Science Journal of the Malta Chamber of Scientists
www.xjenza.org

Editorial

A Little Piece of Normality

Cristiana Sebu*[1]
[1]*Department of Mathematics, University of Malta, Msida, Malta*

Dear readers and authors of Xjenza Online, as Editor-in-Chief, I am very pleased to announce the release of the first issue of 2020 of Xjenza Online.

This year, the world has been passing through challenging times and the COVID-19 pandemic has become a global phenomenon with consequences that are already dramatic in many areas. This issue of Xjenza Online demonstrates continuity of the scientific endeavour in the Maltese Islands, a little piece of normality during these unsettling times,

The issue opens with an extensive review by Schembri et al. of the scientific literature on the investigation of preconditioning, a complex, strong, evolutionary conserved cellular survival mechanism that is exhibited by different species as well as in different organs.

The following important study by Manwel Debono and Mario Thomas Vassallo investigates the influence of a number of personal factors (age, gender, skills level of job, sector of employment and knowledge of local employment laws, etc.) on the work-related outcomes of Filipino migrants in Malta.

Next, the article by Cuschieri et al. evaluates whether the level of knowledge in reading nutritional labels in the Maltese population is correlated to their oral health status. The results of the study revealed that there is a low awareness of daily sugar intake guidelines and a moderate understanding of nutrition labels. Moreover, age-related trends, educational background, and knowledge in reading and correctly understanding food nutritional labels were related to better oral health.

The issue concludes with a manuscript by Azzopardi et al. which evaluates the quality of communication between the dental clinics and dental laboratories from a dental laboratory technicians' point of view and to offer means for improving communication between these two workplaces.

To conclude, I wish you all to stay strong and safe, and keep up the hope for better times. As always, Xjenza Online will continue to serve the local professional scientific community, to publish high-quality original findings in a peer-reviewed environment, and to help early-career researchers to advance their scientific discourse in the community.

**Correspondence to*: C. Sebu (cristiana.sebu@um.edu.mt)

Xjenza Online - Science Journal of the Malta Chamber of Scientists
www.xjenza.org
DOI: 10.7423/XJENZA.2020.1.01

Research Article

Complex factors in preconditioning a microarray gene

K. Schembri[1], **G. Grech**[2], **C. Saliba**[3], **C. Scerri**[4], **J. Galea**[*1]
[1] *Department of Cardiothoracic Surgery, Mater Dei Hospital, Msida, Malta*
[2] *Department of Pathology, Faculty of Medicine and Surgery, University of Malta, Msida, Malta*
[3] *Centre of Molecular Medicine and Bio-banking, University of Malta, Msida, Malta*
[4] *Department of Physiology, Faculty of Medicine and Surgery, University of Malta, Msida, Malta*

Abstract. Preconditioning is complex, strong, evolutionary conserved cellular survival mechanism that is exhibited by different species as well as in different organs. A focused approach on microarray evaluation of preconditioning will be used to highlight the lack of clarity in investigating this complex phenomenon, exacerbated by the absence of a standardised terminology. This paper is an extensive review of the scientific literature on the investigation of preconditioning by means of a microarray approach. It dissects the design of the experiments used to investigate such phenomenon and classifies the complex factors in investigating preconditioning. It presents an attention to detail to the lexicon with a suggested classification and terminology that describes preconditioning that may help stratify and clarify research in this field.

Keywords: preconditioning, microarray, complex factors, classification

1 Introduction

Preconditioning is a complex, evolutionary conserved, cellular survival phenomenon. The protective effect of preconditioning is described in different species as well as in different organs of the same species such as the heart (Correa-Costa et al., 2012; Jassem et al., 2009; Jun et al., 2011), the lung (Jun et al., 2011), the kidney (Correa-Costa et al., 2012), the liver (Jassem et al., 2009), the intestines (Wang et al., 2009), the retina (Kamphuis et al., 2007), the spinal cord (Carmel et al., 2004; Kim et al., 2008), the brain (Hirata et al., 2007; Kawahara et al., 2004) and skeletal muscle (Harralson et al., 2005; Moses et al., 2005). It is also possible to transfer this protective effect from a preconditioned rat heart to that of a naive rat heart using the coronary effluent (Serejo et al., 2007). The same effect has been shown in rabbits (Dickson et al., 1999; Leung et al., 2014).

This phenomenon falls under the wider term of hormesis. This term was first described by Southam et al. (1943) and recently revived by Calabrese (2004). Hormesis refers to a pattern of cellular responses to stressors whereby a beneficial effect results from exposure to low doses of agents or intensities of environmental factors that are otherwise toxic or lethal when given at higher concentration or intensities (Krenz et al., 2013). Murry et al. (1986) were among the first to report a type of preconditioning known as 'ischemic preconditioning' and referred to it as a 'rapid, adaptive response to a brief ischaemic insult, which slowed the rate of cell death during a subsequent prolonged period of ischemia'. In a dog heart model, they were able to prove that this phenomenon could reduce the infarct size by 75%. Four years later Kitagawa et al. described ischaemic preconditioning in the brain of gerbils (Kitagawa et al., 1990).

Understanding one of the strongest cellular defence mechanisms is challenging for many reasons. A focused approach on microarray evaluation will be used to highlight the lack of clarity in investigating this complex phenomenon, exacerbated by the absence of a standardised terminology. The following is a review of the scientific literature investigating preconditioning by means of a microarray approach and presents an attention to detail to the lexicon with a suggested terminology describing preconditioning that may help stratify and clarify research in this field.

Correspondence to: J. Galea (joseph.f.galea@um.edu.mt)

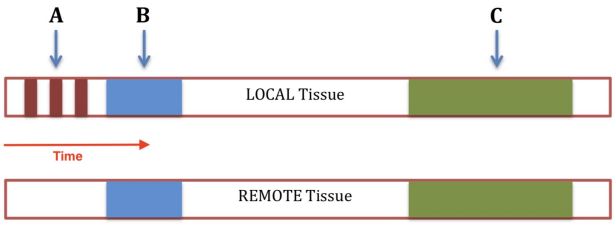

Figure 1: Showing: A (red) – Challenge. (Single or separated by two reperfusion episodes) B (blue) – Early Protection from Insult C (green) – Late protection from Insult

2 Preconditioning, gene expression and microarrays

Preconditioning is triggered by a stimulus, which will be forthwith referred as the 'challenge'. This challenge will protect the cell from a more potent ensuing event from now on referred to as the 'insult'. The protective effect is bi-temporal and is exhibited in local as well as in remote tissue (figure 1). Thus, preconditioning can be described as having four phases of protection. The first phase of protection occurs within minutes of the insult A (Red in figure 1), lasts 2 to 3 hours (B) (Blue in figure 1) and is commonly referred to as classic preconditioning (Bolli, 2000). The second phase of protection comes on at about 24 hours after the challenge and lasts up to 72 hours (C) (Green in figure 1) and is commonly known as the second window of protection (SWOP) (X. M. Yang et al., 1996). The above two phases describe local protection. The protective effect is transmitted to remote organs giving rise to two other phases commonly known as early and late remote preconditioning (Leung et al., 2014; Przyklenk et al., 1993). Towards the beginning of the 1990's the main focus of investigation was on the classic phase of preconditioning. Thornton et al. (1990) reinforced this drive by showing that the inhibition of protein synthesis did not alter myocardial protection afforded by preconditioning. The receptor-based response seen in classic preconditioning is a vital rapid response to the stressor (challenge) and can be considered a 'knee jerk or reflex' response that is not dependent on gene transcription. The delayed response which was described in 1995 by Yellon et al. is however a complex gene expression response, possibly an 'intelligent' response with the capability of anticipating potential ensuing threats (insults). Two main genetic approaches have been used in studying this aspect of preconditioning; candidate gene approach and genome wide analysis. The former is built around a hypothesis about the role of particular pathways such as inflammation, followed by a search for changes in specific gene expression levels related to inflammation by means of tools such as the polymerase chain reaction (PCR). These are in vitro models that are very useful because biochemical molecules can be used to alter the pathway under investigation and study its effect and relevance. A top to bottom approach using genome wide analysis interrogating the expression of thousands of genes in a single experiment such as in microarray analysis or next generation sequencing (NGS) as compared to the latter reductionist approach is an important tool in uncovering key molecular events in the cell's response to preconditioning. Limitations of these gene expression studies include, restricted time points, limited and biased transcripts represented on the array, the nature of the sample analysed, as well as an absence of clearly defined models (Kawahara et al., 2004).

3 Complex factors in preconditioning

Several factors that make preconditioning a complex process to study can be identified. These can be broadly subdivided into intrinsic and extrinsic factors. Intrinsic factors relate to the nature of the phenomenon and include; a wide spectrum of challenges, a bi-temporal nature and a spatial element. The extrinsic factors relate to the diverse experimental designs adopted by researchers, terminology and semantics used in describing the phenomenon and the overwhelming information generated by recent technology.

3.1 Intrinsic Factors

The intrinsic factors are inherent to the phenomenon and thus are not amenable to alteration however when identified they can be approached systematically facilitating a holistic approach in researching the phenomenon.

3.1.1 Wide spectrum of challenges

The first intrinsic factor is the wide spectrum of challenges that can induce preconditioning leading to the activation of diverse complex networks culminating to a common effect of enhanced cellular tolerance. These challenges include; hypoxia (Bernaudin et al., 2002), hyperthermia (Du et al., 2010), hypothermia (Nishio et al., 2000), epileptic fits (Sasahira et al., 1995) and drugs such as acetylsalicylic acid (Riepe et al., 1997). These are not simply challenges exclusive to the laboratory but have also been studied in the natural setting in humans. This is thought to occur in patients with ischaemic heart disease who exhibits recurrent anginal chest pain (Costa et al., 2005; Wall et al., 1994) or in patients with cerebrovascular disease who exhibit transient ischemic attacks (Moncayo et al., 2000). The different challenges studied in different species under different experimental conditions looking at different phases of preconditioning leads to a multiplier effect on the number of complex variables.

3.1.2 Bi-temporal nature

The second intrinsic complex factor is the bi-temporal nature creating three scenarios for investigation the third being the processes happening between the first and second instance. Each scenario is a complex event to study in its own merit. The preconditioning challenge invokes an early response with a very rapid manifestation of cellular protection that lasts a few hours and a late response or second wave becoming active at 24 hours from the initial challenge and lasting 72 to 96 hours (figure 1). The first wave is dependent on preformed molecules and activation of receptors such as adenosine A1/A3 (Murphy et al., 2008; Tsukamoto et al., 2005), opioid receptor activation (Schultz et al., 1995) and to a lesser degree bradykinin B2 (Wall et al., 1994). These molecules in turn activate downstream signalling cascades the earliest being protein kinase C (PKC). Downstream targets of PKC activation include 5'-nucleotidase, glycogen synthase kinase-3B (GSK-3B), mitochondrial permeability transition pore (mPTP), ATP-sensitive potassium channels in plasma membranes and mitochondria, proteins involved in apoptosis (Bax/Bad and Bcl-2), and adenosine A2b receptors (Costa et al., 2005; Hausenloy et al., 2003; Murphy et al., 2008; Tsukamoto et al., 2005; X. Yang et al., 2011). This does not exclude the possibility of an early genomic response but this is overshadowed by studies looking at the biochemical response. This is in contrast to the exponential increase in the literature regarding the extensive genetic response in the SWOP. A highlight of this response is the very important up-regulation of an intrinsic pro-survival genetic program that has been shown to attenuate apoptosis (Stein et al., 2007).

Intuitively the bi-temporal nature of the phenomenon drives research into these two time points potentially undermining inquiry into the interim period that possibly involves cellular memory. It is very plausible that the second wave involves the activation of a cellular memory mechanism allowing the cell to mount the response 24 hours after the initial preconditioning stimulus. This hypothesis is supported by evidence of cellular memory from studies of a similar phenomenon described in plants known as 'priming' (Pastor et al., 2013).

3.1.3 Spatial element

The third intrinsic factor is the spatial element. The protective effects are noted both locally at the site of preconditioning as well as in remote organs involving complex processes of cell signalling (Guo et al., 2019). Thus distant organs are somehow receiving the preconditioning trigger allowing them to respond effectively to the challenge, another mechanism that is still not fully understood (Billah et al., 2018). The remote organ protection effect is manifested for both temporal events that is the classic and SWOP. This remote effect introduces three scenarios with their own complex factors. The first is the local mechanism by which a challenged organ creates a signal that conditioning has happened. The second scenario is the transmission of this signal that is thought to involve both neural and humoral factors (Lim et al., 2010; Shimizu et al., 2009) and the third is the interpretation of this signal by distant organs and the mounting of a protective response.

3.2 Extrinsic factors

Studies of preconditioning using microarray techniques were chosen as the main criterion in order to simplify and focus analysis on a specific manageable scenario. Twenty-eight studies from PubMed satisfied the criterion of microarray and preconditioning and are shown in table 1. The extrinsic factors will be explored further by using the 28 studies referred to in table 1.

3.2.1 Classification and terminology

The first extrinsic factor is process classification and terminology. Using gene expression as the scenario it is clear from the literature that it is challenging to the unfamiliar reader to understand what phase of the preconditioning phenomenon is under investigation. This is confounded by the fact that different authors use different terminology to describe the same phases of preconditioning. In order to clarify and simplify this issue of preconditioning phases it is suggested that they are classified into four different phases based on temporal and spatial factors and that a standard terminology with an abbreviation system is adopted. The temporal response can be subdivided into two parts, early and late. The early response, referred to as 'classical', 'immediate', 'acute' or 'early phase' preconditioning is very rapid and confers tolerance lasting between 2 to 3 hours (figure 1). This is followed by an interim period where tolerance is not exhibited. The late phase is referred to as the second window of protection 'SWOP', 'delayed' preconditioning and 'late phase' preconditioning sets in at around 24 hours after the initial challenge and lasts up to 72 hours. Both the early and the late responses have a spatial component that is local and remote, transmitting the signal to distant cells and organs. The remote component is known as remote preconditioning. Remote preconditioning is expressed in both temporal aspects and thus the distant cells exhibit both early remote preconditioning as well as late remote preconditioning. Table 2 illustrates current terms used in describing preconditioning and a proposed classification and nomenclature shown in italics that integrates the different aspects of preconditioning.

The proposed terms and abbreviations would thus be local early preconditioning (LEPC), local late preconditioning (LLPC), remote early preconditioning (REPC),

	Spatial – Local	Spatial – Remote
Temporal – Early (2 to 3 hours)	Local early PC (LEPC) *Classical PC* *Immediate PC* *Acute PC* *Early phase PC*	Remote early PC (REPC) *Remote PC* *Remote ischemic PC*
Temporal – Late (24 to 72 hours)	Local late PC (LLPC) *Second window of protection* *Delayed PC* *Late Phase PC*	Remote late PC (RLPC) *Remote delayed PC*

Table 2: Current and proposed terms describing preconditioning (PC). The terms in italics are alternative terms that are found in the literature.

System	Species	Type of challenge	Challenge protocol	Challenge - insult interval	Type of insult	PC phase	Genes, Fold Change & Platform Setting	Experimental Design	First author, Journal & Year
Brain									
Cerebral cortex	*Mus musculus* 8-10 weeks male C57BL/6J	MCAO	Single 15-minute episode of MCAO	3 days	60 minutes MCAO	Second phase/ SWOP	7500 genes 2.2 fold Affymetrix MG_U74AV1	- Challenge at 24 hours - Insult at 24 hours - Insult altered by challenge 3 days before	Stenzel-Poore, *Lancet*, 2003
Hippocampus (CA1 cells)	*Rattus norvegicus* male Wistar SPF	BCAO	Single 2-minute episode of BCAO	3 days	6 minutes BCAO	Second phase/ SWOP	7000 genes 2 fold Affymetrix RG_U34A	- Challenge at 1, 3, 12, 24 & 48 hours - Insult at 1, 3, 12, 24 & 48 hours - Insult altered by challenge 3 days before	Kawahara, *J Cereb Blood Flow Metab*, 2004
Frontoparietal cortex	*Rattus norvegicus* adult male SHR **kwaa**	MCAO	Single 10-minute episode of MCAO	3 days	60 minutes MCAO	Second phase/ SWOP	1263 genes 2 fold Affymetrix RG_U34	- Challenge at 3, 6, 12, 24 & 72 hours - Insult at 6 hours - Insult altered by challenge 3 days before	Dhodda, *J Neurochem*, 2004
Cerebral cortex	*Mus musculus* adult male Swiss(not starved)	Hypoxia by 8% oxygen in nitrogen	Single 1 or 6 hour episode of hypoxia	12,18 & 24 hours	Permanent MCAO	Second phase/ SWOP	6000 genes 1.5 fold Affymetrix MG_U17A	- 2 challenges at 12, 18, 24 & 72 hours - Insult at 6 hours - Insult altered by challenge 12, 18 & 24 hours before	Tang, *Neurobiol Dis*, 2006
Hippocampus (CA3 sector)	*Mus musculus* C57BL/6	Seizure by intra-peritoneal kainic acid	Single episode of seizures	1 day	Status epilepticus by intra-amygdala kainic acid	Second phase/ SWOP	39000 genes 1.8 fold Affymetrix 430 2.0	- Challenge at 24 hours - NA - Insult altered by challenge 1 day	Hatazaki, *Neuroscience*, 2007

Table 1: Showing a description of preconditioning microarray experiments according to system, species, type of challenge, challenge protocol, challenge-insult interval, type of insult, preconditioning phase, genes, fold change and microarray platform setting, gene expression profile analysis and fist author, journal, year and reference number. (SHR – spontaneously hypertensive; MCAO – middle cerebral artery occlusion; BCAO bilateral cerebral artery occlusion ; HBO – hyperbaric oxygen; CpG – cytosine-guanine; LPS - lipopolysaccharide; OGD – oxygen-glucose deprivation; CAO – coronary artery occlusion; IPC – ischemic preconditioning; APC – anesthetic preconditioning; MAC – minimum alveolar concentration: SMAO – ; BP – blood pressure; NA – Not Available; PC – Preconditioning and SWOP – second window of protection (table continues overleaf, 1/6)

Cerebral cortex	*Rattus norvegicus* neonatal Sprague Dawley	Hypoxia by 8% oxygen in nitrogen (36°C)	Single 3 hour episode of hypoxia	2, 8 & 24 hours	Killed	NA	chip 30000 genes 1.2 fold Affymetrix Rat230_2	before - Challenge at 2, 8 & 24 hours - NA - NA	Gustavsson, *Pediatr Res*, 2007
Hippocampus (CA1 cells)	*Rattus norvegicus* neonatal male Wistar	HBO (3.5 atmosphere absolute)	Single 1 hour episode of HBO each day for 5 consecutive days	6, 12, 24 & 72 hours	8 minutes forebrain ischemia	First/ classic & second phase/ SWOP	20500 genes Fold change NA AgilentDNA Oligo	- NA - NA - Insult altered by challenge 6, 12, 24 & 72 hours before	Hirata, *Brain Res*, 2007
Forebrain (global ischemia)	*Rattus norvegicus* male Wistar (fasted)	BCAO	Single 3 minute episode of BCAO	3 days	6 minutes BCAO	Second phase/ SWOP	23060 genes 1.25 fold Affymetrix Rat230_2	- NA - Insult at 1, 4 & 24 hours - Insult altered by challenge 3 days before	Feng, *Brain Res*, 2007
Hippocampus (CA1 & CA3 sectors)	*Rattus norvegicus* adult male Sprague Dawley	Seizures by intraperitoneal Kainic acid	Single 20 minute episode of seizures on day 1 & day 2	1 day	Status epilepticus by intra-peritoneal kainate or pilocarpine	Second phase/ SWOP	10179 genes 1.25 fold Affymetrix RAE230A	- Challenge at 24 hours - Insult at 1 & 3 days - Insult altered by challenge 1 day before	Borges, *Neurobiol Dis*, 2007
Frontal cortex	*Mus musculus* 8-10 weeks C57BL/6	CpG oligodeoxynucleotide intraperitoneal injection	Single episode of CpG	3 days	MCAO (time not specified)	Second phase/ SWOP	NA 1.5 fold Affymetrix MOE430 2.0	- NA - Insult at 24 hours -Insult altered by challenge 3 days before	Marsh,*Stroke*, 2009
Frontal cortex	*Mus musculus*	LPS intraperitoneal injection	Single episode of LPS	3 days	45 minutes MCAO	Second phase/ SWOP	NA	- Challenge at 3, 24 & 72 hours - Insult at 3 & 24	Marsh, *J Neurosci*, 2009

Table 1: Continuation of table 1 (2/6)

	C57BL/6						1.5 fold Affymetrix MOE430 2.0	hours - Insult altered by challenge 3 days before	
Hippocampus	*Rattusnorvegicus* adult Sprague Dawley	OGD	Single 5 minute episode of OGD	NA	10 minutes OGD	NA	NA 1.3 fold Affymetrix Rat230_2	- Challenge at 3, 6 & 12 hours - NA - NA	Benardete, *Brain Res*, 2009
Cerebral cortex	*Mus musculus* adult male C57BL/6J	MCAO	Single 15 minute episode of MCAO	1 day	60 minutes MCAO	Second phase/ SWOP	NA	- Challenge at 24 hours - Insult at 24 hours - Insult altered by challenge 1day before	Lusardi, *J Cereb Blood Flow Metab*, 2010
Cortical neurons (*in vitro*)	*Rattus norvegicus* 18 day embryonic Wistar	OGD	Single 15 minute episode of OGD alternating with 15 minute reperfusion for 3 cyles	1 day	120 minutes OGD	Second phase/ SWOP	NA 1.5 fold Agilent G413 60mer 4x44	- Challenge at 3 hours - NA - Insult altered by challenge 1 day before	Prasad, *J Mol Neurosci*, 2012
Heart									
Heart (*in vivo*)	*Oryctolagus cuniculus* New Zealand white rabbit	Circumflex branch CAO	Single 5 minute episode of CAO alternating with 5 minute reperfusion for 2 cycles	NA	NA	NA	18376 genes 5fold NA	- Challenge at 5 hours - NA - NA	Simkhovich, *Heart Dis*, 2002
Heart (Langendorf isolated & perfused)	*Rattus norvegicus* male Wistar	Langendorff heart no flow ischemia	Single 5 minute episode of ischemiaalternating with 5 minutereperfusion for 3 cycles	NA	30 minutes no flow myocardial ischemia	NA	3200 genes NA NA	- NA - Insult at 2 hours -NA	Onody, *FEBS Lett*, 2003

Table 1: Continuation of table 1 (3/6)

Heart (Langendorf isolated & perfused)	*Rattus norvegicus* male Wistar	IPC by no flow ischemia & APC by isoflurance (1.5 MAC)	IPC - Single 5 minute episode of ischemia alternating with 5 minute reperfusion for 3 cycles APC – Single 110 minute episode of isoflurance	NA	NA	NA	8800 genes 2 fold Affymetrix RG_U34A	- Challenge at 110 minutes - NA - NA	Sergeev, *Anesthesiology*, 2004
Heart (*in vivo*)	*Mus musculus* 10-12 weeks C57BL/6	Hind limb ischemia by occlusion of femoral artery	Single 4 minute episode of occlusion alternating with 4 minute reperfusion for 6 cycles	15 minutes & 24 hours	Killed	NA	NA 1.5 fold AffymetrixMG_430 A	- Challenge at 15 minutes & 24 hours - NA - NA	Konstantinov, *J Thorac Cardiovasc Surg*, 2005
Heart (*in vivo*)	*Mus musculus*/ *Rattus norvegicus* male ICR/ Wistar	Hypoxia by a high-altitude chamber (380 Torr)	Single 15 hour episode of hypoxia for 2, 4 & 8 weeks	NA	NA	NA	6144 genes 2 fold NA	– Challenge at 2, 4 & 8 weeks - NA - NA	Chen, *Shock*, 2005
Myocardial, renal, intestinal, & lung	*Mus musculus* adult male Swiss Webster	SMAO	Single 2-minute episode of SMAO alternating with 2- minute reperfusion for 2 cycles	1 day	Killed	NA	1176 genes 1.7 fold NA	- Challenge at 24 hours - NA - NA	Huda, *Heart Lung Circ*, 2005
Heart (*in vivo*)	*Rattus norvegicus* male Wistar	NA	Single 5 minute episode of ischemia alternating with 10 minute reperfusion for 2	10 minutes	40 minutes ischemia (type not specified)	First/ classic phase	NA NA	- NA - Insult at 30 minutes - Insult altered by challenge 10 minutes before	Canatan, *Cell Biochem Funct*, 2008

Table 1: Continuation of table 1 (4/6)

			cycles				CodeLink bioarrays		
Blood									
Leukocytes	*Homo sapiens* adult male and female	Forearm ischemia by BP cuff inflation (2 00mmHg)	Single 5 minute episode of ischemia alternating with 5 minute reperfusionfor 3 cycles	NA	NA	NA	NA 1.5 fold Affymetrix HG_U133A	- Challenge at 24 hours - NA - NA	Konstantinov, *Physiol Genomics*, 2004
Retina									
Retina	*Rattus norvegicus* Male Wistar	Eye anterior chamber induced pressure by a 1.7m head	Single 5 minute episode of ischemia alternating with 24 hour reperfusion	1 day	60 minutes of anterior chamber raised pressure	Second phase/ SWOP	NA NA AgilentG4130A	- NA - Insult at 1, 2, 6 & 12 hours – Insult altered by challenge 1 day before	Kamphuis, *Mol Vis*, 2007
Lung									
Lung	*Rattus norvegicus*	Cessation of ventilation and perfusion by clamping of pulmonary vessels	Single 5 minute episode of ischemia alternating with5 minute reperfusion for 3 cycles	NA	2 hours of cold ischemia	NA	22226 genes 2 fold Illumina Rat Ref-12 expression beadchip	- NA - Insult at 1, 3, 6 & 24 hours - NA	Jun, *J Surg Res*, 2011
Intestines									
Small intestine (transplant)	*Rattus norvegicus* adult male Sprague Dawley	SMAO	Single 10 minute episode of ischemia alternating with 10 minute reperfusion	10 minutes	Transplantation	First/ classic phase	4096 genes NA NA	- NA - Insult at 1 hour - Insult altered by challenge 10 minutes before	Wang, *J Surg Res*, 2009

Table 1: Continuation of table 1 (5/6)

Kidney									
Kidney (*in vivo*)	*Mus musculus* male C57BL/6	No flow ischemia by clamping of both renal pedicles	Single 15 minute episode of ischemia	1 week	45 minute renal pedicle cross clamp	Second phase/ SWOP	NA 2/3 fold Agilent 4x44 K whole genome microarray	- NA - Insult at 6 hours - Insult altered by challenge 1 week before	Correa-Costa, *PLoS One*, 2012
Liver									
Liver (*in vivo*)	*Homo sapiens*	Pringle's manoeuvre occluding porta hepatis by a tourniquet	Single 10 minute episode of porta hepatis clamping	30 minutes	Transplantation	First/ classic phase	NA NA Affymetrix HG_U133A	- NA - Insult at 2 hours - Insult altered by challenge 30 minutes before	Jassem, *Liver Transpl*, 2009
Liver (*in vivo*)	*Homo sapiens*	Pringle's manoeuvre occluding porta hepatis by a tourniquet	Single 10 minute episode of porta hepatis clamping	NA	Transplantation	First/ classic phase NA?	NA NA NA	- NA - Insult at 90 minutes - NA	Raza, *Liver Transpl*, 2010

Table 1: Continuation of table 1 (6/6)

and remote late preconditioning (RLPC). Another terminological issue is the terms used when referring to the stimuli used to trigger preconditioning; the main stressor that is modified by preconditioning. Since many stimuli can trigger preconditioning and there are different methods for achieving this, it would be helpful if the stimuli used to trigger preconditioning are always referred to as the 'challenge' and the main stressor that is modified by preconditioning is referred to as the 'insult'.

3.2.2 Diverse investigational design

The second extrinsic complexity factor refers to the diverse investigational design adopted by researchers. In such a complex process, structure of design using standard protocols, classification and nomenclature is of utmost importance. Different preconditioning challenges elicit different biochemical and genetic response pathways limiting the significance of comparisons between studies. The different challenges in microarray studies utilized to induce preconditioning include hypoxia (MCAO, BCAO, hypoxia chamber, CAO, NFI, HLI, SMA, FAI, EAIP, CPV and OPH) (Bernaudin et al., 2002), hyperbaric oxygen (HBO), high altitude (Ostrowski et al., 2008), oxygen glucose deprivation (OGD) (Himori et al., 1991; Ito et al., 2000), hyperthermia (Du et al., 2010), hypothermia (Nishio et al., 2000), lipopolysaccharides (LPS) and oligodeoxynucleotide (Huang et al., 2013; Yu et al., 1999). Other challenges used in preconditioning experiments but not in these microarray studies are epileptic seizures (Belosjorow et al., 1999; Rosenzweig et al., 2007; Sasahira et al., 1995), cortical spreading depression (Kobayashi et al., 1995), chemical preconditioning with compounds such as 3-nitropropionic acid (3-NP) (Riepe et al., 1996), antibiotics such as erythromycin and kanamycin (Huber et al., 1999), acetylsalicylic acid (Riepe et al., 1997), N-methyl-D-aspartate (NMDA) (Himori et al., 1991), doxorubicin (Ito et al., 2000), 2-deoxyglucose (Yu et al., 1999) and sulfur dioxide (Huang et al., 2013). Microarrays interrogate a huge number of genes that may vary from one thousand to thirty-five thousand genes generating a huge amount of data. A comparison of different microarrays would be a good approach to understand the genomic response in preconditioning but the diversity of challenges used in this field is an important limiting factor.

Another important factor in design apart from the type of challenge is the duration and frequency of the challenge. The duration of the hypoxic challenge used by different investigators varies from 5 to 15 minutes of bilateral cerebral artery occlusion (BCAO). Another issue in structure is defining clearly what phase of the preconditioning is under investigation; local or remote, classic or SWOP. Gene expression investigations can focus on the effect of challenge on gene expression in local or remote tissue when compared to controls as well as the altering effect of the challenge on the insult expression profile. Out of the 7 studies on the heart, 6 looked at the effect of the challenge on gene expression whilst only one investigation looked at the effect of challenge in altering gene expression profile during the insult. In the latter study the time period between the challenge and the insult is not specified leaving unanswered the issue of whether classic or second window of protection was under study. Therefore, when studying the effect of the challenge on the insult gene expression profile, the timing between the challenge and the insult needs to be clearly defined. There is also large variability in the insult methods used. In the neuro studies the middle cerebral artery occlusion (MCAO) occlusion challenge varied from 45 to 60 minutes to permanent. Given the limited number of microarray studies in preconditioning it would be useful to focus on specific organs. Most of the work has been carried out on the brain (14 studies) and the heart (7 studies), undoubtedly due to the clinical importance of myocardial infarction and stroke, the commonest causes of death in western countries. Single studies investigated blood, retina, lung, small intestines, kidney and liver. Species variability included 14 studies in rats, 10 in mice, 2 in humans and 1 in the rabbit. Only two studies looked at the gene expression changes secondary to preconditioning at a remote site.

3.2.3 Overwhelming information

The final complex factor is the inevitable information overload generated by the advent of an ever-increasing array of powerful data generating investigational tools available for the researcher and which are constantly evolving. Tools such as microarrays have generated terabytes of data and as can be seen from table 1 the types of arrays used and the number of genes investigated has varied over time. This complicates the issue of data integration as well as the comparison of data with earlier investigations. Another new technology, which is bound to generate an even greater load of information, is next generation sequencing. New discoveries such as epigenetics can become a potential contributor to information overload. In fact, research into the epigenetics of preconditioning has started to be published from 2013 (Thompson et al., 2013).

4 Conclusion

Complex systems in biology such as preconditioning need a concerted effort in order to be deciphered. Scientific approaches, such as systems biology, an interdisciplinary field of study that focuses on complex interactions within biological systems, using a holistic approach as opposed to the more traditional reductionism are essential. The study of preconditioning needs

a 'systems thinking' approach based on a set of habits or practices facilitating the research in this field. This review proposes a basic practice, that of a standardized nomenclature and classification. The terms defined included 'phases' of preconditioning, 'challenge' and 'insult'. Table 2 is a proposal of terms used to describe the four phases of preconditioning. A clearer description of the investigation should also be taken into consideration. A definition from the outset of the model, whether in vitro or in vivo, the species studied, the type of challenge and the challenge protocol whether it is single or multiple episodes, form part of an essential approach in understanding preconditioning. When it comes to microarrays other essential issues include the design of an experiment that looks into the genetic expression response to the challenge, the genetic expression response to the insult and how the challenge alters the genetic response of the insult. Finally, time points such as the interval between the challenge and the insult and the interval between the challenge or insult and the gene expression investigation should be clearly defined from the outset.

References

Belosjorow, S., Schulz, R., Dörge, H., Schade, F. U. & Heusch, G. (1999). Endotoxin and ischemic preconditioning: TNF-α concentration and myocardial infarct development in rabbits. *Am J Physiol*, *277*(H2470–5).

Benardete, E. A. & Bergold, P. (2009). Genomic analysis of ischemic preconditioning in adult rat 3. hippocampal slice cultures. *Brain Res*, *1292*, 107–122.

Bernaudin, M., Tang, Y., Reilly, M., Petit, E. & Sharp, F. R. (2002). Brain genomic response following hypoxia and re-oxygenation in the neonatal rat. identification of genes that might contribute to hypoxia-induced ischemic tolerance. *J Biol Chem*, *177*, 39728–39738.

Billah, M., Ridiandres, A., Allahwala, U. et al. (2018). Circulating mediators of remote ischemic preconditioning: Search for the missing link between non-lethal ischemia and cardioptotection. *Oncotarget*, *10*, 216–244.

Bolli, R. (2000). The late phase of preconditioning. *Circle Res*, *87*, 972–983.

Borges, K., Shaw, R. & Dingledine, R. (2007). Gene expression changes after seizure preconditioning in the three major hippocampal cell layers. *Neurobiol Dis*, *26*, 66–77.

Calabrese, E. J. (2004). Hormesis: A revolution in toxicology, risk assessment and medicine. *EMBO reports 2004, 5 (suppl 1)*, S37–40.

Canatan, H. (2008). The effect of cardiac ischemic preconditioning on rat left ventricular gene expression profile. *Cell Biochem Funct*, *26*, 179–184.

Carmel, J. B., Kakinohana, O., Mestril, R., Young, W., Marsala, M. & Hart, R. P. (2004). Mediators of ischemic preconditioning identified by microarray analysis of rat spinal cord. *Exp Neurol*, *185*, 81–96.

Chen, W. J., Chen, H. W., Yu, S. L. et al. (2005). Gene expression profiles in hypoxic preconditioning using cDNA microarray analysis: Altered expression of an angiogenic factor, carcinoembryonic antigen-related cell adhesion molecule 1. *Shock*, *24*, 124–131.

Correa-Costa, M., Azevedo, H., Amano, M. T. et al. (2012). Transcriptome analysis of renal ischemia/reperfusion injury and its modulation by ischemic pre-conditioning or hemin treatment. *PLoS One*, *7*, e49569.

Costa, A. D., Garlid, K. D., West, I. C. et al. (2005). Protein kinase G transmits the cardioprotective signal from cytosol to mitochondria. *Circ Res*, *97*, 329–336.

Dickson, E. W., Lorbar, M., Porcaro, W. A. et al. (1999). Rabbit heart can be "preconditioned" via transfer of coronary effluent. *Am J Physiol*, *227*, H2451–H2457.

Du, F., Zhu, L., Qian, Z. M., Wu, X. M., Yung, W. H. & Ke, Y. (2010). Hyperthermic preconditioning protects astrocytes from ischemia/reperfusion injury by up-regulation of HIF-1 alpha expression and binding activity. *Biochim Biophys Acta*, *1802*, 1048–1053.

Feng, Z., Davis, D. P., Šášik, R., Patel, H. H., Drummond, J. C. & Patel, P. M. (2007). Pathway and gene ontology-based analysis of gene expression in a rat model of cerebral ischemic tolerance. *Brain Res*, *1177*, 103–123.

Guo, Z. N., Guo, W. T., Liu, J. et al. (2019). Changes in cerebral auto regulation and blood biomarkers after remote ischemic preconditioning. *Neurology*, *93*, e8–e19.

Gustavsson, M., Wilson, M. A., Mallard, C., Rousset, C., Johnston, M. V. & Hagberg, H. (2007). Global gene expression in the developing rat brain after hypoxic preconditioning: Involvement of apoptotic mechanisms? *Pediatr Res*, *61*, 444–450.

Harralson, T., Grossi, F. V., Quan, E. E., Tecimer, T. et al. (2005). Ischemic preconditioning of skeletal muscle: Duration of late-phase protection. *Ann Plast Surg*, *55*(2), 216–222.

Hatazaki, S., Bellver-Estelles, C., Jimenez-Mateos, E. M. et al. (2007). Microarray profile of seizure damage-refractory hippocampal CA3 in a mouse model of epileptic preconditioning. *Neuroscience*, *150*, 467–477.

Hausenloy, D. J., Duchen, M. R. & Yellon, D. M. (2003). Inhibiting mitochondrial permeability transition pore opening at reperfusion protects against ischaemia-reperfusion injury. *Cardiovasc Res*, *60*, 617–625.

Himori, N., Moreau, J. L. & Martin, J. R. (1991). Cerebral ischemia decreases the behavioral effects and mortality rate elicited by activation of NMDA receptors in mice. *Neuropharmacology*, *30*, 1179–1186.

Hirata, T., Cui, Y. J., Funakoshi, T. et al. (2007). The temporal profile of genomic responses and protein synthesis in ischemic tolerance of the rat brain induced by repeated hyperbaric oxygen. *Brain Res*, *1130*, 214–222.

Huang, P., Sun, Y., Yang, J. et al. (2013). The ERK1/2 signaling pathway is involved in sulfur dioxide preconditioning-induced protection against cardiac dysfunction in isolated perfused rat heart subjected to myocardial ischemia/reperfusion. *Int J Mol Sci*, *14*, 22190–22201.

Huber, R., Kasischke, K., Ludolph, A. C. & Riepe, M. W. (1999). Increase of cellular hypoxic tolerance by erythromycin and other antibiotics. *Neuroreport*, *10*, 1543–1546.

Huda, R., Chung, D. H. & Mathru, M. (2005). Ischemic preconditioning at a distance: Altered gene expression in mouse heart and other organs following brief occlusion of the mesenteric artery. *Heart Lung Circ*, *14*, 36–43.

Ito, K., Ozasa, H., Sanada, K. & Horikawa, S. (2000). Doxorubicin preconditioning: A protection against rat hepatic ischemia-reperfusion injury. *Hepatology*, *31*, 416–419.

Jassem, W., Fuggle, S., Thompson, R. et al. (2009). Effect of ischemic preconditioning on the genomic response to reperfusion injury in deceased donor liver transplantation. *Liver Transpl*, *15*, 1750–1765.

Jun, N., Ke, J., Gang, C., Lin, C., Jinsong, L. & Jianjun, W. (2011). The protective effect of ischemic preconditioning associated with altered gene expression profiles in rat lung after reperfusion. *J Surg Res*, *168*, 281–293.

Kamphuis, W., Dijk, F. & Bergen, A. A. (2007). Ischemic preconditioning alters the pattern of gene expression changes in response to full retinal ischemia. *Mol Vis*, *13*, 1892–1901.

Kawahara, N., Wang, Y., Mukasa, A. et al. (2004). Genome-wide gene expression analysis for induced ischemic tolerance and delayed neuronal death following transient global ischemia in rats. *J Cereb Blood Flow Metab*, *24*, 212–223.

Kim, K. O., Choe, G., Chung, S. H. & Kim, C. S. (2008). Delayed pharmacological pre-conditioning effect of mitochondrial atp-sensitive potassium channel opener on neurologic injury in a rabbit model of spinal cord ischemia. *Acta Anaesthesiol Scand*, *52*, 236–242.

Kitagawa, K., Matsumoto, M., Tagaya, M. et al. (1990). 'ischemic tolerance' phenomenon found in the brain. *Brain Res*, *528*, 21–24.

Kobayashi, S., Harris, V. A. & Welsh, F. A. (1995). Spreading depression induces tolerance of cortical neurons to ischemia in rat brain. *J Cereb Blood Flow Metab*, *15*, 721–727.

Konstantinov, I. E., Arab, S., Kharbanda, R. K. et al. (2004). The remote ischemic preconditioning stimulus modifies inflammatory gene expression in humans. *Physiol Genomics*, *19*, 143–150.

Krenz, M., Baines, C., Kalogeris, T. & Korthuis, R. (2013). Cell survival programs and ischemia/reperfusion: Hormesis, preconditioning, and cardioprotection. *Colloquium Series on Integrated Systems Physiology: From Molecule to Function*, *5:3*, 1–122.

Leung, C. H., Wang, L., Nielsen, J. M. et al. (2014). Remote cardioprotection by transfer of coronary effluent from ischemic preconditioned rabbit heart preserves mitochondrial integrity and function via adenosine receptor activation. *Cardiovasc Drugs Ther*, *28*, 7–17.

Lim, S. Y., Yellon, D. M. & Hausenloy, D. J. (2010). The neural and humoral pathways in remote limb ischemic preconditioning. *Basic Res Cardiol*.

Loukogeorgakis, S. P., Panagiotidou, A. ., Broadhead, M. W., Donald, A., Deanfield, J. E. & MacAllister, R. J. (2005). Remote ischemic preconditioning provides early and late protection against endothelial ischemia-reperfusion injury in humans: Role of the autonomic nervous system. *J Am Coll Cardiol*, *46*, 450–456.

Lusardi, T. A., Farr, C. D., Faulkner, C. L. et al. (2010). Ischemic preconditioning regulates expression of microRNAs and a predicted target, MeCP2, in mouse cortex. *J Cereb Blood Flow Metab*, *30*, 744–756.

Marsh, B., Stevens, S. L., Packard, A. E. B. et al. (2009). Systemic lipopolysaccharide protects the brain from ischemic injury by reprogramming the response of the brain to stroke: A critical role for IRF3. *J Neurosci*, *29*, 9839–9849.

Marsh, B. J., Stevens, S. L., Hunter, B. & Stenzel-Poore, M. P. (2009). Inflammation and the emerging role of the toll-like receptor system in acute brain ischemia. *Stroke*, *40*, S34–S37.

Moncayo, J., de Freitas, G. R., Bogousslavsky, J., Altieri, M. & van Melle, G. (2000). Do transient ischemic attacks have a neuroprotective effect? *Neurology*, *54*, 2089–2094.

Moses, M. A., Addison, P. D., Neligan, P. C. et al. (2005). Inducing late phase of infarct protection in skeletal muscle by remote preconditioning: Efficacy and mechanism. *Am J Physiol Regul Integr Comp Physiol*, *289*, R1609–R1617.

Murphy, E. & Steenbergen, C. (2008). Mechanisms underlying acute protection from cardiac ischemia-reperfusion injury. *Physiol Rev*, *88*, 581–609.

Murry, C. E., Jennings, R. B. & Reimer, K. A. (1986). Preconditioning with ischemia: A delay of lethal cell injury in ischemic myocardium. *Circulation*, *74*, 1124.

Nishio, S., Yunoki, M., Chen, Z. F., Anzivino, M. J. & Lee, K. S. (2000). Ischemic tolerance in the rat neocortex following hypothermic preconditioning. *J Neurosurg*, *93*, 845–851.

Ónody, A., Zvara, Á., Hackler, L., Vígh, L., Ferdinandy, P. & G Puskás, L. (2003). Effect of classic preconditioning on the gene expression pattern of rat hearts: A DNA microarray study. *FEBS letters*, *536*, 35–40.

Ostrowski, R. P., Graupner, G., Titova, E., Zhang, J. et al. (2008). The hyperbaric oxygen preconditioning-induced brain protection is mediated by a reduction of early apoptosis after transient global cerebral ischemia. *Neurobiol Dis*, *29*, 1–13.

Pastor, V., Luna, E., Mauch-Mani, B., Ton, J. & Flors, V. (2013). Primed plants do not forget. *Environ Exp Bot*, *94*, 46–56.

Prasad, S. S., Russell, M., Nowakowska, M., Williams, A. & Yauk, C. (2012). Gene expression analysis to identify molecular correlates of pre- and post-conditioning derived neuroprotection. *J Mol Neurosci*, *47*, 322–339.

Przyklenk, K., Bauer, B., Ovize, M., Kloner, R. A. & Whittaker, P. (1993). Regional ischemic 'preconditioning' protects remote virgin myocardium from subsequent sustained coronary occlusion. *Circulation*, *87*, 893–899.

Raza, A., Dikdan, G., Desai, K. K. et al. (2010). Global gene expression profiles of ischemic preconditioning in deceased donor liver transplantation. *Liver Transpl*, *16*, 588–599.

Riepe, M. W., Kasischke, K. & Raupach, A. (1997). Acetylsalicylic acid increases tolerance against hypoxic and chemical hypoxia. *Stroke*, *28*, 2006–2011.

Riepe, M. W., Niemi, W. N., Megow, D., Ludolph, A. C. & Carpenter, D. O. (1996). Mitochondrial oxidation in rat hippocampus can be preconditioned by selective chemical inhibition of succinic dehydrogenase. *Exp Neurol*, *138*, 15–21.

Rosenzweig, H. L., Minami, M., Lessov, N. S. et al. (2007). Endotoxin preconditioning protects against the cytotoxic effects of TNFalpha after stroke: A novel role for TNFalpha in LPS-ischemic tolerance. *J Cereb Blood Flow Metab*, *27*, 1663–1674.

Sasahira, M., Lowry, T., Simon, R. P. & Greenberg, D. A. (1995). Epileptic tolerance: Prior seizures protect against seizure-induced neuronal injury. *Neurosci Lett*, *185*, 95–98.

Schultz, J. E., Rose, E., Yao, Z. & Gross, G. J. (1995). Evidence for involvement of opioid receptors in ischemic preconditioning in rat hearts. *Am J Physiol*, *268*, H2157–H2161.

Serejo, F. C., Rodrigues, L. F. J., da Silva Tavares, K. C., de Carvalho, A. C. C. & Nascimento, J. H. M. (2007). Cardioprotective properties of humoral factors released from rat hearts subject to ischemic preconditioning. *J Cardiovasc Pharmacol*, *49*, 214.

Sergeev, P., da Silva, E., R. Lucchinetti et al. (2004). Trigger-dependent gene expression profiles in cardiac preconditioning: Evidence for distinct genetic programs in ischemic and anesthetic preconditioning. *Anesthesiology*, *100*, 474–488.

Shimizu, M., Tropak, M., Diaz, R. J. et al. (2009). Transient limb ischaemia remotely preconditions through a humoral mechanism acting directly on the myocardium: Evidence suggesting cross-species protection. *Clin Sci (Lond)*, *117*, 191–200.

Simkhovich, B. Z., Abdishoo, S., Poizat, C., Hale, S. L., Kedes, L. H. & Kloner, R. A. (2002). Gene activity changes in ischemically reconditioned rabbit heart gene: Discovery array study. *Heart Dis*, *4*, 63–69.

Southam, C. M. & Ehrlich, J. (1943). Effects of extracts of western red-cedar heartwood on certain wood-decaying fungi in culture. *Phytopathology*, *33*, 517–524.

Stein, A. B., Bolli, R., Guo, Y. et al. (2007). The late phase of ischemic preconditioning induces a prosurvival genetic program that results in marked attenuation of apoptosis. *J Mol Cell Cardiol*, *42*, 1075–1085.

Stenzel-Poore, M. P., Stevens, S. L., Xiong, Z. et al. (2003). Effect of ischaemic preconditioning on genomic response to cerebral ischaemia: Similarity to neuroprotective strategies in hibernation and hypoxia-tolerant states. *The Lancet*, *362*, 1028–1037.

Tang, Y., Pacary, E., Fréret, T. et al. (2006). Effect of hypoxic preconditioning on brain genomic response before and following ischemia in the adult mouse: Identification of potential neuroprotective candidates for stroke. *Neurobiol Dis*, *21*, 18–28.

Thompson, J. W., Dave, K. R., Young, J. I. & Perez-Pinzon, M. A. (2013). Ischemic preconditioning alters the epigenetic profile of the brain from ischemic

intolerance to ischemic tolerance. *Neurotherapeutics*, *10*, 789–797.

Thornton, J., Striplin, S., Liu, G. S. et al. (1990). Inhibition of protein synthesis does not block myocardial protection afforded by preconditioning. *Am J Physiol*, *259*, H1822:H1825.

Tsukamoto, O., Asanuma, H., Kim, J. et al. (2005). A role of opening of mitochondrial ATP-sensitive potassium channels in the infarct size-limiting effect of ischemic preconditioning via activation of protein kinase C in the canine heart. *Biochem Biophys Res Commun*, *338*, 1460–1466.

Vk, D., Sailor, K. A. & Bowen, K. K. (2004). Putative endogenous mediators of preconditioning-induced ischemic tolerance in rat brain identified by genomic and proteomic analysis. *J Neurochem*, *89*, 73–89.

Wall, T. M., Sheehy, R. & Hartman, J. C. (1994). Role of bradykinin in myocardial preconditioning. *J Pharmacol Exp Ther*, *270*, 681–689.

Wang, S., Fan, L., Gao, K. & Li, G. (2009). The protective effect of ischemic preconditioning associated with altered gene expression profiles in intestinal grafts after reperfusion. *J Surg Res*, *153*, 340–346.

Yang, X., Xin, W., Yang, X. M. et al. (2011). A2B adenosine receptors inhibit superoxide production from mitochondrial complex I in rabbit cardiomyocytes via a mechanism sensitive to Pertussis toxin. *Br J Pharmacol*, *163*, 995–1006.

Yang, X. M., Baxter, G. F., Heads, R. J., Yellon, D. M., Downey, J. M. & Cohen, M. V. (1996). Infarct limitation of the second window of protection in a conscious rabbit model. *Cardiovasc Res*, *31*, 777–783.

Yellon, D. M. & Baxter, G. F. (1995). A "second window of protection" or delayed preconditioning phenomenon: Future horizons for myocardial protection? *J Mol Cell Cardiol*, *27*, 1023–1024.

Yu, Z. F. & Mattson, M. P. (1999). Dietary restriction and 2-deoxyglucose administration reduce focal ischemic brain damage and improve behavioral outcome: Evidence for a preconditioning mechanism. *J Neurosci Res*, *57*, 830–839.

Debono, M. & Vassallo, M.T. (2020). *Xjenza Online*, 8:16–31.

Xjenza Online - Science Journal of the Malta Chamber of Scientists
www.xjenza.org
DOI: 10.7423/XJENZA.2020.1.02

Research Article

Predictors of Employment Outcomes among Filipino Workers in Malta

M. Debono[*1], **M. T. Vassallo**[2]
[1] *Centre for Labour studies, University of Malta, Msida, Malta*
[2] *Faculty of Economics, Management and Accountancy, University of Malta, Msida, Malta*

Abstract. The work-related experiences of migrants vary significantly across groups and are affected by the interaction of the migrants' characteristics with those of the host country. This study investigates the influence of a number of personal factors on the work-related outcomes of Filipino migrants in Malta. Data about seven personal characteristics and nine work-related outcomes were gathered from a sample of 317 Filipino workers and analyzed through inferential statistics. Male and female respondents experience similar work outcomes, apart from access to training which is higher among males. Older workers have better work outcomes than younger ones. They are treated more fairly, face less discrimination, take less sick leave and are less likely to exhibit presenteeism. Knowledge of local employment laws is related to higher levels of job satisfaction, fair treatment, and ability to influence decisions at work. Counter intuitively, level of education is positively related to perceived discrimination. Besides, having a high skilled job and working in the public sector are related to greater health and safety risks and more sick leave. These unexpected results may be explained through the migrants' higher expectations and greater awareness and sensitivity towards working conditions. This study confirms the utility of a nuanced approach when examining the working conditions of Filipino migrants and highlights the predictive ability of age, skills level of job, sector of employment and knowledge of local employment laws.

Keywords: Filipino workers, migrants, predictors, employment outcomes, Malta

Acknowledgements. The authors would like to thank: the Consulate of the Republic of the Philippines and the Filipino Community in Malta for providing access to the participants; the European Foundation for the Improvement of Living and Working Conditions for granting permission to use the raw data of the 6th EWCS; Jobsplus (Malta) for supplying data about Filipino workers in Malta.

1 Introduction

It is widely recognized that the active labour market participation of migrants is an important contributor towards their social integration (Cheung et al., 2014). Research indicates that migrants often experience worse employment outcomes than nationals (Ambrosini et al., 2007; OECD/EU, 2018). The labour market situation of migrants in many countries appears to have worsened in both absolute and relative terms since the 2007–8 global financial crisis (OECD, 2013) and has remained particularly bad in Southern Europe due to the general economic difficulties of the region (OECD/EU, 2018).

Migrants are a heterogeneous category that might have very little in common apart from living in a foreign country. By only focusing on the most common work experiences or challenges of migrants, it is easy to miss significant variations from such average experiences. Indeed, the work-related experiences of migrants vary significantly across groups (OECD, 2013). Such outcomes are inevitably affected by the interaction of different aspects of the host country with the migrant's personal factors. Aspects of the host country, such as the economy, culture, legal framework, and political climate, may play an important role in the work experiences of migrants. On the other hand, research also indicates the important role that intersectionality (i.e. how different aspects of a person's identity such as race, class, gender etc. combine and lead to discrimination) plays in increasing the vulnerability experienced by migrant workers (e.g. Alberti et al., 2013; Ressia et al., 2017). For example, a highly qualified female worker from a lower caste in India would experience different career barriers in liberal Sweden than in India, and would also

Correspondence to: M. Debono (manwel.debono@um.edu.mt)

experience different career barriers from a low-skilled Norwegian man living in Sweden.

While third country nationals living within the EU experience worse social outcomes than European migrants (OECD/EU, 2018), their working conditions are not particularly high on the national agendas of EU countries, a situation reflecting the negative sentiment towards foreigners which has spread across the world in recent years. This is not to say that governments are not doing anything to help the immigrants. Indeed, many countries are working "to improve the process of recognition of qualifications, promote language courses, and ensure that immigrants are included in active labour market policies, while alleviating the constraints that may limit the employment opportunities for [different] migrant groups" (OECD/EU, 2018, p. 69). Since the employment outcomes of migrants have significant consequences on their social integration and on a country's larger social cohesion, the predictors of positive work outcomes merit particular attention and have significant policy implications.

The aim of this study is to investigate the influence of a number of personal factors on the work-related outcomes of Filipino migrants living in the European country of Malta. This study explores whether foreign research findings are replicable within the specific scenario of Malta. In particular, it is hypothesized that seven personal factors of Filipino workers, namely gender, age, years spent in Malta, level of education, skill level of job, employment sector, and knowledge of employment law are related to nine important employment outcomes, namely skills adequacy, access to training, occupational health and safety, perceived discrimination, sick leave, presenteeism, job satisfaction, fairness of treatment and ability to influence decisions at work.

Malta is the smallest member state of the European Union (EU) by both geographical area (316 sq km) and population (c. 475,000 inhabitants); it is also by far the densest (with over 1,500 inhabitants per sq km). In recent years, and until the arrival of Covid-19, the country had experienced an unprecedented trend of economic expansion, registering the highest real GDP growth (at 6.7%) in the EU in 2018 (European Commission, 2019). Strong performance in particular sectors such as finance, iGaming, tourism, retail, and construction has contributed to this trend. The need for human resources was increasing in line with the expansion of the economy. Unemployment was very low and employers were experiencing staff shortages, a situation that was stifling business growth (Costa, 2018). According to the European Commission (2018), over 30% of the companies in Malta were struggling to fill job vacancies, which were often being taken up by foreign workers. The presence of EU internal migrants and 'third country nationals' (that is, migrants coming from outside the EU) was rapidly increasing, aided by government policy meant to assist employers in resolving their human resource needs. The ratio of foreign workers thus boomed from about 1% in 2000 (Central Bank of Malta, 2016) to about 20% in 2018.

The focus on Filipino workers in this study derives from the fact that they are the largest group of third country nationals in Malta, consisting of a total of 2,882 workers in April 2018 (Jobsplus, 2018). About one out of every five third country national migrant workers in Malta is Filipino (Jobsplus, 2018). Contextualizing the Maltese situation within the EU scenario, "around 800,000 Filipinos live in Europe, making it a less popular destination for their diaspora (estimated at 10.5 million) than the Americas or Asia (4.3 million each). Nevertheless, the Philippines is consistently among the fifteen countries of origin of non-EU migrants to the EU. The largest Filipino communities [in Europe] are in the United Kingdom (220,000) and Italy (184,000)" (European Parliament, 2018, p. 6).

After outlining the rationale, scope and context of this study, the next section reviews research about significant predictors of work-related outcomes among migrants.

2 Review of Literature

This section presents research findings divided across four interdependent dimensions, namely: skills adequacy and training opportunities; occupational health and safety and sick leave; worker participation and job satisfaction; and fair treatment and indiscriminate conditions of work. These four dimensions were chosen due to the significant role they play in the quality of working lives. Besides, as will be discussed below, international literature indicates that migrants and nationals vary in their experience of such dimensions.

2.1 Skills adequacy and training opportunities

Working above or below one's skill levels is conducive to negative work and personal outcomes. 45% of a sample of Latin American migrants in Germany researched by Espinoza-Castro et al. (2018) reported symptoms of distress as a consequence of working below their skill level, resulting in poor psychosocial wellbeing. On the other hand, a good match between one's skills and one's job may improve work performance and contribute to overall wellbeing at work. For example, research highlighted the importance of skill utilization for job satisfaction among high skilled migrants (e.g. Tian et al., 2018).

A survey across EU countries showed that the prevalence of educational mismatch is highest among third country nationals (CEDEFOP, 2018). While over the past decade, the over qualification gap between third- and host-country nationals has decreased, 42% of highly

educated non-EU nationals are still currently over-qualified for the job they do, against 22% of highly-educated EU nationals (OECD/EU, 2018). The average rate of over-qualification among third country workers is higher in particular EU countries such as Italy and Greece (OECD/EU, 2015). In Italy "the general pattern for foreign workers appears to be a fragmented career, either restricted to seasonal or temporary jobs or alternating between legal and illegal employment" (Venturini et al., 2008, p. 517). This reality probably also reflects the situation of migrants in other countries.

Accreditation problems, a language disadvantage, lack of labour market information, and identity-based discrimination may all lead to migrants taking jobs below their skill levels (Sert, 2016). Professional regulatory bodies often underestimate the worth of foreign qualifications. Besides, foreign work experience tends to be devalued by employers for reasons that "range from discrimination and racism based on country of origin, to ignorance about the value migrants' experience could offer an organization" (Suto, 2009, p. 419).

Research evidence indicates that skills mismatch varies among different social groups. More migrant women than men appear to be overqualified. "EU-wide, the immigrant female over-qualification rate is 14 percentage points higher than that of their native peers, while the male rate is 11 percentage points higher" (OECD/EU, 2018, p. 149). It has been noted that irrespective of their country of origin, young workers in Europe are at risk of "being trapped in jobs that do not reflect their skills and qualifications" (Simola, 2018, pp. 460–461). The outcomes of young people with a migrant background in Europe are less favourable than those of their peers with native-born parents (OECD/EU, 2018). One assumes that, in general and over time, people move closer to jobs matching their skills. Thus, older Maltese persons are more likely to be in jobs that match their skills level (Eurofund, 2017) when compared to younger workers.

Training opportunities are a means of increasing the person-job fit. Research indicates that access to training varies according to different factors. For example, access is higher in the public sector than the private sector (Božič, 2019). The reasons for this might include the fact that private companies face more challenges (including financial and HR constraints) to invest in training and their fear of losing trained employees. Workers' level of education is also correlated to greater access to training (Božič, 2019). This finding has been replicated among Maltese workers (Eurofund, 2017). The unequal distribution of training opportunities might be due to the organisations' larger economic returns in training highly-educated workers. At the same time, poorly-educated workers might be less willing to participate in training, due to economic preferences and personality traits (Fouarge et al., 2013). Access to training also tends to be positively correlated to age (Božič, 2019). However, older persons in Malta have less access to training than younger ones (Eurofund, 2017). While data for Maltese workers indicate that workers in high skilled jobs are more likely to receive training than those in low skilled jobs, they are also more likely to feel that they need further training to cope well with their duties than persons in low skilled jobs (Eurofund, 2017).

The decreased likelihood of migrants to access training has been well documented (e.g. Grainger, 2006). The need for training is accentuated by the fact that, among non-EU nationals aged 15 to 64 years, 19% (or 2.6 million individuals) only achieved primary school education. While that share has declined by 2.5% percentage points over the last decade, it remains four times as high as among nationals (OECD/EU, 2018). It is unsurprising that the higher accident rates among migrants have been related to these workers' relative inexperience and lack of safety training (Koukoulaki, 2010). On their own, training and qualifications may be unable to improve the employment outcomes of migrants. Indeed, gaps in unemployment between host- and third-country nationals are wider among the highly rather than the poorly educated (OECD/EU, 2018).

Trade unions in Europe have been vocal advocates for basic training and re-skilling programmes for migrant workers. In 2007, the Trade Union Congress (TUC) in the UK acknowledged that a large number of migrant workers have considerable difficulty with speaking and understanding English, and this could be one of the most significant barriers to ensuring that they are suitably trained and informed (Trade Union Congress UK, 2007). To this effect, unions both in Malta and elsewhere have taken the lead to offer access to language training for migrants and to educate their shop stewards on how to function within multicultural workplaces (General Workers Union, 2020; International Labor Organisation, 2005).

2.2 Occupational health and safety and sick leave

Migrants are more likely to experience occupational health and safety risks than nationals. Higher occupational injury rates are consistently documented among migrants when compared to native workers (Koukoulaki, 2010; Sterud et al., 2018), and these rates appear to be related to their different working conditions (You et al., 2015). It is well known that migrants concentrate in specific sectors and occupations (Ellis et al., 2007). They often work in hotels and catering, construction and care work, sectors which, as García-Pérez et al. (2019) affirm, have a higher incidence of precarious employment. Indeed, in their systematic attempt to summarize in-

ternational literature that examines working conditions among immigrants in Europe and Canada, Sterud et al. (2018) confirm that poor occupational factors may partly contribute to the higher risk of sick leave or disability pension among immigrants. Maltese persons with lower levels of education are more likely to experience health or safety risks than those with higher education (Eurofund, 2017).

The above-mentioned sectors are often non-unionized. As expected, Niu (2010) reports that non-unionised workers are subject to higher health and safety risks. The reasons for this could include differences in training in safer work practices and in working experiences, as well as different job assignments in connection to age, sex and physical size and strength. The absence of unionization among migrant workers who form part of this "traditionally unorganized and invisible" workforce (Garofalo Geymonat et al., 2017) renders their working environment fertile ground for abuse, exploitation and denial of labour and human rights, which results in health and safety problems.

While difficult to quantify, it is well known that many migrants have irregular and undocumented legal status. This status may direct migrants to less regulated or protected employment sectors. Thus, as expected, Benach et al. (2011) conclude that migrant status is a key cross-cutting factor linking employment and working conditions to health inequalities. Migrants, especially irregular ones, may also experience language barriers in the receiving country: such barriers are known to also impede safe and healthy work environments (Viveros-Guzmán et al., 2015).

Among the multitude of factors that may contribute to greater occupational health and safety risks among migrants, one finds the interesting though insufficiently studied aspect of cultural practices. For example, in a study among Filipino workers in Alaska, Garcia et al. (2017) mention two cultural values of Filipinos, namely 'pakikisama' (or getting along with others) and 'hiya' (or shame), that may end up increasing health and safety risks at work. In order to continue getting along with others, when Filipinos "are treated unfairly or with disrespect from supervisors or when they feel they may have made a mistake, they are less likely to report disrespect or mistakes or they will minimize the situation" (Garcia et al., 2017, p. 223). On the other hand, the fear (or shame) of being unable to reach their goals may drive Filipino supervisors to put too much pressure on their workers.

Indeed, the potential effects of culture in relation to health and safety are important and wide ranging. For example, culture may affect the likelihood of reporting minor injuries and health issues. Third-country nationals across the EU report being in better health than nationals, particularly in Southern Europe; however, evidence shows that non-EU foreigners are less likely to report poor health than domestic nationals (OECD/EU, 2015). Culture may also affect the amount of leave taken by employees. In their study on the legitimacy of absenteeism from work, Addae et al. (2013) found that there are normative differences based on ethnic diversity about what constitutes a reasonable level of absence from work. Thus Japanese workers view absenteeism from work as least legitimate, followed by Americans and then Canadians, reflecting the differences in absence rates across these countries (Addae et al., 2013).

Differences in occupational health and safety risks are also related to demographics. Young workers, especially males aged between 15 and 24 years, are more likely than older workers to report non-fatal injuries at work (Woods et al., 2010). The reasons that have been put forward for this include the young workers' greater propensity to take risks, illusion of invulnerability, rebelliousness, greater propensity for substance abuse, lack of control in their workplace, and lower levels of unionization (Woods et al., 2010). International research also links higher risks of precariousness and health and safety to female workers (e.g. Niu, 2010; Ronda-Pérez et al., 2012). Having said that, according to Eurofund (2017) data, Maltese men are more likely to believe that their health or safety is at risk because of their work than Maltese women.

Research carried out in Australia also indicates that "recent immigrants, compared to native-born workers, are more likely to work in jobs that expose them to hazards and increase their risk of injury" (Kosny et al., 2016, p. 99). This is in line with a study showing that short stay and undocumented migrants in Sweden presented lower health related quality of life than those staying for a longer period of time (Andersson et al., 2018). In another study about Latin-American migrants in Germany, Espinoza-Castro et al. (2018) found that, while the link between time of residence in the host country and psychological and physiological distress was not statistically significant, there appeared a trend of decreasing distress with longer time of residency.

2.3 Worker participation and job satisfaction

Gonzales (2010) recognizes the positive consequences of workers' direct participation at the place of work in terms of stronger work relations, job enrichment and higher degree of influence. Worker participation also helps workers to feel more in control of their lives, which may lead to a better ability to deal with stress (Woods et al., 2010). Pillinger (2016) observes that when vulnerable workers, such as migrants, are denied their legitimate voice within their organization and are not given any opportunity to participate in collective bargaining and access to justice, they are more likely to experi-

ence psychosocial risks and violence at the workplace. However, Gonzales (2010) also argues that direct participation may lead to some negative outcomes such as greater time pressures and stress as a result of work intensification.

Gonzales (2010) concludes that direct participation is weaker in those industries where there is greater dependence on low-skilled work, where organisations rely heavily on insecure forms of work and were unions are not well established. In addition, García-Pérez et al. (2019) maintain that part-time employment is associated with poorer working conditions, including fewer opportunities for participation. As discussed earlier in this study, migrant workers tend to find themselves in such jobs. Thus, it is likely that they do not have much voice in their work. In a qualitative study about immigrants' perceptions on their working conditions in Spain, Ahoen et al. (2009) found that informants' deficient language skills, non-transferability of their education and training and, most of all, their immigrant status left them with little choice but to work under poor conditions and without any voice in their working environment.

Low workplace participation may decrease job satisfaction. Job satisfaction is a very important attitude as it reflects a person's psychological well-being and, though the link is not straightforward, it may lead to motivation and higher work performance (Arnold et al., 2016). Job satisfaction has also been linked to other work outcomes such as absenteeism (Arnold et al., 2016).

Some research evidence indicates that migrants (including internal ones) experience lower levels of job satisfaction when compared to locals (Chowhan et al., 2012; Siow et al., 2013; Tian et al., 2018). In their investigations of occupational realties of migrant workers in the health sector, de Vries et al. (2016) conclude that migration seems to 'pay-off' in terms of work and labour conditions but, with the exception of doctors, migrants reported a lower quality of life due to rock bottom levels of job satisfaction. In their study about correlates of career satisfaction in Canada among high paid managers and professionals, Yap et al. (2014) similarly conclude that immigrants experience lower career satisfaction than native-borns. In particular, research connects skilled migrants with low levels of satisfaction (Tian et al., 2018). Since skilled migrants would have invested considerable time, money and effort to achieve their skills level, their skills and job may play a particularly important role in their self-definition. Thus, it has been hypothesized that "when skilled migrants sense a low level of skill utilization, the sense of a less-than-ideal person-job fit limits the opportunity for skilled migrants to form [a] positive self-concept through the context of work-based situations and activities, which is a critical source of meaning and self-definition for migrants" (Tian et al., 2018, pp. 264–265). On the other hand, some studies link migrants in unskilled work to higher levels of job satisfaction. For example Olesen et al. (2012) report that "lower job expectations among the immigrant cleaners may result in higher satisfaction and, therefore, a more positive view on the psychosocial work environment" (p. 94).

Most barriers experienced by migrants tend to diminish over time in the receiving country (Rendall et al., 2010). In line with this, research indicates that the gap in job dissatisfaction between migrants and native-borns diminished among long-term migrants (Kifle et al., 2016). In relation to this finding, there is also considerable evidence showing that job satisfaction increases with age among workers in general (Arnold et al., 2016). This might be partly explained by the fact that, over time, workers manage to move to jobs that they fit better in. Besides, older persons have more realistic and healthy expectations. However, it is unclear whether this finding holds among migrants.

2.4 Fair treatment and indiscriminate conditions of work

The experiences of many migrants are characterized by discrimination and marginalization (Secretary-General, U.N., 2016). Eurostat and the Labour Force Survey showed that there is discrimination against migrant workers at all stages of the employment cycle, including during hiring and recruitment, as well as layoffs (European Parliament, 2014). Buckley et al. (2016) maintain that the risk of discrimination among migrant workers varies according to a number of factors, namely employment sector, gender and ethnicity, employment skills, nature of employment contract, 'visibility' of ethnicity and socio-economic status. Almost 40% of non-EU nationals in Greece and more than one-third in Belgium consider that they belong to a group that has been subject to discrimination (OECD/EU, 2018). Perceived discrimination or bullying were also found to be consistently higher among immigrant workers than among natives in the review of literature carried out by Sterud et al. (2018).

Female migrants are sometimes at risk of double or triple discrimination on the basis of age, gender and/or ethnicity (European Parliament, 2014). The Trade Union Congress UK (2007) maintains that there is a strong link between the high levels of sexual harassment experienced by younger women and the fact that the latter are more likely to be in low-paid, casual, and insecure work. Similarly, Poulston (2008) states that casual, part-time, young, and female workers are particularly vulnerable to sexual harassment. Apart from gender, age might also increase people's susceptibility to discrimination. It has been documented that in Europe,

young people are "far more likely than other groups to be employed in precarious jobs" (Simola, 2018, p. 460), which places them at higher risk of discrimination.

Discrimination may be a major reason why migrants end up in particular jobs according to their ethnic background. The 'visibility' of a migrant's ethnicity—which varies according to the skin, hair and eye colour of the native population—exposes them to more risks, including unmet mental health needs (Office of the Surgeon General (US), Center for Mental Health Services (US) & National Institute of Mental Health, 2001). A study carried out in Italy found that "African immigrants have the fewest career prospects while Eastern European and Asian workers are less far behind" (Venturini et al., 2008, p. 517). Ruhs et al. (2010, p. 27) maintain that "employers draw on socially meaningful stereotypes or their own experiences generalized" to explain the suitability of particular nationalities for specific jobs. Duncan et al. (2004) argue that sometimes, workers' appropriateness is determined categorically, based on the gender, age, race and/or nationality of the job candidates, rather than individual merit. Thus, for instance, specific traits are generally attributed to Filipinos, such as the ability to get along with others in order to avoid conflict (Andres, 1996).

Over the years, EU countries have construed unique ways to restrict EU migrants' access to rights in their countries, and consequentially increase the migrants' precariousness (Simola, 2018). Researching on the extent of labour integration of migrants in Cyprus, Trimikliniotis et al. (2011) ponder on the ineffective labour market regulations and the reproduction of racist ideologies by 'scapegoating' migrants which is the guise behind the brewing of extreme right and racist ideas. The European Commission's country report on Malta in 2018 states that, while measures are in place to facilitate migrants' recruitment, there are indications that certain third country migrants may not fully benefit from standard rights and conditions and may also encounter discrimination (European Commission, 2018).

39% of immigrants/ethnic minorities in the EU are unaware of legislation forbidding discrimination in employment and so may not report incidents (European Parliament, 2014). This lack of legislative awareness, according to the European Parliament, renders migrant workers even more vulnerable to lower remuneration, anti-social working hours and discriminatory practices by colleagues and customers. In relation to this finding, according to the OECD/EU (2015), the lower a person's level of education, the keener their sense of discrimination. Indeed, 23% of less-educated non-EU nationals believe they belong to a singled-out group, while the rate among the highly educated is 16%. In relation to this point, in a study revolving around the hospitality industry, Ram (2018) concludes that low status employees may face structure-related violence both from their bosses and from clients. Having said that, employment discrimination against skilled migrants has also been amply documented (Dietz et al., 2015), with either their skills being devalued or being viewed as a threat to locals. This finding might not be replicated among nationals. For example, Maltese persons in high skilled jobs are more likely to be treated fairly at work than employees in low skilled jobs (Eurofund, 2017).

Chiswick's (1978) "labour-market assimilation hypothesis" suggests that institutional and individual discrimination against foreign-born workers decreases with additional years in the receiving country, "as the migrant obtains authorization to work legally in a greater range of occupations and employment sectors, and as the migrant's increasing language and cultural skills potentially reduce individual employer discrimination that is related little to their job-performance abilities" (Rendall et al., 2010, p. 384). According to Hamori (2009), data from the Northern and the Western EU member states are consistent with Chiswick's (1978) hypothesis. However, "the employment gap between natives and similar EU-born was smaller in magnitude than that between natives and otherwise-comparable individuals born outside the EU. Furthermore, as opposed to those born outside the EU, convergence was almost complete for the EU-born after 10 years of residence in the receiving country" Hamori (2009, p. 19). On the other hand, data about Southern and Eastern Europe are not in line with Chiswick (1978). For instance, the employment rate of women born outside the EU living in Southern Europe exceeds those of native-born. Rendall et al. (2010) also confirm that the labour-market assimilation hypothesis does not clearly explain the labour market trajectories of women.

3 Method

This section outlines the participants, research instrument, and procedure adopted in this study.

3.1 Population and participants

This study was carried out among the population of Filipino workers in Malta. As can be seen in Table 1, most of these workers are female and under the age of 40 (67% each). The large majority of these migrants work in elementary occupations or services and sales (43% and 39% respectively). Besides, the most common employment sector among Filipino workers is Administrative and Support Service Activities, followed by Human Health and Social Work Activities (employing 40% and 23% of Filipinos respectively) (Jobsplus, 2018).

317 individuals participated in this survey, representing 11% of all the Filipino workers in Malta in 2018. While participation in the survey was based on oppor-

	Gender		Age		*Total*
	Female	Male	< 40	40+	
Elementary Occupations	712	537	882	367	1,249
Services & sales workers	955	177	652	480	1,132
Professionals	114	73	173	14	187
Plant & machine operator & assemblers	65	59	81	43	124
Technicians & Associate Professionals	45	49	72	22	94
Craft & related trades workers	12	35	32	15	47
Clerks & support workers	22	4	22	4	26
Managers	15	8	18	5	23
Grand Total	1,940	942	1,932	950	2,882

Table 1: Occupational Categories by Gender and Age (April 2018), Source: Jobsplus 2018

tunity sampling, the respondents approximated the population in terms of gender, age, and occupational categories. The sample consisted of 241 females and 76 males (forming 76% and 24% of the total respondents respectively). 61% of the respondents were younger than 40 years, while 72% worked in elementary or services and sales occupations. Most of the respondents had lived in Malta between one and five years (59.7%). The large majority of the individuals included in the sample (82.6%) were in possession of a post-secondary or tertiary level of education, whereas the remaining had a secondary level of education (17.4%).

3.2 Research Instrument

The research instrument consisted of a brief questionnaire of 24 mainly close-ended items focusing on demographics details, basic employment information, working conditions and job-related attitudes and perceptions. Most of the items derived from the 6th European Working Conditions Survey (Eurofund, 2019). The questionnaire was accompanied by a covering note explaining the purpose of the study, guaranteeing anonymity and providing the researchers' contact details.

3.3 Procedure

The questionnaire was modified and finalized after conducting a pilot study. Data were gathered in two different ways. The researchers were given the opportunity to distribute a hard copy of the questionnaire during a Christmas party organized by Filipino community groups in Malta. The method returned a rather low number of 91 properly filled questionnaires. In order to boost the number of replies, an online version of the questionnaire was developed and the link was distributed among the Filipino community in Malta in January 2019. This method yielded a further 226 replies, bringing the total of filled questionnaires to 317. The results were inputted onto a spreadsheet and examined through the Statistical Package for the Social Sciences (SPSS). Chi-Square tests were carried out to analyse potential relations between the independent and dependent variables of interest in this study.

4 Results

The results section is divided into seven subsections, namely according to: gender; age; years spent in Malta; level of education; level of skill required by job; employment sector and knowledge of employment laws.

4.1 Gender

Chi square tests reveal that the gender of the respondents is not significantly related to almost any of the dependent variables of interest in this study. Table 2 indicates that being male or female is not strongly linked to one's skills adequacy, job satisfaction, the level of work absenteeism or presenteeism, one's perception of health and safety risk at work, fair treatment or discrimination, or influence on important work decisions. However, male respondents are significantly more likely to have undergone some type of training over the past year (which could have been paid for by the employer, by the respondents themselves, or on-the-job-training) when compared to their female peers: $\chi^2(1, N = 317) = 6.8$, $p < 0.01$.

4.2 Age

As can be seen in Table 3, when compared to the younger respondents, older respondents aged 40+ years spent significantly fewer days absent from work due to health issues: $\chi^2(1, N = 298) = 11.8$, $p < 0.01$, and worked less while sick over past year: $\chi^2(1, N = 283) = 7.0$, $p < 0.01$. Older respondents are also significantly

	Male (%)[1]	Female (%)[1]	N	P
Adequately skilled	45.2	55.1	300	2.2
Access to training over past year	90.8	77.2	317	6.8**
Occupational health/ safety at risk	57.7	44.3	283	3.8
Discriminated at work over past year	32.4	25.6	301	1.3
Took health-related leave over past year	73.0	69.0	300	0.4
Worked while sick over past year	50.7	50.0	285	0.0
Overall satisfied with working conditions	62.5	65.9	304	0.3
Treated fairly at the workplace	63.4	68.6	281	0.6
Able to influence important work decisions	62.9	69.6	277	1.1

[1] Yes answers only, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Work outcomes by gender

less likely to have experienced discrimination at work over the previous year $\chi^2(1, N = 299) = 8.1$, $p < 0.01$. Besides, they are more likely to perceive to be treated fairly at work: $\chi^2(1, N = 280) = 11.1$, $p < 0.01$. However, no significant age differences were found in relation to skills adequacy, access to training, occupational health and safety at work, overall satisfaction with working conditions and ability to influence important work decisions.

4.3 Years Spent in Malta

Chi Square tests reveal that Filipino workers who have been in Malta for less than a year took less health-related leave over the course of the year prior to the survey $\chi^2(2, N = 296) = 15.0$, $p < 0.01$ (see Table 4). On the other hand, the respondents who lived in Malta between 1 and 5 years are most likely to have suffered from discrimination at work during the past year $\chi^2(2, N = 297) = 13.4$, $p < 0.01$. The number of years that Filipino workers spend in Malta was not found to be related to skills adequacy, access to training, occupational health and safety risks, presenteeism, overall satisfaction with working conditions, fair treatment or ability to influence important work decisions.

4.4 Level of Education

When compared to the respondents with a secondary level of education, those with a post-secondary or tertiary level of education report: higher levels of discrimination at work over the previous year: $\chi^2(1, N = 300) = 6.3$, $p < 0.05$; and greater likelihood of having worked while sick over the previous year: $\chi^2(1, N = 284) = 5.3$, $p < 0.05$. However, as can be seen from Table 5, level of education is not strongly related to skills adequacy, access to education, occupational health and safety risk, health-related leave, overall satisfaction with working conditions, fair treatment at the workplace or ability to influence important work decisions.

4.5 Level of skill required by job

Chi squared tests indicate that respondents working in high skilled jobs are more likely to feel that their health or safety is at risk because of their work when compared to their peers working in low skilled jobs: $\chi^2(1, N = 283) = 4.7$, $p < 0.05$, and also took more health-related leave over the previous year $\chi^2(1N = 300) = 4.1$, $p < 0.05$. Besides, respondents working in high skilled jobs were also more likely to access training when compared to those working in low skilled jobs: $\chi^2(1, N = 317) = 4.7$, $p < 0.05$. On the other hand, the level of skills required by their job was not significantly related to levels of skills adequacy, discrimination, presenteeism, work satisfaction, fair treatment or ability to influence important work decisions (See Table 6).

4.6 Employment sector

Respondents who work in the public sector are significantly more likely to have undergone some form of training than those in the private sector $\chi^2(1, N = 312) = 4.0$, $p < 0.05$ (see Table 7). They are also more likely to state that their health or safety is at risk because of their work: $\chi^2(1, N = 279) = 13.2$, $p < 0.001$. Besides, respondents working in the public sector took significantly more health-related leave over the past year when compared to their peers working in the private sector: $\chi^2(1, N = 296) = 6.6$, $p < 0.05$. However, the sector of employment is not linked to skills adequacy, discrimination, unfair treatment, job satisfaction, ability to influence important work decisions, or presenteeism.

4.7 Knowledge of Employment Laws

As can be seen in Table 8, Chi Square tests reveal that knowledge of Malta's employment laws is correlated to: greater levels of job satisfaction: $\chi^2(1, N = 278) = 7.5$,

	< 40 (%)[1]	40+ (%)[1]	N	P
Adequately skilled	53.0	53.0	298	0.0
Access to training over past year	82.8	76.4	315	1.9
Occupational health/ safety at risk	52.3	41.3	281	3.3
Discriminated at work over past year	32.8	17.7	299	8.1**
Took health-related leave over past year	76.9	58.0	298	11.8**
Worked while sick over past year	56.0	39.6	283	7.0**
Overall satisfied with working conditions	61.3	70.2	302	2.5
Treated fairly at the workplace	60.0	79.1	280	11.1**
Able to influence important work decisions	64.3	72.9	275	2.2

[1] Yes answers only, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Work outcomes by age

	< 1 (%)[1]	1–5 (%)[1]	> 5 (%)[1]	N	P
Adequately skilled	53.8	50.3	59.0	298	1.7
Access to training over past year	81.0	81.8	77.4	313	0.7
Occupational health/ safety at risk	55.9	46.7	43.4	279	1.5
Discriminated at work over past year	12.5	34.7	17.3	297	13.4**
Took health-related leave over past year	43.2	75.0	72.3	296	15.0**
Worked while sick over past year	39.4	53.5	44.9	281	3.1
Overall satisfied with working conditions	54.1	64.2	72.6	300	4.1
Treated fairly at the workplace	69.4	63.1	76.0	279	4.0
Able to influence important work decisions	63.9	65.6	76.8	273	3.2

[1] Yes answers only, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Work outcomes by years spent in Malta

	Secondary (%)[1]	Post-sec/Tertiary (%)[1]	N	P
Adequately skilled	57.1	52.0	299	0.4
Access to training over past year	76.4	81.6	316	0.8
Occupational health/ safety at risk	37.5	50.0	282	2.5
Discriminated at work over past year	12.5	30.2	300	6.3*
Took health-related leave over past year	65.3	70.8	299	0.6
Worked while sick over past year	34.8	53.4	284	5.3*
Overall satisfied with working conditions	64.8	65.1	303	0.0
Treated fairly at the workplace	75.0	65.7	280	1.5
Able to influence important work decisions	70.7	67.4	277	0.2

[1] Yes answers only, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Work outcomes by level of education

	High (%)[1]	Low (%)[1]	N	P
Adequately skilled	53.7	52.5	300	0.0
Access to training over past year	92.9	78.5	317	4.7*
Occupational health/ safety at risk	63.4	45.0	283	4.7*
Discriminated at work over past year	37.5	25.7	301	2.4
Took health-related leave over past year	83.3	67.8	300	4.1*
Worked while sick over past year	63.4	48.0	285	3.4
Overall satisfied with working conditions	61.9	65.6	304	0.2
Treated fairly at the workplace	56.4	69.0	281	2.4
Able to influence important work decisions	68.3	67.8	277	0.0

[1] Yes answers only, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Work outcomes by level of skill required by job

	Public (%)[1]	Private (%)[1]	N	P
Adequately skilled	60.0	51.2	295	1.2
Access to training over past year	91.1	78.3	312	4.0*
Occupational health/ safety at risk	73.8	43.5	279	13.2***
Discriminated at work over past year	37.8	25.5	296	2.9
Took health-related leave over past year	86.4	67.1	296	6.6*
Worked while sick over past year	51.2	49.4	280	0.0
Overall satisfied with working conditions	75.0	62.9	300	2.4
Treated fairly at the workplace	58.1	68.5	278	1.8
Able to influence important work decisions	65.9	68.2	274	0.1

[1] Yes answers only, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Work outcomes by employment sector

$p < 0.01$; fair treatment at the workplace: $\chi^2(1, N = 268) = 4.4$, $p < 0.05$; and ability to influence important work decisions: $\chi^2(1, N = 272) = 3.9$, $p < 0.05$. However, knowledge of Malta's employment laws is not strongly linked to skills adequacy, access to training, occupational health and safety, work discrimination, sick leave or presenteeism.

5 Discussion

Many of the findings emerging from this study reflect the trends and patterns between the selected personal factors and employment outcomes established in international studies. However, certain findings reveal atypical relations that do not support the conclusions of foreign research. In view of this, major results are discussed in the idiosyncratic context of Filipinos working in the small island state of Malta.

This study reveals that certain personal characteristics may be more or less helpful in influencing the work outcomes of the examined sample of workers. For example, gender was not found to be an important factor predicting the examined work realities of Filipinos in Malta, with the exception that males tend to receive more training than females. This finding challenges international research which indicates that female migrant workers generally tend to face more negative employment outcomes than their male counterparts, such as greater levels of discrimination (e.g. European Parliament, 2014; Trade Union Congress UK, 2007), over-qualification for their jobs (OECD/EU, 2018) and higher occupational risks and precariousness (García-Pérez et al., 2019; Niu, 2010). The similarity in the examined work-related outcomes emerged despite the gender differences in the work that Filipinos normally do in Malta. This finding signals that females (in general) do not feel that they are treated any worse than their male counterparts at work. One could argue that this finding derives from under-reporting, wherein Filipinas might feel more uneasy or insecure than males to report ill-treatment, consequently creating the illusion that gender is not a significant personal determinant of work outcomes. However, this explanation is debatable, as when compared to their male counterparts, Filipinas tend to have more positive (though not statistically significant) scores on nearly all of the studied work outcomes.

The gender difference in access to training reflects the situation across the Maltese population and in Europe in general. If one excludes potential discriminatory practices from employers which this study did not find evidence for, one may search for the reasons of such a condition by focusing on the type of work done by both genders, their responsibilities outside work, and their work orientation. Filipina migrants in Malta are more likely to work as live-in care workers than their male counterparts. Such a job often requires very long working hours (more than 48 hours per week) which reduces the possibility of taking part in any training outside working hours. Besides, being employed in a family environment also precludes these women from structured on-the job training opportunities which one might have in a larger and more formal organisation. Filipina workers might also have more family responsibilities outside their work, thus limiting their free time. Besides, due to their greater family commitments (both in Malta and in the Philippines) they might have less long-term, career goals. This might reduce their interest in furthering their education and training.

Age is an important predictor of the studied work-related outcomes. When compared to their older peers, younger Filipino workers take more sick leave and are more likely to work while sick (presenteeism). This situation might be influenced by factors such as limited job experience, illusion of invulnerability, greater propensity towards taking risks and substance abuse (Woods et al., 2010). However, lower levels of health may also derive from discrimination and unfair treatment, which younger Filipino workers are also more likely to experience. Indeed, discrimination is based on prejudice which in turn often derives from lack of interaction. Older workers might have reduced the level of prejudice against them through the longer time they had to build relations with employers and co-workers.

Rendall et al. (2010) argue that most barriers experienced by migrants tend to diminish over time in the receiving country. This perspective received some support from the present study which shows that Filipinos who spent between 1 and 5 years in Malta are the most likely to report having been discriminated over the previous year. Respondents who have lived longer in Malta are probably better equipped to prevent being discriminated and to deal with any emerging situations that may lead to discrimination. With the passage of time, they might have acquired additional experience, nurtured their bridging social capital, integrated more within the local society and established useful contacts from whom they could obtain advice and guidance. In this vein, Kahanec et al. (2009) conclude that social networks—that tend to be strengthened with time—may play an important role in smoothing frictions encountered by migrants in the labour market. On the other hand, those who have lived in Malta for less than a year and who might still be on work probation, might not have had enough time to experience discrimination, or might have tried to ignore it in their pursuit of their new life in the country. Filipino migrants who spent less than a year in Malta reported that they took least sick leave, probably for similar reasons. Furthermore, a lack

	Yes (%)[1]	Unsure/No (%)[1]	N	P
Adequately skilled	51.4	52.7	270	0.0
Access to training over past year	78.9	85.0	282	1.7
Occupational health/ safety at risk	46.5	48.7	257	0.1
Discriminated at work over past year	21.9	31.7	272	3.1
Took health-related leave over past year	64.1	74.4	271	3.3
Worked while sick over past year	45.9	56.9	258	2.9
Overall satisfied with working conditions	72.5	56.2	278	7.5**
Treated fairly at the workplace	74.8	62.4	268	4.4*
Able to influence important work decisions	75.2	63.7	272	3.9*

[1] Yes answers only, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Work outcomes by knowledge of local employment laws

of pre-departure orientation and training in the country of origin might contribute towards higher levels of vulnerability among newly arrived migrants who opt to cede their rights because of fear and insecurity. Lamenting about such lack of orientation, a Filipina migrant in Malta interviewed by Vassallo et al. (2020) stated that: "When I decided to leave the Philippines, I was invited for a one-off meeting, together with hundreds of others, to orientate us about what it will imply to live in a foreign country (p. 203)."

The resulting relationship between the level of education attained by Filipinos and certain work outcomes yielded unexpected results. Higher qualified Filipino workers are more likely to feel discriminated at work than their lower qualified peers. This finding contrasts sharply with international surveys showing a significant statistical relationship between non-qualified migrant workers and higher incidence of discriminatory conditions on the place of work (OECD/EU, 2015; Ram, 2018; Trade Union Congress UK, 2007). There might be different reasons to explain this unanticipated result. One of these could be that graduate migrant Filipinos might have higher expectations and more sensitivity towards discrimination than the lower qualified respondents; thus the former are more likely to detect injustice and report abusive treatment than the latter. This tentative explanation may be viewed alongside another significant finding showing that, when Filipino respondents declare that they are knowledgeable about Malta's employment laws, they also declare that they experience higher levels of job satisfaction, fair treatment and ability to influence important work decisions. Hence, migrant workers with a higher level of education and greater knowledgeable of domestic employment legislation may be more empowered to uphold their rights and may be more resourceful to challenge the situation if they think that they are treated unjustly. This state of play is encapsulated in the following narrative by a graduate Filipina worker who is underemployed as a live-in carer in Malta:

> "We work more hours than we are paid for. In the third year of my employment, I wrote a letter of appeal to adjust my salary because I was underpaid. If you will not ask for it, they would not give it to you. However, you need to know what the law says. Unfortunately, many of my fellows don't report anything because they are poorly educated and do not know the law"
>
> (unpublished quote from Vassallo et al., 2020).

Nonetheless, highly educated migrant workers might still be willing to compromise on their rights, perhaps due to their commitment towards their employer or work duties. Indeed, the more highly qualified Filipino workers in Malta are more likely to work while sick. Garcia et al. (2017) presented arguments that may help explain this phenomenon of presenteeism. Filipinos, when compared to other nationals, might be less likely to report sick for the previously mentioned cultural values of getting along with others and shame. Thus, going to work while sick might reflect their effort not to let down their employer and co-workers. The more highly educated Filipinos might feel more pressed by these values than their lower educated peers. Alternatively, or in addition to the previous argument, the more highly educated Filipinos might exhibit more presenteeism in order to reduce the possibility of discrimination by their employer, which as discussed above, they perceive to a greater extent than their lower qualified peers.

Besides the level of education, level of skill required by job is another factor that may help determine benefi-

cial or adverse work-related realities. The current study suggests three significant conclusions. First, Filipinos who work in high skilled jobs are more likely to have access to training; second, they are more likely to feel that their health or safety is at risk, and; third, they took more sick leave during the previous year. The first positive relationship between highly skilled workers and their greater propensity to undergo training is in line with international research (e.g. Božič, 2019). It has been well-documented that low skilled workers can find themselves in a 'low-skill trap' (OECD, 2019). Many migrant workers have low-level positions with limited opportunities for development and can often expect limited returns to training, such as higher wages or access to better jobs (Burdett et al., 2002; OECD, 2017). The positive relation between high skilled migrants, health and safety risks, and tendency to take sick leave appears to contradict international research which clearly shows that poorly educated migrants are more prone to higher incidence of precarious employment (García-Pérez et al., 2019; Sterud et al., 2018; You et al., 2015). A possible explanation for the current finding might be the higher expectations and greater sensitivity regarding potentially unhealthy work circumstances that the more highly qualified Filipino migrants in Malta have, when compared to their less qualified peers.

The sector of employment is another personal factor that was scrutinized to assess its impact on the examined work outcomes. As expected, Filipinos working in the public sector have more access to training when compared to their counterparts in the private sector. This finding is in line with international and national literature which highlights the better working conditions of public sector employees (e.g. Božič, 2019; Eurofund, 2017). Governments in many countries promote the lifelong development of their employees through scholarships, flexible working hours and other arrangements. The large scale of the organisations and the fact that these operate outside the competitive private sector facilitate such actions.

On the other hand and unexpectedly, Filipinos who work in the public sector are more likely to feel that their health or safety is at risk and take more sick leave than their peers working in the private sector. This finding reflects the same pattern established by another survey (Eurofund, 2017) showing that Maltese people working in the public sector also report experiencing more occupational health or safety risks than those in the private sector. In this case, the locals and migrant workers are exhibiting similar trends which may be an indication that, as public officers, they both feel more secure to report health and safety hazards and to take sick leave when compared to their peers working in the private sector. This finding could also be affected by the fact that migrant workers are probably more likely to be unionised when they work in the public than the private sector. Unionization serves as a guarantor of employment rights and a shield against abuse (Garofalo Geymonat et al., 2017; Niu, 2010). Unions make an effort to promote health and safety among their members. Thus, membership in unions may increase one's health and safety awareness and expectations. At the same time, being a member of a trade union may also decrease the fear of negative employment outcomes potentially associated with the taking of sick leave. Thus Filipino workers in the public sector might feel more comfortable taking sick leave when they need to, when compared to those who work in the private sector.

6 Conclusion: A Narrower Focus

"The labour market behaviour of ethnic communities in advanced societies and the social determinants of their labour market outcomes are important empirical issues with significant policy consequences" (Kahanec et al., 2009, p. 167). Past research amply shows the varying employment trajectories and outcomes among migrants with different ethnic backgrounds (OECD, 2013). This exploratory analysis adds to the literature by highlighting that important differences also exist within specific ethnic migrant groups. Our main contribution is to emphasise the need for a nuanced approach when considering the working situation of migrants. The lumping together of all foreign born or foreign nationality persons as sometimes done in large studies (Rendall et al., 2010) fails to bring about a sufficient understanding of the phenomenon of migrant work to inform effective policies and strategies that may improve the situation of specific groups of migrants. Past literature shows that third country migrants in Europe face greater challenges than EU-born ones (Rendall et al., 2010), and that the employment outcomes of third country migrants varies by nationality (Venturini et al., 2008). The current study supports the need to study migrants with an even narrower focus and a finer lens, by delving into the varying outcomes of migrants hailing from the same country according to their socio-demographic characteristics.

This study also supports the idea of intersectionality which may add up to increase the work difficulties experienced by migrants. Age, the skill level of their job, their sector of employment and their knowledge of local employment laws appear to be particularly useful predictors of employment outcomes, unlike gender which does not seem to be as significant. This study suggests that knowledge and experience may lead to better work outcomes. Social networks may also play an important role in solving information problems and other frictions encountered by migrants in the labour market (Kahanec et al., 2009). However, seemingly better-placed migrants

who have higher levels of education and are in highly-skilled and public sector jobs, appear to experience some worse employment outcomes. These results have been tentatively explained through the potentially higher expectations and levels of awareness and sensitivity of the seemingly more privileged groups of migrants.

The cross-sectional nature of this study limits its ability to understand the nature and causes of the particular relations emerging between the examined dependent and independent variables. Qualitative research investigating the current findings could help provide deeper answers in this regard. Besides, it would be useful to research other ethnic groups of migrants in the Maltese society to establish which of the relations highlighted in the current study hold true and which do not in this regard. This would further delineate the nature of the nuanced relationship between specific ethnic groups and the Maltese society.

References

Addae, H. M., Johns, G. & Boeis, K. (2013). The legitimacy of absenteeism from work: A nine nation exploratory study. *Cross Cultural Management*, *20*(3), 402–428.

Ahoen, E. Q., Porthé, V., Vásquez, V., García, A. M., López-Jacob, M. J., Ruiz-Frutos, C., Ronda-Pérez, E., Benach, J. & Benavides, F. G. (2009). A qualitative study about immigrant workers' perceptions of their working conditions in spain. *Community Health*, *63*(11), 936–942.

Alberti, G., Holgate, J. & Tapia, M. (2013). Organising migrants as workers or as migrant workers? intersectionality, trade unions and precarious work. *The International Journal of Human Resource Management*, *24*(22), 4132–4148.

Ambrosini, M. & Barone, C. (2007). Employment and working conditions of migrant workers. *Dublin, Ireland: European Foundation for the Improvement of Living and Working Conditions*.

Andersson, L., Hjern, A. & Ascher, H. (2018). Undocumented adult migrants in sweden: Mental health and associated factors. *BMC Public Health*, *18*(1369).

Andres, T. Q. D. (1996). Understanding the positiveness of filipino values. *Quezon City, Philippines: Rex Book Store*.

Arnold, J., Randall, R., Patterson, F., Silvester, J., Robertson, I., Cooper, C., Burnes, B., Harris, D. & Axtell, C. (2016). *Work psychology: Understanding human behaviour in the workplace*. Pearson.

Benach, J., Muntaner, C., Delclos, C., Menendez, M. & Ronquillo, C. (2011). Migration and "low-skilled" workers in destination countries. *PLoS Med*, *8*(6), 1–4.

Božič. (2019). Can I be trained too? an analysis of determinants of the access to training. *Dynamic Relationships Management Journal*, *8*(2), 55–64.

Buckley, M., Zendel, A., Biggar, J., Frederiksen, L. & Wells, J. (2016). Migrant work and employment in the construction sector. [Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---migrant/documents/publication/wcms_538487.pdf]. *Geneve, Switzerland: International Labour Organization*.

Burdett, K. & Smith, E. (2002). The low skill trap. *European Economic Review*, *46*(8), 1439–1451.

CEDEFOP. (2018). Insights into skill shortages and skill mismatch: Learning from Cedefop's European skills and jobs survey [Retrieved from https://www.cedefop.europa.eu/files/3075_en.pdf]. *Luxembourg: Publications Office of the European Union*.

Central Bank of Malta. (2016). Assessing the economic impact of foreign workers in Malta [Retrieved from https://www.centralbankmalta.org/quarterly-review]. *Quarterly Review 2016*, *1*, 39–44.

Cheung, S. Y. & Phillimore, J. (2014). Refugees, social capital, and labour market integration in the UK. *Sociology*, *48*(3), 518–536.

Chiswick, B. R. (1978). The effect of Americanization on the earnings of foreign-born men. *Journal of political Economy*, *86*(5), 897–921.

Chowhan, J., Zeytinoglu, I. & Cooke, G. (2012). Are immigrants' pay and benefits satisfaction different than Canadian-born? *Relations industrielles/Industrial Relations*, *67*(1), 3–24.

Costa, M. (2018). Lack of skilled labour is greatest business challenge, Malta Chamber of Commerce says [Retrieved from https://www.maltatoday.com.mt/business/business_news/85612/lack_of_skilled_labour_is_greatest_business_challenge_malta_chamber_of_commerce_says]. *MaltaToday*.

de Vries, D. H., Steinmetz, S. & Tijdens, K. G. (2016). Does migration 'pay off' for foreign-born migrant health workers? an exploratory analysis using the global WageIndicator dataset. *Human Resources for Health*, *14*(1), 40.

Dietz, J., Joshi, C., Esses, V. M., Hamilton, L. K. & Gabarrot, F. (2015). The skill paradox: Explaining and reducing employment discrimination against skilled immigrants. *The International Journal of Human Resource Management*, *26*(10), 1318–1334.

Duncan, C. & Loretto, W. (2004). Never the right age? gender and age-based discrimination in employment. *Gender, Work and Organization Journal*, *11*(1), 95–115.

Ellis, M., Wright, R. & Parks, V. (2007). Geography and the immigrant division of labor. *Economic Geography*, *83*(3), 255–281.

Espinoza-Castro, B., Vasquez Rueda, L. E., Mendoza Lopez, R. V. & Radon, K. (2018). Working below skill level as risk factor for distress among Latin American migrants living in Germany: A cross-sectional study. *Journal of Immigrant and Minority Health*, *21*(5), 1012–1018.

Eurofund. (2017). European working conditions survey integrated data file, 1991–2015 [Retrieved from https://doi.org/10.5255/UKDA-SN-7363-4]. *UK Data Service*, *SN 7363*.

Eurofund. (2019). EWCS 2015 questionnaire [Retrieved from https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/sixth-european-working-conditions-survey-2015/ewcs-2015-questionnaire]. *UK Data Service*.

European Commission. (2018). Commission staff working document – country report Malta 2018 [Retrieved from https://eur-lex.europa.eu/legal-content/FR/ALL/?uri=CELEX:52018SC0216].

European Commission. (2019). European economic forecast summer 2019 (interim). *Luxembourg: Publications Office of the European Union*.

European Parliament. (2014). Discrimination of migrant workers at the workplace. *Luxembourg: Publications Office of the European Union*.

European Parliament. (2018). EU–Philippines relations beyond trade and aid? *Luxembourg: Publications Office of the European Union*.

Fouarge, D., Schils, T. & De Grip, A. (2013). Why do low-educated workers invest less in further training? *Applied Economics*, *45*(18), 2587–2601.

Garcia, G. M. & De Castro, B. (2017). Working conditions, occupational injuries, and health among Filipino fish processing workers in Dutch Harbor, Alaska. *Workplace Health & Safety*, *65*(5), 219–226.

García-Pérez, C., Prieto-Alaiz, M. & Simón, H. (2019). Multidimensional measurement of precarious employment using hedonic weights: Evidence from Spain [Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0148296319305831]. *Journal of Business Research*.

Garofalo Geymonat, G. & Marchetti, S. (2017). Domestic workers speak: A global fight for rights and recognition [Retrieved from https://www.opendemocracy.net/en/beyond-trafficking-and-slavery/global-landscape-of-voices-for-labour-right/]. *Open democracy*.

General Workers Union. (2020). Education – Reggie Miller Foundation [Retrieved from https://gwu.org.mt/ReadText.php?ID1=L&ID2=39].

Gonzales, M. C. (2010). Workers' direct participation at the workplace and job quality in europe. *Journal of European Social Policy*, *20*(2), 160–168.

Grainger, K. (2006). Equal access to training for black and minority ethnic nurses. *Nursing Standard*, *20*(42), 41–49.

Hamori, S. (2009). Employment convergence of immigrants in the European Union: Differences across genders, regions of origin and destination. *Budapest Working Papers On The Labour Market BWP – 2009/7*.

International Labor Organisation. (2005). Bureau for workers' activities: Trade union best practice initiatives for migrant workers [http://www.ituc-csi.org/IMG/pdf/d3s1best_practices.pdf].

Jobsplus. (2018). Third country nationals working in Malta 2010–2018. *Malta: Jobsplus unpublished data*.

Kahanec, M. & Mendola, M. (2009). Social determinants of labor market status of ethnic minorities in Britain [In A.F. Constant, K. Tatsiramos, & K.F. Zimmermann (Eds.), Research in Labor Economics Vol 29 – Ethnicity and labor market outcomes (pp. 167–195). Bingley, UK: Emerald Group Publishing].

Kifle, T., Kler, P. & Shankar, S. (2016). Immigrant job satisfaction: The Australian experience. *International Journal of Manpower*, *37*(1), 99–114.

Kosny, A. & Allen, A. R. (2016). Falling through the cracks? an analysis of health and safety resources for migrant workers in Australia. *International Journal of Migration, Health and Social Care*, *12*(2), 99–108.

Koukoulaki, T. (2010). New trends in work environment: New effects on safet. *Safety Science*, *48*(8), 936–942.

Niu, S. (2010). Ergonomics and occupational safety and health: An ILO perspective. *Applied Ergonomics*, *41*(6), 744–753.

OECD. (2013). International migration outlook 2013 [Retrieved from https://www.oecd-ilibrary.org].

OECD. (2017). Educational opportunity for all: Overcoming inequality throughout the life course [Retrieved from http://dx.doi.org/10.1787/9789264287457-en].

OECD. (2019). Getting skills right: Engaging low-skilled adults in learning [Retrieved from www.oecd.org/employment/emp/engaging-low-skilled-adults-2019.pdf].

OECD/EU. (2015). Indicators of immigrant integration: Settling in [Retrieved from http://www.oecd.org/els/mig/Indicators-of-Immigrant-Integration-2015.pdf].

OECD/EU. (2018). Settling in 2018: Indicators of immigrant integration [Retrieved from http://www.oecd.org/publications/indicators-of-immigrant-integration-2018-9789264307216-en.htm].

Office of the Surgeon General (US), Center for Mental Health Services (US) & National Institute of Men-

tal Health. (2001). Mental health: Culture, race, and ethnicity: A supplement to mental health [Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK44246/]. *USA: Publications and Reports of the Surgeon General*.

Olesen, K., Carneiro, I. G., Jørgensen, M. B., Flyvholm, M. A., Rugulies, R., Rasmussen, C. D. N., Søgaard, K. & Holtermann, A. (2012). Psychosocial work environment among immigrant and Danish cleaners. *International Archives of Occupational and Environmental Health*, *85*(1), 89–95.

Pillinger, J. (2016). Psychosocial risks and violence in the world of work: A trade union perspective. *International Journal of Labour Research*, *8*(1–2), 35–61.

Poulston, J. (2008). Metamorphosis in hospitality: A tradition of sexual harassment. *International Journal of Hospitality Management*, *27*(2), 232–240.

Ram, Y. (2018). Hostility or hospitality? a review on violence, bullying and sexual harassment in the tourism and hospitality industry. *Current Issues in Tourism*, *21*(7), 760–774.

Rendall, M. S., Tsang, F., Rubin, J. K., Rabinovich, L. & Janta, B. (2010). Contrasting trajectories of labor-market integration between migrant women in Western and Southern Europe. *European Journal of Population/Revue européenne de Démographie*, *26*(4), 383–410.

Ressia, S., Strachan, G. & Bailey, J. (2017). Operationalizing intersectionality: An approach to uncovering the complexity of the migrant job search in Australia. *Gender, Work & Organization*, *24*(4), 376–397.

Ronda-Pérez, E. R., Benavides, F. G., Levecque, K., Love, J. G., Felt, E. & Van Rossem, R. (2012). Differences in working conditions and employment arrangements among migrant and non-migrant workers in Europe. *Ethnicity & Health*, *17*(6), 563–577.

Ruhs, M. & Anderson, B. (2010). Who needs migrant workers? labour shortages, immigration and public policy. *Oxford, UK: Oxford Scholarship Online*.

Secretary-General, U.N. (2016). In safety and dignity: Addressing large movements of refugees and migrants: Report of the Secretary-General [Retrieved from http://www.un.org/en/ga/search/view_doc.asp?symbol=A/70/59]. *UN Doc. A/70/59, 21*.

Sert, D. Ş. (2016). From skill translation to devaluation: The de-qualification of migrants in Turkey. *New Perspectives on Turkey*, *54*, 97–117.

Simola, A. (2018). Lost in administration: (re) producing precarious citizenship for young university-educated intra-EU migrants in Brussels. *Work, Employment and Society*, *32*(3), 458–474.

Siow, E. & Ng, J. (2013). Internal migration of nurses in the United States: Migratory prompts and difference in job satisfaction between migrants and non-migrants. *Nursing Economics*, *31*(3), 128–137.

Sterud, T., Tynes, T., Sivesind Mehlum, I., Veiersted, K. B., Bergbom, B., Airila, A., Johansson, B., Brendler-Lindqvist, M., Hviid, K. & Flyvholm, M. A. (2018). A systematic review of working conditions and occupational health among immigrants in Europe and Canada. *Public Health*, *18*(1), 770.

Suto, M. (2009). Ompromised careers: The occupational transition of immigration and resettlement. *Work*, *32*(4), 417–429.

Tian, A. W., Wang, Y. & Chia, T. (2018). Put my skills to use? understanding the joint effect of job security and skill utilization on job satisfaction between skilled migrants and Australian born workers in Australia. *Social Indicators Research*, *139*(1), 259–275.

Trade Union Congress UK. (2007). Safety migrant workers: A practical guide for safety representatives. *London, UK: TUC publications*.

Trimikliniotis, N. & Demetriou, C. (2011). Labour integration of migrant workers in cyprus: A critical appraisal [In M. Pajnik & G. Campani (Eds.), Precarious migrant labour across Europe (pp. 73–96). Ljubljana, Slovenia: The Peace Institute & Institute for Contemporary Social and Political Studies].

Vassallo, M. T. & Debono, M. (2020). Labouring behind closed doors: The living and working conditions of filipino live-in carers in Malta [In E. Ozen, & S. Grima (Eds.), Finance, insurance and risk management Vol 1 – Uncertainty and challenges in contemporary economic behaviour (pp. 195–215). Bingley, UK: Emerald Group Publishing.].

Venturini, A. & Villosio, C. (2008). Labour-market assimilation of foreign workers in italy. *Oxford Review of Economic Policy*, *24*(3), 517–541.

Viveros-Guzmán, A. & Gertler, M. (2015). Latino farmworkers in Saskatchewan: Language barriers and health and safety. *Journal of Agromedicine*, *20*(3), 341–348.

Woods, S. A. & West, M. A. (2010). The psychology of work and organizations. *London, UK: Cengage Learning*.

Yap, M., Holmes, M., Hannan, C. & Cukier, W. (2014). Correlates of career satisfaction in Canada: The immigrants' experience. *Journal of International Migration & Integration*, *15*(1), 49–71.

You, S. F. & Wong, Y. F. (2015). Explaining occupational injury rates between migrant and native workers in Taiwan, 1998–2011. *Asian and Pacific Migration Journal*, *24*(4), 512–539.

Xjenza Online - Science Journal of the Malta Chamber of Scientists
www.xjenza.org
DOI: 10.7423/XJENZA.2020.1.03

Research Article

The Correlation Between The Level Of Knowledge In Reading Nutritional Labels And Oral Health

L. Cuschieri*[1], M. R. Visan[1], A. M. Agius[1], G. Gatt[2], N. J. Attard[1]
[1] *Department of Oral Rehabilitation and Community Care, Faculty of Dental Surgery, University of Malta, Msida, Malta*
[2] *Department of Child Dental Health and Orthodontics, Faculty of Dental Surgery, University of Malta, Msida, Malta*

Abstract. Objectives. To establish whether the level of knowledge in reading nutritional labels in the Maltese population is correlated to their oral health status.

Materials and Methods. Participants were recruited from dental screenings on the Mobile Dental Unit (MDU) or at the University of Malta dental teaching clinics. A questionnaire was used to collect general information, participants' awareness of WHO sugar guidelines, food preferences, and their level of knowledge in reading nutrition labels. The decayed, missing, and filled teeth (DMFT) Index and erosion scores were also recorded.

Results. A total of 122 random subjects participated in this research project, of which 62.3% were females. 17.2% of the total sample were aware of the WHO guidelines regarding sugar intake. 41.7% of people showed a good level of knowledge in reading nutrition labels. Mean DMFT scores and care index were found to be $10.5 \pm 7.2\%$ and $37.2 \pm 30.3\%$ respectively. Furthermore, the BEWE index was found to be $1.2 \pm 3.3\%$. Higher educational levels were associated with healthier diets. Within the 35–65 years group, DMFT was significantly lower if the respondent had the ability to read labels.

Conclusion. The study showed that there is a low awareness of WHO daily sugar intake guidelines and a moderate understanding of nutrition labels. Age-related trends, educational background, and knowledge in reading and correctly understanding food nutritional labels were related to better oral health.

Keywords: oral health, nutrition, public health, DMFT, mobile dental unit, nutritional labels

Abbreviations. MDU – Mobile Dental Unit; WHO – World Health Organisation; DMFT – The Decayed, Missing and Filled Teeth Index; ICDAS – International Caries Detection and Assessment System; BMC – Bio-Med Central; FDI – Fédération Dentaire Internationale, ADA – American Dental Association; NHS – National Health Service; SPSS – Statistical Package for the Social Science; BEWE – Basic Erosive Wear Examination

Acknowledgements. We would like to thank Professor Arthur R.G. Cortes for the statistical analysis of the data in this article.

1 Introduction

Diet and eating habits have a significant influence on oral and general health (Scardina et al., 2012; Touger-Decker et al., 2007). Sugary food and drinks have been shown to be the main cause of tooth decay (Hawkes, 2014). The deficiency of certain nutrients in the diet lowers the resistance of oral tissues towards infection. This may contribute to periodontal disease, which is a major cause of tooth loss in adults. In addition to this, certain oral conditions such as tooth erosion, oral cancer, and even craniofacial development, all have nutritional influences (Moynihan et al., 2004). It has been shown that general health and quality of the diet are determined by social support, socioeconomic status, culture, and oral health (Patrick et al., 2006).

Excess consumption of fats, sugars, and sodium, as well as a low fibre diet, have been convincingly associated with an increased risk of obesity, cardiovascular disease, diabetes and dental disease such as tooth decay and periodontal disease (Casanova et al., 2014; Hu et al.,

*Correspondence to: L. Cuschieri (laura.cuschieri5@gmail.com)

2011; Pischon et al., 2007). Knowledge of nutrition, in addition to specific knowledge about dietary guidelines related to whole grains, protein, dairy, and fruit, has also been found to positively influence healthy eating habits (Kolodinsky et al., 2007). Prices, familiarity, ethical concerns, health, as well as environmental factors, all influence food consumption (Vabø et al., 2014).

Likewise excessive consumption of what are thought to be "healthy" food and drinks containing naturally occurring sugars, such as foods that are not consumed in their natural form which include any processed, blended or dried foods, can also lead to tooth decay even if oral hygiene is properly maintained (Sadler, 2017). As highlighted in the journal BMC of Public Health, sugars are the main cause of dental caries in children and adults (Sheiham et al., 2000). Taking all this into consideration, the FDI and ADA recommended the consumption of raw vegetables and fruits, plain yogurt, cheese, and less sugar containing foods for a diet that is dentally beneficial.

Food preferences are associated with consumer capability to understand nutritional information. The best carriers of nutritional information are labels, as well as claims made on the packaged foods and in promotion content. An individual's ability to read and understand nutrition labels affects food choices and helps the individual keep a tab on food items that are high in fat, sat and added sugar (NHS, 2018). Miller et al. (2015) noted that information on sugar content as well as total fats, saturated fats and salts available on food labels are often overlooked or underutilised by the consumer. There is mixed or inconsistent information on whether the label information affects consumers' choices (Fenko et al., 2016). Several countries have issued guidance documents and legislations with regards to food labelling in order to make it easier for the consumer to read and understand product information (Directorate, 2013; FSA, 2018).

A higher level of education is associated with healthier dietary patterns (Lê et al., 2013). In this study, it was also seen to affect DMFT, as it was found to be lower in participants who were able to read and/or tend to cook their own meals rather than eat out. This proves that higher education benefits an individual in many ways. Better educated people typically have higher earning power, resulting in better access to health care and are more likely to invest in healthier lifestyles by choosing a better diet and housing (Zimmerman et al., 2015).

This study investigates the relationship between oral health and the ability to effectively read food labels in the Maltese population.

2 Materials & Methods

The participants consisted of patients who attended for a dental check up on the Mobile Dental Unit (MDU) or the Dental Teaching Clinic at Mater Dei Hospital. They were approached about the study and voluntarily participated by filling in a self-reported questionnaire that was followed by an oral examination.

Inclusion criteria: Participants over 18 years of age who gave informed consent.

Exclusion criteria: Participants with literacy and linguistic barriers that prevented them from reading food labels.

2.1 Research Protocol

Approvals from the University Research Ethics Committee (UREC) and the Faculty Research Ethics Committee (FREC) were obtained (UREC-DP 1801015DSG | DSG-2017-18-012). Patients signed their written acceptance regarding their participation in the research, through a Consent and Information Letter. All data obtained was anonymous.

2.2 Questionnaire

The questionnaire was divided into the following parts:

- Sociodemographic characteristics (age, nationality, education level and medical history).
- Knowledge of the daily sugar intake guidelines recommended by the WHO, lifestyle behaviour and the major determining factor when purchasing a food item (e.g. calories, taste, price).
- Knowledge of various foods in terms of sugar content and level of "healthiness".
- Level of understanding and utilisation of food labels as well as interest in improving and acquiring more knowledge.

2.3 Clinical Examinations

Screening was carried out in the MDU and at the University Dental Teaching Clinic at MDH. A standardised light source, Daray X200LED examination light giving an 8.000 lx at 1 m and 32.000 lx at 0.5 m (Daray Lighting Ltd., Leighton Buzzard, Luton, UK) available on the MDU was utilised during the examination of patients. As part of the clinical examination, participants were asked about their medical history, medications, smoking history, oral hygiene and dietary habits. This was followed by the screening of soft tissues and teeth present and their condition, including restorations, dental caries, trauma, erosive tooth wear, number of functional units present, prostheses, periodontal status including presence of plaque and calculus, and soft tissues and oral mucosal conditions. Sterile front surface reflecting mirror and ball-ended WHO CPITN-E were used for the clinical examination. Trained scribed recorded data onto number-coded data input sheets. Fol-

lowing the examination, oral hygiene instructions (OHI) were provided and intra-oral demonstration of oral hygiene aids were carried out based on patients' needs. The participants were informed about their oral health condition and were referred for dental treatment as necessary.

2.4 Data Analysis

Data gathered from questionnaires and oral screenings were inputted into Microsoft Excel and statistical tests were performed using SPSS 20.0 software. Mann-Whitney, Kruskal-Wallis, and χ^2 tests of independence were used to assess the association between socio-demographic profile, food habits, knowledge of reading labels and oral health variables. Spearman's non-linear coefficient was estimated to quantify the correlation between ordinal or continuous variables. The significance level was set at $p < 0.05$.

3 Results

122 participants enrolled in the study, 76 (62.3%) were females and 46 (37.7%) were male. 24.6% had a graduate or post-graduate degree, 32.8% with post-secondary and diploma level and 42.6% had a secondary level education or less. 43.4% of subjects reported a systemic disease. The most frequent diseases were found to be cardiovascular (23.8%) and endocrine (16.4%).

3.1 Diet and Food Consumption

42.6% of people reported awareness of the WHO guidelines regarding daily sugar intake. However only 17.2% provided the correct answer of 20–30 g. According to the participants' self-assessment of their diet, 3.3% consider their diet to be unhealthy whilst the majority (73.7%) have a moderately healthy diet. Figure 1 shows that 70% usually eat vegetables a minimum 3–5 times a week, 50% fruit and 40% fish. Taste was found to be the most important aspect taken into account when purchasing a product $p = 0.001$, according to the Kruskal–Wallis Test. Note that rank score for 'low sugar content' lies in the middle of the series ($p < 0.05$). There was a statistically significant correlation between the perception of unhealthy food and those foods that have a high sugar-content such as drinks, desserts, and meal food. The same cannot be said for foods consumed for breakfast such as cereals, dried fruits, and flavoured yogurt. Although they have a high sugar content, they were considered to be healthy food by the participants.

3.2 Knowledge on Food Labels

85.1% stated to have the ability to read labels, 51.2% do it regularly and 26.4% answered with 'sometimes'. A 0–9 Visual Analogue Scale (VAS), (figure 5), assessed the perceived knowledge, interest and usefulness of food label interpretation. Self-assessment of the knowledge was moderate (5.7), with participants showing an increased interest in learning how to understand labels. In order to determine whether the participants were truly able to read and understand food labels, food label cut outs were used. 41.7% of participants showed a very good level of knowledge with an additional 47.5% providing a partially correct answer.

3.3 Oral Health

The mean DMFT score and care index was found to be 10.5 ± 7.2 and $37.2 \pm 30.3\%$ respectively, and $\frac{3}{4}$ of participants presented with missing teeth. The general score for erosion, measured with the BEWE index was 1.2 ± 3.3 (median 0).

3.4 Healthy Diet and Exercise

The following trends in the results were as follows:

- Participants with a degree or a higher educational level were associated with healthier diets (36.7%). ($P = 0.040$, chi-square test)
- Participants who read labels regularly exhibit a better self-assessment of their diet however, such difference was not satistically significant, according to the chi-square test ($p = 0.122$).
- Participants who consider themselves capable of reading labels do exercise more often (71% weekly) against 33% in other groups.
- There is a statistically significant association between those who exercise more often and the capability of reading labels (71% of which exercise weekly) ($p = 0.002$, according to the chi-square test).
- There was no significant difference ($p > 0.05$) between the diet (chosen food types from the questionnaire) of people that consider themselves healthy and moderately healthy consumers with the exception of vegetable consumption ($p = 0.039$). 74% of people under the 'healthy diet' group eat vegetables every day whilst this was seen to drop to 47% in the 'moderately healthy' group.

3.5 Oral Health and Label Reading

The oral health variable DMFT was crossed with each label reading group variable, stratifying by different demographic factors in order to control their confounding effects (Mann-Whitney U test at $p < 0.05$). The no/sometimes were grouped together in order to have binary variables for statistical analysis.

4 Discussion

The requirements for each nutrient and micronutrient vary with age, stage in the life cycle, physical activity, lifestyle, psychological and socio-cultural factors. Therefore, it is interesting to note that the role of nutrition in health promotion, the maintenance of good

	Total		Everyday		3-5 times a week		2-3 times a week		Once a week		Less than once a week	
	N	%	N	%	N	%	N	%	N	%	N	%
Q12 A - WFC Meat	118	100.0	1	0.8	18	15.3	42	35.8	33	28.0	24	20.3
Q12 B - WFC Poultry	117	100.0	7	6.0	32	27.4	45	38.5	19	16.2	14	12.0
Q12 C - WFC Pasta Pizza	117	100.0	1	0.9	10	8.5	23	19.7	34	29.1	49	41.9
Q12 D - WFC Fruit	117	100.0	38	32.5	20	17.1	33	28.2	17	14.5	9	7.7
Q12 E - WFC Veg	120	100.0	63	52.5	21	17.5	19	15.8	4	3.3	13	10.8
Q12 F - WFC Fish	118	100.0	29	24.6	17	14.4	21	17.8	21	17.8	30	25.4

Figure 1: Weekly food consumption (WFC)

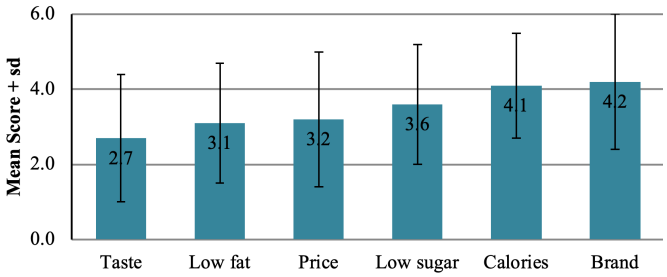

Figure 2: Product factors that influence purchase. The participants were asked to rank the factors in order of preference from 1 to 6, 1 being the most important factor.

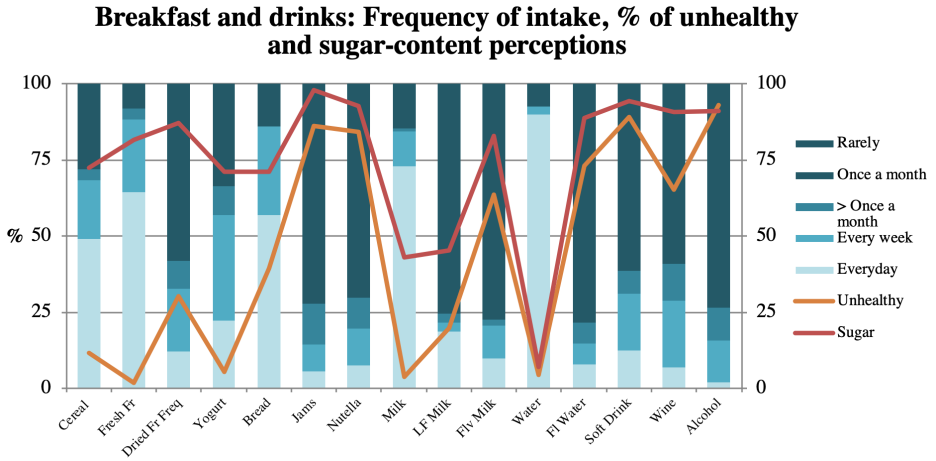

Figure 3: Breakfast and drinks: Frequency of intake, % of unhealthy and sugar-content perceptions.

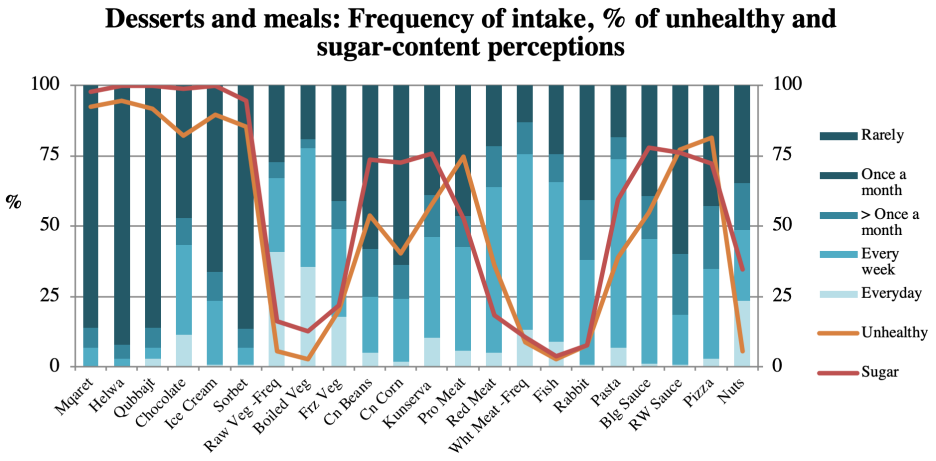

Figure 4: Desserts and meals: Frequency of intake, % of unhealthy and sugar-content perceptions.

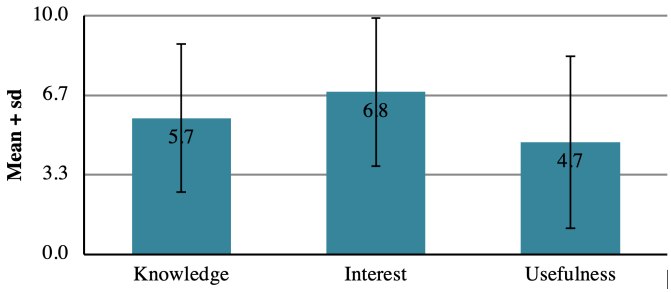

Figure 5: The participants' perception of food labels was measured using VAS to assess their current knowledge, interest in learning more and their usefulness.

No. Of Restored Teeth	Total	No/Sometimes	Yes
N	31	4	27
Mean	3.8	7.8	3.2
Standard Deviation	3.4	3.8	2.9
Minimum	0.0	3.0	0.0
Maximum	12.0	12.0	10.0
Median	3.0	8.0	3.0

Figure 6: Restored teeth stratified by the ability to read labels ($p = 0.031$, according to the Mann–Whitney test)

DMFT	Total	No/Sometimes	Yes
N	31	4	27
Mean	9.2	16.3	8.1
Standard Deviation	5.9	8.7	4.7
Minimum	1.0	7.0	1.0
Maximum	28.0	28.0	17.0
Median	10.0	15.0	7.0

Figure 7: DMFT stratified by the ability to read labels ($p = 0.010$, according to the Mann–Whitney test)

health, the prevention of disorders and diseases, and the recovery of disease: for example, repair and regeneration of soft and hard tissues, should not be underestimated (Stanski et al., 2015).

4.1 Oral Health, Gender and Age

DMFT and/or restored teeth were found to be significantly lower in respondents who were able to read labels, with females having considerably lower values than males, possibly due to higher health-conscious tendencies (Hamasha et al., 2018; Kudirkaite et al., 2016). In the group of under 35 years, the mean number of restored teeth was significantly lower if the respondent reads labels regularly. This shows that there is a relationship between respondents that are aware of what they consume and their oral health status.

4.2 WHO Guideline Awareness

For the question "Are you aware of the WHO guidelines regarding daily sugar intake?" approximately half of the participants gave a positive answer, however on further investigation of the validity of the responses using a follow up question, only 17% of participants answered correctly. Similar results were obtained in a study carried out by Tierney et al. (2017) in Norther Ireland in which the majority of participants were not aware of the guidelines.

4.3 Food consumption, Label Usage and Product Purchases

Taste was the predominant characteristic that encourages the participants to purchase a food product over another. It is important to note that "low sugar content" was not considered to be very important by the consumers/participants. This study's results indicate that there is a correlation between the foods that are perceived as unhealthy and those with a high sugar content. That being said, this did not apply for certain breakfast foods such as cereals, canned fruits, dried fruits, and yogurts that contain high sugar content but were perceived to be healthy. 85% of participants stated that they were able to read and understand labels however only 41.7% of which gave a correct answer. These findings indicate that better comprehension in reading nutritional labels is required and that certain food labels should be improved visually and simplified. Unfortunately, nutritional labeling alone is insufficient to modify eating habits, as it can only be utilized as a tool to help consumers make healthier food choices in order to improve their health and prevent chronic diseases (Ollberding et al., 2011). 51.2% of participants claimed to read labels on a regular basis, whilst an additional 26.2% responded with "sometimes", and the rest (23%) with "no".

4.4 Healthy Lifestyle and Oral Health

The self-assessment of the diet, exercise practice and eating out habits can be considered as three key indicators on the participant's lifestyle status. When comparing the results in relation to educational level, it became apparent that people with a higher educational level (36.7%) were linked to a more healthy diet, when compared to the participants with a lower educational level (18.7%). These trends were similar to other studies (Lê et al., 2013). 71% of the participants who consider themselves capable of reading labels exercise more often than the ones who can't read labels 33%. A statistically significant association between frequency of reading labels with exercise weekly or daily was also found ($p = 0.002$).

5 Study Limitations

This study presents the following limitations—a limited sample size along with convenience sampling method. It would also be beneficial that a future study looks also at the periodontal health of participants.

6 Conclusion

The study showed that there was lack of awareness with regards to the WHO daily sugar intake guidelines and a moderate understanding of nutrition labels. Age-related trends, educational background, and knowledge in reading and correctly understanding food labels were associated with oral health, diet and exercise.

References

Casanova, L., Hughes, F. J. & Preshaw, P. M. (2014). Diabetes and periodontal disease: A two-way relationship. *Bdj*, *217*(8), 433.

Daly, R. M., Elsner, R., Allen, P. F. & Burke, F. M. (2003). Associations between self-reported dental status and diet. *Journal of Oral Rehabilitation*, *30*(10), 964–970.

De Andrade, F. B., De França Caldas Jr, A. & Kitoko, P. M. (2009). Relationship between oral health, nutrient intake and nutritional status in a sample of brazilian elderly people. *Gerodontology*, *26*(1), 40–45.

Directorate, E. H. (2013). A focus on the labelling of food products [Retrieved from https : / / deputyprimeminister . gov . mt / en / environmental / Documents / Publications - Env - Health/7focus201308_labelling_en.pdf].

Fenko, A., Kersten, L. & Bialkova, S. (2016). Overcoming consumer scepticism toward food labels: The role of multisensory experience. *Food Quality and Preference*, *48*, 81–92.

FSA. (2018). Packaging and labelling [Retrieved from https://www.food.gov.uk/business-guidance/packaging-and-labelling].

Hamasha, A. A., Alshehri, A., Alshubaiki, A., Alssafi, F., Alamam, H. & Alshunaiber, R. (2018). Gender-specific oral health beliefs and behaviors among adult patients attending king abdulaziz medical city in riyadh. *The Saudi Dental Journal*, *30*(3), 226–231.

Hawkes, N. (2014). WHO may revise guideline on sugar to combat tooth decay.

Hu, F. B., Liu, Y. & Willett, W. C. (2011). Preventing chronic diseases by promoting healthy diet and lifestyle: Public policy implications for China. *Obesity Reviews*, *12*(7), 552–559.

Kolodinsky, J., Harvey-Berino, J. R., Berlin, L., Johnson, R. K. & Reynolds, T. W. (2007). Knowledge of current dietary guidelines and food choice by college students: Better eaters have higher knowledge of dietary guidance. *Journal of the American Dietetic Association*, *107*(8), 1409–1413.

Kudirkaite, I., Lopatiene, K., Zubiene, J. & Saldunaite, K. (2016). Age and gender influence on oral hygiene among adolescents with fixed orthodontic appliances. *Stomatologija*, *18*(2), 61–65.

Lê, J., Dallongeville, J., Wagner, A., Arveiler, D., Haas, B., Cottel, D. & Dauchet, L. (2013). Attitudes toward healthy eating: A mediator of the educational level-diet relationship. *European Journal of Clinical Nutrition*, *67*(8), 808–814.

Miller, L. M. S. & Cassady, D. L. (2015). The effects of nutrition knowledge on food lable use. a review of the literature. *Appetite*, *92*, 207–216.

Moynihan, P. & Petersen, P. E. (2004). Diet, nutrition and the prevention of dental diseases. *Public Health Nutrition; Public Health Nutr*, *7*(1), 201–226.

NHS. (2018). Food labels [Retrieved from https://www.nhs.uk/live-well/eat-well/how-to-read-food-labels/].

Ollberding, N. J., Wolf, R. L. & Contento, I. (2011). Food label use and its relation to dietary intake among us adults. *Journal of the American Dietetic Association*, *111*(5), S47–S51.

Patrick, D. L., Lee, R. S. Y., Nucci, M., Grembowski, D., Jolles, C. Z. & Milgrom, P. (2006). Reducing oral health disparities: A focus on social and cultural determinants. *BMC Oral Health*, *6*.

Pischon, N., Heng, N., Bernimoulin, J., Kleber, B., Willich, S. N. & Pischon, T. (2007). Obesity, inflammation, and periodontal disease. *Journal of Dental Research*, *86*(5), 400–409.

Sadler, M. J. (2017). Dried fruit and dental health – how strong is the evidence? *Nutrition Bulletin*, *42*(2), 338–345.

Scardina, G. & Messina, P. (2012). Good oral health and diet. *ournal of Biomedicine and Biotechnology*, *2012*(720692).

Sheiham, A. & Watt, R. G. (2000). The common risk factor approach: A rational basis for promoting oral health. *Community Dentistry and Oral Epidemiology: Commentary*, *28*(6), 399–406.

Stanski, R. & Palmer, C. A. (2015). Oral health and nutrition as gatekeepers to overall health: We are all in this together. *European Journal of General Dentistry*, *4*(3), 99.

Tierney, M., Gallagher, A. M., Giotis, E. S. & Pentieva, K. (2017). An online survey on consumer knowledge and understanding of added sugars. *Nutrients*, *9*(1).

Touger-Decker, R. & Mobley, C. C. (2007). Position of the american dietetic association: Oral health and nutrition. *Journal of the American Dietetic Association*, *107*(8), 1418–1428.

Vabø, M. & Hansen, H. (2014). The relationship between food preferences and food choice: A theoretical discussion. *International Journal of Business and Social Science*, *5*(7).

Zimmerman, E. B., Woolf, S. H. & Haley, A. (2015). Understanding the relationship between education and health: A review of the evidence and an examination of community perspectives. *Population Health: Behavioral and Social Science Insights. Rockville: Agency for Healthcare Research and Quality*, *347–384*.

Xjenza Online - Science Journal of the Malta Chamber of Scientists
www.xjenza.org
DOI: 10.7423/XJENZA.2020.1.04

Research Article

Quality of communication between dentists and dental laboratory technicians in Malta

L. Azzopardi[*1], **M. Zarb**[1], **E. E. Alzoubi**[1]
[1]*Faculty of Dental Surgery, University of Malta, Msida, Malta*

Abstract. Purpose. The purpose of this study was to assess the quality of communication between the dental clinic and dental laboratory from a dental laboratory technicians' point of view and to offer means for improving communication between these two workplaces.

Methods and Materials. This pilot study was carried out on 38 dental laboratory technicians comprising of 14 dental laboratory technicians from the Dental Laboratory –Dental Department, Mater Dei Hospital along with 24 dental laboratory technicians from private dental laboratories spread across the Maltese Islands. The study used binomial tests as the form for inferential analysis of results with the reference level of significance set up to 5%($\alpha = 0.05$) whereby a percentage of 75% was viewed as being significantly disparate from $p = 50\%$ with 84.6% of statistical power, assuming a 95% level of confidence. The collection of data was taken through the use of a questionnaire issued on a one-time basis.

Results. The study reported 65.6% of dental technicians received impressions in a non-disinfected state ($p = 0.110$). 40.6% of dental technicians found the written dental clinic prescription card instructions as 'Good' ($p = 0.001$**) whilst 46.9% 'Occasionally' interact with their dental patients ($p = 0.215$). 31.3% of dental technicians view themselves as 'Important-Very important' ($p = 0.302$). The majority of dental technicians are comfortable discussing prosthesis design with dentists (87.5%) ($p \leqslant 0.001$***).

Conclusion. Communication between the dental clinic and dental laboratory was found to possess several strengths and weaknesses in the eyes of Maltese dental technicians. There is room for improvement in communication between these two dental workplaces.

Keywords: communication, dentists, laboratory, clinic, technologists

Acknowledgements. The researcher would like to thank his supervisor and co-supervisor (Dr Emad Eddin and Mr Mario Zarb respectively) for their help and advice throughout data collection. The researcher would also like to thank those that participated in the research study.

1 Introduction

Communication may be described as the action of sending and receiving information either through verbal or non-verbal forms (Berry et al., 2014). This may be seen through speech, writing, charts, maps, and images for example. Individuals possess the capacity to communicate through these various means with the overall aim being to bring about a degree of understanding between the person sending the information and the person receiving the information (Berry et al., 2014). Good quality communication between the dentist and the dental laboratory technician is considered fundamental since it influences the potential for producing high-quality prostheses (Lynch et al., 2005). This may be further expressed through certain dental clinics and laboratories shifting from a written to a computer-based form of communication (Alshiddi, 2014). The three most predominantly used forms of communication between the dental laboratory and dental clinic are: Paper-based communication, Online Web-based Communication and Dental Office–Laboratory Web Content Management System (WCMS) (Alshiddi, 2014).

Paper-based Communication- Usually evident through a laboratory card issued from the dental clinic and forwarded onto the dental laboratory consisting of handwritten details clarifying specific important details to the dental laboratory technician. These details may come in the clinician's name, patient's

Correspondence to: L. Azzopardi (liam.azzopardi.17@um.edu.mt)

identification, and a type of prosthesis to be manufactured for example. This method does, however, possess major drawbacks for communicating certain aspects of dentistry. This is the most frequent form of communication between the clinic and laboratory with only 26% of dental lab technicians indicating that the laboratory cards possessed the appropriate infomation which enabled them to perform their work to the best of their ability (Afsharzand et al., 2006). Another possible drawback of this form of communication arises when needing to successfully select the appropriate shade of the tooth, the lack of visual involvement may leave the technician speculating and requiring further information from his/her dental counterpart which would further delay the time for completion of the prosthesis (Alshiddi, 2014).

Online Web-based Communication- this is a form of communication whereby data may be transferred from the dental clinic to the dental laboratory employing the internet. This form of communication may appear advantageous for sending the laboratory patient impression scans and tooth shades (Alshiddi, 2014). This form of communication has become a satisfactory means for conveying information as this form may reduce time spent waiting for written laboratory cards from the clinic, may regulate collection of information, preprogramme preparation of proposed prosthesis and appliance along with its fabrication along with the ability to disclose certain sensitive information that one may wish to be kept private (Alshiddi, 2014). Telecommunication applications such as GoToMeeting and WebEx, for example, may help in allowing both the dentist and dental technician to interact with one another on cases from a more visual viewpoint (Alshiddi, 2014). Web conference applications such as these enable interaction with the patient especially in situations where it is difficult to arrange a face-to-face meeting with the patient. The dental technician may be able to grasp a clearer understanding of the patients tooth shade for example. Conference calls enable the possibility for discussion and interaction amongst all involved and offer a viable means for communication of required data (Alshiddi, 2014). Dental Office-Laboratory Web Content Management System (WCMS)- Web content management system is a form of application software enabling dental colleagues to work and assist one another on any patient cases. It may be used as an instrument for communication between the dental clinic and dental lab and may even develop or enhance the working relationship between both dental workplaces (Alshiddi, 2014). Through this form of communication, work may be sent to dental clinics and dental labs in different locations with dental professionals being able to track patient cases whilst also possessing the option to update their fellow dental colleagues on the progression of each case. An exclusive platform designed for the transferal of data between dental clinics and dental labs offers convenience for all with all important information being stored and accessible from one place.

Communication should not be strictly kept between the dentist and dental laboratory technician exclusively but also through other staff members such as dental assistants and receptionists in the dental office along with the dental lab owner, receptionist, and distributor of dental prosthesis. (Alshiddi, 2014).

The main purpose of this study was to assess the various communicative forms in terms of quality of communication between the dental clinic and dental laboratory from a dental laboratory technicians' point of view in the hope that it would offer a means for improving communication in both the Dental Laboratory–Dental Department, Mater Dei Hospital and also private laboratories.

2 Materials and Methods

The pilot study involved 38 dental laboratory technicians comprising of 14 dental technologists from the dental laboratory situated at Mater Dei Hospital Malta along with 24 dental laboratory technicians from private dental laboratories. Each individual's identity was kept anonymous over the course of the study period. Dental laboratory technicians were each issued initially with a participant information letter informing the participant of what the study entails along with a consent form which he or she were required to sign before participating in the research study. Following acquirement of each dental laboratory technicians' consent to the research study, Dental laboratory technicians were each issued with a questionnaire as shown in figure 1, to be filled in on a one-time basis. Following the investigation period, the dental laboratory questionnaire was collected from each participant. Each participant was able to contact the researcher in case of withdrawing from the study or in case of a query or question. The questionnaire used in this study sought to bewas centered around the dental laboratory technician's views on communication between the dental clinic and dental laboratory and featured responses that impact possible means for improvement on quality in communication between the dental laboratory and dental clinic along with any possible insight into main areas for wrongdoing in technical work and subsequent miscommunications. Binomial testing was the method of inferential analysis used throughout. This statistical testing form compared the number of positive responses against negative responses for each binary question. The reference level of significance for results was set at 5% ($\alpha = 0.05$) whilst a percentage of 75% was viewed as being of greater statistical import-

Quality of communication between dentists and dental laboratory technicians in Malta

QUESTIONNAIRE

Regarding disinfection

1. Has dentist disinfected master impression properly?

YES NO

If NO, how has master impression not been disinfected properly? Evidence of blood or other biohazards?

Concerning written dental clinic prescription cards

2. Please rate written instructions on a scale of 1 to 5. 1 being POOR and 5 being EXCELLENT.

1 2 3 4 5

If graded 3 or less, what can be improved in your opinion?

Regarding removable prosthesis

3. Is a design drawing indicated for RPD?

YES NO

4. Does dentist use colour coding in design drawing?

YES NO

5. Does dentist indicate the shade to be used for artificial teeth?

YES NO

6. Does dentist offer insight on the type of occlusal scheme?

YES NO

7. For temporary RPD, does the dentist specify which tooth or teeth require clasping?

YES NO

8. Does dentist provide any information with regards to finishing of removable prosthesis?

YES NO

9. Does the dentist form a posterior palatal seal on removable prosthesis?

YES NO

For fixed prosthesis

10. Is form of metal alloy to be used specified?

YES NO

11. Are the designs for the gingival margins shown?

YES NO

12. Does dentist offer any sort of design drawings?

YES NO

13. Are the number of pontics needed for fixed prosthesis specified?

YES NO

14. Does dentist offer insight with regards to the shade to be used for teeth?

YES NO

15. Has dentist indicated the type of occlusal scheme?

YES NO

16. Is the type of porcelain glaze to be used specified?

YES NO

Regarding any form of prosthesis

17. Does dentist contact you and ask for your input on design of prosthesis?

YES NO

If Yes, how frequently

REGULARLY SOMETIMES SPARINGLY RARELY

18. Do you feel comfortable and at ease when discussing prosthetic construction with dentist?

YES NO

19. How often do you interact with the dentist's patient regarding their dental case?

FREQUENTLY OCCASIONALLY RARELY NEVER

20. Do you feel secondary or integral throughout the fabrication process? Please rate in terms of importance on a scale of 1 to 5. 1 being UNIMPORTANT and 5 being EXTREMELY IMPORTANT.

1 2 3 4 5

Figure 1: Questions related to assessing the quality of communications between dentists and dental laboratory technicians in Malta

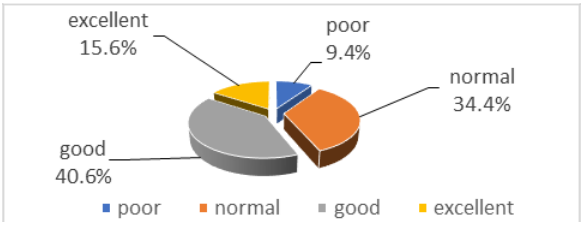

Figure 2: Assessment of written dental clinic prescription cards following 'Excellent', 'Poor', 'Normal', 'Good' component selections. Collected from MDH dental laboratory technicians and private dental laboratory technicians. N = number of participants tested.

ance as opposed to 50% with 84.6% of statistical power, assuming a 95% level of confidence.

3 Results

38 questionnaires were distributed to the Dental Laboratory/Dental Department, Mater Dei Hospital and private clinics of which 32 responded. 21 males and 11 females participated in the pilot study with their ages ranging from 21 to 64 years. Binomial testing was the method of inferential analysis used throughout. This statistical testing form compared the number of positive responses against negative responses for each binary question. The reference level of significance for results was set at 5% ($\alpha = 0.05$) whilst a percentage of 75% was viewed as being of greater statistical importance as opposed to 50% with 84.6% of statistical power, assuming a 95% level of confidence. 34.4% of dental technologists believe that the master impressions are properly disinfected before entering the dental laboratory from the dental clinic. An absence of disinfection of the master impression tends to be the most likely scenario with more than half (65.6%) reporting an absence for disinfection of the master impression. Following Binomial tests, A p-value of 0.110 was found from the Binomial test when assessing the rate for disinfection.

When assessing the quality of written dental clinic prescription cards, a proportion larger than 50% (56.2%) found the quality of dental clinic prescription cards to be 'good-excellent' with a marginal percentage of only 9.4% viewing written dental clinic prescription cards to be of 'poor' quality (figure 2). A p-value of 0.001** from the Binomial test supports the notion that written dental clinic prescription card instructions are properly written.

With regards to questions related to removable prostheses (table 1), the majority of dental laboratory technicians indicate that a design drawing is indicated for RPD (removable prosthetic denture) (59.4%) ($p = 0.377$) whereas colour-coding was evident in design drawings in only 25% of cases ($p = 0.007$**). In 90.6% of cases, the dentist was shown to have specified the shade to be used for the artificial teeth ($p \leqslant 0.001$***). This result was very conclusive. From the study, it was shown that more often than not, dentists in Malta do not tend to offer any insight into the type of occlusal scheme to be adopted (65.6%) ($p = 0.110$) nor is a posterior palatal seal formed on the removable prosthesis (81.2%) ($p = 0.001$**). In the majority of cases (84.4%), the dentist was shown to specify the required tooth or teeth for clasping ($p \leqslant 0.001$***). There is a tendency for the dentist to give leeway and freedom to the dental laboratory technician to decide on how to finish the removable prosthesis with 59.4% ($p = 0.377$) of cases confirming this. From the binomial tests, percentages differed largely to 50%, showing strengths and weaknesses of the workflow. Results amounting to statistical significance were seen in questions 4, 5, 7 and 9 whereas weak tendencies were seen in questions 3, 6 and 8. It can be assumed from the results gathered from questions related to fixed prostheses (table 2) that the form of metal alloy to be used for the fixed prosthesis is sometimes given to the dental technician with it being stated in 46.9% of cases and not specified in 53.1% of cases ($p = 0.860$). Designs for gingival margins were found to be shown in only 31.3% of cases ($p = 0.050$) with similar results found with regards to the dentist offering a form of design drawing 37.5% of the time only ($p = 0.215$). There is a general tendency for dentists to specify the number of pontics needed for a fixed prosthesis (75%) ($p = 0.007$**) and for the dentist to offer insight with regards to shade to be used for teeth with findings reporting that this is the case 87.5% of the time ($p \leqslant 0.001$***). Just like in removable prosthesis design, the dentists do not tend to indicate the type of occlusal scheme to be used but rather it seems to be left to the dental laboratory technician with the type of occlusal scheme being offered to the dental laboratory technician on 37.5% of the time ($p = 0.215$). The porcelain glaze to be used when finishing the fixed prosthesis was indicated on 18.8% of the time ($p = 0.001$**). Statistically significant results were found in questions 13, 14 and 16.

When it came to affirmative responses for contact between dentists and dental technicians (table 3), a slightly greater percentage than 50% responded with 'Yes' 53.1% ($n = 17$) ($p = 0.860$). The two-part question followed up with the dental technician being asked further to rate the level of contact between themselves and dentists to which 41.2 % ($n = 7$) responded with 'Sometimes' whereas the same number of dental technicians communicate with their dentist 'Sparingly' 41.2% (n=7), a mere 17.6% ($n = 3$) of technicians contact their dentist 'Rarely'. The p-value from Binomial tests ($p \leqslant 0.001$***) supports the notion that dental technicians are comfortable communicating with dentists.

		Total		*No*		*Yes*	
		N	%	*N*	%	*N*	%
Q3	Is a design drawing indicated for RPD?	32	100	13	40.6	19	59.4
Q4	Does dentist use colour-coding in design drawing?	32	100	24	75	8	25
Q5	Does the dentist indicate the shade to be used for artificial teeth?	32	100	3	9.4	29	90.6
Q6	Does the dentist offer insight into the type of occlusal scheme?	32	100	21	65.6	11	34.4
Q7	For temporary RPD, does the dentist specify which tooth or teeth require clasping?	32	100	5	15.6	27	84.4
Q8	Does the dentist provide any information with regards to the finishing of removable prosthesis?	32	100	19	59.4	13	40.6
Q9	Does the dentist form a posterior palatal seal on removable prosthesis?	32	100	26	81.2	6	18.8

Table 1: Questions related to removable prosthesis consisting of Total, No, Yes for questions 3–9. N = number of participants tested and number for Yes/No response.

		Total		*No*		*Yes*	
		N	%	*N*	%	*N*	%
Q10	Is the form of metal alloy to be used specified?	32	100	17	53.1	15	46.9
Q11	Are the designs for the gingival margins shown?	32	100	22	68.7	10	31.3
Q12	Does the dentist offer any sort of design drawings?	32	100	20	62.5	12	37.5
Q13	Are the number of pontics needed for fixed prosthesis specified?	32	100	8	25	24	75
Q14	Does the dentist offer insight with regards to the shade to be used for teeth?	32	100	4	12.5	28	87.5
Q15	Has the dentist indicated the type of occlusal scheme?	32	100	20	62.5	12	37.5
Q16	Is the type of porcelain glaze to be used specified?	32	100	26	81.2	6	18.8

Table 2: Questions related to removable prosthesis consisting of Total, No, Yes for questions 10–16. N = number of participants tested and number for Yes/No response.

	N	%
Total	32	100
Frequently	5	15.6
Occasionally	15	46.9
Rarely	9	28.1
Never	3	9.4

Table 3: Frequency of dentist contact consisting of total selections with 'Sometimes', 'Sparingly', 'Rarely' selection of variables to choose from. N = number of participants tested and number for 'Sometimes', 'Sparingly', 'Rarely' responses.

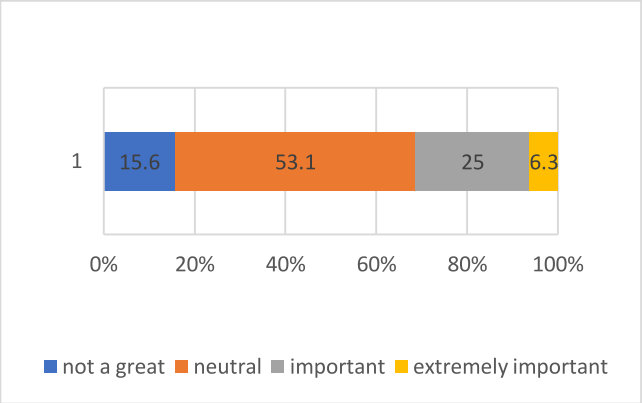

Figure 3: Rating level of importance felt by dental laboratory technicians throughout prosthesis fabrication process following 'Not great', 'Neutral', 'Important', 'Extremely Important' component selections. Collected from MDH dental laboratory technicians and private dental laboratory technicians. N = number of participants tested.

Table 4 shows the responses gauged from dental technicians with regards to the interaction they receive from their patients with regards to the patients' specific dental case. From the results received, the majority stated that they 'Occasionally' interact with their patient regarding their case (46.9%) whilst 37.5% ($n = 12$) view their interaction rate with the patient as 'Rarely-Never'. Only 15.6% of dental technicians 'Frequently' interact with their patients ($p = 0.215$). The p-value shows a weak tendency and shows that there is not enough statistical evidence to assume that communication between dental technicians and patients is a general pattern.

17 out of 32 dental technicians feel 'Neutral' throughout the entire prosthesis fabrication process (53.1%). 53.1% feel neither greatly important nor 'extremely important' when it comes to the prosthesis fabrication process. It was worth noting that only 6.3% viewed themselves as 'Extremely Important' with 25% of dental technicians viewing themselves as being 'Important' whereas 15.6% of participants rated their level of importance throughout the prosthesis fabrication process as 'Not of great importance' ($p = 0.302$). Figure 3 shows the dental technicians' Assessment of importance throughout prosthesis fabrication process in the form of a horizontal bar graph. No statistically significant results amounted from question 20.

4 Discussion

The research study was directed in a way to investigate the quality of communication between dentists and dental laboratory technicians from the perspective of a dental laboratory technician and to understand their beliefs on communication in the dental environment. A percentage of 34.4% found the master impression to be disinfected correctly with disinfection indicated on the written dental prescription card. When compared to other studies, there is an obvious lack of tendency for disinfection to be indicated. A measly 7% of written instructions stated disinfection of prosthesis (Sui et al., 2014). This marginal figure was further echoed in the study by Alammari et al. (2018) who found 9.75% of written cases reporting disinfection of the master impression. These results conflicted with 81% of dental laboratory technicians reporting clear disinfection of the master impression in the clinical study performed by Al-AlSheikh (2012). Of those that marked that disinfection had not been clearly stated, many attributed improper disinfections mainly due to blood and saliva and/or any other debris left on the surface of the master impression. The 34.4% percentage as reported by dental laboratory technicians throughout Maltese dental laboratories may be viewed as an area for improvement. A possible means could be by ensuring the written dental clinic prescription cards contain details regarding proper disinfection whereby a dentist would have to mark for disinfection rather than leaving things to guesswork for the dental laboratory technician. Improper disinfection of master impressions increases the chance for cross-contamination in the dental workplace (Al-AlSheikh, 2012). The most common responses were that written instructions should specify disinfection whilst also specifying greater detail with regards to the patient age, gender as referenced in the studies by Dawson et al. (2008) and Goodlin (2006). By making such adjustments, this may in turn lead to an improvement in lab work and positive outcomes for the dentist, dental laboratory technician and patient.

Various studies showed a lack of concise communication between the dental clinic and dental laboratory (Alammari et al., 2018). Alammari et al. (2018) in their cross-sectional study reported 55% of written instructions for dental cases as poor whereas written instructions were described as 'clear' in 31% of cases in the study by Kilfeather et al. (2010). 36.5% of data was considered satisfactory and clear whilst 22.8% of cases were viewed as unsatisfactory and poor (Alammari et al., 2018). The cross-sectional study by Al-AlSheikh (2012) indicated that 50% of written instructions were clear and understandable. The research study reported a 'good-very good' assessment of 56.2% for written dental clinic prescription cards. In general, the results correlate with other studies with most dental laboratory technicians able to understand the instructions given by the dentist to fabricate a form of prosthesis.

Dental laboratory technicians from Malta were also asked for means for improvement concerning written dental clinic prescription cards if they gave the instruc-

	N	%
Total	17	100
Sometimes	7	41.2
Sparingly	7	41.2
Rarely	3	17.6

Table 4: Frequency for dental technologist interaction with dentist's patients regarding their dental case consisting of total selections with 'Frequently', 'Occasionally', 'Rarely', 'Never' selection of variables to choose from. N = number of participants tested and numbers for 'Frequently', 'Occasionally', 'Rarely', 'Never' responses.

tions an average rating.

Dental laboratory technicians were questioned on aspects regarding removable prosthesis, some of the key issues discussed were colour coding in design, occlusal scheme, and shade indication for example. 75% of dental technologists indicate that the dentist does not use colour coding in design drawings, colour coding may be seen as a useful tool to make use of since it may better illustrate all components of the removable prosthesis and perhaps limit the chance for misinterpretation if a design diagram is poorly drawn for example (Al-AlSheikh, 2012; Davenport et al., 2000). 56% of cases were recorded as not being colour coded (Al-AlSheikh, 2012). The type of porcelain glaze to be used for fixed prosthesis was specified in only 18.8% of cases in this research study, this figure conflicted with that found in the study by Al-AlSheikh (2012) which reported indication for the type of porcelain glaze in 73% of cases. All 32 dental laboratory technicians who participated in the study were asked to rate themselves in terms of their own opinion with regards to importance in the prosthesis fabrication process from 1 to 5 with 1 being unimportant and 5 being extremely important. From the results, only 6.3% of dental technicians viewed themselves as 'Extremely important' with most technologists feeling neutral throughout the whole process (53.1%). When compared to the cross-sectional study carried out by Berry et al. (2014), 26% of responses felt secondary throughout the fabrication process and were not given as much importance as they felt they warranted given their position as being entrusted with producing a prosthesis to function inside a patient's mouth (Davenport et al., 2000). The large majority, 87.5% feel comfortable and at ease when discussing prosthesis design with a dentist.which gives reason to believe that dental technicians feel capable of taking on the workload given to them. From the research study, only 15.6% of dental laboratory technicians interact with patient's regarding their dental case 'Frequently' which suggests that there is room for improvement in this department for dental laboratory technicians to engage with dentist's patients on a more frequent basis. In the study by Dawson et al. (2008), 46.9% of dental laboratory technicians occasionally interact with the patient whilst 28.1% rarely do. Dawson et al. (2008) suggest that engaging and exposing the dental technician more to the environment may yield better results with regards to decision making in treatment plans and restorative practices.

5 Conclusion

From the findings, it can be concluded that:

- Good quality communication between both dental technologists and dentists is not always present Dental technologists were largely in agreement that they are more than comfortable when it comes to discussing prosthesis construction with their dentist (87.5%).
- Dental technicians view themselves as playing neither a prominent nor insignificant role in the process of prosthesis production.
- Contact with dentist's patients is not unusual however is not always observed.

References

Afsharzand, Z., Rashedi, B. & Petropoulos, V. C. (2006). Dentist communication with the dental laboratory for prosthodontic treatment using implants. *Journal of Prosthodontics*, *15*(3), 202–207.

Al-AlSheikh, H. M. (2012). Quality of communication between dentists and dental technicians for fixed and removable prosthodontics. *King Saud University Journal of Dental Sciences*, *3*(2), 55–60.

Alammari, M. & Albagar, R. (2018). Assessment of the perceived communication competence of senior undergraduate dental students: A study of the quality of data and orders written in prosthodontics' laboratory forms. *Journal of International Oral Health*.

Alshiddi, I. F. (2014). Communication between dental office and dental laboratory: From paper-based to web-based. *Pakistan Oral & Dental Journal*, *34*(3), 555–559.

Berry, J., Nesbit, M., Saberi, S. & Petridis, H. (2014). Communication methods and production techniques in fixed prosthesis fabrication: A UK based survey. Part 1: Communication methods. *British Dental Journal*, *217*(6), E13.

Bhola, S., Hellyer, P. H. & Radford, D. R. (2018). The importance of communication in the construction of partial dentures. *British Dental Journal*, *224*(11), 853–856.

Davenport, J. C., Basker, R. M., Heath, J. R., Ralph, J. P., Glantz, P. O. & Hammond, P. (2000). Communication between the dentist and the dental technician. *British Dental Journal*.

Dawson, P., Cranham, J. & Pace, S. (2008). Records for success: A step-by-step approach will ensure effective communication with the laboratory and great clinical outcomes. *Oral Health*, *98*(4), 45–46, 49–50, 52.

Goodlin, R. (2006). The essential tools: A guide to dentist-laboratory communication. *Oral Health*, *96*(7), 3–54, 57–58, 61–63.

Haj-Ali, R., AlQuran, F. & Adel, O. (2012). Dental laboratory communication regarding removable dental prosthesis design in the UAE. *ournal of Prosthodontics*.

Juszczyk, A. S., Clark, R. K. F. & Radford, D. R. (2009). UK dental laboratory technicians' views on the efficacy and teaching of clinical-laboratory communication. *British Dental Journal*.

Kilfeather, G. P., Lynch, C. D., Sloan, A. J. et al. (2010). Dentist-dental technician communication. *Dental Abstracts*, *55*(5), 239–240.

Krzyzostaniak, L. (2017). What digital dentistry means for implants? *Digital Esthetics*, *42*(5), 12–14, 16–17.

Lynch, C. D. & Allen, P. F. (2005). Quality of communication between dental practitioners and dental technicians for fixed prosthodontics in Ireland. *Journal of Oral Rehabilitation*.

Pelligra, P. (2016). How to communicate with orthodontic laboratories. *Seminars in Orthodontics*.

Perry, R. & Orfanidis, J. (2012). The power of communication. *Dental Products Report*, *46*(2), 64–67.

Rotsaert, M. (2007). Communication: The key to predictable restorations. *Oral Health*, *97*(7), 12–14, 17–18, 20.

Stewart, C. A. (2011). An audit of dental prescriptions between clinics and dental laboratories. *British Dental Journal*.

Sui, L., Wu, X., Wu, S., Gao, P. & Li, R. (2014). The quality of written instructions for dental prostheses in China. *Journal of Prosthodontics*.

Tulbah, H., AlHamdan, E., AlQahtani, A., AlShahrani, A. & AlShaye, M. (2017). Quality of communication between dentists and dental laboratory technicians for fixed prosthodontics in Riyadh, Saudi Arabia.

Woodhead, C. M. (1996). Communication. *Journal of the Royal College of Surgeons of Edinburgh*, *41*(4), 275–276.

XJENZA ONLINE
VOLUME 8 ISSUE 1, 2020

Table of Contents

Articles