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Open Science

Open Science Philosophy

Open science encompasses unrestricted access to scientific research articles, access to data from public research, and collaborative research enabled by information and communication technology tools, models, and incentives. Broadening access to scientific research publications and data is at the heart of open science. The objective of open science is to make research outputs and its potential benefits available to the entire world and in the hands of as many as possible:

- Open science promotes a more accurate verification of scientific research results. Scientific inquiry and discovery can be sped up by combining the tools of science and information technologies. Open science will benefit society and researchers by providing faster, easier, and more efficient availability of research outputs.
- Open science reduces duplication in collecting, creating, transferring, and re-using scientific material.
- Open science increases productivity in an era of tight budgets.
- Open science results in great innovation potential and increased consumer choice from public research.
- Open science promotes public trust in science. Greater citizen engagement leads to active participation in scientific experiments and data collection.

Open Science Index

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Open Science

Open Society

An open society allows individuals to change their roles and to benefit from corresponding changes in status. Open science depends to a greater or lesser extent on digital technologies and innovations in structural processes by an open society. When realized, open science research and innovation can create investment opportunities for new and better products and services and therefore increase competitiveness and employment. Open science research and innovation is a key component of thematic open science priorities. Central to the open science digital infrastructure is enabling industry to benefit from digital technology and to underpin scientific advances through the development of an open society. Open science research and innovation can also contribute to society as a global actor because scientific relations can flourish even where global relations are strained. Open science has a critical role across many areas of decision making in providing evidence that helps understand the risks and benefits of different open science choices. Digital technology is making the conduct of open science and innovation more collaborative, more global, and more open to global citizens. Open society must embrace these changes and reinforce its position as the leading power for science, for new ideas, and for investing sustainably in the future.

It is apparent in open society that the way science works is fundamentally changing, and an equally significant transformation is taking place in how organizations and societies innovate. The advent of digital technology is making research and innovation more open, collaborative, and global. These exchanges are leading open society to develop open science and to set goals for research and innovation priority. Open science goals are materializing in the development of scientific research and innovation platforms and greater acceptance of scientific data generated by open science research. Open science research and innovation do not need help from open society to come up with great ideas, but the level of success ideas ultimately reach is undoubtedly influenced by regulation, financing, public support, and market access. Open society is playing a crucial role in improving all these success factors.

Open Science

Open science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and collaborative tools. These innovations capture a systemic change to the way science and research have been carried out for the last fifty years. Science is shifting from the standard practice of publishing research results in scientific publications after the research and reviews are completed. The shift is towards sharing and using all available knowledge at an earlier stage in the research process. Open science is to science what digital technology is to social and economic transactions: allowing end users to be producers of ideas, relations, and services and in doing so, enabling new working models, new social relationships and leading to a new modus operandi for science. Open science is as important and disruptive as e-commerce has been for the retail industry. Just like e-commerce, the open science research paradigm shift affects the whole business cycle of doing science and research. From the selection of research subjects to the carrying out of research, to its use and re-use, to the role of universities, and that of publishers are all dramatically changed. Just as the internet and globalization have profoundly changed the way we do business, interact socially, consume culture, and buy goods, these changes are now profoundly impacting how one does research and science.

The discussion on broadening the footprint of science and on novel ways to produce and spread knowledge gradually evolved from two global trends: Open Access and Open Source. The former refers to online, peer-reviewed scholarly outputs, which are free to read, with limited or no copyright and licensing restrictions, while open source refers to software created without any proprietary restriction and which can be accessed and freely used. Although open access became primarily associated with a particular publishing

or scientific dissemination practice, open access already sought to induce a broader practice that includes the general re-use of all kinds of research products, not just publications or data. It is only more recently that open science has coalesced into the concept of a transformed scientific practice, shifting the focus of researchers' activity from publishing as fast as possible to sharing knowledge as early as possible. Open science is defined as the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process. As a result, the way science is done in the future will look significantly different from the way it is done now. Open science is the ongoing evolution in the modus operandi of doing research and organizing science. This evolution is enabled by digital technology and is driven by both the globalization of the scientific community and increasing public demand to address the societal challenges of our times. Open science entails the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open science impacts the entire research cycle, from the inception of research to its publication, and on how this cycle is organized. The outer circle reflects the new interconnected nature of open science, while the inner circle shows the entire scientific process, from the conceptualization of research ideas to publishing. Each step in the scientific process is linked to ongoing changes brought about by open science, including the emergence of alternative systems to establish a scientific reputation; changes in the way quality and impact of research are evaluated; the growing use of scientific blogs; open annotation; and open access to data and publications. All institutions involved in science are affected, including research organizations, research councils, and funding bodies. The trends are irreversible, and they have already grown well beyond individual projects. Theses changes predominantly result from a bottom-up process driven by a growing number of researchers who increasingly employ social media in their research and initiate globally coordinated research projects while sharing results at an early stage in the research process.

Open science is encompassed in five schools of thought:

- the infrastructure school, concerned with technological architecture
- the public school, concerned with the accessibility of knowledge creation
- the measurement school, concerned with alternative impact assessment
- the democratic school, concerned with access to knowledge
- the pragmatic school, concerned with collaborative research

According to the measurement school, the reputation and evaluation of individual researchers are still mainly based on citation-based metrics. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The impact factor is a measure reflecting the average number of citations to articles published in an academic journal and is used as a proxy for the relative importance of a journal.

Numerous criticisms have been made of citation-based metrics, primarily when used, and often misused, to assess the performance of individual researchers. These metrics:

- are often not applicable at the individual level
- do not take into account the broader social and economic function of scientific research
- are not adapted to the increased scale of research
- cannot recognize new types of work that researchers are performing

Web-based metrics for measuring research output, popularized as altmetrics, have recently received much attention: some measure the impact at the article level, others make it possible to assess the many outcomes of research in addition to the number of scientific articles and references. The current reputation and evaluation system has to adapt to the new dynamics of open science and acknowledge and incentivize

engagement in open science. Researchers engaging in open science have growing expectations that their work, including intermediate products such as research data, will be better rewarded or taken into account in their career development. Vice-versa, the use, and reuse of open data will require appropriate codes of conduct requiring, for example, the proper acknowledgment of the original creator of the data.

These ongoing changes are progressively transforming scientific practices with innovative tools to facilitate communication, collaboration, and data analysis. Researchers that increasingly work together to create knowledge can employ online tools and create a shared space where creative conversation and collaboration can occur. As a result, the problem-solving process can be faster, and the range of problems that can be solved can be expanded. The ecosystem underpinning open science is evolving very rapidly. Social network platforms for researchers already attract millions of users and are being used to begin and validate more research projects.

Furthermore, the trends towards open access are redefining the framework conditions for science and thus have an impact on how open innovation is produced by encouraging a more dynamic circulation of knowledge. It can enable more science-based startups to emerge thanks to the exploitation of openly accessible research results. Open science, however, does not mean free science. It is essential to ensure that intellectual property is protected before making knowledge publicly available in order to subsequently attract investments that can help translate research results into innovation. If this is taken into account, fuller and broader access to scientific publications and research data can help to accelerate innovation. Investments that boost research and innovation in open science would benefit society with fewer barriers to knowledge transfer, open access to scientific research, and greater mobility of researchers. In this context, open access can help overcome the barriers that innovative organizations face in accessing the results of research funded by the public.

Open innovation

An open society is the largest producer of knowledge, but the phenomenon of open science is changing every aspect of the scientific method by becoming more open, inclusive, and interdisciplinary. Ensuring open society is at the forefront of open science means promoting open access to scientific data and publications alongside the highest standards of research integrity. There are few forces in this globe as engaging and unifying as science. The universal language of science maintains open channels of communication globally. Open society can maximize its gains through maintaining its presence at the highest level of scientific endeavor, and by promoting a competitive edge in the knowledge society of the information age. The ideas and initiatives described in this publication can stimulate anyone interested in open science research and innovation. It is designed to encourage debate and lead to new ideas on what and open society should do, should not do, or do differently.

An open society can lead to a research powerhouse; however, open society rarely succeeds in turning research into innovation and in getting research results to the global market. Open society must improve at making the most of its innovation talent, and that is where open innovation comes into play. The basic premise of open innovation is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets while fostering a stronger culture of entrepreneurship. Open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation. This original notion of open innovation was primarily based on transferring knowledge, expertise, and even resources from one company or research institution to another. This notion assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they seek to improve their performance. The concept of open innovation is continually evolving and is moving from linear, bilateral transactions and collaborations

towards dynamic, networked, multi-collaborative innovation ecosystems. This means that a specific innovation can no longer be seen as the result of predefined and isolated innovation activities but rather as the outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment. This co-creation takes place in different parts of the innovation ecosystem and requires knowledge exchange and absorptive capacities from all the actors involved, whether businesses, academia, financial institutions, public authorities, or citizens.

Open innovation is a broad term, which encompasses several different nuances and approaches. Two main elements underpin the most recent conceptions of open innovation: the users are in the spotlight and invention becomes an innovation only if users become a part of the value creation process. Notions such as user innovation emphasize the role of citizens and users in the innovation processes as distributed' sources of knowledge. This kind of public engagement is one of the aims of open science research and innovation. The term 'open' in these contexts has also been used as a synonym for 'user-centric'; creating a well-functioning ecosystem that allows co-creation and becomes essential for open innovation. In this ecosystem, relevant stakeholders are collaborating along and across industry and sector-specific value chains to co-create solutions for socio-economic and business challenges. One important element to keep in mind when discussing open innovation is that it cannot be defined in absolutely precise terms. It may be better to think of it as a point on a continuum where there is a range of context-dependent innovation activities at different stages, from research to development through to commercialization, and where some activities are more open than others. Open innovation is gaining momentum thanks to new large-scale trends such as digitalization and the mass participation and collaboration in innovation that it enables. The speed and scale of digitalization are accelerating and transforming the way one designs, develops, and manufactures products, the way one delivers services, and the products and services themselves. It is enabling innovative processes and new ways of doing business, introducing new cross-sector value chains and infrastructures.

Open society must ensure that it capitalizes on the benefits that these developments promise for citizens in terms of tackling societal challenges and boosting business and industry. Drawing on these trends, and with the aim of helping build an open innovation ecosystem in open society, the open society's concept of open innovation is characterized by:

- combining the power of ideas and knowledge from different actors to co-create new products and find solutions to societal needs
- creating shared economic and social value, including a citizen and user-centric approach
- capitalizing on the implications of trends such as digitalization, mass participation, and collaboration

In order to encourage the transition from linear knowledge transfer towards more dynamic knowledge circulation, experts agree that it is essential to create and support an open innovation ecosystem that facilitates the translation of knowledge into socio-economic value. In addition to the formal supply-side elements such as research skills, excellent science, funding and intellectual property management, there is also a need to concentrate on the demand side aspects of knowledge circulation, making sure that scientific work corresponds to the needs of the users and that knowledge is findable, accessible, interpretable and reusable. Open access to research results aims to make science more reliable, efficient, and responsive and is the springboard for increased innovation opportunities, e.g. by enabling more science-based startups to emerge. Prioritizing open science does not, however, automatically ensure that research results and scientific knowledge are commercialized or transformed into socio-economic value. In order for this to happen, open innovation must help to connect and exploit the results of open science and facilitate the faster translation of discoveries into societal use and economic value.

Open Science

Collaborations with global partners represent important sources of knowledge circulation. The globalization of research and innovation is not a new phenomenon, but it has intensified in the last decade, particularly in terms of collaborative research, international technology production, and worldwide mobility of researchers and innovative entrepreneurs. Global collaboration plays a significant role both in improving the competitiveness of open innovation ecosystems and in fostering new knowledge production worldwide. It ensures access to a broader set of competencies, resources, and skills wherever they are located, and it yields positive impacts in terms of scientific quality and research results. Collaboration enables global standard-setting, allows global challenges to be tackled more effectively, and facilitates participation in global value chains and new and emerging markets.

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Open Science

Scholarly Research Review

The scholarly research review is a multidimensional evaluation procedure in which standard peer review models can be adapted in line with the ethos of scientific research, including accessible identities between reviewer and author, publishing review reports and enabling greater participation in the peer review process. Scholarly research review methods are employed to maintain standards of quality, improve performance, provide credibility, and determine suitability for publication. *Responsible Peer Review Procedure:* Responsible peer review ensures that scholarly research meets accepted disciplinary standards and ensures the dissemination of only relevant findings, free from bias, unwarranted claims, and unacceptable interpretations. Principles of responsible peer review:

• Honesty in all aspects of research
• Accountability in the conduct of research
• Professional courtesy and fairness in working with others
• Good stewardship of research on behalf of others

The responsibilities of peer review apply to scholarly researchers at all stages of peer review: Fairness, Transparency, Independence, Appropriateness and Balance, Participation, Confidentiality, Impartiality, Timeliness, Quality and Excellence, Professionalism, and Duty to Report.

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• Scholarly Research Review Interaction: Direct reciprocal discussion between author(s) and reviewers, and/or between reviewers, is allowed and encouraged

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• Scholarly Research Review Final-version Reviewing: Editorial revision of the language and format is conducted on the final version of the manuscript for publication

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All submitted manuscripts are subject to the scholarly research review process, in which there are three stages of evaluation for consideration: pre-review manuscripts, chair-review presentation, and final-review manuscripts. All submitted full text papers, that may still be withstand the editorial review process, are presented in the conference proceedings. Manuscripts are tracked and all actions are logged by internal and external reviewers according to publication policy. External reviewers' editorial analysis consists of the evaluation reports of the conference session chairs and participants in addition to online internal and external reviewers' reports. Based on completion of the scholarly research review process, those manuscripts meeting the publication standards are published 10 days after the event date.

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Immuno-Field Effect Transistor Using Carbon Nanotubes Network – Based for Human Serum Albumin Highly Sensitive Detection

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Abstract. Human serum albumin plays a significant part in the physiological functions of the human body system (HSA). HSA level monitoring is critical for early detection of HSA-related illnesses. The goal of this study is to show that a field effect transistor (FET)-based immunosensor can assess HSA using high aspect ratio carbon nanotubes network (CNT) as a transducer. The CNT network were deposited using air brush technique, and the FET device was made using a shadow mask process. Field emission scanning electron microscopy and a current-voltage measurement system were used to examine the morphology and electrical properties of the CNT network, respectively. X-ray photoelectron spectroscopy and Fourier transform infrared spectroscopy were used to confirm the surface alteration of the CNT. The detection process is based on covalent binding interactions between an antibody and an HSA target, which resulted in a change in the manufactured biosensor's drain current (Id). In a linear range between 1 ng/ml and 10 zg/ml, the biosensor has a high sensitivity of 0.826 mA (g/ml)-1 and a LOD value of 1.9 zg/ml. HSA was also identified in a genuine serum despite interference from other biomolecules, demonstrating the CNT-FET immunosensor's ability to quantify HSA in a complex biological environment.

Keywords: *Carbon nanotubes network, biosensor, human serum albumin*

Online Learning Versus Face to Face Learning: A Sentiment Analysis on General Education Mathematics in the Modern World of University of San Carlos School of Arts and Sciences Students Using Natural Language Processing

Derek Brandon G. Yu, Clyde Vincent O. Pilapil, Christine F. Peña

***Abstract*—**College students of Cebu province have been indoors since March 2020 and a challenge encountered is the sudden shift from face to face to online learning and with the lack of empirical data on online learning on Higher Education Institutions (HEIs) in the Philippines. Sentiments on face to face and online learning will be collected from University of San Carlos (USC), School of Arts and Sciences (SAS) students regarding Mathematics in the Modern World (MMW), a General Education (GE) course. Natural Language Processing with machine learning algorithms will be used to classify the sentiments of the students. Results of the research study are the themes identified through topic modelling and the overall sentiments of the students in USC SAS

***Keywords*—** Natural language processing, online learning, sentiment analysis, topic modelling.

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Machine Learning Techniques for Covid-19 Detection: A comparative Analysis

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***Abstract*—**Covid-19 virus spread has been one of the extreme pandemics across the globe. It is also referred as corona virus which is a contagious disease that continuously mutates into numerous variants. Currently, the B.1.1.529 variant labeled as omicron is detected in South Africa. The huge spread of Covid-19 disease has affected several lives and has surged exceptional pressure on the healthcare systems worldwide. Also, everyday life and the global economy have been at stake. This research aims to predict COVID-19 disease in its initial stage to reduce the death count. Machine Learning (ML) is nowadays used in almost every area. As the Covid-19 cases start rising heavily, a huge burden is caused on the hospitals. To reduce this burden, this paper predicts Covid-19 disease is based on the symptoms and medical history of the patient. This research presents a unique architecture for covid-19 detection using ML techniques integrated with feature dimensionality reduction. This paper uses a standard UCI dataset for predicting covid-19 disease. This dataset comprises symptoms of 5434 patients. This paper also compares several supervised ML techniques on the presented architecture. The architecture has also utilized 10-fold cross validation process for generalization and Principal Component Analysis (PCA) technique for feature reduction. Standard parameters are used to evaluate the proposed architecture including F1-Score, precision, accuracy, recall, Receiver Operating Characteristic (ROC) and Area under curve (AUC). The results depict that Decision tree, Random Forest and neural networks outperform all other state of the art ML techniques. This achieved result can help effectively in identifying covid 19 infection cases.

***Keywords*—**supervised machine learning, Covid-19 prediction, Healthcare analytics, Random Forest, Neural Network.

I. Introduction

WORLD Health Organization (WHO) has shown concern related to viral and infectious diseases that cause a severe risk to the health as well as well-being of people. Covid-19 is a wide-ranging family of virus that produces varying symptoms such as flu and common cold to critical respiratory issues. As stated by NCBI, "In past two decades, several viral epidemics like Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) have been registered" [1]. WHO declared pandemic in 2002 - 2004 and H1N1 influenza in 2009. In 2019, a few instances of unfamiliar low respiratory infections were spotted in Wuhan city of China around December 2019. This spotted mysterious infection having diseases like pneumonia was termed "COVID-19" by WHO. By 30th January this strain had impacted nearly 20 countries and hence WHO pronounced this infection as a Public Health Emergency of International Concern (PHEIC). The common signs are dry cough, fatigue and fever. Other less common symptoms are loss of smell or taste, headache, joint pain, nasal congestion, vomiting, diarrhea, chills, dizziness and sore throat. It rapidly becomes pandemic due to a huge upsurge in the cases as well as mortality rate. So far, specific treatments are still not available for this virus. Hence, the only possible way to decrease the spread of the virus is by maintaining hygiene (i.e washing hands, sanitizing), having social distancing and taking vaccinations. Currently, there have been several recoveries throughout the globe and active cases are reducing. The pandemic, however, is still not under control. Seniors with medical issues such as diabetes, heart illness, cancer, lung disease, etc. have a higher risk through this virus [2]. Also, virus is continuously bringing up new strains by mutation. Currently, Omicron, detected in South Africa is a big threat to the world as it has the highest mutation in contrast to its previous mutations. This virus has shaken the world in respect of health, hygiene and most importantly economy of the whole globe. Many countries have announced lockdown and sealed their borders. As major economic activities are shut down, the normal routine of people is affected to a major extent. Hence, the primary requirement is to realize the features as well as characteristics of this disease.

Methods to detect COVID-19 disease include rapid tests, RTPCR tests. Once Covid has detected the effect of the virus in the body can be detected using several measures such as Chest CT images, blood tests and X-ray images. In the blood test, Complete Blood Count(CBC), D-Dimer and C-reactive Protein (CRP), S-ferritin, Alanine Aminotransferease (ALT), Lactate dehydrogenase (LDH) are measured. CBC showcases the comprehensive health and also detects infection's range [3]. Inflammation in the human body is detected using CRP which is a protein made by the liver [4]. Blood clots dissolve is detected using D-dimer [5]. To measure the iron in the body S-ferritin is utilized which is a blood of a protein [6]. Liver damage can be checked using the ALT test [7]. The harmed tissues of the human body can be estimated using LDH which is an enzyme discovered in body's major cells [8]. Thus, the paper aims to predict whether the person has covid or not based on several symptoms such as breathing problems, dry cough, fever, sore throat, asthma, running nose, chronic lung disorder, heart disease, headache and diabetes.

There are several areas where AI has given promising results. It includes Computer vision [9,10], Machine learning [11] and

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healthcare [12]. Hence, AI techniques can also be utilized to predict COVID-19 infection. As the Covid-19 cases start rising heavily, a huge burden is caused on the hospitals. Also, early diagnosis is very crucial for this virus. Covid-19 cases are increasing heavily and there is a lack of awareness and fear. Due to this, people go through the test for verifying whether they are infected or not. For the detection of Covid-19 infection, there are currently just a few analytical tests available. Therefore, there is a requirement to employ an automatic prediction mechanism to efficiently predict the infection and reduce the utilization of test kits. This will also help in detecting the infection at an early stage and prevent spreading amongst individuals by providing proper treatment to them at an initial stage.

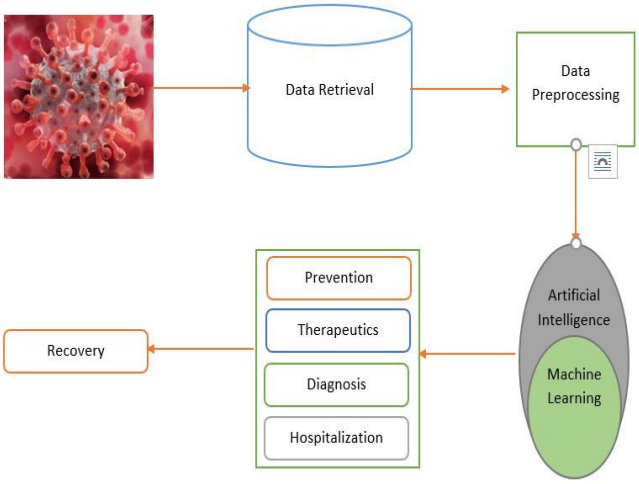

Fig. 1. Architecture for generalized Covid-19 detection to recovery process using AI and ML.

Fig. 1. showcases how AI and ML can help in predicting several roles such as prevention, diagnosis, hospitalization, etc. It also provides a brief overview of stages a person goes through from infection to recovery and how ML helps in this phase. Machine Learning (ML) is indeed a potential technique that can be very helpful in prevention against the COVID-19. ML can be utilized to handle enormous data and efficiently forecast the infection through several symptoms. It can help in diagnosing as well as predicting COVID-19. Three categories of machine learning include unsupervised, supervised and reinforcement learning. Unsupervised machine learning is a technique which does not have labelled data. In this technique, training samples are provided to the machine and the machine identifies the hidden patterns from the dataset. Using labelled datasets, supervised machine learning trains the system. The samples are labeled according to the class to which they belong [13]. The machine analyses the labelled data and predicts new instances based on results retrieved from the past data. In reinforcement learning, a trial-and-error approach is utilized with an objective to determine the most suitable steps by a machine that acts as an agent [14]. Whenever the machine executes a task correctly, it is rewarded and its state is increased. In case, a machine doesn't execute its task it is punished and its state is also decreased. This task is continuously repeated numerous times until the machine performs a specific task successfully or reaches the specified number of states. Reinforcement learning is utilized in training robots to provide personal assistance and also to present tasks like humans.

The major contribution of the paper is that it proposes an efficient ML architecture that provides high accuracy for predicting the covid-19 based on symptoms. Also, it pre-processes the data before providing it for training to increase the efficiency of the proposed architecture.

Section II showcases the related literature works carried out in this field. In section III the proposed architecture and description of the same is showcased. Section IV showcases experimental results and analysis and finally, the conclusion and future scope are presented at last.

II. Related Work

G. Monika et al. [15] offered three machine learning algorithms for evaluating Covid19 cases: Decision Tree Regressor, Polynomial Regression, and Random Forest. For Polynomial Regression, their model obtains 90% accuracy. R. Gupta et al. used machine learning approaches including the Regression model and the Susceptible Exposed Infectious Removed (SEIR) model to predict variance in COVID-19 disease contamination. The RMS log error was calculated to be 1.52 for the RMS model and 1.75 for the Regression model. C. Iwendi et al. combined the Random Forest and Adaboost techniques in their research [17]. The model has a 0.86 F1 score and a 94 percent accuracy rate. For forecasting human intelligence, S. Makridakis et al. offered statistical approaches and ML training [18].

Several surveys mention the use of machine learning for COVID-19 diagnosis. A. F. M. Batista et al. utilized the Kaggle dataset [19] to precisely classified patients of COVID-19 of Brazil with 85% accuracy utilizing the Support Vector Machine (SVM) method [20]. M.R.H. Mondal utilized multilayer perceptron (MLP) and XGBoost and achieved 91% classification accuracy on the same dataset [19]. D. Goodman Meza precisely classified COVID-19 patients with 91% cases on UCLA Health System dataset of USA. Z. Meng et al. and Y. sun et al. measured COVID-19 with accuracies of 89% and 91% respectively [21, 22].

In last two years, several studies have been proposed in which AI was used to identify, prevent, and predict the COVID-19 pandemic. L. Wang et al. [23] used Chest X-Ray images (CXR) and presented a Convolutional Neural Network (CNN) architecture for COVID-19 prediction in patients. The ImageNet model is trained using an open-source dataset of CXR pictures to apply transfer learning. Pal et al. used a Long Short Term Memory (LSTM) model on weather and trends data from a given country to anticipate the country's specific risk of COVID-19 [24]. For anticipating the spread of the pandemic in China, Liu et al. used machine learning on data containing internet activity, papers from health organizations, media activity, and news reports [25]. For the next 70 days, C. Bayes et al. employed the Bayesian approach to forecast deaths in Peru [26]. Beck et al. used Bidirectional Encoder Representations from the Transformers (BERT) to categorize commercial drugs

which can be given to COVID-19 patients [27]. Tang et al. utilized the Random Forest based ML method on CT scans images to examine patients infected with patients [28]. A Generative Adversarial Network (GAN) model is recommended to identify pneumonia from Chest X-Ray scan images at early stage by Khalifa et al. [29]. Sujatha et al., applied Multilayer perceptron, linear regression and Vector autoregression model for predicting the epidemiological pattern of COVID-2019 cases [30]. Waheed et al. utilized a deep learning approach for production of CXR images by introducing a model such as Auxiliary Classifier Generative Adversarial Network (ACGAN). This is also called CovidGAN [31].

Wu et al. presented a system to detect COVID-19 and classify whether it is covid-19 or Pneumonia [32]. There is a challenge to quickly diagnosis the disease. Hence, a Random forest-based ML model is used which had 95.95 % accuracy. The dataset compromises 253 records from 169 suspected patients. Each record comprises 49 parameters. However, only 11 parameters were chosen as final indicators. To ensure reliability several validation methods were used. Bastug et al. proposed an architecture that forecasts the severe prognosis of COVID-19 [33]. They utilized laboratory as well as clinical data to handle COVID-19 patients and recognize patients that require Intensive Care Unit (ICU). Brinati et al. presented a Random Forest based machine learning system to detect COVID-19 [34]. The architecture was compared with other ML techniques. Random Forest has the highest accuracy on their two proposed model with 82% and 86%. Hussein et al. proposed an analysis intending to evaluate clinical features as well as radiological features of COVID-19 patients. The prime aim is to analyse whether a patient requires ICU or not [35]. For analysis, laboratory data of 72 COVID-19 patients were utilized. The data covered Complete blood count, D-dimer, seru, ferritin and C reactive protein. The limitation is that dataset has a very less information of COVID-19 patients.

This research primarily aims on identifying the existence of COVID-19 in a person. Hence, a supervised ML model has to be developed. This paper predicts COVID-19 symptoms using several machine learning methods such as Neural Network, Support Vector Machine, (SVM), K Nearest Neighbours (KNN), Decision Tree and Random Forest (RT) along with feature reduction done by PCA.

III. COVID-19 DETECTION USING MACHINE LEARNING TECHNIQUES

The proposed architecture for detection of covid-19 based on symptoms is given in Fig. 3.

A. Data Collection

The dataset used for the detection of covid-19 using ML techniques is a freely available dataset from Kaggle [36]. The dataset consists of various symptoms of the patients i.e., features used for training and the outcome i.e. the target variable. There are 20 features and one target variable. The dataset consists of 5434 instances. The features and target variable are given below [37].

Breathing Problem. This showcases whther the patient is suffering from shortness of breath.

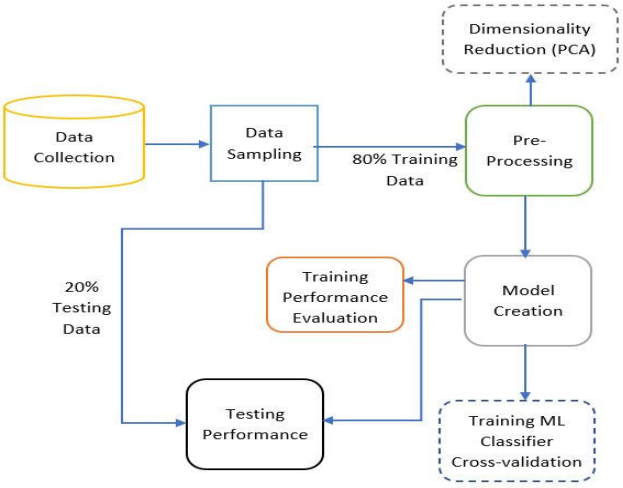

Fig. 2 Architecture for detection of covid-19 using ML

The architecture consists of three modules:

Fever. This field describes whether the patient is having a fever or not.

Dry Cough. This field highlights whether the patient is suffering from continuous coughing without mucus.

Sore Throat. This field depicts whether the patient is suffering from a sore throat.

Running Nose. This field mentions whether the patient is suffering from a runny nose.

Asthma. This field mentions whether the patient is suffering from asthma or not.

Chronic Lung Disease. This field showcases whether the patient is suffering from lung disease.

Headache. This field describes whether the patient is suffering from a headache.

Heart Disease. This field mentions whether the patient has cardiovascular disease

Diabetes. This field represents whether the patient has diabetes.

Hypertension. This field denotes wheterh the patient has high blood pressure.

Fatigue. This field showcases whether the patient is experiencing tiredness.

Gastrointestinal. This field represents whether the patient has any gastrointestinal problems.

Abroad Travel. This field verifies whether the patient has gone abroad recently.

Contact with COVID-19 Patient. This field verifies weather the patient had been in contact with COVID-19 infected person.

Attended Large Gathering. This field describes whether the patient or any family member had appeared in a public meeting.

Visited Public Exposed Places. This field denotes whether the patient had visited mosques or temples, public gardens and other such religious places recently.
Family working in public. This field describes whether any family member of the patient working in an office, market area, etc.
Exposed places. The field verified whether the patient is exposed to crowded areas.
Wearing Mask. This field showcases whether the patient is wearing a mask all the time.
Sanitization from Market. This field represents whether the things brought from the market were sanitized before using it.
Covid 19. This field describes whether the patient is detected as covid positive or negative.

B. Data Sampling

Training and testing data are separated from the dataset for measuring performance of the trained model. The trained model receives 80% of the dataset, while the tested model receives 20% of the dataset.

C. Pre-processing

The dataset contains some features which are not so relevant as others for training the model. So, those features need to be removed to prevent the curse of dimensionality issue while training the ML algorithm. Here, "dimensionality" denotes the count of features in the dataset. In this, the curve of dimensionality is defined as "when the number of variables is large as compared to the number of instances in the dataset, the ML algorithms are unable to train effective models". Thus, to solve this problem, the paper used Principal Component Analysis (PCA) for feature reduction.

D. Model Creation

The model is created by training the original as well as the reduced features selected and extracted by PCA. Multiple supervised ML techniques along with the 10-fold cross-validation are used for training the model. To generalize the architecture on the selected dataset, k-fold cross-validation is utilized. This provides the solution to the overfitting issue that increases because of several features or containing noisy data. For training, the proposed work uses various classification algorithms such as neural network, K-Nearest Neighbour (KNN), Support Vector Machine (SVM), decision tree, Naïve Bayes and Random Forest.

E. Evaluation Parameters

The training and testing assessment of the proposed architecture is done by utilizing standard parameters that include Confusion matrix, Classification accuracy (CA), F1 measure, precision, recall, ROC and Area under Curve (AUC).
Confusion Matrix. This parameter is utilized for the binary classification which is showcased in Fig. 3.

	Actual Yes	Actual No
Predicted Yes	True Positive (TP)	False Negative (FN)
Predicted No	False Positive (FP)	True Negative (TN)

Fig. 3. Confusion Matrix

In Fig. 3, True Positive (TP) are the occurrences of the dataset that are predicted as well as classified as true. The occurrences that are predicted as well as classified as false are called True Negative (TN). In False Positives (FP), the occurrences that are false, however classifier predicts it as true. Finally, the occurrences that are true, however classifier predicts it as false are called False Negative (FN).
Classification Accuracy. Accuracy is the number of correct predictions made by the classification model to the total number of predictions made.

$$Classification\ Accuracy\ (CA) = \frac{TP+TN}{TP+FP+TN+FN} \quad (1)$$

Recall. Recall is the percentage of predicted positives by the model out of the total positive values in the dataset.

$$Recall\ (True\ Positive\ Rate) = \frac{TP}{TP+FN} \quad (2)$$

Precision. Precision is the percentage of true positives in the dataset out of all the positive predicted values by the model.

$$Precision\ (Positive\ Predictive\ value) = \frac{TP}{TP+FP} \quad (3)$$

***F1 Score*:** F1 score is the harmonic mean of precision and recall. Mathematically, it is the weighted average of precision and recall as in eq. 4.

$$F1\ score = \frac{2*Precision*Recall}{Precision+Recall} \quad (4)$$

ROC curve: The Receiver Operating Characteristic (ROC) curve is used to measure the performance so that ability of classifiers can be examined by varying its discrimination threshold [12]. ROC is a graph that plots the FP rate (specificity) versus TP rate (sensitivity). Here, at (0,1) point, all the occurrences are precisely classed for all the classifiers in their specific group. This showcases the efficiency of a classifier. Generally, a classifier has a varying parameter that varies in such a way that the TP is in proportionate to FP. A point (FP, TP) is retrieved by varying the parameter value. To plot the ROC curve, a series of such points are deployed. A single point (FP, TP) also called ROC point is used to describe a classifier that does not have fluctuating parameter and it is showcased through a single point.
Area under curve: This parameter estimates the likelihood which showcases the proficiency of the classifier to differentiate amongst several classes. In this curve when the utilized features are normalized, high preference is given to the positive observation in contrast to a negative observation. Hence, the score of AUC is 1 for the classifier that is perfect.

$$AUC = P\ (m_1 > m_2) \quad (5)$$

Here, m1 is the score of the observation that is positive and m2 is the score of the observation that is negative.

IV. Units Experimental Results and Analysis

The proposed approach is simulated in the Orange Data Mining tool (version:3.24). The tool is open-source and widely used for Data mining, data visualization, machine learning and image processing.

Table 1 shows the training results with 10 fold cross validation with PCA. Decision tree and Random Forest outperforms with the highest F1 score of 98.0 %. Table 2 showcases training results with 10 fold cross validation without PCA. Decision Tree, random forest and neural networks

perform well with a 98.2% F1 score.

TABLE I
UNITS RESULTS WITH TRAINING 10 FOLD CROSS-VALIDATION PCA

Model	AUC	CA	F1	Precision	Recall
SVM	0.935	0.892	0.894	0.896	0.892
Naïve Bayes	0.989	0.965	0.964	0.964	0.965
kNN	0.996	0.974	0.974	0.975	0.974
Neural Network	0.998	0.978	0.978	0.978	0.978
Decision Tree	0.998	0.980	0.980	0.980	0.980
Random Forest	0.998	0.980	0.980	0.981	0.980

TABLE II
TRAINING 10 FOLD CROSS VALIDATION WITHOUT PCA

Model	AUC	CA	F1	Precision	Recall
SVM	0.931	0.877	0.882	0.891	0.877
kNN	0.959	0.967	0.966	0.968	0.967
Naïve Bayes	0.990	0.966	0.965	0.965	0.966
Decision Tree	0.998	0.982	0.982	0.982	0.982
Random Forest	0.998	0.982	0.982	0.982	0.982
Neural Network	0.998	0.982	0.982	0.982	0.982

Table 3 and Table 4 shows testing results with and without PCA respectively. Decision tree, Random forest and neural network perform well with 98.7% F1 score with PCA while Random forest and neural network perform well with 99% F1 score without PCA.

TABLE III
TESTING WITH PCA

Model	AUC	CA	F1	Precision	Recall
SVM	0.955	0.936	0.935	0.935	0.936
Naïve Bayes	0.992	0.970	0.969	0.969	0.970
kNN	0.999	0.983	0.982	0.982	0.983
Random Forest	0.999	0.987	0.987	0.987	0.987
Neural Network	0.999	0.987	0.987	0.987	0.987
Decision Tree	0.999	0.987	0.987	0.987	0.987

TABLE II
TESTING WITHOUT PCA

Model	AUC	CA	F1	Precision	Recall
kNN	0.945	0.972	0.971	0.973	0.972
SVM	0.973	0.909	0.913	0.921	0.909
Naïve Bayes	0.992	0.970	0.969	0.969	0.970
Decision Tree	0.999	0.987	0.987	0.987	0.987
Random Forest	0.999	0.990	0.990	0.990	0.990
Neural Network	0.999	0.990	0.990	0.990	0.990

Fig 4. depicts the ROC curve of test data with PCA and Fig 5. depicts the ROC curve of test data without PCA. From Fig 4, it is clear that SVM and Naïve Bayes don't perform well as their graph is quite far from the ideal point (0,1) while knn, decision tree, random forest and neural network perform well as their graphs are too close to the point (0,1). From fig. 5., it is clear that the decision tree, random forest and neural networks perform well while SVM and knn don't perform well.

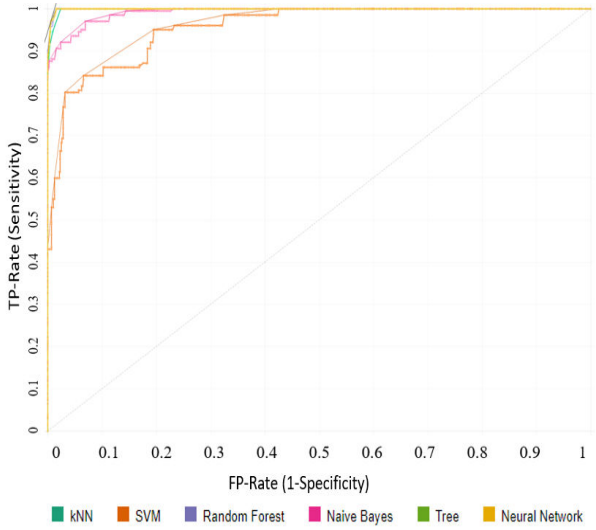

Fig. 4. ROC curve testing with PCA

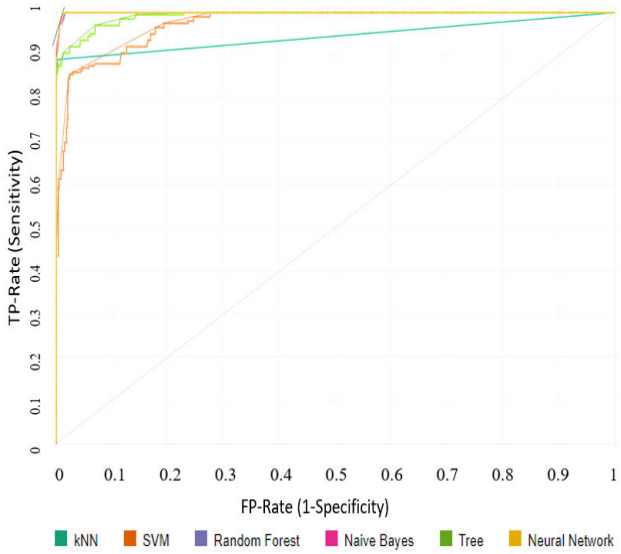

Fig.5. ROC curve testing without PCA

V. CONCLUSION AND FUTURE SCOPE

Covid-19 has caused a big panic worldwide. All sectors are facing challenges to handle this situation. Government organizations and researchers are worried that several percentages of the world's population will be affected by this pandemic. Also, the virus is continuously mutating and coming up with a new strain. Currently, Omicron variant reported first in South Africa has put all researches into a dilemma. AI has emerged as a savior by providing impactful solutions to almost all sectors. This paper showcases a unique architecture for Covid-19 disease identification in a patient by using symptoms and medical history. In this paper, the ML approach is used for identifying the occurrence of Covid-19. Hence, several ML

algorithms such as knn, svm, random forest, naïve bayes, tree, neural network are applied in the architecture. The paper utilized the standard UCI dataset which has symptoms and medical history for 5434 patients. The model is evaluated using standard parameters such as Confusion matrix, accuracy, precision, recall, F1 score, ROC and AUC. The evaluation parameters depict that the Decision tree, Random forest and neural networks outperform other state of the art ML techniques. In the future, ML Techniques can be utilized in tracing Covid cases, forecasting, producing dashboards, diagnosing and giving suitable medications, producing alerts to manage social distancing and several other processes for controlling the spread of the virus.

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Understanding the Fundamental Driver of Semiconductor Radiation Tolerance with Experiment and Theory

Julie V. Logan, Preston T. Webster, Kevin B. Woller, Christian P. Morath, and Michael P. Short

***Abstract*—**Semiconductors, as the base of critical electronic systems, are exposed to damaging radiation while operating in space, nuclear reactors, and particle accelerator environments. What innate property allows some semiconductors to sustain little damage while others accumulate defects rapidly with dose is at present, poorly understood. This limits the extent to which radiation tolerance can be implemented as a design criterion. To address this problem of determining the driver of semiconductor radiation tolerance, the first step is to generate a dataset of the relative radiation tolerance of a large range of semiconductors (exposed to the same radiation damage and characterized in the same way). To accomplish this, Rutherford backscatter channeling experiments are used to compare the displaced lattice atom buildup in InAs, InP, GaP, GaN, ZnO, MgO, and Si as a function of step-wise alpha particle dose. With this experimental information on radiation-induced incorporation of interstitial defects in hand, hybrid density functional theory electron densities (and their derived quantities) are calculated and their gradient and Laplacian are evaluated to obtain key fundamental information about the interactions in each material. It is shown that simple, undifferentiated values (which are typically used to describe bond strength) are insufficient to predict radiation tolerance. Instead, the curvature of the electron density at bond critical points provides a measure of radiation tolerance consistent with the experimental results obtained. This curvature and associated forces surrounding bond critical points disfavors localization of displaced lattice atoms at these points, favoring their diffusion toward perfect lattice positions. With this criterion to predict radiation tolerance, simple density functional theory simulations can be conducted on potential new materials to gain insight into how they may operate in demanding high radiation environments.

***Keywords*—**Density functional theory, GaN, GaP, InAs, InP, MgO, radiation tolerance, Rutherford backscatter channeling

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Drone Swarm Routing and Scheduling for Off-shore Wind Turbine Blades Inspection

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***Abstract*—** In off-shore wind farms, turbine blade inspection accessibility under various sea states is very challenging and greatly affects the downtime of wind turbines. Maintenance of any offshore system is not an easy task due to the restricted logistics and accessibility. The multirotor unmanned helicopter is of increasing interest in inspection applications due to its manoeuvrability and payload capacity. These advantages increase when many of them are deployed simultaneously in a swarm. Hence this paper proposes a drone swarm framework for inspecting offshore wind turbine blades and nacelles so as to reduce downtime. One of the big challenges of this task is that when operating a drone swarm, an individual drone may not have enough power to fly and communicate during missions and it has no capability of refueling due to its small size. Once the drone power is drained, there are no signals transmitted and the links become intermittent. Vessels equipped with 5G masts and small power units are utilised as platforms for drones to recharge/swap batteries. The research work aims at designing a smart energy management system, which provides automated vessel and drone routing and recharging plans. To achieve this goal, a novel mathematical optimisation model is developed with the main objective of minimising the number of drones and vessels, which carry the charging stations, and the downtime of the wind turbines. There are a number of constraints to be considered, such as each wind turbine must be inspected once and only once by one drone; each drone can inspect at most one wind turbine after recharging, then fly back to the charging station; collision should be avoided during the drone flying; all wind turbines in the wind farm should be inspected within the given time window. We have developed a real-time Ant Colony Optimisation (ACO) algorithm to generate real-time and near-optimal solutions to the drone swarm routing problem. The schedule will generate efficient and real-time solutions to indicate the inspection tasks, time windows, and the optimal routes of the drones to access the turbines. Experiments are conducted to evaluate the quality of the solutions generated by ACO.

***Keywords*—** drone swarm, routing, scheduling, optimisation model, ant colony optimization.

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Techno-economic and Social Feasibility of Off-grid Solar PV Power Supply in Rural Communities of Pakistan: Case-study of Village Helario in Tharparkar

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***Abstract*—** Universal access to clean energy in Pakistan remains a critical challenge under centralised governance, the limited share of renewables and techno-economic limitations of grid expansion. About 56 million people in Pakistan (~26% of the population) still lack access to electricity.

Tackling this challenge requires innovative energy system solutions that meet sustainability targets in line with COP26. The project addresses this gap through a techno-economic and social feasibility study of off-grid microgeneration in the remote village of Helario, Tharparkar. The site lacks a grid connection and community residents currently rely on fuelwood, dung, kerosene oil, etc. for their daily needs. The study location (24°42′ N, 69°39′ E) is ideal for solar energy utilization with solar irradiance of 4.5-5.0 kWh/m 2 and 2300-2700 sunshine hours/year. The study will use a mixed-methods approach to 1) conduct a baseline assessment of available energy resources and electricity demands, specifically women's energy needs; 2) design an off-grid solar PV system to meet projected demand, and 3) provide design guidelines with policy implications for decentralised off-grid rural electrification.

Through a multidisciplinary approach that integrates the project collaborators' diverse expertise, the project aims to contribute to Pakistan's Intended Nationally Determined Contribution (INDC) 2030 by focusing on the intersections between SDG11 (Sustainable communities), SDG7 (clean energy access) and SDG5 (gender equality) for improved energy sustainability, affordability, and equity.

***Keywords*—** Solar PV,Offgrid,Rural Community,Pakistan.

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Restoring Ecosystem Balance in Arid Regions; A Case Study of a Royal Nature Reserve in the Kingdom of Saudi Arabia

Talal AlHarigi, Kawther AlShlash, Mariska Weijerman

***Abstract*—**The government of Saudi Arabia has developed an ambitious "Vision 2030", which includes a Green Initiative (i.e., the planting of 10 billion trees) and the establishment of seven Royal Reserves as protected areas that comprise 13% of the total land area. The main objective of the reserves is to restore ecosystem balance and reconnect people with nature. Two royal reserves are managed by The Imam Abdulaziz bin Mohammed Royal Reserve Development Authority, including Imam Abdulaziz bin Mohammed Royal Reserve and King Khalid Royal Reserve. The authority has developed a management plan to enhance the habitat through seed dispersal and the planting of 10 million trees, and to restock wildlife that was once abundant in these arid ecosystems (e.g., oryx, Nubian ibex, gazelles, red-necked ostrich). Expectations are that with the restoration of the native vegetation, soil condition and natural hydrologic processes will improve and lead to further enhancement of vegetation and, over time, an increase in biodiversity of flora and fauna. To evaluate the management strategies in reaching these expectations, a comprehensive monitoring and evaluation program was developed. The main objectives of this program are to (1) monitor the status and trends of indicator species, (2) improve desert ecosystem understanding, (3) assess the effects of human activities, and (4) provide science-based management recommendations. Using a random stratified survey design, a diverse suite of survey methods will be implemented, including belt and quadrant transects, camera traps, GPS tracking devices, and drones. Data will be gathered on biotic parameters (plant and animal diversity, density, and distribution) and abiotic parameters (humidity, temperature, precipitation, wind, air, soil quality, vibrations, and noise levels) to meet the goals of the monitoring program. This case study intends to provide a detailed overview of the management plan and monitoring program of two royal reserves and outlines the types of data gathered which can be made available for future research projects.

***Keywords*—**Camera traps, desert ecosystem, enhancement, GPS tracking, management evaluation, monitoring, planting, restocking, restoration.

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Remote Sensing through Deep Neural Networks for Satellite Image Classification

Teja Sai Puligadda

***Abstract*—** Satellite images in detail can serve an important role in the geographic study. Quantitative and qualitative information provided by the satellite and remote sensing images minimizes the complexity of work and time. Data/images are captured at regular intervals by satellite remote sensing systems, and the amount of data collected is often enormous, and it expands rapidly as technology develops. Interpreting remote sensing images, geographic data mining, and researching distinct vegetation types such as agricultural and forests are all part of satellite image categorization. One of the biggest challenge data scientists faces while classifying satellite images is finding the best suitable classification algorithms based on the available that could able to classify images with utmost accuracy. In order to categorize satellite images, which is difficult due to the sheer volume of data, many academics are turning to deep learning machine algorithms. As, the CNN algorithm gives high accuracy in image recognition problems and automatically detects the important features without any human supervision and the ANN algorithm stores information on the entire network (Abhishek Gupta., 2020), these two deep learning algorithms have been used for satellite image classification. This project focuses on remote sensing through Deep Neural Networks i.e., ANN and CNN with Deep Sat (SAT-4) Airborne dataset for classifying images. Thus, in this project of classifying satellite images, the algorithms ANN and CNN are implemented, evaluated & compared and the performance is analyzed through evaluation metrics such as Accuracy and Loss. Additionally, the Neural Network algorithm which gives the lowest bias and lowest variance in solving multi-class satellite image classification is analyzed.

***Keywords*—** artificial neural network, convolutional neural network, remote sensing, accuracy, loss.

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Ergonomic Adaptations in Visually Impaired Workers - A Literature Review

Kamila Troper, Pedro Mestre, Maria Lurdes Menano, Joana Mendonça, Maria João Costa, Sandra Demel

***Abstract*—** Introduction: Visual impairment is a problem that has an influence on hundreds of thousands of people all over the world. Although it is possible for a Visually Impaired person to do most jobs, the right training, technological assistance, and emotional support are essential. Ergonomics be able to solve many of the problems/issues with the relative ease of positioning, lighting and design of the workplace. A little forethought can make a tremendous difference to the ease with which a person with an impairment function. Objectives: Review the main ergonomic adaptation measures reported in the literature in order to promote better working conditions and safety measures for the visually impaired. Methodology: This was an exploratory-descriptive, qualitative literature systematic review study. The main databases used were: PubMed, BIREME, LILACS, with articles and studies published between 2000 and 2021. Results: Based on the principles of the theoretical references of ergonomic analysis of work, the main restructuring of the physical space of the workstations were: Accessibility facilities and assistive technologies; A screen reader that captures information from a computer and sends it in real-time to a speech synthesizer or Braille terminal; Installations of software with voice recognition, Monitors with enlarged screens; Magnification software; Adequate lighting, magnifying lenses in addition to recommendations regarding signage and clearance of the places where the visually impaired pass through. Conclusions: Employability rates for people with visual impairments(both those who are blind and those who have low vision)are low and continue to be a concern to the world and for researchers as a topic of international interest. Although numerous authors have identified barriers to employment and proposed strategies to remediate or circumvent those barriers, people with visual impairments continue to experience high rates of unemployment.

***Keywords*—** ergonomic adaptations, visual impairments, ergonomic analysis of work, systematic review.

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Transverse Behavior of Frictional Flat Belt Driven by Tapered Pulley- Change of Transverse Force Under Driving State –

Satoko Fujiwara, Kiyotaka Obunai, Kazuya Okubo

***Abstract*—**A skew is one of important problems for designing the conveyor and transmission with frictional flat belt, in which running belt is deviated in width direction due to the transverse force applied to the belt. The skew often not only degrades the stability of the path of belt, but also causes some damages of the belt and auxiliary machines. However, the transverse behavior such as the skew has not been discussed quantitatively in detail for frictional belts. The objective of this study is to clarify the transverse behavior of frictional flat belt driven by tapered pulley. Commercially available rubber flat belt reinforced by polyamide film was prepared as the test belt where the thickness and length were 1.25 mm and 630 mm, respectively. Test belt was driven between two pulleys made of aluminum alloy, where diameter and inter-axial length were 50 mm and 150 mm, respectively. Some tapered pulleys were applied where tapered angles were 0 deg (for comparison), 2 deg, 4 deg and 6 deg. In order to alternatively investigate the transverse behavior, the transverse force applied to the belt was measured, when the skew was constrained at the string under driving state. The transverse force was measured by a load cell having free rollers contacting on the side surface of the belt when the displacement in the belt width direction was constrained. The conditions of observed bending stiffness in-plane of the belt were changed by preparing three types of belts (the width of the belt was 20, 30, and 40 mm) where their observed stiffnesses were changed. The contributions of the bending stiffness in-plane of belt and initial inter-axial force to the transverse were discussed in experiments. The inter-axial force was also changed by setting a distance (about 240 mm) between the two pulleys. Influence of observed bending stiffness in-plane of the belt and initial inter-axial force on the transverse force were investigated. The experimental results showed that the transverse force was increased with an increase of observed bending stiffness in-plane of the belt and initial inter-axial force. The transverse force acting on the belt running on the tapered pulley was classified into multiple components. Those were components of forces applied with the deflection of the inter-axial force according to the change of taper angle, the resultant force by the bending moment applied on the belt winding around the tapered pulley and the reaction force applied due to the shearing deformation. The calculation result of the transverse force was almost agreed with experimental data when those components were formulated. It was also shown that the most contribution was specified to be the shearing deformation, regardless of the test conditions. This study found that transverse behavior of frictional flat belt driven by tapered pulley was explained by the summation of those components of forces.

***Keywords*—** skew, frictional flat belt, transverse force, tapered pulley

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Modeling and Energy Analysis of Limestone Decomposition with Microwave Heating

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***Abstract*—**Energy transition is spurred by structural changes in energy demand, supply, and prices. Microwave technology was first proposed as a faster alternative for cooking food. It was found that food heated instantly when interacting with high-frequency electromagnetic waves. The dielectric properties account for a material's ability to absorb electromagnetic energy and to dissipate this energy in the form of heat. Many energy intense industries could benefit from electromagnetic heating, since many of the raw materials are dielectric at high temperatures. Limestone sedimentary rock is a dielectric material intensively used in the cement industry to produce unslaked lime.

A numerical 3D model was implemented in COMSOL Multiphysics to study the limestone continuous processing under microwave heating. The model solves the two-way coupling between Energy equation and Maxwell's equations as well as the coupling between heat transfer and chemical interfaces. Complementary, a controller was implemented to optimize the overall heating efficiency and control the numerical model stability. This was done by continuously matching the cavity impedance and predicting the required energy for the system, avoiding energy inefficiencies. This controller was developed in MATLAB and successfully fulfilled all these goals.

The limestone load influence on thermal decomposition and overall process efficiency was the main object of this study. The procedure considered the Verification and Validation of the chemical kinetics model separately from the coupled model. The chemical model was found to correctly describe the chosen kinetic equation, and the coupled model successfully solved the equations describing the numerical model.

The interaction between flow of material and electric field poynting vector revealed to influence limestone decomposition, as a result from the low dielectric properties of limestone. The numerical model considered this effect and took advantage from this interaction.

The model demonstrated to be highly unstable when solving non-linear temperature distributions. Limestone has a dielectric loss response that increases with temperature and has low thermal conductivity. For this reason limestone is prone to produce thermal runaway under electromagnetic heating, as well as numerical model instabilities.

Five different scenarios were tested by considering material fill ratio of 30%, 50%, 65%, 80% and 100%. Simulating the tube rotation for mixing enhancement was proven to be beneficial and crucial for all loads considered. When uniform temperature distribution is accomplished, the electromagnetic field and material interaction is facilitated. The results pointed out the inefficient development of the electric field within the bed for 30% fill ratio. The thermal efficiency showed the propensity to stabilize around 90% for loads higher than 50%. The process accomplished maximum microwave efficiency of 75% for the 80% fill ratio, sustaining that the tube has an optimal fill of material. Electric field peak detachment was observed for the case with 100% fill ratio, justifying the lower efficiencies compared to 80%. Microwave technology has been demonstrated to be an important ally for the decarbonization of the cement industry.

***Keywords*—**CFD Numerical Simulations, Efficiency Optimization, Electromagnetic Heating, Impedance Matching, Limestone Continuous Processing.

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Path-Spin to Spin-Spin Hybrid Quantum Entanglement: A Conversion Protocol

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Abstract

Path-spin hybrid entanglement generated and confined in a single spin-1/2 particle is converted to spin-spin hybrid interparticle entanglement which finds its important applications in quantum information processing. This protocol uses beam splitter, spin flipper, spin measurement, classical channel, unitary transformations etc. and requires no collective operation on the pair of particles whose spin variables share complete entanglement after the accomplishment of the protocol. The specialty of the protocol lies in the fact that the path-spin entanglement is transferred between spin degrees of freedom of two separate particles initially possessed by a single party.

PACS: 03.65.Ud – Entanglement and quantum nonlocality (e.g. EPR paradox, Bell's inequalities, GHZ states, etc.)

Introduction

Quantum entanglement is one of the unique characteristics of quantum mechanics and usually accomplished either by having two entangled particles emitted from a single source or by having two interacting particles. The concept of entanglement lies at the heart of EPR paradox, violations of Bell's inequalities and non-locality in quantum mechanics. Experimental exploration in manipulating entanglement is an important exercise which helps in the distribution of entanglement between distant parties. One such experimental scheme is entanglement swapping [1]-[3] which allows one to entangle two quantum systems that have never interacted directly with each other. Also spatially separated entangled pairs of particles find numerous applications in several other robust information processing protocols such as cryptography based on Bell's theorem [4]-[6], super-dense coding [7]-[9], teleportation [10]-[12], cheating bit commitment [13], [14], testing Bell's inequalities [15], [16] etc. Meanwhile, some researchers reported various propositions of experimental demonstration of entanglement swapping [2], [17], [18].

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Entanglement swapping may be applicable to the construction of telephone exchange [19]. The first and foremost implication of entanglement was noticed in terms of position-momentum variables [20] and subsequently extended to discrete spin variables [21], for the systems described in Hilbert spaces for discrete variables [22] etc. With the aid of shared entanglement and classical communication channel, quantum teleportation permits transfer of an unknown quantum state from one particle to a distant particle bypassing the need to transfer the particle itself. Also spatially separated multi-particle entangled states have many potential applications [23]-[25]. Quantum entanglement provides subtle physical insights into ultimate limit of phenomena such as phase transitions in solid state systems [26], [27], black hole physics [28]-[31] etc. Lately, hybrid entanglement in mutually exclusive Hilbert spaces such as between linear momentum and spin turns out to be an important subject of investigation for the researchers. Quantum mechanical theory confirms the existence of hybrid entangled states in Hilbert spaces. However, practical realization of such states is yet to be explored completely.

Fascinating progress in this direction has been achieved in recent times by the generation of intraparticle hybrid entanglement between different degrees of freedom of a single particle, such as the entanglement developed between the polarization and linear momentum of a photon, polarization and angular momentum of a photon etc. Since such type of entanglement is confined to a single particle, it can be conserved effortlessly against decay effects. But it seems cumbersome to exercise intraparticle hybrid entanglement as a tool of quantum information processing because entanglement is not shared between two spatially separated particles. It is, however, possible to transfer intraparticle entanglement into compatible inter-particle degrees of freedom of two spatially separated particles. Generation of an entanglement between path and spin degrees of freedom of a spin ½ particle was first proposed by a group [32], [33] and subsequently experimentally realized [34]. Also, the intraparticle hybrid entanglement has been effectively employed in the context of neutrino oscillations [35] as well as in order to demonstrate photon non-locality [36]. Information transfer using a single particle path-spin hybrid entanglement has also been proposed [37]. The authors of [32], [33] dealt with a theoretical model for teleporting an unknown quantum state between two distant parties, Alice and Bob, creating path-spin entangled state and using a series of operations like spin-measurements, unitary operations, classical communication channel etc. In our present paper we introduce a protocol and show the feasibility of converting the path-spin intraparticle entanglement state onto spin-spin interparticle entanglement state by a different technique.

Theory and Results

We consider a spin-$\frac{1}{2}$ particle (Z1) with initial spin polarization along + z axis (denoted by $\left|\uparrow_z\right\rangle$). The joint path-spin state for the particle is written as $\left|s\right\rangle_{ps}^{1}=\left|\psi_0\right\rangle_p\otimes\left|\uparrow_z\right\rangle_s$, where p and s refers to the path and spin variables, respectively. The spin state $\left|\uparrow_z\right\rangle$ of Z1 will be indicated by $\left|0\right\rangle_s^1$. The particle Z1 is allowed to fall on a beam-splitter BS1 by Alice which acts only on the path-state of Z1. The state of Z1 after ejecting from BS1 becomes $\left|s\right\rangle_{ps}^{1}=\left(i\alpha_1\left|0\right\rangle_p^1+\beta_1\left|1\right\rangle_p^1\right)\otimes\left|0\right\rangle_s^1$, where $\left|0\right\rangle_p^1$ and $\left|1\right\rangle_p^1$ are reflected and transmitted channels, respectively. The orthogonal path-states $\left|0\right\rangle_p^1$ and $\left|1\right\rangle_p^1$ are the eigenstates of the projection operators $P\left(\left|0\right\rangle_p\right)$ and $P\left(\left|1\right\rangle_p\right)$ which can be assumed to be related to the observables that determine the channel in which the Z1 is found. In this context, it is worth mentioning that the coexistence of path and spin variables enables the single particle to be considered effectively as two qubits. Next the particle corresponding to the channel $\left|0\right\rangle_p^1$ passes through a spin flipper that contains a uniform magnetic field along +x axis which flips the spin state $\left|0\right\rangle_s^1$ to $\left|1\right\rangle_s^1$. Now the path-spin entangled state of Z1 becomes $\left|s_2\right\rangle_{ps}^{1}=i\alpha_1\left|0\right\rangle_p^1\otimes\left|1\right\rangle_s^1+\beta_1\left|1\right\rangle_p^1\otimes\left|0\right\rangle_s^1$. Our target is to use this entangled state as a resource for spin-spin hybrid interparticle entanglement generation between the two particles (Z3 and Z4) initially occupied by another party Bob. Alice holds a particle (Z2) in an unknown state given as $\left|\psi_2\right\rangle=\alpha_2\left|0\right\rangle_s^2+\beta_2\left|1\right\rangle_s^2$. She performs a CNOT operation considering the Z1 particle's spin state as the control qubit and the Z2 particle's spin state as the target qubit. After this operation the combined state of Z1 and Z2 is given by:

$$\left|s\right\rangle_{pss}^{12}=i\alpha_1\alpha_2\left|0\right\rangle_p^1\left|11\right\rangle_s^{12}+i\alpha_1\beta_2\left|0\right\rangle_p^1\left|10\right\rangle_s^{12}+\beta_1\alpha_2\left|1\right\rangle_p^1\left|00\right\rangle_s^{12}+\beta_1\beta_2\left|1\right\rangle_p^1\left|01\right\rangle_s^{12}.$$

Alice then dispatches the particle Z1 to Bob. When Bob acknowledges that he has received the particle, Alice measures the spin of the particle Z2 by Stern-Gerlech (SG) device along the z-axis. Probable results of spin measurements on Alice's Z2 particle lead to the corresponding states with the respective probabilities as given in Table 1.

TABLE 1

Table for the outcome after suitable unitary operation on the final state of the Bob's particle

Alice's spin measurement	**State of particle1 after spin measurement**	**Probability of spin measurement**
$\left\|0\right\rangle_s^2$	$i\alpha_1\beta_2\left\|0\right\rangle_p^1\left\|1\right\rangle_s^1+\beta_1\alpha_2\left\|1\right\rangle_p^1\left\|0\right\rangle_s^1$	$\alpha_1^2\beta_2^2+\beta_1^2\alpha_2^2$

$\|1\rangle_s^2$	$i\alpha_1\alpha_2\|0\rangle_p^1\|1\rangle_s^1+\beta_1\beta_2\|1\rangle_p^1\|0\rangle_s^1$	$\alpha_1^2\alpha_2^2+\beta_1^2\beta_2^2$

Subsequently, Alice classically confers with Bob to report him the results of her spin measurements (i.e., spin up or spin down for Z2). Now the residual action is to be performed by Bob to generate spin-spin entanglement between two particles (Z3 and Z4) at his end initially. Observe that Bob has three particles in hand, Z1 (given by Alice), and other two particles Z3 and Z4 from initial stage. The particle Z3 is in an unknown state given by $|\psi_3\rangle=\alpha_3|0\rangle_s^3+\beta_3|1\rangle_s^3$ whereas Z4 is in known state (in spin up state $|0\rangle_s^4$). On the basis of the data that Alice sends to Bob, the following operations are performed by him to reach the goal.

Case 1: Result of spin measurement of the particle Z2: $|0\rangle_s^2$

After receiving the particle Z1 from Alice, Bob sends it through a 50-50 beam-splitter (BS2). The action of this beam splitter on the states $|0\rangle_p^1$ and $|1\rangle_p^1$ is given by:

$$|0\rangle_p^1\rightarrow\frac{1}{\sqrt{2}}\left(|a\rangle_p^1+i|b\rangle_p^1\right),\text{ and }|1\rangle_p^1\rightarrow\frac{1}{\sqrt{2}}\left(|b\rangle_p^1+i|a\rangle_p^1\right).$$

Next Bob makes a CNOT operation using the spin states of Z1 and Z3 as the control and target qubits, respectively. Now the joint path-spin state becomes:

$|S\rangle_{ps}^{13}=i\alpha_1\beta_2\alpha_3|0\rangle_p^1|11\rangle_s^{13}+i\alpha_1\beta_2\beta_3|0\rangle_p^1|10\rangle_s^{13}+\beta_1\alpha_2\alpha_3|1\rangle_p^1|00\rangle_s^{13}+\beta_1\alpha_2\beta_3|1\rangle_p^1|01\rangle_s^{13}$. Bob further makes another CNOT operation taking Z1's spin state as the control qubit and Z4's spin state as the target qubit. The resultant path-spin state is expressed as:

$$|S\rangle_{pss}^{134}=|0\rangle_p^1|1\rangle_s^1(i\alpha_1\beta_2\alpha_3|11\rangle_s^{34}+i\alpha_1\beta_2\beta_3|01\rangle_s^{34})+|1\rangle_p^1|0\rangle_s^1(\beta_1\alpha_2\beta_3|10\rangle_s^{34}+\beta_1\alpha_2\alpha_3|00\rangle_s^{34}).$$

Normalization leads to:

$$|S\rangle_{pss}^{134}=N\left[|0\rangle_p^1|1\rangle_s^1(i\alpha_1\beta_2\alpha_3|11\rangle_s^{34}+i\alpha_1\beta_2\beta_3|01\rangle_s^{34})+|1\rangle_p^1|0\rangle_s^1(\beta_1\alpha_2\beta_3|10\rangle_s^{34}+\beta_1\alpha_2\alpha_3|00\rangle_s^{34})\right],$$

where the normalization constant $N=\left[\left(\alpha_1^2\beta_2^2+\beta_1^2\alpha_2^2\right)\left(\alpha_3^2+\beta_3^2\right)\right]^{-1/2}$. Expressing $|0\rangle_s^1$ and $|1\rangle_s^1$ in the form of linear superpositions of $|0_x\rangle_s^1$ and $|1_x\rangle_s^1$ as $|0\rangle_s^1=\frac{1}{\sqrt{2}}\left(|0_x\rangle_s^1+|1_x\rangle_s^1\right)$ and $|1\rangle_s^1=\frac{1}{\sqrt{2}}\left(|0_x\rangle_s^1-|1_x\rangle_s^1\right)$, we obtain $|S\rangle_{pss}^{134}=T_1|a\rangle_p^1|0_x\rangle_s^1+T_2|a\rangle_p^1|1_x\rangle_s^1+T_3|b\rangle_p^1|0_x\rangle_s^1+T_4|b\rangle_p^1|1_x\rangle_s^1$.

where,

$$T_1 = \frac{iN}{2}\left(\alpha_1\beta_2\alpha_3\left|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left|00\right\rangle_s^{34} + \alpha_1\beta_2\beta_3\left|01\right\rangle_s^{34} + \beta_1\alpha_2\beta_3\left|10\right\rangle_s^{34}\right),$$

$$T_2 = \frac{iN}{2}\left(-\alpha_1\beta_2\alpha_3\left|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left|00\right\rangle_s^{34} - \alpha_1\beta_2\beta_3\left|01\right\rangle_s^{34} + \beta_1\alpha_2\beta_3\left|10\right\rangle_s^{34}\right),$$

$$T_3 = \frac{N}{2}\left(-\alpha_1\beta_2\alpha_3\left|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left|00\right\rangle_s^{34} - \alpha_1\beta_2\beta_3\left|01\right\rangle_s^{34} + \beta_1\alpha_2\beta_3\left|10\right\rangle_s^{34}\right),$$

$$T_4 = \frac{N}{2}\left(\alpha_1\beta_2\alpha_3\left|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left|00\right\rangle_s^{34} + \alpha_1\beta_2\beta_3\left|01\right\rangle_s^{34} + \beta_1\alpha_2\beta_3\left|10\right\rangle_s^{34}\right).$$

Bob measures the spin of the Z1 by two sets of SG apparatus placed in both the paths $\left|a\right\rangle_p^1$ and $\left|b\right\rangle_p^1$ along the x axis. There are four probable outcomes of his measurement, i.e., $\left|a\right\rangle_p^1 \otimes \left|0_x\right\rangle_s^1, \left|a\right\rangle_p^1 \otimes \left|1_x\right\rangle_s^1, \left|b\right\rangle_p^1 \otimes \left|0_x\right\rangle_s^1$ and $\left|b\right\rangle_p^1 \otimes \left|1_x\right\rangle_s^1$. Bob carries out a corresponding unitary operation to spawn entangled states between particles Z3 and Z4. The results of these operations are provided in Table 2.

TABLE 2

Table for the outcome after suitable unitary operation on the final state of the Bob's particle

Path-spin measurement	Unitary operation	Final state of the Bob's particle	Nature of the final state
$\left\|a\right\rangle_p^1 \otimes \left\|0_x\right\rangle_s^1$	σ_z	$iN(-\alpha_1\beta_2\alpha_3\left\|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left\|00\right\rangle_s^{34})$	Entangled
$\left\|a\right\rangle_p^1 \otimes \left\|1_x\right\rangle_s^1$	σ_z	$iN(\alpha_1\beta_2\alpha_3\left\|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left\|00\right\rangle_s^{34})$	Entangled
$\left\|b\right\rangle_p^1 \otimes \left\|0_x\right\rangle_s^1$	σ_z	$N(\alpha_1\beta_2\alpha_3\left\|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left\|00\right\rangle_s^{34})$	Entangled
$\left\|b\right\rangle_p^1 \otimes \left\|1_x\right\rangle_s^1$	σ_z	$N(-\alpha_1\beta_2\alpha_3\left\|11\right\rangle_s^{34} + \beta_1\alpha_2\alpha_3\left\|00\right\rangle_s^{34})$	Entangled

So far, we assume that particle Z3 is in an unknown state and particle Z4 is in the known state. If the particle Z3 also stays in a known state, two different possibilities arise: $\alpha_3 = 1, \beta_3 = 0$ and $\alpha_3 = 0, \beta_3 = 1$. In such cases, Bob creates entangled states by sorting compatible unitary transformations as presented in Table 3 and Table 4, respectively.

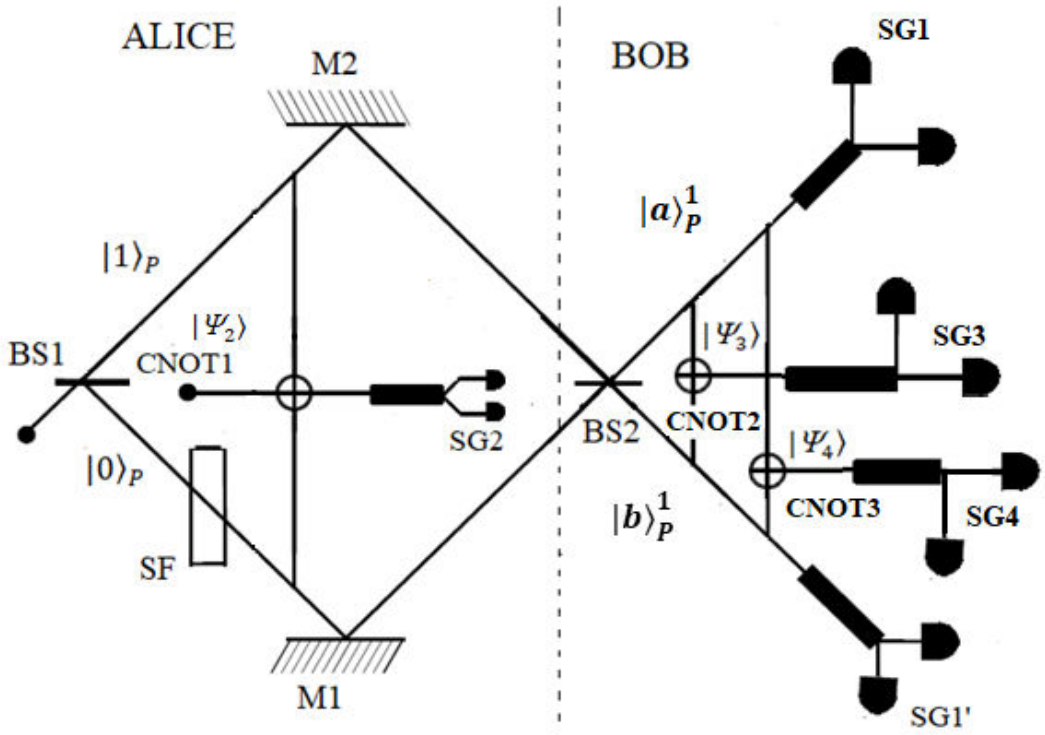

Fig. 1: A spin-1/2 particle (labeled as Z1) having an initial up-spin polarized state is allowed to fall on a beam-splitter BS1. A spin flipper is placed in the reflected channel. One CNOT operation is performed by Alice involving the particle Z1 and particle Z2 which is in an unknown state. Alice sends Z1 to Bob who lets this particle fall on another beam-splitter BS2. Bob measures the spin of the Z1 using two SG devices SG 1 and SG 1′. Alice then measures the spin of Z2 using SG 2 along the *z*-axis. According to the results of the spin measurements (that Alice classically informs Bob), Bob performs two successive CNOT operations using particles Z1, Z3; Z1, Z4, and measures path-spin states of the particle Z1. Finally, Bob performs appropriate unitary operation to create spin-spin entangled states between Z3 and Z4.

TABLE 3

Table for the outcome after suitable unitary operation on the final state of the Bob's particle

[The Z3 particle's initial spin state: $|0\rangle_s^3$]

Path-spin measurement	**Unitary operation**	**Final state of the Bob's particle**	**Nature of the final state**
$\|a\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{iN'}{2}(\alpha_1\beta_2\|11\rangle_s^{34} + \beta_1\alpha_2\|00\rangle_s^{34})$	Entangled
$\|a\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{iN'}{2}(-\alpha_1\beta_2\|11\rangle_s^{34} + \beta_1\alpha_2\|00\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{N'}{2}(-\alpha_1\beta_2\|11\rangle_s^{34} + \beta_1\alpha_2\|00\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{N'}{2}(\alpha_1\beta_2\|11\rangle_s^{34} + \beta_1\alpha_2\|00\rangle_s^{34})$	Entangled

In all cases the normalization constant becomes $N' = \left(\alpha_1^2\beta_2^2 + \beta_1^2\alpha_2^2\right)^{-1/2}$

TABLE 4

Table for the outcome after suitable unitary operation on the final state of the Bob's particle (The Z3 particle's initial spin state: $|1\rangle_s^3$)

Path-spin measurement	Unitary operation	Final state of the Bob's particle	Nature of the final state
$\|a\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{iN'}{2}(\alpha_1\beta_2\|01\rangle_s^{34} + \beta_1\alpha_2\|10\rangle_s^{34})$	Entangled
$\|a\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{iN'}{2}(-\alpha_1\beta_2\|01\rangle_s^{34} + \beta_1\alpha_2\|10\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{N'}{2}(-\alpha_1\beta_2\|01\rangle_s^{34} + \beta_1\alpha_2\|10\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{N'}{2}(\alpha_1\beta_2\|01\rangle_s^{34} + \beta_1\alpha_2\|10\rangle_s^{34})$	Entangled

Case 2: Spin measurement of the particle Z2: $|1\rangle_s^2$

Bob repeats the procedure as described for Case 1. He allows the particle Z1 to fall on a 50-50 beam splitter and performs two subsequent CNOT operations using particle Z1 and two particles (Z3 and Z4) initially possessed by him. Thereafter he measures the spin of particle Z1 using the SG device. Finally, Bob executes suitable unitary operations to generate entangled states between the spin states of the particles Z3 and Z4 (presented in Table 5).

TABLE 5

Table for the outcome after suitable unitary operation on the final state of the Bob's particle

Path-spin measurement	Unitary operation	Final state of the Bob's particle	Nature of the final state
$\|a\rangle_p^1 \otimes \|0_x\rangle_s^1$	σ_z	$iM(-\alpha_1\alpha_2\alpha_3\|11\rangle_s^{34} + \beta_1\beta_2\alpha_3\|00\rangle_s^{34})$	Entangled
$\|a\rangle_p^1 \otimes \|1_x\rangle_s^1$	σ_z	$iM(\alpha_1\alpha_2\alpha_3\|11\rangle_s^{34} + \beta_1\beta_2\alpha_3\|00\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|0_x\rangle_s^1$	σ_z	$M(\alpha_1\alpha_2\alpha_3\|11\rangle_s^{34} + \beta_1\beta_2\alpha_3\|00\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|1_x\rangle_s^1$	σ_z	$M(-\alpha_1\alpha_2\alpha_3\|11\rangle_s^{34} + \beta_1\beta_2\alpha_3\|00\rangle_s^{34})$	Entangled

where normalization constant $M = \left[\left(\alpha_1^2\alpha_2^2 + \beta_1^2\beta_2^2\right)\left(\alpha_3^2 + \beta_3^2\right)\right]^{-1/2}$. If the particle Z3 stays in a known state (either $|0\rangle_s^3$ or $|1\rangle_s^3$), Bob can create entangled states by choosing suitable unitary transformations as presented in Table 6 and Table 7, respectively.

TABLE 6

Table for the outcome after suitable unitary operation on the final state of the Bob's particle (The Z3 particle's initial spin state: $|0\rangle_s^3$)

Path-spin measurement	Unitary operation	Final state of the Bob's particle	Nature of the final state
$\|a\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{iM'}{2}(\alpha_1\alpha_2\|11\rangle_s^{34} + \beta_1\beta_2\|00\rangle_s^{34})$	Entangled
$\|a\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{iM'}{2}(-\alpha_1\alpha_2\|11\rangle_s^{34} + \beta_1\beta_2\|00\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{M'}{2}(-\alpha_1\alpha_2\|11\rangle_s^{34} + \beta_1\beta_2\|00\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{M'}{2}(\alpha_1\alpha_2\|11\rangle_s^{34} + \beta_1\beta_2\|00\rangle_s^{34})$	Entangled

Here the normalization constant becomes: $M' = \left(\alpha_1^2\alpha_2^2 + \beta_1^2\beta_2^2\right)^{-1/2}$.

TABLE 7

Table for the outcome after suitable unitary operation on the final state of the Bob's particle (The Z3 particle's initial spin state: $|1\rangle_s^3$)

Path-spin measurement	Unitary operation	Final state of the Bob's particle	Nature of the final state
$\|a\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{iM'}{2}(\alpha_1\alpha_2\|01\rangle_s^{34} + \beta_1\beta_2\|10\rangle_s^{34})$	Entangled
$\|a\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{iM'}{2}(-\alpha_1\alpha_2\|01\rangle_s^{34} + \beta_1\beta_2\|10\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|0_x\rangle_s^1$	I	$\frac{M'}{2}(-\alpha_1\alpha_2\|01\rangle_s^{34} + \beta_1\beta_2\|10\rangle_s^{34})$	Entangled
$\|b\rangle_p^1 \otimes \|1_x\rangle_s^1$	I	$\frac{M'}{2}(\alpha_1\alpha_2\|01\rangle_s^{34} + \beta_1\beta_2\|10\rangle_s^{34})$	Entangled

Conclusion

To conclude, we have devised a protocol that effectively converts the intraparticle path-spin entanglement into interparticle spin-spin entanglement using definite operations like spin measurement, classical communication channel, CNOT operations etc. In this connection, it is to be noted that our current protocol deviates from that presented in [38], notwithstanding the fact that the focus of two the works are close. So

far as the protocol is concerned, in [38] Alice makes a CNOT operation employing the second particle Z2 and afterwards sends it to a third-party Charlie without making spin measurement on it. But, in our present work, Alice measures the spin of Z2 and informs the outcome of her measurement to Bob through a classical channel. Another point is that, when we have done with the protocol, the path-spin entanglement is transferred between spin degrees of freedom of two separate particles initially possessed by a single party Bob. It is the main distinction from the previous work where the entanglement is swapped to the spin degrees of freedom of the two particles possessed by different parties. Although the pair of particles correlated by the spin-spin entanglement (when the protocol ends) are located at same place, unlike the case in [38], they can be regarded as non-interacting in the sense that the particle Z1 independently interacts with them (two consecutive CNOT operations) i.e., no combined operation is performed on the particles Z3 and Z4.

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Heating of Cold Ions by Emic Waves Using MMS Observations

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***Abstract*—** The EMIC waves whose frequency ranges from 0.001 Hz to 5 Hz in the Earth's magnetosphere and have received considerable attention for energy transport across the magnetosphere. Since these waves act as a mechanism for the loss of energetic electrons from the Van Allen radiation belts to the atmosphere, therefore, it is necessary to understand how and where they can be produced, as well as the direction of waves along the magnetic field lines. In this letter, the excitation of the EMIC waves is studied by taking into account the hot proton temperature anisotropy having energy ranging from 7 KeV to 26 KeV with a minimum resonant energy of 6.9KeV. However, the opposite effect can be observed for the hot protons for energy less than the minimum resonant energy. It is revealed that as long as the intensity of the EMIC waves increases, the number density and temperature anisotropy of the protons also increase within the energy range from 1eV to 100 eV.

***Keywords*—** EMIC waves, temperature anisotropy of hot protons, energization of the cold proton, magnetospheric multiscale (MMS) satellite observations.

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The Influence of the Regional Sectoral Structure On The Socio-Economic Development of the Arkhangelsk Region

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Abstract

The socio-economic development of regions and countries is an important research issue. Today, in the face of many negative events in the global and regional economies, it is especially important to identify those areas that can serve as sources of economic growth and the basis for the well-being of the population. This study aims to identify the most important sectors of the economy of the Arkhangelsk region that can contribute to the socio-economic development of the region as a whole. For research, the Arkhangelsk region was taken as one of the typical Russian regions that do not have significant reserves of hydrocarbons, nor there are located any large industrial complexes. In this regard, the question of possible origins of economic growth seems especially relevant. The basis of this study constitutes the distributed lag regression model (ADL model) developed by the authors, which is based on quarterly data on the socio-economic development of the Arkhangelsk region for the period 2004-2016. As a result, we obtained three equations reflecting the dynamics of three indicators of the socio-economic development of the region - the average wage, the regional GRP, and the birth rate. The influencing factors are the shares in GRP of such sectors as agriculture, mining, manufacturing, construction, wholesale and retail trade, hotels and restaurants, as well as the financial sector. The study showed that the greatest influence on the socio-economic development of the region is exerted by such industries as wholesale and retail trade, construction, and industrial sectors.
The study can be the basis for forecasting and modeling the socio-economic development of the Arkhangelsk region in the short and medium-term. It also can be helpful while analyzing the effectiveness of measures aimed at stimulating those or other industries of the region. The model can be used in developing a regional development strategy.

Key-words: socio-economic development, regional sectoral structure, Arkhangelsk region

Introduction

The presented research analyzes the socio-economic development of the Arkhangelsk region. The research topic is relevant since economic growth is a long-term development goal of any region. The topic of economic growth has gained particular importance keeping in mind many negative events in international economics during the last decade. In this regard, it is important to identify some possible factors contributing to the development of the region, the growth of the welfare of its inhabitants. Having determined the main growth points of the regional economy, it

is possible to form a long-term strategy for the socio-economic development of the region, which will take into account the current features of economic relations.

The work is concentrated around a dynamic econometric model that was developed by the authors to describe and analyze the economic development of the Arkhangelsk region. The model consists of three equations, it is a regression model with a distributed lag, where the factors of the socio-economic development of the region are the contributions of the main regional economic sectors to the GRP. As a result, one can assess the role of a particular industry to regional socio-economic development. The effect of stimulating measures of one or another regional branch can be estimated with the equations. So the socio-economic indicators for the region, and ultimately the quality of life of the population can be both analyzed and managed. The Arkhangelsk region was chosen as an object of analysis because it is a typical Russian region. Nevertheless, it has some peculiarities, but the region has no vast oil and gas reserves, nor financial centers or heavily industrialized areas. Accordingly, the question of possible growth-points for the regional economy is very relevant. The subject of research is the socio-economic development of the Arkhangelsk region.

Within the research, the authors analyzed the current dynamics of the socio-economic development of the region using the quarterly data for all the studied indicators for the period 2003-2016.

The purpose of the research is to analyze the role of regional segments of the sectoral structure in the socio-economic development of the Arkhangelsk region. To achieve this goal, the following tasks were accomplished:

- conducting a general overview of the socio-economic situation of the region;
- analysis of the contribution of various sectors to the GRP;
- elaboration of an ADL-model reflecting the impact of the regional sectors on socio-economic development;
- identification of the most significant segments of the region's economy for socio-economic development.

To solve the aforementioned problems, the authors used the applied Gretl software package for econometric modeling. The application of the software can be explained by the following points. Firstly, it is a free, fairly convenient, and versatile package for performing econometric calculations. Secondly, Gretl provides an opportunity to "feel" all the details and subtleties of the studied methods when they are implemented based on the corresponding vector-matrix relationships, which gives more opportunities for data analysis.

Analysis of research in this field. Analysis of modern research lets us conclude that many scholars touch upon the topic of regional economic growth and development in various aspects. Alongside with the conceptual works on economic growth and development, there is a lot of other works can be classified according to the growth factor taken into the analysis.

Among the conceptual research there could be mentioned such books as (Pike et al., 2006), (Gigliotti et al., 2018), (Raudino & Raudino, 2016) and (Acemoglu, 2008). These researchers disclose the development process as a multi-purpose one including many aspects as sustainability and environmental safety. Besides, the problem of sustainability and sustainable development is touched upon in the works (Nijkamp & Vreeker, 2000) (De Sousa Fragoso, 2015) (Gigliotti et al., 2018) (Shahraki, 2019).

Many researchers have focused on such factors as human capital (Gennaioli et al., 2011) and innovations (Cooke & Leydesdorff, 2006) (Lagendijk & Cornford, 2000) (Gennaioli et al., 2013) (Vermeulen, 2017) (Fleisher et al., 2010) (Gordon & McCann, 2005). These works analyze the relationship of regional development with investments in research and development, the number of researchers, intangible assets, patent payments, and know-how. The influence of small businesses on regional development is disclosed in many works. For instance, in (Freshwater et al., 2019) the role of small and medium-sized companies in the socio-economic development of the region is analyzed. Many studies are also based on the factor of entrepreneurship, small and

medium business (González-Pernía & Peña-Legazkue, 2015) (Dejardin & Fritsch, 2011) (Bashir et al., 2014) (Kasseeah, 2016) (Wennekers & Thurik, 1999) (Audretsch & Keilbach, 2004) (Audretsch & Keilbach, 2004) (Audretsch et al., 2013) (Audretsch & Keilbach, 2005) (Malecki, 1993) (Dahlstrand, 2007) (Baptista et al., 2008) (Noseleit, 2013) (Andreeva et al., 2016).

Some studies relate to the impact on global economic development processes (Coe et al., 2004) (Scott & Storper, 2007). Some scholars associate regional economic development with social capital (Iyer et al., 2005), and in some works, growth is linked with the problem of income inequality (Seligson & Kuznets, 2019). The work (Gallup et al., 1999) studies the location of a region as the main factor of economic development. Several studies touch upon the relationship between the environment and economic growth (Mäler, 2013) (Green & Studies, 2012). Some works are testing relatively new concepts and creating new trends in regional development. In particular, the work (Ross et al., 2016) explores the advantages and disadvantages of the formation of the so-called megaregions, agglomerations of large cities, and adjacent territories.

In (Crespo-Cuaresma et al., 2011) the regional development factors are analyzed with the quantile approach, where differences in the influence of individual growth factors are monitored based on regression analysis. The work (Caliendo et al., 2018) considers aggregate economic activity as a derivative of the activity of various sectors of the economy. This research is somewhat similar to the present study.

The economic and geographical position of the region. Arkhangelsk region has a favorable economic and geographical position. It is located in the north of the East European Plain, in geographic coordinates between 60.5 and 70 degrees North latitude. It is washed by the White, Barents and Kara Seas. Modern Arkhangelsk is not only the largest seaport in the North, since the Northern Sea Route passes through it, but also a complex transport hub connected with other regions of Russia by air, rail and road. The main type of transport is rail, although there are several airports located in the region. The region traditionally exports various products mainly related to its forest resources to the countries of near and far abroad.

The Arkhangelsk region is a region of the forest industry, the fishing industry, modern shipbuilding, and also Russian cosmonautics.

More than 24 thousand enterprises and organizations of all forms of ownership and management are registered in the region.

Regional economic development is based on the most traditional sectors like forestry, construction industry. Here also the developed infrastructure of commercial ports, including the Arkhangelsk Sea Port, the northern gateway to Russia, plays a significant role. The port provides a substantial part of freight traffic in this region.

The climate of the region is temperate continental, in the northwest - marine, in the northeast - subarctic, that is, there are cool summers and long cold winters. The territory of the region is a vast plain with a weak slope towards the White and Barents Seas.

Arkhangelsk region has significant forest resources. The area covered by forest is 22.3 million hectares. The total stock of wood is more than 2500 million m^3. Coniferous species (pine, spruce) 80% prevail in the composition of the forest fund, deciduous species (birch, aspen) are about 20%.

The area is rich in minerals. The efforts of geological prospectors in the Arkhangelsk region created a powerful raw material base for the development of oil and gas production and processing in the Nenets Autonomous District, which is a part of the region. The only diamondiferous province in Europe has been opened in the Arkhangelsk region. The minerals mined in the region are diamonds, lead, zinc, silver, coal, bauxite, gypsum.

The main component of socio-economic development in the research is the GRP. The indicator is taken in the model as the variable Y_2. The structure and dynamics of the GRP of the Arkhangelsk region. The region is developing successfully and with good dynamics. This can be evidenced by the steady growth of GRP (Figure 1) over the past 13 years, excluding crises that have occurred during this time. The figure shows the quarterly dynamics of GRP in a thousand rubles.

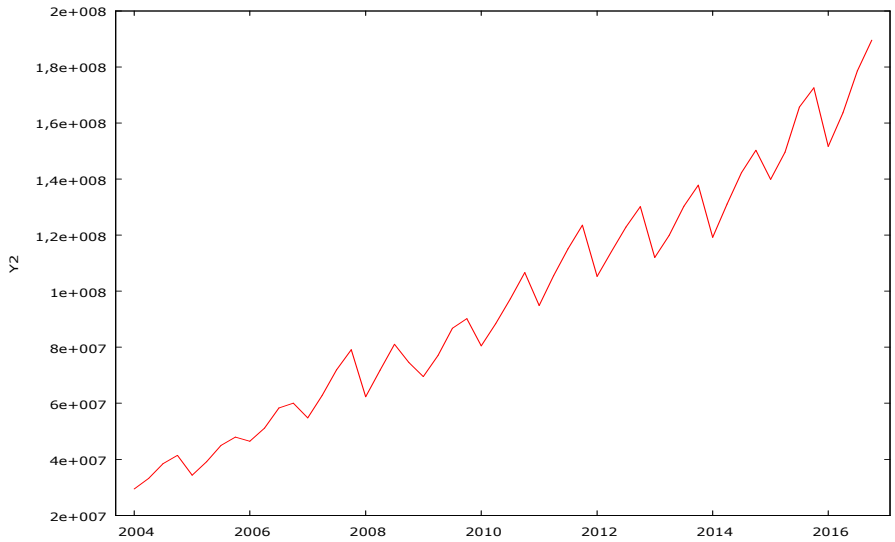

Figure 1. GRP of the Arkhangelsk region, thousand rubles (quarterly data)

The share of agriculture (Figure 2) from 2005 to 2016 decreased from 5.5% to 3%. Relatively low values of this indicator are primarily associated with the geographical location of the region. Despite some objective difficulties, the regional government sees potential in the development of the agricultural industry: from 2012 to 2016, the volume of state support for the agricultural sector amounted to almost 6 bln. rubles.

In particular, investment projects in dairy farming are being actively implemented in the region: over the past five years, 22 livestock facilities for 6,000 cattle places have been commissioned. This will increase the annual milk production by about 10%. Support is also provided to enterprises whose activities contribute to import substitution in the fields of vegetable growing and beef cattle breeding.

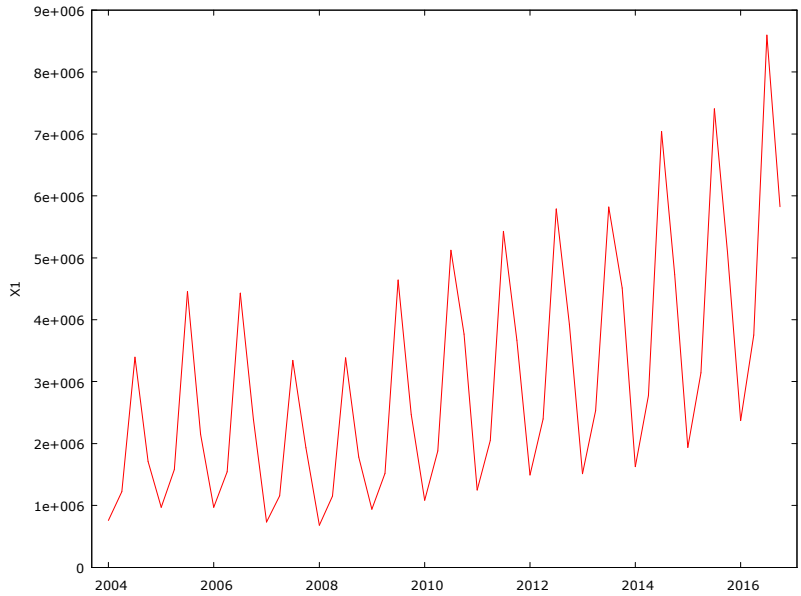

Figure 2 GRP created by agriculture, hunting and forestry
of the Arkhangelsk region, thousand rubles (quarterly data)

Mineral extraction (Figure 3) is the main source of GRP in the Arkhangelsk region and amounts up to 30% in 2016. Arkhangelsk region ranks second in the country in accounted reserves of diamonds, which make up about 20% of the total Russian. A work financed by both attracted and own funds of the extraction industry is being carried out to search and evaluate

deposits of diamonds, gold, and bauxites. The federal budget finances also the regional work of forecasting and prospecting for diamonds and evaluation work on fresh groundwater.

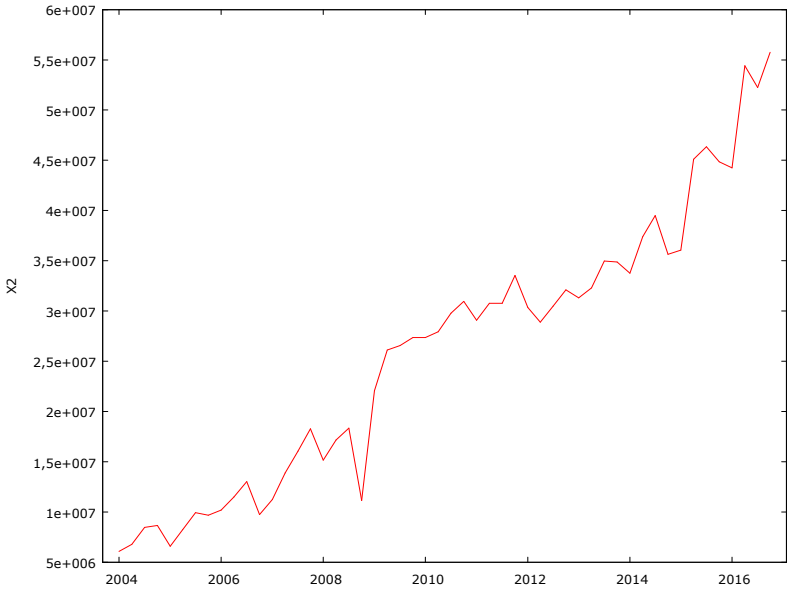

Figure 3. GRP created by the mining industry
in the Arkhangelsk region, thousand rubles (quarterly data)

One of the most developed industries of the Arkhangelsk region is forestry, woodworking, and pulp and paper industry. The machine-building industry is the second largest, next to the forestry. The share of manufacturing in the GRP structure during the period of 2005 to 2016 decreased by about 5% and amounted to 14%.

The Arkhangelsk region is one of the leading forestry centers in Russia. The largest chemical and mechanical wood processing facilities are located here. The region provides a third of the Russian pulp and cardboard volumes, up to 8% of lumber, and up to 11% of the paper. Due to its convenient geographical location, the timber industry of the region is engaged primarily in export activities. The lumber is exported to 80 countries. Among the importers are Germany, France, Poland, Italy, Belgium, Great Britain, the Netherlands, China, Azerbaijan, Egypt. Below is a graph of the manufacturing dynamics in the Arkhangelsk region (Figure 4).

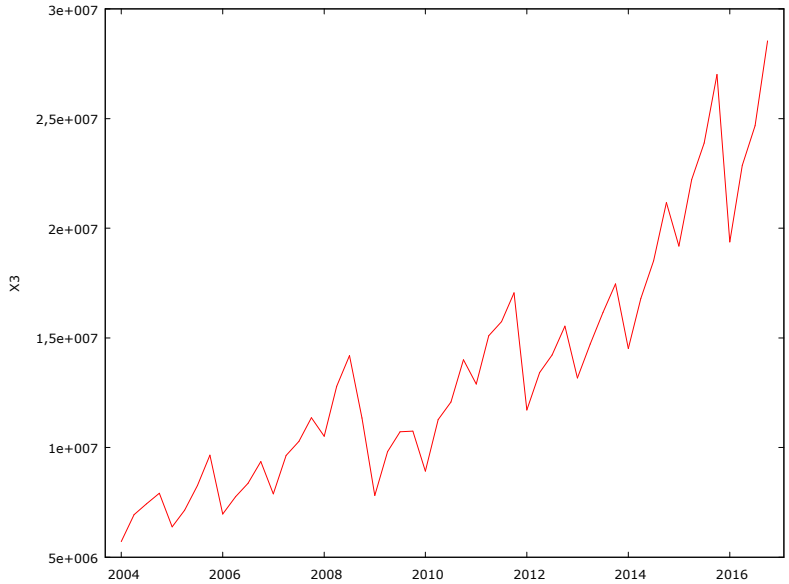

Figure 4. GRP created by manufacturing

of the Arkhangelsk region, thousand rubles (quarterly data)

The region is in the middle of the list of the regions in the North-West Federal District in terms of housing construction. The construction of 1,547 buildings and structures was launched in 2016. Some 1,360 buildings were for residential use. In money terms, the contribution of the sector to the GRP amounted to 41 bln. rubles, which is 9% higher as of 2015.

Over the analyzed period, the sector of construction created stable cash flows the regional budget, therefore, in relative terms, the share of the sector in the regional GRP remained constant and amounted to about 7%. Below there is a graph of regional construction sector dynamics for the period (Figure 5).

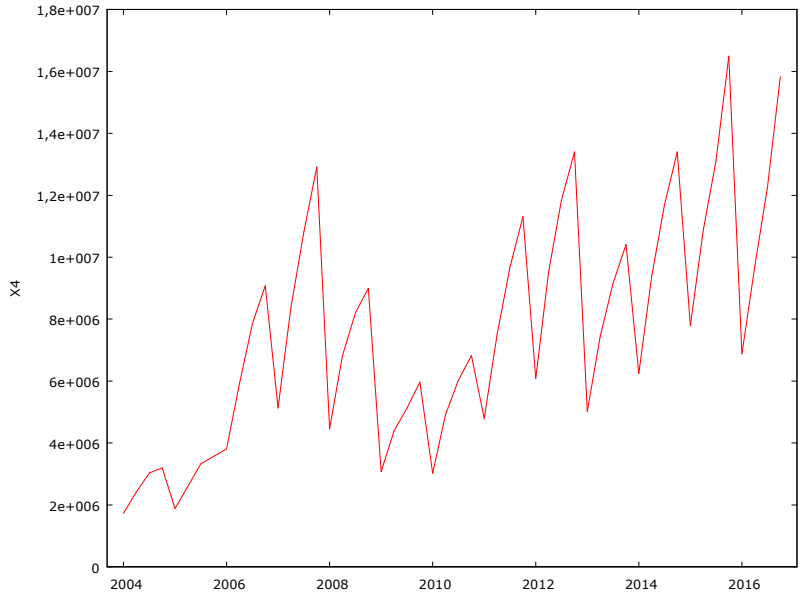

Figure 5. GRP created by the construction sector
in the Arkhangelsk region, thousand rubles (quarterly data)

The share of wholesale and retail trade (Figure 6) decreased from 11.4% from 2005 to 7.5% in 2016. The full title of the article in statistics data is “Wholesale and retail trade, repair of motor vehicles, motorcycles, and items of personal use”. The sector plays an important role in the regional economy, its share in the GRP is close to construction.

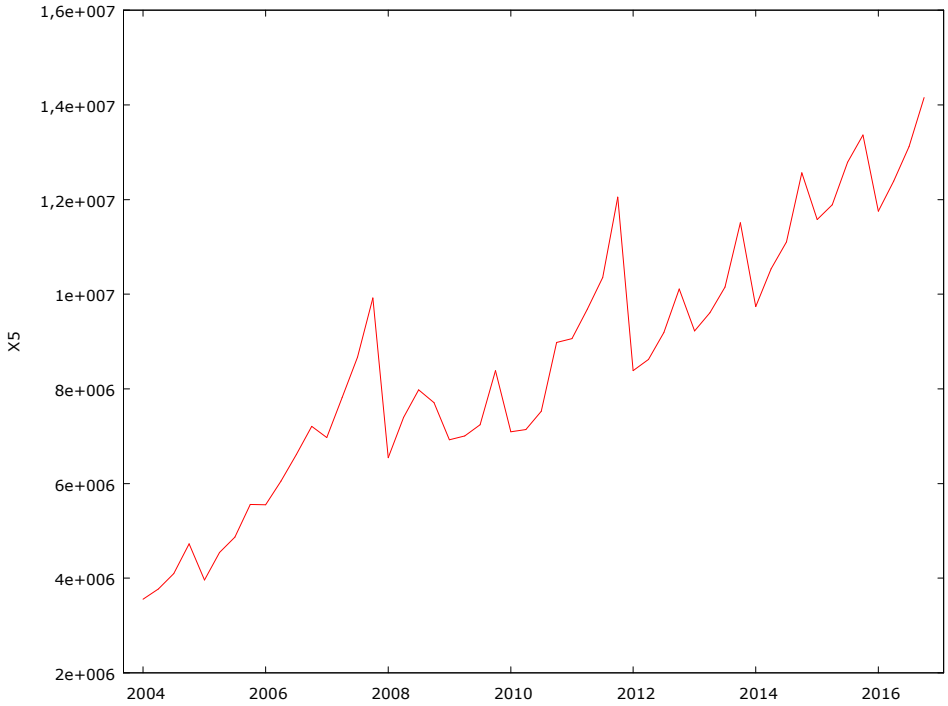

Figure 6. GRP generated by wholesale and retail trade
in the Arkhangelsk region, thousand rubles (quarterly data)

The region does not have a highly developed sector of tourism and entertainment. The same applies to the financial sector. The share of GRP created by these areas of activity is small, the total contribution of the both to GRP can be estimated at 2-2.5%.

The labor market and employment in the region. The labor market is considered in the research as a component of socio-economic development. The indicator of the labor market taken into the analysis is the average regional wage rate (Y_1). The situation on the labor market in the Arkhangelsk region in 2016 is stable. According to the statements of the regional officials, no massive reductions in enterprises and organizations in the region are expected.

The number of unemployed in the Arkhangelsk region is 10,147 people. The number of vacancies is 8,800. The officially registered unemployment rate is 1.7 percent.

According to monitoring data, the largest releases are planned at the Solombalsky Pulp and Paper Factory - about 100 people and due to the closure of production at the Oktyabrsky House-Building Factory - up to 170 people. However, at least partially the dismissed workers can be employed at the newly organized production of particle boards.

The regional labor market has an increased demand for construction professions (bricklayer, concrete worker, carpenter, finisher) and some drivers, sellers, skilled workers in shipbuilding are required as well.

Over half of 3.2 thousand vacancies for specialists and employees are in the sphere of healthcare: more than a thousand doctors and paramedics are required, and about 600 vacancies for nurses. Besides, the region needs about a thousand unskilled specialists - workers, cleaners, janitors.

The salary chart for the period from 2004 to 2016 is presented below (Figure 7).

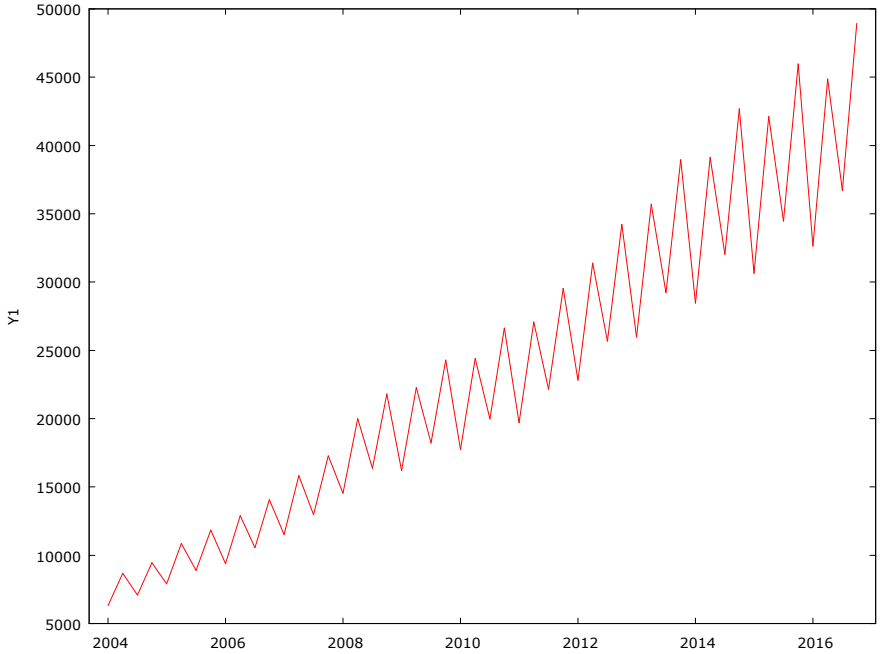

Figure 7. Graph of the average monthly wage
in the Arkhangelsk region, rub. (quarterly data)

Demographic situation. The demographic situation is also important as it is included in the research as one of the variables – Y_3 (the birthrate). The regional birth rate is still lower than the mortality rate. So, in 2016, the natural population decrease in the region amounted to a little more than 900 people. The main causes of deaths are diseases of the cardiovascular system, cancer, trauma, poisoning, and road accidents.

The birth rate graph is presented below (Figure 8).

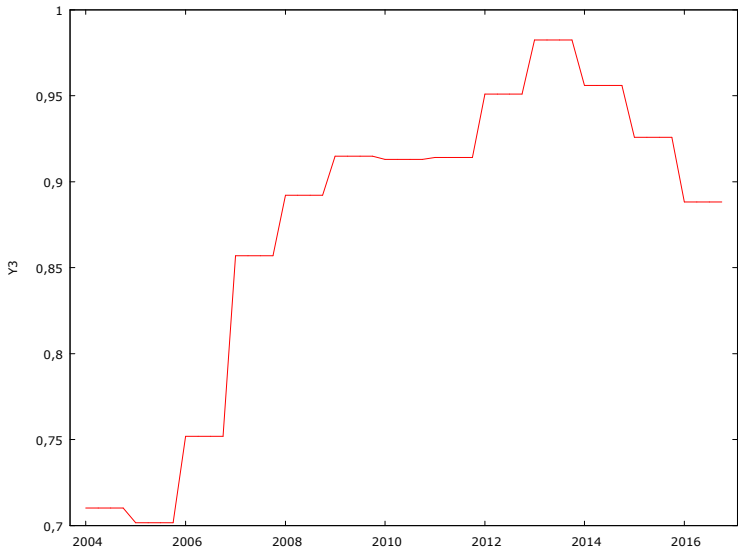

Figure 8. Graph of the birth rate
in the Arkhangelsk region, (quarterly data)

Thus, we have performed some preliminary analyses for the region and now we move on to the method used in the research.

2. Method

The main idea of the study is to analyze the dynamics of the socio-economic development of the region. The analysis has to reveal the role of the regional sectoral structure in the dynamics of the selected indicators of socio-economic development. Using a regression model, the indicators appear to be dependent on the activity of various sectors of the regional economy. If significant relationships are found, it can be argued that through the stimulation of certain sectors of the regional economy, it is possible to influence the dynamics of the indicators of regional development. The research used quarterly data on the main indicators of the socio-economic development of the region for the period 2004-2016. The study has endogenous and exogenous variables of the regression model.

The following indicators of socio-economic development are endogenous (resulting) variables:

Y1 - average monthly wage per employee, rubles.

Y2 - gross regional product at basic prices

Y3 - birth rate

For exogenous variables that determine socio-economic development, were taken the following:

X1 - the share of agriculture, hunting, and fishing in the GRP, rubles.

X2 - the share of the mining sector in the GRP, rubles.

X3 - the share of manufacturing in the GRP, rubles.

X4 - the share of construction in the GRP, rubles.

X5 - the share of wholesale and retail trade in the GRP, rubles.

X6 - the share of hotel and restaurant business in the GRP, rubles.

X7 - the share of the financial sector in the GRP, rubles.

The model, which estimates the regression dependence between variables, includes not only the factors themselves but also the same exogenous variables taken with a lag, as well as an element of autoregression. This model is often used in economic studies and is called the autoregressive model with a distributed lag or ADL-model. A similar approach is employed in the work (Shvetsov et al., 2019).

Creating an ADL-model involves several steps, the first of which is checking the stationarity of time series since the time series that make up the model must be stationary. This test was conducted in the study according to three well-known criteria - the extended Dickey-Fuller criterion (ADF test), the ADF-GLS criterion, and the KPSS criterion.

Let's check the data for stationarity using the tests. If the time series appears to be stationary at least in two tests out of thee, we are assuming the time series to be stationary. When running the ADF and ADF-GLS tests we construct an autoregression with some coefficient for the time series. If the coefficient in autoregression exceeds the absolute threshold value of 0.2, the hypothesis of stationarity of the series is accepted, so the time series is assumed as TS time series. Otherwise, the time series is nonstationary, so it is a DS time series. According to the KPSS test, the hypothesis of stationarity of the series is accepted with the p-value greater than 0.05. The considered time series for all the variables in our case appeared to be non-stationary, i.e. DS. The test results are shown in Table 1 below:

Table 1. The results of the tests for stationarity of the initial data time series

Variable	**Stationarity test**			**Result**
	ADF	ADF-GLS	KPSS	
X_1	0.055	0.078	<0.01	DS
X_2	0.014	0.047	<0.01	DS
X_3	0.023	0.004	<0.01	DS
X_4	-0.129	-0.097	<0.01	DS
X_5	-0.031	0.03	<0.01	DS
X_6	0.023	0.012	<0.01	DS

X_7	-0.044	-0.019	<0.01	DS
Y_1	0.003	-0.005	<0.01	DS
Y_2	0.014	0.017	<0.01	DS
Y_3	-0.15	-0.031	<0.01	DS

To modify the initial nonstationary time series, we carry out the standard differentiation procedure. The next step will be a new check for stationarity of the differentiated series according to the tests ADF, ADF-GLS, KPSS. The logic of the tests remains the same. The results are presented in Table 2 below:

Table 2. The results of the tests for stationarity of the modified (differentiated) time series

Variable	**Stationarity test**			**Result**
	ADF	ADF-GLS	KPSS	
d_X_1	-2.048	-2.048	>0.1	TS
d_X_2	-0.988	-1.12	>0.1	TS
d_X_3	-1.556	-0.43	>0.1	TS
d_X_4	-1.772	-0.675	>0.1	TS
d_X_5	-1.655	-1.636	>0.1	TS
d_X_6	-0.905	-0.701	0.086	TS
d_X_7	-0.894	-0.878	>0.1	TS
d_Y_1	-1.787	-0.016	0.093	TS
d_Y_2	-1.889	-0.642	0.090	TS
d_Y_3	-0.453	-0.438	0.047	TS

As we can see from the table 2, all the differentiated time series turned out to be stationary, and we will carry out further the procedure for construction of the model with the obtained differentiated variables, which we denote by d_X instead of the original time series X.

3. Results and discussion

Following the steps of creating the model, we are trying to find the variables and the lags of the variables that influence the resulting values significantly. Other variables with insufficient influencing power will be excluded from the equations. As a result of this sequence of steps, we obtain the final relationship between the independent and dependent variables that we have selected for the model.

Firstly, we construct autoregressions for every dependent variable. The autoregression includes the lagged variable up to the 10th period. The most significant lags of a 1%-5% significance level are selected. Secondly, the search for the lags of exogenous variables is carried out similarly. Multiple one-factor models are constructed. Insignificant coefficients for variables are removed from the regressions. As a result, a search for possible regressors of the equation with the most significant lags is performed for each endogenous variable. A general equation is formed with all potentially significant variables and lags for each endogenous variable.

After determining the significant lags for dependent variables (Y_1-Y_3), as well as significant lags for independent variables (X_1-X_7) and after removing all the non-significant variables from the equations, we obtain the three-equations model.

Table 3 below shows the coefficients of the first equation for the indicator of the average monthly wage in the region, the equations for d_Y1

Table 3. The first equation of the model for d_Y1

	Coefficient	*St.error*	*t-statistics*	*P-value*	
const	966.187	364.917	2.6477	0.01336	**
d_X1_3	0.00175115	0.000368654	4.7501	0.00006	***

d_X1_8	−0.00186226	0.000317045	-5.8738	<0.00001	***
d_X2_4	−0.000280662	7.95502e-05	-3.5281	0.00152	***
d_X2_8	−0.000132958	7.09858e-05	-1.8730	0.07193	*
d_X3_1	−0.000564844	0.000146153	-3.8647	0.00063	***
d_X3_5	−0.00042446	0.000188601	-2.2506	0.03276	**
d_X5	0.00341959	0.000468584	7.2977	<0.00001	***
d_X5_4	0.0027972	0.000404462	6.9158	<0.00001	***
d_X6_3	−0.0294762	0.00507719	-5.8056	<0.00001	***
d_X6_8	0.0226778	0.00352775	6.4284	<0.00001	***
d_X7	−0.0258883	0.00587882	-4.4037	0.00015	***
u(-3)	−0.280587	0.0561957	-4.9930	0.00001	***
u(-4)	0.557687	0.0533295	10.4574	<0.00001	***

Avg.of dep.variable	578.5845	St.dev.of dep.variable	2076.570
RSS	37944882	St.error of the model	1185.481
R-squared	0.987530	Adj. R-squared	0.982450
F(11, 27)	8.145176	P-value (F)	4.72e-06
rho	−0.254592	Durbin-Watson	2.335517

The significance level of the coefficients of the equation can be determined in table 3 by the rightmost column. Three stars correspond to a 1% significance level; two stars correspond to a 5% significance level; one star tells us of a 10% significance level of the coefficient. In the notation of variables, d denotes the differentiated time series of the initial variable, the first digit is the number of the variable, the second is the lag. So, if we have d_X2_4, then we understand it as the second exogenous variable X_2 on the forth lag.

Similarly, the other two equations of the model were obtained for the regional GRP and the birth rate. Table 4 below shows the second equation for d_Y2:

Table 4. The second equation of the model for d_Y2

	Coefficient	*St.error*	*t-statistics*	*P-value*	
const	1.32753e+06	222797	5.9585	<0.00001	***
d_X2	0.460387	0.0938229	4.9070	0.00002	***
d_X3	1.14526	0.232136	4.9336	0.00002	***
d_X3_8	0.572677	0.248967	2.3002	0.02751	**
d_X4	1.31321	0.187354	7.0093	<0.00001	***
d_X4_8	0.601476	0.155099	3.8780	0.00044	***
d_X5	1.45118	0.444448	3.2651	0.00245	***

Avg.of dep.variable	3297152	St.dev.of dep.variable	10451956
RSS	1.63e+14	St.error of the model	2155687
R-squared	0.966006	Adj. R-squared	0.960179
F(11, 27)	206.7416	P-value (F)	8.04e-26
rho	0.185084	Durbin-Watson	1.609672

Table 5 below shows the third equation for d_Y3:

Table 5. The third equation of the model for d_Y3

	Coefficient	*St.error*	*t-statistics*	*P-value*	
const	−0.0076671	0.00178743	-4.2895	0.00016	***
d_X6_8	8.20782e-08	1.17427e-08	6.9897	<0.00001	***
d_X7	−1.889e-07	1.48301e-08	-12.7370	<0.00001	***
d_X7_8	1.27967e-07	1.64643e-08	7.7724	<0.00001	***
u(-4)	0.345691	0.0707395	4.8868	0.00003	***
u(-8)	0.253519	0.0326531	7.7640	<0.00001	***

Avg.of dep.variable	−0.002267	St.dev.of dep.variable	0.012823

RSS	0.000499		St.error of the model	0.004012
R-squared	0.917463		Adj. R-squared	0.909475
F(11, 27)	105.4526		P-value (F)	2.36e-16
rho	0.131285		Durbin-Watson	1.607282

The model with differentiated time series will have the form presented in table 6.

Table 6. The ADL-model with differentiated time series

Variable	Equations of the model
d_Y_1	$d\_Y_1 = 0.0018d\_X_1^3 - 0.0019d\_X_1^8 - 0.00028d\_X_2^4 - 0.00013d\_X_2^8 - 0.00056d\_X_3^1 - 0.00042d\_X_3^5 + 0.0034d\_X_5^0 + 0.0028d\_X_5^4 - 0.0029d\_X_6^3 + 0.023d\_X_6^8 - 0.026d\_X_7^0 - 0.28d\_Y_1^3 + 0.56d\_Y_1^4 + 966.2$
d_Y_2	$d\_Y_2 = 0.46d\_X_2^0 + 1.15d\_X_3^0 + 0.57d\_X_3^8 + 1.31d\_X_4^0 + 0.6d\_X_4^8 + 1.45d\_X_5^0 + 1.33\times10^6$
d_Y_3	$d\_Y_3 = 8.21\times10^{-8}d\_X_6^8 - 1.89\times10^{-7}d\_X_7^0 + 1.28\times10^{-7}d\_X_7^8 + 0.35d\_Y_3^4 + 0.25d\_Y_3^8 - 0.0077$

Having transformed the model from differentiated time series to the initial values, we get the final model:

Table 7. The final equations of the ADL-model

Variable	Equations of the model
Y_1	$Y_1 = Y_1^1 - 0.28Y_1^3 + 0.84Y_1^4 - 0.56Y_1^5 + 0.0018X_1^3 - 0.0018X_1^4 - 0.0019X_1^8 + 0.0019X_1^9 - 0.00028X_2^4 + 0.00028X_2^5 - 0.00013X_2^8 + 0.00013X_2^9 - 0.00056X_3^1 + 0.00056X_3^2 - 0.00042X_3^5 + 0.00042X_3^6 + 0.0034X_5^0 - 0.0034X_5^1 + 0.0028X_5^4 - 0.0028X_5^5 - 0.0029X_6^3 + 0.0029X_6^4 + 0.023X_6^8 - 0.023X_6^9 - 0.026X_7^0 + 0.026X_7^1 + 966.2$
Y_2	$Y_2 = Y_2^1 + 0.46X_2^0 - 0.46X_2^1 + 1.15X_3^0 - 1.15X_3^1 + 0.57X_3^8 - 0.57X_3^9 + 1.31X_4^0 - 1.31X_4^1 + 0.6X_4^8 - 0.6X_4^9 + 1.45X_5^0 - 1.45X_5^1 + 1.33\times10^6$
Y_3	$Y_3 = Y_3^1 + 8.21\times10^{-8}X_6^8 - 8.21\times10^{-8}X_6^9 - 1.89\times10^{-7}X_7^0 + 1.89\times10^{-7}X_7^1 + 1.28\times10^{-7}X_7^8 - 1.28\times10^{-7}X_7^9 + 0.35Y_3^4 - 0.35Y_3^5 + 0.25Y_3^8 - 0.25Y_3^9 - 0.0077$

As can be seen in all the equations of the model, all coefficients of the variables are significant, and the value of the coefficient of determination varies from 0.91 to 0.98, which indicates the high accuracy of the model. All equations of the model are significant by the F-criterion. Moreover, the second and third equations have very high values of the F-criterion.

The coefficients for the model variables are also significant, mainly at the 1% level. Some coefficients are still left in the equations, although their significance is somewhat lower. This was done to improve the accuracy of the model.

According to the constructed model, we can conclude that the average regional wage in the current period is most closely related to the wage for the previous quarters (3 and 4 quarters ago) and with the sector of wholesale and retail trade. It is the sphere of wholesale and retail trade that has the most significant positive effect on the average wage in the region. If we take the activity in the sector of trade as a constant value, then the current increase in the contribution of the sector to the GRP by 10 thousand rubles will increase the average regional wage by 34 rubles.

The second equation for the GRP shows the dependence of the indicator on the mining and manufacturing sectors, construction, wholesale and retail trade. If we take these factors as conditionally constant for the previous periods, then the current increase of the manufacturing sector by 1 ruble will bring about an increase of the GRP by 1.15 rubles, the increase in the construction sector by 1 ruble will give a GRP increase of 1.31 rubles, and, finally, an increase in the retail sector by 1 ruble will mean an increase of the GRP by 1.45 rubles. And again one should mention the revealed special stimulating role of the trading sector for the GRP dynamics.

The birth rate is largely determined by the birth rate for the previous quarters (4 and 8 lags ago). The GRP created by restaurants and hotels for the previous 8th quarter has some positive impact, and the development of the financial sector is constraining the regional birth rate.

Conclusion

Within the research, the authors worked out a model consisting of three equations describing the dynamics of the socio-economic development of the Arkhangelsk region in various aspects. The first equation speaks of the average wage in the region, the second - the dynamics of the GRP, and the third equation is the dynamics of the birth rate in the region. The factors influencing the socio-economic development of the region are the shares of GRP created by various sectors of the regional economy in monetary terms.

The first equation allows us to conclude that almost all sectors influence the size of the average regional monthly wage. Here we can talk about the positive impact of the agricultural sector (X_1), wholesale and retail sector (X_5) and the negative impact of the mining sector (X_2), manufacturing industry (X_3), as well as the tourism (X_6) and financial (X_7) sectors. The wholesale and retail sector has a significant positive effect. The negative influence of the extractive and manufacturing sectors can be explained mainly by their extensive development, which implies the development of the industry goes along with the attraction of low-skilled labor. Hence, this will reduce the average wage in the region. The construction sector (X_4) does not have a significant impact on the level of average regional wages.

The second equation models the influence of the selected sectors of the regional economy on the dynamics of GRP. The equation shows a significant positive contribution of mining and manufacturing sectors as well as of the sectors of construction and trade to the economic development of the region. Due to the relative weakness of agriculture, tourism, and the financial sector in the region, the influence of these sectors on the GRP has not been identified. It is worth noting a significant positive role of wholesale and retail trade (X_5) and construction (X_4) sector in the GRP dynamics.

The third equation analyzes the dynamics of the birth rate in the region. The indicator is largely determined by the previous values on lags 4 and 8. The equation also shows a weak positive impact of the regional tourism sector and the negative impact of the financial sector.

The authors can delineate also some guidelines for further research in the field, such as the analysis of development not only of some separate regions but on the country level. Moreover, some comparative studies using cluster analysis and grouping regions and countries according to their development properties. The latter could probably give some guidelines for interregional cooperation and trade.

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Investigation into the Feasibility of Introducing Hyperloop to the UK

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***Abstract*—** This study analyses route planning, socioeconomic effect, cost estimates, and comparison with other transportation for Hyperloop. The purpose of the paper is not to make an argument for the replacement of existing modes of transport with Hyperloop, as we recognise that the introduction of a new mode of transportation is a complex issue. Instead, we discuss the strategies, implications and feasibility of the integration of this new mode of transportation into the UK's current transport system.

***Keywords*—** Hyperloop,Sustainability,Innovation,Student Research.

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Acetic Acid Adsorption and Decomposition on Pt(111): Comparisons to Ni(111)

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***Abstract*—**The interaction of organic molecules with metal surfaces is of interest in numerous technological applications, such as catalysis, bone replacement, and biosensors. Acetic acid is one of the main productsof bio-oils produced from the pyrolysis of hemicellulosic feedstocks. However, their high oxygen content makes them unsuitable for use as fuels. Hydrodeoxygenation is a proven technique for catalytic deoxygenation of bio-oils.

An understanding of the energetics and control of the bond-breaking sequences of biomass-derived oxygenates on metal surfaces will enable a guided optimization of existingcatalysts and development of more active/selective processes for biomass transformations to fuels. Such investigations have been carried out with the aid of ultrahigh vacuum and its concomitant techniques.

The high catalytic activity of platinum in biomass-derived oxygenate transformations has sparked a lot of interest. We herein exploit infrared reflection absorption spectroscopy(IRAS), temperature-programmed desorption(TPD) and density functional theory(DFT) to study the adsorption and decomposition of acetic acid on a Pt(111) surface, which was then compared with Ni(111), a model non-noble metal. We found that acetic acid adsorbs molecularly on the Pt(111) surface, interacting through the lone pair of electrons of one oxygen atomat 90 K. At 140 K, the molecular form is still predominant, with some dissociative adsorption (in the form of acetate and hydrogen). Annealing to 193 K led to complete dehydrogenation of molecular acetic acid species leaving adsorbed acetate. At 440 K, decomposition of the acetate species occurs via decarbonylation and decarboxylation as evidenced by desorption peaks for H_2,CO, CO_2 and CH_X fragments (x=1, 2) in theTPD.The assignments for the experimental IR peaks were made using visualization of the DFT-calculated vibrational modes.The results showed that acetate adsorbs in a bridged bidentate ($\mu_2\eta^2$(O,O)) configuration. The coexistence of linear and bridge bonded CO was also predicted by the DFT results. Similar molecular acid adsorption energy was predicted in the case of Ni(111) whereas a significant difference was found for acetate adsorption.

***Keywords*—** acetic acid, platinum, nickel, infared-absorption spectrocopy, temperature programmed desorption, density functional theory

Long-Baseline Single-epoch RTK Positioning Method Based on BDS-3 and Galileo Penta-Frequency Ionosphere-Reduced Combinations

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***Abstract*—** In order to take full advantages of the BDS-3 penta-frequency signals in the long-baseline RTK positioning, a long-baseline RTK positioning method based on the BDS-3 penta-frequency ionospheric-reduced (IR) combinations is proposed. First, the low noise and weak ionospheric delay characteristics of the multi-frequency combined observations of BDS-3is analyzed. Second, the multi-frequency extra-wide-lane (EWL)/ wide-lane (WL) combinations with long-wavelengths are constructed. Third, the fixed IR EWL combinations are used to constrain the IR WL, then constrain narrow-lane (NL)ambiguityies and start multi-epoch filtering. There is no need to consider the influence of ionospheric parameters in the third step. Compared with the estimated ionospheric model, the proposed method reduces the number of parameters by half, so it is suitable for the use of multi-frequency and multi-system real-time RTK. The results using real data show that the stepwise fixed model of the IR EWL/WL/NL combinations can realize long-baseline instantaneous cimeter-level positioning.

***Keywords*—** penta-frequency, ionospheric-reduced (IR), RTK positioning, long-baseline.

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Cybercrime Stage Based Intervention: Through the Eyes of A Cyber Threat Actor

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***Abstract*—**Cybercrimes are on the rise, in part due to technological advancements, as well as increased avenues of exploitation. Sophisticated threat actors are leveraging on such advancements to execute their malicious intentions. The increase in cybercrimes is prevalent, and it seems unlikely that they can be easily eradicated. A more serious concern is that the community may come to accept the notion that this will become the trend. As such, the key question revolves around how we can reduce cybercrime in this evolving landscape. In our paper, we propose to build a systematic framework, through the lens of a cyber threat actor. We explore the motivation factors behind the crimes and the crime stages of the threat actors. We then formulate intervention plans, so as to discourage the act of committing malicious cyber activities, and also aim to integrate ex-cyber offenders back into the society.

***Keywords*—**crime motivations, crime prevention, cybercrime, ex-cyber criminals

I. Introduction

Cybercrime is no stranger to the law enforcement personnel, cyber defenders, or the public community. The recent COVID-19 pandemic has pushed for the transformation in the modes of communication, accelerated the culture of remote working and increased utilization of online collaboration platforms [1] – [2]. These activities have resulted in the heavy reliance on digital and network communications, opening up new vulnerability channels. While the general population may still be navigating the changes and disruptions to their lifestyles, threat actors are constantly monitoring and thinking of exploitation avenues. Therefore, it is unsurprising to see a rise in cyber-attacks during this period [3] – [5].

The trend of rising number of cyber-attacks is not showing signs of slowing down, and it does not seem likely that we are able to eradicate cybercrimes either. In a 2020 Check Point Security Report [6], it was mentioned that the cyber landscape will continue to face challenges in Supply Chain, Cloud Environments, and Internet-of-Things devices. Ransomware and phishing attacks remain rampant, especially in the wake of the COVID-19 pandemic. Furthermore, the transnational nature of cyber-attacks makes it even harder to prevent and contain them. The impacts are borderless and widespread, often with devastating effects to the victims.

In dealing with cyber protection, many people understand the asymmetric nature between the role of a defender and that of an attacker. The defender has to consider and protect all vulnerable points of entry that can be exploited, while the attacker is able to focus on one or a few entry points to carry out an attack successfully [7]. As such, cyber defenders are inclined to develop technologies and solutions to provide the comprehensive protection to mitigate as many attacks as possible. This strategy of buffing the system defenses is indeed crucial to prevent breaches and damages, and may prevent the attacks from happening. However, it does not address the key question: Why are cybercrimes committed in the first place?

Our paper seeks to approach the crime prevention statement from another angle; to understand the life stages and features of a threat actor, the corresponding motivation factors that may be influencing their choices, and propose intervention plans that may be relevant to them. Kevin Mitnick, arguably the world's most infamous hacker, laments in his book *The Art of Deception* [8] that the human factor is security's weakest link. While the comment is mainly targeted at people who may be ignorant to security practices, it can also apply to threat actors, who may have extremist beliefs or have fallen into temptation to commit malicious activities despite knowing that they should not be doing so. With some proposed intervention plans, the hope is to discourage a life away from malicious activities, and integrate ex-cyber criminals back into society where they can contribute positively to the community.

The remainder of this paper is organized as follows. We explore a list of motivation factors that may be considered by threat actors in Section II. The crime periods, features, and interventions are discussed in Section III. We will conclude the paper with a reflection and outlook in Section IV, with thoughts on further research directions.

II. Motivation Factors

Motivation factors form an important aspect when we deal with cybercrimes. Threat actors often carry out their activities with certain intentions and personal goals. In the case of Kevin Mitnick, it was his quest for personal knowledge and intellectual challenge [9]-[10]. For the hackers belonging to Lazarus Group, it is believed that they were primarily motivated by financial gain, due to their assaults on numerous financial institutions such as banks from various countries [11]. No matter what the nature of the crime is, we can try to attribute a motivation factor, or at times, multiple factors to a cybercrime.

Numerous researches have been conducted to understand and classify cybercrime motivation factors. In [12], the authors identified six types of motivation factors; addiction to computer networks, curiosity in the networks, thrill of illicit findings, attaining power over computer systems, peer recognition from other hackers, and finding security vulnerabilities. Smith [13] categorized the motivations into four broad categories, namely economic, political, ideological and behavioral / emotional. In [14], Ablon mooted that threat actors are spurred by different

motivations. Cybercriminals are generally motivated by monetary rewards, while cyberterrorists may be more motivated by ideologies. Li [15] explored and provided an extensive list of motivations in an effort to distinguish them as much as possible. However, though some of them are distinctive among one another, there are some that are still quite similar. Nonetheless, the author tried to highlight the differences to his best effort. This motivations list forms part of the basis in our proposed paper.

Through the review of these researches, we classify the motivation factors in a generic manner, under the umbrella of root motivational categories. For example, economic and monetary rewards may be grouped under financial gains. Hacking for entertainment and thrill of illicit findings may be grouped under thrill factors. Undermining a government website may be grouped under terroristic factors, and cyber robin hoods may be grouped under idealistic factors.

This further classification helps to provide an overview of the root motivation factors of concern that can be relevant in each crime stage. For the crime stages, it is also possible that there are multiple root motivations that are associated with each stage. Additionally, some root motivations may play a bigger part in influencing the crimes committed.

Building upon the motivations mentioned in [15], we further categorize them by linking each motivation to a root category, or multiple categories in some cases. The following seven categories are adopted and used as root motivations to classify the list; they are for *Financial Factor*, for *Reputational Factor*, for *Idealistic Factor*, for *Terroristic Factor*, for *Retaliation Factor*, for *Thrill Factor*, and for *Intellectual Factor*.

Financial Factor: Goldman and McCoy [16] described that financial motivated attacks account for a considerable proportion of cyber-attacks. The main incentive for these attacks is to monetize cyber activities such as exploiting stolen credit card details, or selling personal identifiable information. It can also mean stealing intellectual property such as technologies and trade secrets of organizations, or gaining unauthorized access to services without having to pay for them.

Reputational Factor: Some threat actors view illegal cyber activities as a pathway to increase their online reputation. Through these activities, they gain a sense of popularity and recognition from their peers as a validation of their capabilities [17]. Additionally, they may adore and strive to emulate threat actors with a higher degree of reputation.

Idealistic Factor: This category of motivations arises from situations that do not conform to the personal beliefs and expectations of the threat actors. Government websites may be defaced due to the unhappiness of the public [18], and school systems may be hacked by their own students to change the examination grades [19]. Even though the self-justification to themselves is for a greater good or self-righteousness, the acts are conducted through unlawful means.

Terroristic Factor: In 2016, Ardit Ferizi was charged with cyberterrorism by the US Department of Justice [20]. He was caught hacking and obtaining sensitive information on US military and federal personnel, and subsequently shared the information with the ISIS. In [21], some threat actors were found to send death and sexual threats to their victims, in a bid to intimidate them to abide to their instructions. Such motivations can lead to devastating consequences to individuals and/or to the whole nation.

Retaliation Factor: For motivations belonging to this category, the victims initiate the cybercrimes themselves against the harm they received from cyber attacks and/or other forms of mistreat. In [15], the author cited a few examples where the victims reacted with unlawful actions against their perpetuators. In [22], J. A. Lewis described that there were numerous voices in the US government to allow organizations to retaliate against cyber attacks, and added on to remark that it was not a good idea.

Thrill Factor: For some incidents, the purposes of them cannot be determined, even after going through the investigations. Some threat actors target their victims for no specific reason, and often just for the thrill of it [23]. This may occur when the threat actors wish to experience the satisfaction and adrenaline of hacking into the systems successfully, or simply because they find it enjoyable or the act to be humorous. Although the incidents may not directly cause any immediate financial loss as the threat actors are not motivated by such, it will nonetheless, adversely affect the image and branding of the victims. Eventually, this lowers the confidence from investors and customers alike, leading to reduced businesses.

Intellectual Factor: Hacking for intellectual reasons is common both in ethical and non-ethical hacking communities. Ethical hackers invade systems to discover vulnerabilities, or to test novel techniques and improve their penetration testing skills. All these are done in a controlled fashion, and usually initiated by the legitimate parties hiring them. For non-ethical hackers, targeting companies with shored up cyber defenses is one of the best ways to assess, gauge and prove their capabilities. The main motivation is their quest to improve their skills and intellectual capabilities, with little regards for moral values.

Table I highlights our categorization of the motivations, based on how each of them is associated to the root motivation(s). This presents a clear overview to where each motivation belongs. Additionally, in the list of motivations as described in [15], the author raised the possibility that some motivations can be uncertain, or affected by mental challenges. For such cases, it may be difficult to associate a root motivation with them, as the justification to commit the act may not be straightforward. For this reason, we have excluded them from our table. These excluded motivations are labeled as *Unclear motive* (e.g. perpetuator accessed and printed unauthorized information about an acquaintance, and subsequently handed a copy of the information to the victim himself) and *Influence by psychological depression* (e.g. perpetuator was diagnosed to have committed the act under the state of clinical depression and unsound mind).

Looking at the categorization, we can see that there is a wide range of root motivation factors that can affect the decision making of the threat actors to achieve their causes, or to satisfy their own desires. As such, we will survey the environmental and individualistic features that can potentially guide the threat actors to rightful or wrongful directions.

Motivation	**Category**						
	Financial Factor	*Reputational Factor*	*Idealistic Factor*	*Terroristic Factor*	*Retaliation Factor*	*Thrill Factor*	*Intellectual Factor*
Pursue free flow of information			✓				
Realize free expression of ego		✓					
Take technical challenge						✓	✓
Curiosity to seek new knowledge							✓
Test system security and resilience							✓
Take an adventure in cyberspace						✓	
Practise and show off programming and technical skills							✓
Tentative attacks against potentially vulnerable devices							✓
Hacking out of hatred				✓			
Hacking to acquire financial gains or avoid payment	✓						
Hacking into more advanced systems to leverage on their capabilities							✓
Hacking to change academic results			✓	✓			
Harassment and/or murder			✓	✓			
Mobilize political movement			✓	✓			
Launch cyber warfare				✓			
Unleash anti-computerization actions				✓			
Cyber robin hoods			✓				
Create unfair competition	✓						
Execute trap marketing	✓						
Self-defence					✓		
Hacking for recreation						✓	✓
Employment-related motivations	✓	✓					
Defend the unethical hackers community against legal measures targeted upon them					✓		
Destroy evidence present in information systems					✓		
Sexually motivated misuse				✓			
Deviance					✓		

TABLE I: Motivations listed and categorized according to root motivational factor(s)

III. Cybercrime Timeline Stages

Many proposed models seek to associate motivation factors with cybercrimes to understand the purposes behind. Law enforcement personnel or cyber defenders can leverage on these models to learn about the threat actors, their motives, and their operating habits to better identify them. Other than building the criminals' profiles, the models can also aid the development of cyber defenses based on how the threat actors may attack their targets. Organizations are able to develop defense strategies based on the potential motivational factors, and prevent the attacks from being executed successfully. It may not be easy or possible to develop a one-size-fits-all approach, but the impacts can still be mitigated. In the following sub-sections, we will look at the existing models and tools that are available, and on our proposed methodology to address challenges of cybercrime.

A. Existing models and tools to address challenges of cybercrime

Modarres [24] propose a model based on three root factors that can influence a cyber-attack. By integrating the three root nodes, the authors form an influence model to determine the nature of the attack. They further break down the nodes to finer granularity, establishing sub-nodes that may affect the reasoning to the root motivations. The model also allows different types of links between nodes and sub-nodes to highlight various influences such as amplifying effect, negative connotation, and the direction of influence that the nodes have on one another. The model is shown in Fig. 1.

Motivation: Describes the inclination of a threat actor based on the perceived benefits.

Opportunity: Describes the circumstances and conditions that are advantageous to a threat actor.

Deterrence: Describes the elements that will discourage a threat actor from committing a malicious act.

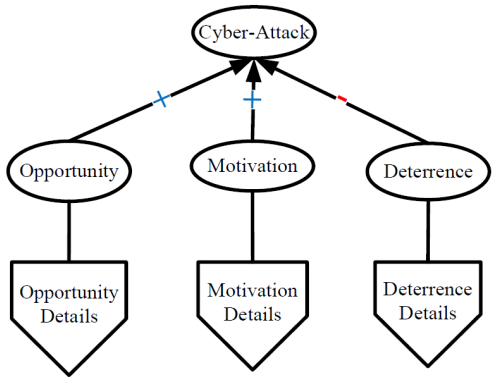

Fig. 1: The Influence Model encompassing root nodes for a cyber-attack [24]

In Ngafeeson's proposed model [25], two key motivational theories are discussed to create a motivational framework for cybercrime classification. These two theories are The Maslow Theory of Hierarchical Needs and The Herzberg Motivation-Hygiene Theory, which focus on the needs and supporting elements to sustain a human physically and psychologically. They form the motivation component as part of the overall framework to explain how potential threat actors can be driven by different needs, employ the use of technologies, and bypass security barriers to reach their security targets. The model aims to provide a holistic and comprehensive perspective to crime classification, combining the elements of humans such as victims / perpetuators, and the elements of tools and systems, such as technologies involved and security barriers. The model framework is depicted in Fig. 2.

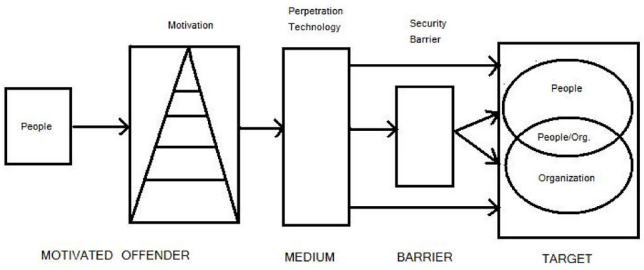

Fig. 2: The Motivational Model of Cybercrime Classification in [25]

Dupont [26] advocated for a monitoring platform to enhance the support and response to crimes. He believed that it is important to harmonize the efforts in tackling cybersecurity crimes, and measure the outcomes and effectiveness of the policies and programs through a consolidated platform. The platform will facilitate the sharing of information, ideas and policies that can provide solutions and knowledge to users who may be facing similar conditions. In his proposed platform, he designed a pilot version of the coding framework with multiple search fields for data as shown in Fig. 3. The aim is to collect as much information as possible, according to the data fields designed in it. The data fields are well thought through, consisting of searches related to different categories such as policy information, evaluation types, methodologies, and any supporting documents that may be useful. Other than just facilitating the knowledge database, the platform may also bring forth other advantages such as tracking the effectiveness and ineffectiveness of the policies. Both features are equally important to allow the review of policies, and enable the refreshing of data if they are outdated or fail to produce the intended results.

Categories	Data Fields
Overview of the policy and search filters	Summary
	Nature of the policy
	Related policies and legislation
	Keywords
	Snapshot data
Description of the policy	Date of implementation or launch
	Place of implementation
	Geographical scope
	Instigator of the policy
	Targeted issue or situation
	Targeted population
	Goals of the policy
	Components of the policy
	Agents in charge of implementation
	Costs
	Source of funding
	Penalties
	Incentives
	Challenges
	Implementation information
Evaluation of the policy	Existence of an evaluation
	Evaluation type
	Evaluator
	Methodology
	Outcomes
Additional references	URL
	Peer-reviewed publications
	Media articles
	Official documents

Fig. 3: Coding Framework of Monitoring Platform in [26]

The mentioned models and tools are useful for discussing plausible motivation factors that may drive cybercrimes. However, there is a lack of correlation between the motivation factors and any conceivable plans to address the motives discussed. Our paper hopes to address this lack of correlation from a fresh angle, and approach this through the lens and life stages of a threat actor. This angle is discussed in the next sub-section.

B. Proposed methodology through the cybercrime stages of a threat actor

Our proposed methodology builds upon the timeline pertaining to the cybercrime stages of the threat actor. They are divided into three segments, namely *Pre-crime period*, *Crime period* and *Post-crime period*. Using this timeline and the root motivational factors as foundations, we postulate the possible environmental and individualistic features, which may affect potential threat actors' decision whether to initiate crimes and go through with the entire process. These features may be unique to one period, or may be applicable to multiple periods. If they are applicable to multiple periods, the presumption is to classify them at the period where they may have the strongest impacts. This will help to provide some insights on the potential challenges faced by them at each stage. Through this understanding of the conditions and motivation factors, intervention plans are proposed to tackle these challenges.

For each stage in the timeline, we will explore different aspects that can influence the actor's decision to commit a crime. First, we look at the environmental features as external influences, such as the behavior of peers around the threat actor, the characteristics of cyber space or the social mindset pertaining to ex-convicts. We think of these conditions as external influences being inflicted upon the actor. Next, we consider the individual features such as the emotional response towards punishment, the self-perceived level of the actor's capabilities, the state of mind of the actor, or any other psychological activators that may trigger a reaction. We think of these conditions as internal influences within the actor. Last but not least, we consider the availability of knowledge and resources that the actors can obtain from, so as to learn the necessary skills and enable them to perform the crimes.

Pre-crime period: This period refers to the time span where the person has not committed any crime, but may evolve to become a potential threat actor. During this period, the activities that the actors engaged are seemingly legitimate. However, they may be facing a great deal of challenges and temptations. For example, avid gamers are often well aware of game modifications or cheat codes, and can use them to their advantage if they are willing to resort to such unorthodox means. Such acts will breach the terms of the games, and gamers risk account banning. However, prosecution by law is still debatable for such incidents [27]. Coupled with generic leniency for first-time offenders, it does not help much in dissuading them from repeated offences, much less eradicate their wrongful intentions. Even so, this is also dependent on the nature of the crime. For example, in [28],the author discussed the arguments either in favour of, or against a reduced sentence for first time offenders. If the first time offenders are of young age, they may lack maturity and discernment of the resulting consequences due to their actions. Thus, there is a stronger plea to reduce the punishment. However, if the first offence is a rape incident as compared to a shoplifting incident, it is arguably trickier to advocate for a reduced sentence.

Another potential challenge is that the person is currently on the receiving end of cyber pranks or attacks. If the effect is damaging to a level that the person cannot withstand, they may seek revenge against the perpetuators, even if it means overstepping the legal boundaries [29]. There are also other temptations such as the opportunity of making a small but quick buck illegally, with perceived low risks [30]. Often, it starts with a small amount, but leads to numerous attempts in the future for greater financial reward, due to greed and further perception of low risk due to accumulated successes.

The anonymity of the cyber realm and activities carried out within, enhances the person's motivations and intentions. Thinking their wrongdoings will not be detected and they will not be caught, it furthers their cause, and provide them the impetus to execute their first crime.

Based on the features in the Pre-crime period, the common root motivations gravitate towards the factors of idealistic, terroristic retaliation, thrill and intellectual. They may have dabbled into illegal activities due to their curiosity to experiment new security techniques, or accidentally ventured into them without knowing. Although possible, financial and reputational factors at pre-crime period are less likely to be the main and sole motivations as cyber attacks are often no easy feat, and potential threat actors have other legitimate opportunities and means to secure their income and build their portfolios. The features of the Pre-crime period are highlighted in TABLE II.

Pre-crime Period	
Environmental Features	
1	Perceived non-illegal hacking outlets (e.g. game modifications, cheat codes)
2	Anonymity of cyber realm and activities
3	Perceived reduced punishment for first offence
Individualistic Features	
1	Clean slate record
2	Victims of cyber attacks
3	Temptation to make a quick buck
Knowledge Resources	
1	Formal education (e.g. computer science, computer engineering)
2	Self-help online resources

TABLE II: Features of the Pre-crime period

Crime period: This period refers to the time span where the threat actor has committed a crime, but not arrested by law enforcement yet. During this period, the threat actors face a new set of challenges through their first misconduct. The key focus here is to review the features that may push them to commit their second crime and onwards, or prompt them to repent and acknowledge their mistakes. In the case of the former, threat actors may perceive these acts as of a non-violent nature,

justifying to themselves that they did no physical harm to the other human beings. Additionally, threat actors may have obtained a heightened sense of confidence, gaining trust in their own capabilities and methods to commit crimes and go undetected, after the successful first attempt. Finally, if their motivation was to seek a thrilling experience, they may indulge in competing with fellow hackers to boast about their misguided achievements, without much consideration to the consequences of their actions. However, if it is the latter, there are some features in this period that may prompt a response towards guilt and repentance. The thought of living an evasive life from the authorities and hidden life from friends and family may be too daunting for some to bear, as it also comes with the lingering fear of arrestment.

Based on the features in the crime period, the common root motivation factors gravitate towards the factors of reputational, idealistic, terroristic, retaliation, thrill and intellectual. As threat actors had a taste of illicit activities without condemnation, they may become more audacious in their behaviors to further their own causes. Similar to pre-crime period, financial factor may be of lesser concern as threat actors are still likely to have legal channels of income if their illegal activities are not yet exposed. These features are highlighted in TABLE III.

Crime Period	
Environmental Features	
1	Unintentional illegal intrusion into unauthorized systems
2	Peer competitive spirit to boost reputation without consideration to consequences of hacking
3	Evasive life due to the need to manage both lawful and unlawful activities (e.g. private vs public working/living/network spaces of activities)
Individualistic Features	
1	Heightened sense of confidence after successful intrusion into systems without being detected
2	Lingering fear of sanctions or arrest
3	Perceived acts possibly as non-violent
Knowledge Resources	
1	Formal education (e.g. computer science, computer engineering)
2	Self-help online resources
3	Hackers Community

TABLE III: Features of the Crime period.

Post-crime period: This period refers to the time span where the threat actors have committed their crimes, and are caught by the authorities. It is applicable where they are caught after committing a single crime or multiple crimes. Here, we make the assumption that their sentences and punishment do not result in their deaths or life imprisonment, which means they have a second opportunity to regain their livelihood back into society in future.

During this period, threat actors often face social stigmas and personal difficulties beyond their control. Due to their criminal records, they may face reduced job opportunities, as hirers may be concerned over offences that are potentially applicable to the organizations' setup and environment. The time spent in confinement, especially if the duration is very long, can also contribute to them losing touch with the society and skill relevancy to the industry. There may also be disruptions to their previous social network and support, making it even harder for them to integrate back to the society.

On the personal aspect, their technical and social skills may also deteriorate, partly because of the lack of practice and work experience. Since the incarceration, they may have also lost their financial support and assets. Faced with these difficulties, the likelihood of recidivism increases.

Based on the features in post-crime period, the common root motivation factors gravitate towards the factors of financial, terroristic and retaliation. Financial stability is the main concern due to the difficulty in landing jobs after they are released. Terroristic and retaliation factors can continue to be strong motivations as they are impelled strongly by personal beliefs. TABLE IV highlights the features in this period.

These three periods mark the evolution of potential threat actors to becoming real and/or serial criminals. For each crime stage, the conditions and motivations that they face may be distinct, or may be applicable to other stages as well. As such, based on these features and conditions, we propose relevant intervention plans to reduce cybercrimes and integrate ex-convicts back into society, which directly address the motive of our paper, in the next sub-section.

Post-crime Period	
Environmental Features	
1	Reduced job opportunities possibly due to criminal record
2	Lost touch with society and skill relevancy to industry
3	Disrupted social network and support
Individualistic Features	
1	Deteriorated technical and social skills
2	Loss of financial support and assets after incarceration
3	Recidivism
Knowledge Resources	
1	Formal education (e.g. computer science, computer engineering)
2	Self-help online resources
3	Hackers Community

TABLE IV: Features of the Post-crime period.

C. Proposed interventions

There are many different strategies to address the topic of cybercrime prevention. One approach is to focus on building and fortifying the organization's defenses through the security products and solutions [6], [31]. This includes having security monitoring and detection systems in place, incorporation of

security protection and real-time threat intelligence to prevent security breaches, manage and monitor access management controls, and other security tools and policies to eliminate security gaps. Another approach is to focus on the human behavior to shape their reactions when challenged with security obstacles [32]. Such areas can include raising security awareness to spot for malicious indicators, establishing good cyber hygiene practices and demonstrate appropriate reactions upon discovering cyber threats. As a holistic approach, organizations spare no effort to ensure their staff members are properly trained to be wary of the cyber pitfalls, and to shore up their cyber defenses against potential exploitations.

In terms of cybercrime prevention, these strategies can be viewed as a defensive stance in relation to the threat actor. This means that they do not actively tackle the motivations of the cyber attacks, which are no less important. Thus, in this paper, we are adopting the posture of seeking to encourage the change in mindset and behaviors of the potential threat actors, threat actors, and the public community pertaining to cybercrime prevention. These are accomplished via the proposed intervention plans, spanning distinctly in each crime period or across a combination of them. To the best of our knowledge, these intervention plans are not readily deployed globally. It is our hope that these proposed plans and framework can trigger more conversations to improve the measures on reduction of cybercrimes in a holistic manner. The interventions are intended to function as initial starting points and encourage afterthoughts, rather than to serve as hard-fix solutions.

The following plans are designed through the insights gained from the features highlighted in the different crime periods:

[i] Formalize cyber topics into early childhood education and curriculum: Education plays an utmost important role, either to learn skills for cyber development, to stay vigilant against threats, or to frame the mindsets of individuals. Technological advancement has allowed children to obtain digital devices at a progressively younger age. As the digital environment becomes more prevalent, the corresponding risks are also increasing. At a young age, humans are taught to be cautious of things that may pose a physical danger (e.g. fire, sharp objects). For items that are seemingly used for leisure purpose (e.g. phones, tablets), the dangers are not as obvious, and definitely not as equivalent to the physical danger.

The benefit of introducing cyber topics early is two-fold. First, it helps to build the knowledge and understanding of the consequences of cyber-attacks, the harm that they can bring to systems, and adverse impacts to humans' livelihoods. We assume that the majority of population is inherently good and do not wish to cause harm to others. Learning about the consequences caused by malicious actions may deter them from committing the act in the first place. Second, it is an opportunity to set healthy cyber pathways in motion. Such initiatives may entail learning on ethical channels of cyber activities and prospects in cyber careers, to inspire generations of cyber defenders.

The main aim of this plan is to institute a strong knowledge base of cyber topics, and inculcate a wholesome set of moral values. By molding the character from young, it builds the person and contributes to reshaping the cyber landscape (e.g. lowered cybercrime rates).

[ii] Cultivate community service programs for first time minor offenders, as an alternative to prison term: There are instances where first time offenders ventured misguided or unknowingly into a crime, often with no malicious intent. It may be due to moments of poor judgement, or inner mental traits that drove them there. They may not see far beyond their actions and the damages that they may cause. As such, the plan can be tailored to educate them on the repercussions of their actions and encourage them to be more aware of and admit to their mistakes.

Though it is with the belief that in a fair justice system, criminals should not be totally let off without consequences, and thus, sending the wrong message to them, their victims and the public, the degree of punishment can and should be administered with appropriate care. This is to also, fairly justify the purpose of the punishment to serve as a sufficient deterrent from future offences and at the same time, answer to everyone at stake for the committed offence. Instead of jail sentences, combinative alternatives may include volunteering activities to educate the public on cyber awareness, participate in cyber trial initiatives to examine their effectiveness, and undertake learning modules of cyber risks and impacts. In the long term, the absence of a criminal record may prove to be more impactful socially and mentally for the person, rather than its presence.

[iii] Reconstruct the working boundaries for ex-offenders: The thought of hiring ex-offenders is an ongoing debate with divided factions; there is no full swing towards supporting any side. The aspiration may be to welcome ex-offenders back into the working society, but the harsh reality is that many of them still face unemployment and discrimination. This is most evident in background screening during the hiring phase. Comparing two people with similar skillset but one of them having a criminal record, there is no impetus to select the ex-offender judging from a trust standpoint [33]. Additionally, the fear of recidivism is a legitimate concern for any employers. In the field of cyber security, this concern is amplified given that they may have the capability to infiltrate your establishment and overturn your security from the inside if hired. Nonetheless, they should not be deprived of an opportunity to redeem themselves.

One possibility is to explore and legislate the working configuration for ex-offenders where their past records will not hinder the hiring considerations as much. An example would be involving them in working with other internal teams to devise strategies to prevent and hunt for insider threats. Having the experience on the offensive side of security, they may provide insights on how to manage such threats and the thinking behind them. Another possibility is to recruit them to participate in technology research and development. Through this method, they can still be engaged intellectually to research and develop viable proof-of-concepts. As with network segregation for cyber protection, there are many ways to segregate roles and responsibilities, and identify important areas of work with good career growth opportunities, that are suitable for cyber ex-offenders.

[iv] Raising the lower limit of maximum punishment for intentional and repeated offenders: The landscape for the prosecution of cybercrimes is relatively newer and with relatively lesser precedents, in part due to the anonymity and transnational nature of them. Furthermore, details of

cybercrimes can vary widely with not many similarities between each case. As a result, prosecutors may find it difficult to determine the appropriate punishment with no suitable reference for comparison [34].

Looking at the upper limit of the maximum punishment for cybercrimes, the U.K.'s Computer Misuse Act prescribed the life imprisonment for offences relating to the loss of life or endangering national security [35], [36]. Under the U.S.'s Computer Fraud and Abuse Act, the maximum sentence is also life imprisonment for any offences that result in deaths [37]. In some countries, the maximum punishment can lead to death sentences depending on the nature and effects of the acts [38], [39]. The upper limit is seemingly more than adequate to offer deterrence, but the same cannot be said to the corresponding lower limit. Many of the sentences prescribe one year jail term as the lowest, which casts doubt on whether the measure is fully effective as a deterrence. In order to establish a harder initial stance to prevent the act in the first place, this aspect can be reviewed further.

[v] Set up cyber rehabilitation centers to provide job transition opportunities, counselling assistance and spearhead community service programs: In 2017, U.K.'s National Crime Agency conducted its first rehabilitation camp for young cyber criminals [40]. The main goal of the camp is to channel their competency towards healthy and lawful outcomes. Another goal is to assess their abilities for potential recruitment in the future. The idea of rehabilitation centers is often used for drug and alcohol addiction, but it can also be applicable to reforming cyber offenders. The rehabilitation camp mentioned is an example of a small-scale initiative. At a larger extent, cyber rehabilitation centers can also explore job opportunities for ex-offenders and provide support in encouraging their transition back into society. Within the centers, job opportunities could be present too, such as job scopes which encompass spearheading reformative initiatives for those in need, managing partnerships with key stakeholders, or to build in-house security capabilities.

D.Mapping and integration of interventions with crime stages

The next element of the framework is to relate the interventions with the three crime stages in a meaningful manner. Each intervention is mapped into either a crime stage, a combination of two crime stages, or three crime stages, if applicable. This is presented in Fig. 4. By associating them in this manner, we can have a more comprehensive outlook and clearer view of the relevance of intervention plans at each crime stage.

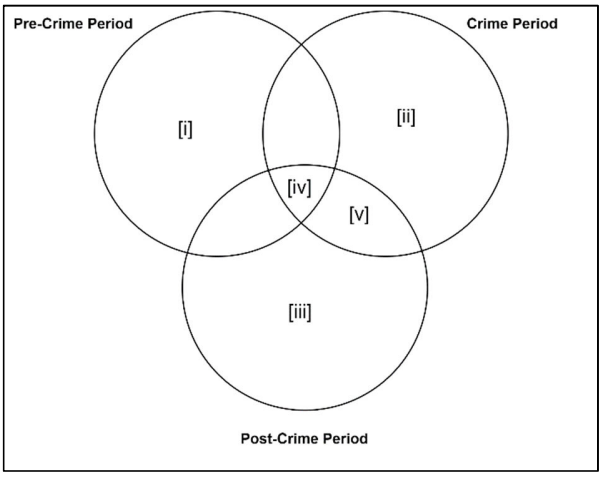

Fig. 4: Mapping the interventions onto crime stages

For example, intervention (i) may prove to be most meaningful when applied during the pre-crime period. The education received can influence the pathway during the formative years of the person. The main purpose is the aversion of a person from carrying out a cybercrime.

For intervention (ii), the objective is not to condemn the person but the crime, and to spur the apologetic behavior towards repentance. This is most relevant to unintentional first-time offenders, who do not wish to continue their missteps.

Intervention (iii) explores the avenues that ex-cyber offenders and businesses alike can take, when looking for talents in an increasingly cyber security demanding landscape.

In intervention (iv), the hope is to discourage any person from thinking of pursuing the crime life, any offenders from continuing to violate the law while risking getting caught, or any ex-offenders from intentionally committing crimes again. Thus, this intervention plan can be applied to all crime stages.

For intervention (v), offenders who had brushes with illegal activities can look for channels to confess while seeking guidance to reform themselves, or for ex-offenders who require assistance to integrate back into society which can be facilitated through various initiatives coordinated by the Center.

IV. Reflection and Outlook

In cybercrime prevention, many factors can affect the beliefs and decisions of the threat actors. Building up security defenses of your solutions and products remain an integral component of cyber security, as it can potentially deter ill intentions and prevent breaches and mishaps. This approach is leaning towards the adoption of technology to protect the systems, data, users and organizations. It is our belief that the other approach of tackling the social and mental construct of the threat actors, can work hand-in-hand in raising the effectiveness of reducing cybercrimes. For both approaches, resources from the government can greatly aid the launch of the proposed initiatives. When businesses see that the authorities are willing to walk the talk in lessening the number of incidents and helping ex-cyber offenders, they will also be more inclined to change their mindset and provide support as well. Thus, it takes commitment from all corners of the society.

For future research directions, we believe there will be more

works on tracking the effectiveness of the various measures for cybercrime prevention. Our paper focuses on the framework and methodology of cybercrime prevention, and may serve as a reference to expand the studies in this topic. The measures and results require a long-term tracking, and more analysis can be done in the future to refine the intervention plans. We hope to see a heavier focus toward helping to shape the behaviors of threat actors or potential ones to reduce cybercrimes in the future.

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Infilling Strategies for Surrogate Model Based Multi-disciplinary Analysis and Applications to Velocity Prediction Programs

Malo Pocheau-Lesteven, Olivier Le Maître

***Abstract*—** Engineering and optimisation of complex systems is often achieved through multi-disciplinary analysis of the system, where each subsystem is modeled and interacts with other subsystems to model the complete system. The coherence of the output of the different sub-systems is achieved through the use of compatibility constraints, which enforce the coupling between the different subsystems. Due to the complexity of some sub-systems and the computational cost of evaluating their respective models, it is often necessary to build surrogate models of these subsystems to allow repeated evaluation these subsystems at a relatively low computational cost. In this paper, gaussian processes are used, as their probabilistic nature is leveraged to evaluate the likelihood of satisfying the compatibility constraints. This paper presents infilling strategies to build accurate surrogate models of the subsystems in areas where they are likely to meet the compatibility constraint. It is shown that these infilling strategies can reduce the computational cost of building surrogate models for a given level of accuracy. An application of these methods to velocity prediction programs used in offshore racing naval architecture further demonstrates these method's applicability in a real engineering context. Also, some examples of the application of uncertainty quantification to field of naval architecture are presented.

***Keywords*—** infilling strategy, gaussian process, multi disciplinary analysis, velocity prediction program.

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Interspecific Hybridization in Natural Sturgeon Populations of the Eastern Black Sea: The Consequence of Drastic Population Decline

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***Abstract*—** The eastern part of the Black Sea and its tributaries are suitable habitats for several sturgeon species, among which Acipenser gueldenstaedtii, A. stellatus, A. nudiventris, A. persicus, A. sturio, and H. huso are well documented. However, different threats have led these species to a dramatic decline; all of them are currently listed as Critically Endangered and some Locally Extinct in that area. We tested 94 wild sturgeon samples from the Black Sea and Rioni River by analyzing the mitochondrial Control Region and nuclear markers for hybrid identification. The data analyses (1) assessed mitochondrial diversity among samples, (2) identified their species, as well as (3) indicated instances of hybridization. The data collected, besides confirming a sharp decrease of catches of Beluga and Stellate sturgeon in recent years, also revealed four juvenile hybrids between Russian and Stellate sturgeon, providing the first evidence of natural interspecific hybridization in the Rioni. The present communication raises concerns about the status of sturgeon species in this area and underlines the urgent need for conservation programs to restore self-sustaining populations.

***Keywords*—** black sea, sturgeon, Rioni river, interspecific hybridization.

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Using Thermogravimetry Technical to Stady the Stability of Menbrane

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Abstract

This work admits two essential objectives:preparation of three types of polymer-based membrane either PP, HDPE, LDPE with the addition of a suitable solvent non-toxic on the environment or Betyl Acetate (AB) with addition alumina (AL) as a pyrogen. These results were followed analytically by themogravimetry (TG, DTG, DTA) to know the stability of the membrane as revealed by nonlinear Arrhenius plots and / or the in the second step used to calcul activation energy E_a, entropy ΔS and enthalpy ΔH. this resualts gives a satisfactory idea on the choice of suitable membranes. While the polymer solution volume fraction decreased due to solvent and non-solvent removal from polymer solution and blend membrane formation. The predicted results from model of heat treatment process on blend membrane were indicated that increasing in membrane thickness and formation of dense layer in blend membrane, kinetics the parameters obtained were found to be very close to the values reported in the literature. It makes it possible to use single DTG curve to determine the kinetic parameters

Keywords : Thermogravimetry (TG, DTG, DTA), Stability , Activited energy, Enthalpy , Entropy

1- Background

A membrane is a permselective material that allows the transfer of objects from one phase to another action of a driving force. The difference between pressures, concentrations, and electric potentials or temperatures actives transport membranes. Membrane filtration for potabilization is a method of purifying water by applying the pressure difference between the feed and the permeate. Membranes made from synthetic or biomass-based polymers account for more than 80% (Wei Shang et al 2019) of the membrane filtration market.

They have a production cost approximately 10 times lower than that of an inorganic membrane (Haiqing Chang et al 2019) and their implementation is easier than mineral membranes.

Many polymers are used to make membranes, among which cellulose acetate (CA), poly (sulfone) (PSu), poly (ether sulfone) (PES), poly (acrylonitrile) (PAN), poly (ethylene) (PE), poly (propylene) (PP), poly (tetrafluoroethylene) (PTFE), polyvinylidene fluoride (PvDF) and polyvinyl chloride (PVC) (Chang, H et al 2019). This wide variety of polymers, which defines the chemical nature of the membrane, combined with multiple membrane geometries, makes it possible to manufacture membranes with different properties and able to cover varied needs in many areas of use. The membranes are thus classified by filtration domains according to their average pore size. Microfiltration membranes (MF) filter objects of size between about 0.05 μm and 2 μm (Munirasu, S et al 2016).

Ultrafiltration membranes (UF), used in potabilization of water because they retain viruses and bacteria, filter objects with a size between 0.005 microns and 0.1 microns. Finally, nanofiltration (NF) membranes filter nanometric objects. The conducted research demonstrated that different membrane manufacturers using the TIPS method could produce the PP membranes with a similar morphology and properties. All the tested commercial capillary membranes, with inner and outer diameters equal to 1.8 and 2.6 mm, respectively, exhibited a good resistance to wetting during 1000 h of MD process operation (El-Bourawi, M et al 2006)

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The long-term studies of water desalination confirmed that a low surface porosity and smaller size of pores on the capillary surfaces enhances the membrane resistance for wetting. However, the wall of capillary membranes should have a sponge-like structure, with the nominal diameter of pore cells in the range of 1 to 3mm, and the dimensions of “chambers” connecting these cells should not exceed. The first aim of this mini review was (Shaffer, D. L. et al 2013) PET and also modified PET membrane fabrication with different methods for water treatment application.

The second intention was probable application of VFD as a new device for synthesis of PET membrane as a first idea. The new VFD (Mahamed M.A et al 2017) application idea can optimize the production of a commercial membrane with more probable homogenous and higher quality of nanofibers. Further ,we can also apply VFD for recycled PET (rPET) (Song YK et al 2015) solution production to fabricate low cost high quality membrane .Lower energy consumption and faster reaction with smaller effective volume of reactants during membrane fabrication are other positive results of VFD usage too.

At the end the final purpose of recycled bottle grade (Schultz, Cantow 1986, Bonnet, M. et al 1998). In order to analyze the stability of organic-based compounds (polymer), thermogravimetric it one of the most suitable methods which has been used in several works. The term thermal stability is commonly used for endothermic reactions and essentially belongs to thermodynamics (Scott C et al 1994, Seadan M et al 1993). The term activation energy belongs to chemical kinetics. If the activation energy for the exothermic process is high, the initial compounds are kinetically stable. Thermogravimetric (DTG) analysis under non-isothermal conditions in a nitrogen atmosphere at multiple heating rates. The TG - DTA study made it possible to deduce the presence of network water in the external sphere of all polymers.

The decomposition was carried out in three to four well separated steps where involved the loss of water molecules in the first step followed by an organic ligand. therefore, it was concluded that these compounds can be called as thermally stable materials. The thermodynamic-kinetic triplet obtained for each step of the decomposition reaction reflects the mechanism linked to a defined characteristic of the system under study.

Activation energies were obtained assuming the order of reaction under Coats - Redfern Method using TG / DTG and DTA data, where Cd (II) shows the highest values of activation energy per compared to others. Derivation of a detailed theoretical proof of kinetic compensation relations between enthalpy and entropy (Alok dhauundiyal et al 2018, Ratiram Gomaji Chaudhary et al 2019) (or pre-exponential factor and activation energy) should include consideration of influence of vibrational energy (Zwbvbpcrbq BR et al 1976) and the effects of distribution of media molecules around diffusing, subliming, and reacting species as well as energy of intermolecular interaction **(**Ivanov AI et al 1986, Vadim V Krongauz 2019, Sergey Vyazovkin 2020). The Arrhenius treatment it means that one should generally expect the respective Arrhenius plots to be nonlinear and, therefore, the activation energy to vary with temperature. The considered models aord an understanding of the origins, the experimentally observed nonlinear plots and variations in the Arrhenius activation energy. Furthermore, fitting the theoretical temperature dependencies to the experimental ones may permit the evaluation of important intrinsic parameters of the process.

J. Yang et al 2001 illustrate this new method, so-called the ‘‘DTG curve fitting’’ method, by determining the kinetic parameters of six important plastics found in the municipal solid waste stream: highdensity polyethylene (HDPE), low-density polyethylene (LDPE), polystyrene (PS), polypropylene (PP), poly (vinyl chloride) (PVC), and poly(ethylene terephthalate) (PET). This method involves first measuring the weight loss behaviour obtained by using thermogravimetry (TG) and then using the Arrhenius equation to fit the DTG curves obtained from the TG measurement

The purpose of this study is to investigate the kinetics of thermal decomposition of memebrane that will used at water distillation. Devolatization was done with the help of TGA/DTG curves obtained at different heating rates implemented to estimate activation energy (Ea) and frequency factor (A). The effect of heating rate on the

Methods

Preparation method

The experimental preparation of the membranes was made by polymer mixed. To prepare the membrane, polymers (PE, PP) and by adding alumina powder with different quantities the mixture is dissolved in a solvent (butyl acetate, paraffin oil) at a temperature of 130 ° C with stirring for 5 hours until complete dissolution of the polymer (Fig. 1) . Once the colodion is prepared, we spread it out on a glass plate using a manual spreading knife.

Fig.1. Preparation of memebrane at 130°C for 5 hours

The resulting film is exposed to atmospheric conditions for 5 minutes (Fig.2) then immersed in hexane (Fig 3) then ethanol in order to extract the solvent from the membrane after it has been dried in an oven at 70°C. Finally the membrane is left 24 hours at ambient temperature (Fig.4)

Fig.2. Membrane exposed to ambient temperature for 5 minutes

Fig.3 . Membrane immersed in hexane

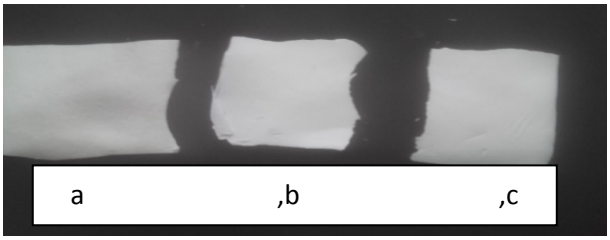

Fig. 4. Real experimental membrane for different percent of Alumina and PP

During our preparation for the membranes we kept quantities AB, LP, HDPE, PHBD the same all we vary the quantities of PP from 0 to 3 g, and a quantity of AL which increases from zero to 1 g. The following table 1 gives the mass of different products used during our work.

The work was carried out under the same conditions to be able to compare the membranes obtained. The real photos of these membranes it given by Fig.4.

Resultat analysis

Thermogravimetric analyzes (TG / DTG / DTA) were carried out under a nitrogen atmosphere at heating rates different from 20°C, 30°C, 50°C / min^{-1} in the range of 0°C to 1000 ° C on using an AL_2O_3 crucible (100µL). These results were carried out at the Environment, Catalysis and Process Analysis laboratory at the National School of Gabes Engineering (ENIG). The thermal curves of the samples were recorded on the Perkin Elmer STA 6000 integrated thermal analyzer with a computer. Kinetic parameters were evaluated using thermal data using TG / DTG / DTA curves.

Effect of heat flow rate

- **Mass losses (m/m_0)**

Thermogravimetric graphs for the polymers are obtained at different heating rates, which are illustrated in Fig 5. The thermo-analytical data show that the decomposition process for E_1, its around 499.28°K at heat flow rates 30°C $minu^{-1}$ and 50°C $minut^{-1}$ wile for 20°C$minu^{-1}$ it is equal 200°C. The decomposition for E_2 memebrane its equal to 381.61°C for the three hot flow rates stadied, and atteined 389.34°C for E_3 for differents heat flow rates and continued to decrease until the temperature reached 531°C decabonisation step for all memebranes preparation.

- **DTG results**

Derived thermogravimetric curves (DTG) for the three membranes at three differents heating rates of 20°C.min^{-1}, 30°C.min^{-1} and 50°C.min^{-1} under inert nitrogen atmosphere are shown in Fig. 6. For E1 membrane we notice that there is only one peak for the three heat flow rates and that the peaks increase and become more and more important as we increase the speeds 20, 30, 50 ° C min^{-1}. Regarding the E2 and E3 membranes, we found the appearance of two peaks for differents heat flow rate study with an intense increase in these peaks when the speed increases with a shift of these two peaks regardless of the E2 and E3 membrane towards the right.

The three different stages showed the temperature range at which dehydration, pyrolysis took place. At the initial stage of pyrolysis, is aimed at drying or removing moisture. Primary pyrolysis reactions decrease between the ranges from 100°C to 380°C at low heating rate; whereas in the event of high heating rates, the same phenomena took place at a slightly elevated temperature ranging from 350°C to 405°C at 20°Cminu^{-1}. In addition, the two peaks (E_2 and E_3) (Strezov V et al 2003) give information on the degradation of the constituent components of the membranes. The variation in the heating rate dramatically affects the locations of the maximum decomposition rate and the maximum temperature deflection in the derived thermogravimetric plot (DTG). As the heating rate increases, the degradation temperature shifted to the right (Fig. 6)

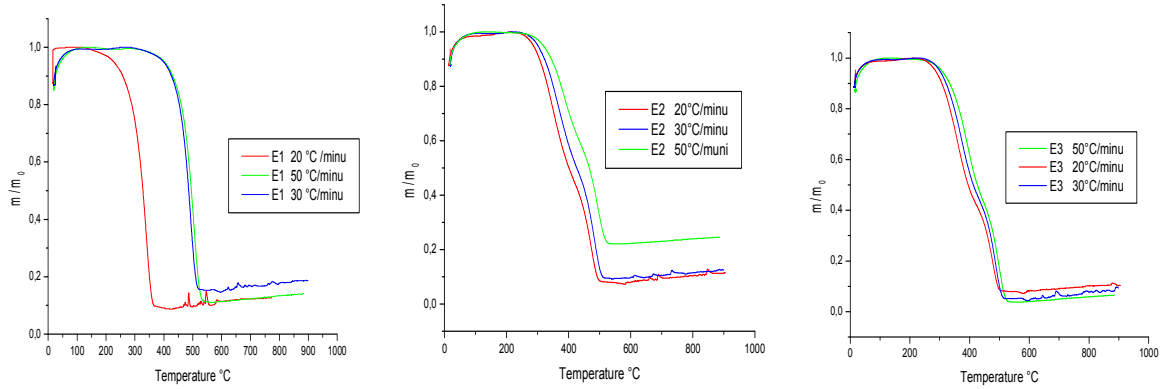

Fig .5 . Effect of differents heat flow rates at E_1, E_2 and E_3

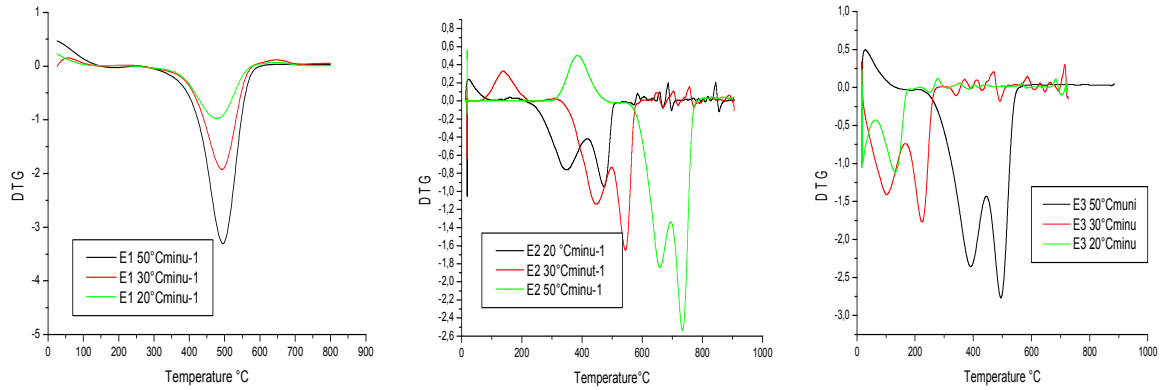

Fig .6 . Variation of DTG for E1 E2 and E3 at different heat flow rates

Experimental study

- **Kinetic theory**

The solid-state decomposition process can be expressed by the rate Eq. (1) (Alok dhauundiyal et al 2013)

$$\frac{dX}{dt} = k(T)f(X) \qquad (1)$$

Where k(T) it's the rate constant, X represents conversion; it can be derived from mass loss data of decomposed sample. It can be stated as:

$$X = \frac{m_0 - m_t}{m_0 - m_r} \qquad (2)$$

Where, m_0 is the initial mass in, m_t is mass recorded at specific instant of time t, and m_r is the residual mass at the end of heating process.
Temperature dependence of rate constant k is obtained from Arrhenius Eq. (3)

$$k = Ae^{-\frac{E_a}{RT}} \quad (3)$$

The passage to logarithm

$$Ln(k) = Ln(A) - \frac{E_a}{RT} \quad (4)$$

Where E_a it's the apparent activation energy, $kJmol^{-1}$is activation energy or minimum energy required to initiate the reaction. The equation was elegantly simple; however, the physicochemical significance of the equation is still debated. T it's the absolute temperature °K. R it's the gas constant, 8.314 $JK^{-1}mol^{-1}$. A it's the frequency factor, min^{-1}. We obtained the basic expression of analytical method by putting the value of rate constant k in Eq. (3). Piloyan et al. 1966 suggested the kinetic analysis that follows Eq. (4).

$$\frac{dX}{dt} = Af(X)e^{-\frac{E_a}{RT}} \quad (5)$$

Taking the natural logarithm of Eq. (5), we obtained Eq. (6)

$$Ln\left(\frac{dX}{dt}\right) = -\frac{E_a}{RT} + LN(A) + Ln(f(X)) \quad (6)$$

Piloyan et al 1966 suggested that the term $ln(f(X))$ could be neglected and thus the value of E_a and ln (A) are estimated by plotting $ln(\frac{da}{dt})$ versus$\frac{1}{T}$. It has been reported that the error rate encountered while estimating E_a values is around 15% to 20%. However, later on, this method has kept with group of methods, which evaluates the kinetic triplet at the single heating rate. Similarly, Criado et al 1994 have also made conclusions on the drawbacks in their study and reported the detail calculation of the error in E_a occurred due to this assumption. Flynn et al 1966 stated that f(X) follows a reaction model in which it varies according to the power of remaining mass fraction:

$$f(X) = (1 - X)^n \quad (7)$$

Where n it is reaction order.

Temperature increase, dT/dt =b (b its the heating rate in K/min), the integration Eq. (8) leads to various differential or integral methods for n= 1 and n not equal to zero or unity. Out of several methods available to allow kinetic analysis of thermogravimetric data, the integral method developed by Coats–Redfern (CR) 1964 has been widely accepted as a reliable method. By using thermogravimetric data (TG/DTG/DTA) different steps of decomposition curve were subjected to find out kinetic analysis under non-isothermal condition by Coats–Redfern method. According to this method above expression can be expressed in logarithmic form where n= 1 and n #1

$$Ln\left(\frac{-Ln(1-\alpha)}{T^2}\right) = Ln\frac{AR}{\beta E_a}\left(1 - \frac{2RT}{E_a}\right) - \frac{E_a}{RT} \quad n = 1 \quad (8)$$

$$Ln\left(\frac{-Ln(1-(1-\alpha)^{1-n}}{T^2}\right) = Ln\frac{AR}{\beta E_a}\left(1 - \frac{2RT}{E_a}\right) - \frac{E_a}{RT} \quad n \neq 1 \quad (9)$$

The E_a can be estimated from the slope of a line established from fitting the TG data $Ln\left(\frac{g(\alpha)}{T^2}\right)$ versus $\frac{1}{T}$ the plot will give a traight line (Rocco AM, 2012). Since the order of reaction is usually not known beforehand, it is first necessary to fit the TG data with an assumed value of n. If the assumed reaction order adequately represents the reaction, the line becomes straight. If not, another reaction rate is assumed and the fitted line is examined for straightness (Tonbul Y et al 2001). By using data obtained from Eq. (9), change in entropy (ΔS), change in enthalpy (ΔH), change in free energy (ΔG) and frequency factors were calculated by standard thermodynamic equations (Mahfouz RM, et al 2002)

- **Discussion**

The thermal degradation behavior of polymer-based membranes was strongly interpreted and discussed. The thermal degradation curves (TG / DTG / DTA) of the different sample (E1 E2 E3) were plotted The initial, semi and final decomposition temperatures and total mass losses for each step of the thermal decomposition of the polymer compounds were studied using TG analysis at a heating rate of 50 ° C min^{-1} under a nitrogen atmosphere was chosen to calculate the thermodynamic quantities. TG analyzes of polymeric compounds were performed for milligram weight loss of compounds versus increase in temperature. Peak temperatures, initial and final decomposition temperatures of all polymeric compounds were identified by DTG analysis, while the DTA method was used to assess endothermic or exothermic weight loss. The thermographs of all polymer compounds are shown in Fig7.8.9 The thermal stability properties of the polymer compounds were evaluated using TG / DTG and the DTA data and results revealed good thermal stabilities for all of the polymer compounds

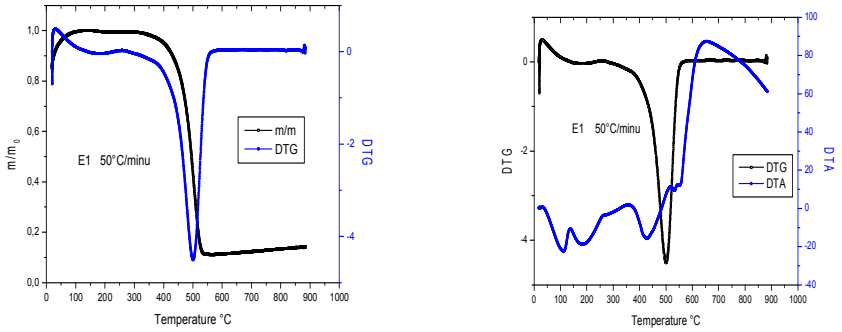

Fig .7 . m/m0/DTG TG/DTA of membrane E1

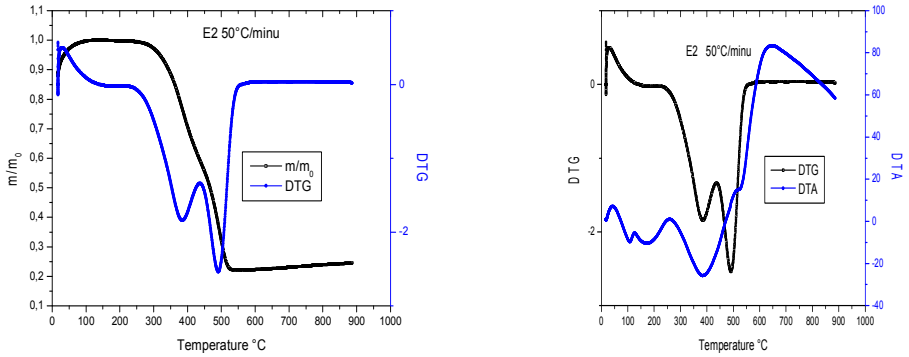

Fig.8. m/m0/DTG TG/DTA of membrane E2

Peaks in T_{DTG} were observed for E1, E2, and E3 at 138.08, 136.68, and 131.71 °C respectively, which may be due to network water loss. Additionally, T_{DTG} peaks were seen in the second peak at 504.3; 394.78 and 400.08 ° C, respectively, which may be associated with the removal of water. The third peak E2 504.81 and 503.36 for E3. The DTG curves of the polymer compounds observed at temperatures below 1000 ° C, indicate the decomposition of the fragment (Fig10)

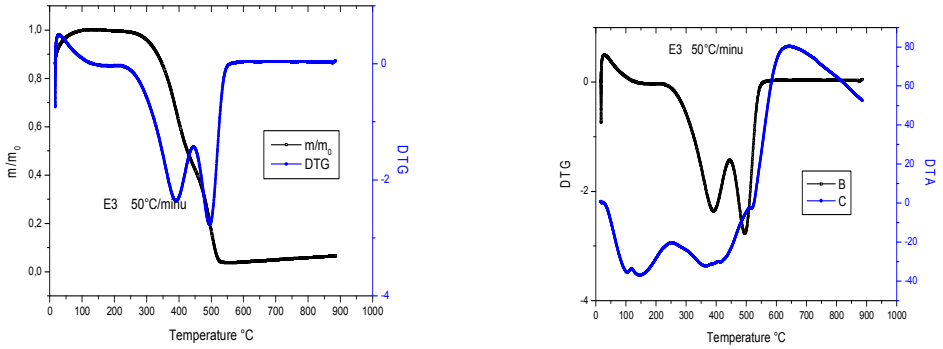

Fig .9 .m/m0/DTG TG/DTA of E3 membrane

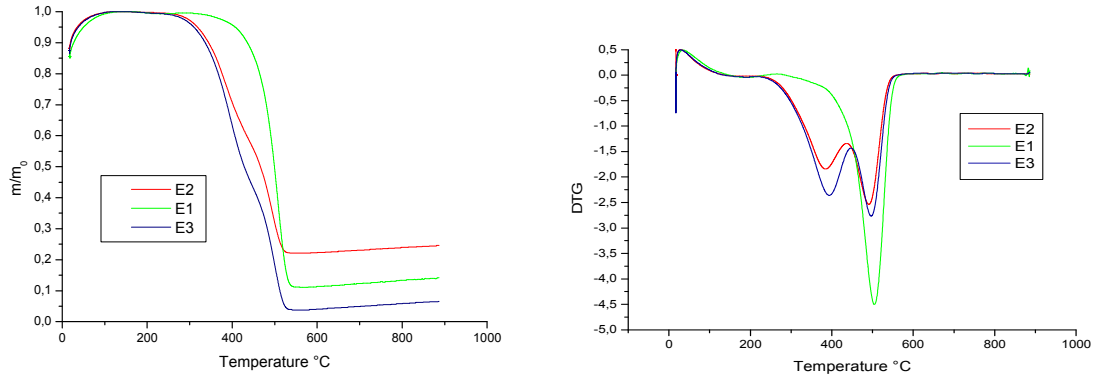

Fig.10 .m/m_0(TG), DTG for E1 E2 E3 for 50°Cmin^{-1}

Polymers have a higher heat capacity above of the glass transition temperature. This change in heat capacity taking place at the glass transition, use to measure the glass transition temperature T_g of a polymer. We notice that the change does not happen instantly, but takes place on a beach temperatures. This makes the exact determination of Tg rather difficult, but we use the well-known tangent method to determine Tg. The temperature at the highest point is called the polymer crystallization temperature T_c It is also possible to measure the area of the "peak", which is the value of the latent heat crystallization of the polymer. This increase tells us that the polymer can crystallize. Heat can allow crystals to form in a polymer, but too much heat can lead to their dismantling. If we continue to heat our polymer after its crystallization point Tc, we may reach another thermal transition called fusion T_f (Fig11)

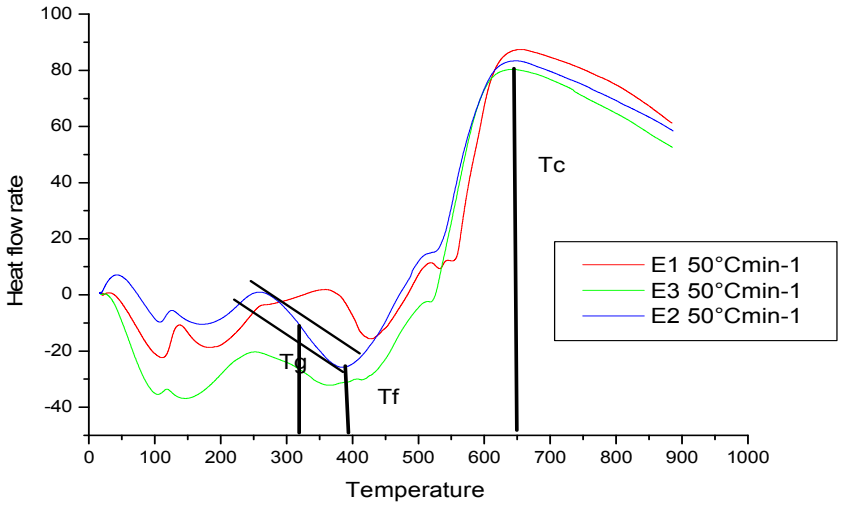

Fig.11. Tc, Tf and Tg for three polymer compound

Table 2 gives the value of temperaure of critallisation T_c, fusionT_f and transitionT_g

The following table 3 gives the different temperature results for the different study curves

Table 3 : Differents temperature for different stady DTG curves

50°C/minu	Step	T_{iDTG} (°C)	Temperature range (°C)	Total decomposition temperature T_{hDTG}) (°C)	$T_{f(DTG)}$ (°C)	$T_{d(DTG)}$(°C)	
E1	1 st	138.08	[100-200]	564.63	556	**Endo**	**Exo**

	2nd	503.3 503.6.	[400-550]			100 185 420 520	150 350 640
E2	1 st 2nd 3rd	136.68 394.78 504.81	[50-200] [250-430] [450-530]	556.93	428,7 530,36	**Endo** 100 180 380	**Exo** 50 250 600
E3	1 st 2nd 3rd	131.71 400.08 503.36	[100-250] [252-450] [451-550]	557.92	429,76 531,78	**Endo** 100 380	**Exo** 120 250 600

The thermal stabilities of all samples were measured using thermodynamic-kinetic parameters, as the performance of the kinetic study under non-isothermal conditions supported the current facts. Non-isothermal methods have been widely used for the evaluation of the kinetics and mechanism of condensed phase reactions.

- **Interpretation of stabilities by thermodynamic kinetic studies**

The thermal stability of the polymers was measured on the basis of the performance values of the coals. The higher the value of the residue, the more the thermal stability will be. The most interesting and reliable parameters in physical chemistry are the thermodynamic and kinetic parameters. The triplet parameter i.e. activation energy, reaction order and pre-exponential factor with thermodynamic parameters such as entropy, enthalpy and Gibbs free energy were complete and valuable, which help to decide on the stability of the polymer compounds. Here, the kinetics and thermodynamics parameters were calculated for each degradation step by the method at a heating rate equal to 50 ° C min^{-1} under nitrogenous conditions and summarized in Table 1.

The thermal degradation linearization curves of all the chelated polymers were elucidated by plotting Ln(g(a)/T²) against 1/T, which gives a line of slope equal to Ea/R and the activation energies were calculated from the slope obtained (Fig12) for each reaction step. Also, correlation obtained coefficients (R²) of the linearized curves were found approximately in the range of 0.98 to 0.99 and displayed in Table 4.

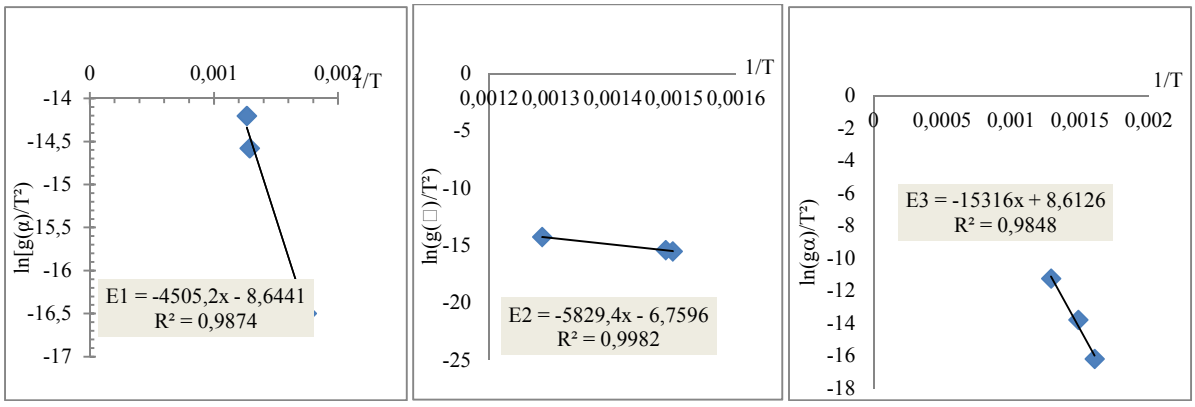

Fig.12. Plot of E_a for E1, E2, E3 for 50°C $minu^{-1}$ heat flow rate

Table 4 : Kinetic parameters of polymers from TG/DTG data

Memebrane type	Ea(kJ/mol)	LnA	A	ΔS(J/mol)	ΔH(kJ/mol)	ΔG(kJ/mol)	R²
E1	37	6.21	497	-195	34	106	0.98
E2	48	7.72	2264	-182	45	112	0.99
E3	127	6.7	816	-190	124	194	0.98

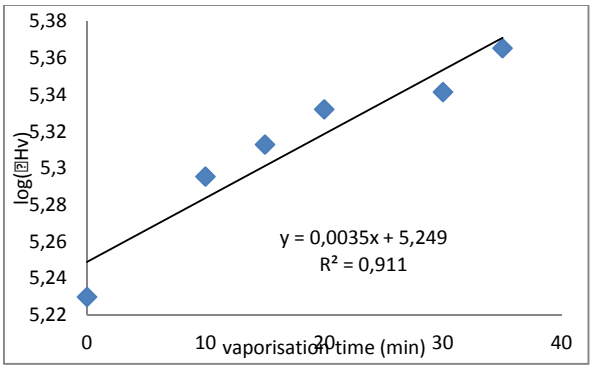

Fig.13. solpe of enthalpy vaporisation

The thermal data and the thermodynamic parameters were significantly inferred by the presence of the thermal stability of the polymer compounds. The order of thermal stability of the polymer compounds on the basis of the degradation of the organic groups, can give an idea on the stability of the compounds (the initial degradation temperature Ti, the decomposition half-temperature (Th), the final decomposition temperature (Tf)) gives the following stability classification for our study membranes, namely: $E_1 > E_2 > E_3$.

Based on studies of kinetic and thermodynamic parameters ((Ea, ΔS , ΔH and ΔG)) we did not obtain the same order of thermal stabilities for us three polymer compounds the order becomes $E_3 > E_2 > E_1$ (Ea3>Ea2>Ea1) (Eathis result is explained by the fact that the activation energy which is none other than the minimum energy required to break the bond or the molecules obtained, i.e. the highest DTG peaks with a maximum mass loss percentage means that it requires a lower activation energy Ea. A high DTG peak with a lower percentage mass loss means that it takes too much energy to remove the molecules. A double bond / triple bond or a strong functional group requires high energy to remove the bond / groups.

In our experimental study we further explains this results because the addition of PP on the thermogravimetric curves of the first sample shows a remarkable drop in mass at 499.28 ° C, on the other hand the third sample shows two levels the first corresponds to 389.34 ° C and the second peak at 531.78 ° C which shows that the third sample is more thermally stable due to the addition of the high amount of PP compared to the first sample and the second samples.

In addition, the addition of alumina on the thermogravimetric curves for the first sample E1 shows a remarkable drop in mass to 499.28 ° C for the second sample E_2 shows two stages the first corresponds to 381.61 ° C and the second peak at 490.35 ° C which shows that the second sample more thermally stable thanks to the addition of alumina compared to the first sample, a larger quantity was added at the third E_3 shows an even important stability compared to E_1 and E_2 it can therefore be concluded that alumina increases the thermal resistance of the membrane studied. However, changing negative entropy values indicate that the dehydrated coordination polymers have more ordered structure and that the reactions are slower than normal.

Correlation between apparent emission activation energy and enthalpy of vaporization

- **Effect of Polymer Solution Temperature :**

Pour the mixture of material on an analysis over the temperature rang (408 436 445 455 460, and 473 K). In corn to know the appropriate temperature of the PP/ HDPE and PP/LDPE solution mixture and to indicate their effect so many correlation it be used
The solubility of the two polymers in solvent is determined by their chemical structure. Polymers will dissolve in solvent whose solubility parameters (δ) are not too different from their dissolution of an amorphous polymer in a solvent which is governed by the free energy of mixing(Mahfouz RM, et al 2002, Miller-Chou B.A.et al 2000)

$$\Delta G = \Delta H - T\Delta S \qquad (10)$$

When the value of Gibbs free energy change of mixing is negative the mixture is stable over a certain composition range and the mixing process will occur spontaneously. Enthalpy change on mixing and entropy change can affect on the Gibbs free energy change signe (Miller-Chou B.A.et al 2000). The Flory–Huggins solution theory uses solubility parameters (δ) of each component in polymer solution to determine miscibility of polymers by Eq. (11):

$$\chi_{ij} = \frac{V_m(\delta i - \delta j)^2}{RT} \qquad (11)$$

The Flory–Huggins interaction parameter *χ*ij is a function of temperature; the mole fraction of each polymer, and the degree of polymerization. In this equation, V_m is an appropriately chosen 'reference volume', often taken to be 100cm^3/mol. The blend miscibility is assumed to decrease with increasing xij.
The heat of mixing for any component can be calculated using equation (12):

$$\Delta H_m = RT\chi_{ij}\phi_i(1-\phi_i) \quad (12)$$

ϕi Volume fraction of component i

As previously mentioned, the basic idea in this approachis to split the total cohesion energy density (CED) into different parts (Hansen C.M 2000) that originate from separate molecular interactions. The dispersive energy (E_d) stems from atomic non-polar forces i.e. dispersive Van der Waals interactions, whereas forces between molecules of permanent dipoles constitute a polar energy contribution (E_p). Due to the specific nature of hydrogen bonding, this energy contribution is considered separately (E_h). These partial cohesion energies E_d, E_p, and E_h are divided by molar volume to result in the corresponding total and partial solubility parameters according to equation 1 :

$$CED = \frac{E}{V} = \frac{(E_d + E_p + E_h)}{V} = \frac{(\Delta H_v - RT)}{V} \quad (13)$$

The Cohesive Energy Density (CED) was in turn defined as the energy needed to break all attractive interactions δ_t in one mole of solvent divided by the molar volume according to Equation 14

$$\delta_t^2 = (CED) = \left(\frac{\Delta E_v}{V_m}\right) = \left(\frac{\Delta H_v - RT}{V_m}\right) = \frac{\Delta H_v - RT}{\frac{1}{\rho_{sol}}} = \rho_{sol}(\Delta H_v - RT) \quad (14)$$

Where

ΔE_v is the latent energy of evaporation and

V_m is the molar volume of the solvent.

ΔH_v latent heat of vaporisation (in case of solvents)

T is the absolute temperatureT.

ρ_{sol} is the density of solvent in theSI system.

Estimation of solubility parameters

For low molecular weight substances (solvents), ΔH_v can be calculated by a number of methods. Experimental values of ΔH_v (Fig13) can be obtained using vapor pressure–temperature data or from heat capacity-temperature measurements. Numerical values for most solvents can be found in the literature. Therefore, estimating values of δ for low molecular weight solvents can be made (Yip Y et al 2006). When values of ΔH_v are known at one temperature, they can be converted to the appropriate ΔH_v values at any other temperature using. Hildebrand developed method to calculate ΔH_v based on an empirical relationship which relates ΔH_v at 25°C to the normal boiling point, Tb; of non-polar liquids(Lee H et al 2010).

$$\Delta H_v = T_b^2 + 23.7T_b - 2950 \quad (15)$$

Where

$$\frac{T_b}{T_c} = 0.567 + \sum \Delta_T - (\sum \Delta_T)^2 \quad (16)$$

If reliable experimental values cannot be found, techniques are available for estimating the critical constants with sufficient accuracy for most design purposes. For organic compounds Lydersen's method is normally used (Chein-Hsiun Tu 1995)

$$T_c = \frac{T_b}{0.567 + \sum \Delta T - (\sum \Delta T)^2} \quad (17)$$

$$P_c = \frac{M}{(0.34 + \sum \Delta T)^2} \quad (18)$$

$$V_c = 0.04 + \sum \Delta V$$

Where Tc = critical temperature, K, Pc = critical pressure, atm (1.0133 bar), Vc = molar volume at the critical conditions, m3/kmol, Tb = normal boiling point, K, M = relative molecular mass, ΔT = critical temperature increments, ΔP = critical pressure increments, ΔV molar volume (Table 5).

Table 5 : Solubility paramteres of polymer solution components

	δ_d	δ_p	δ_h	δCalculeted
HDPE	16,5	2,7	6,1	17,79
LDPE	16,3	5,9	4,1	17,81
PP	18	3	3	18,49
Butyl acetate	15,8	3,7	6,3	17,4

This problem can be overcome by an alternate means of estimating the heat of vaporization at room temperature from data at different temperatures. At low pressures below atmospheric pressure the latent heat of vaporization follows the relationship:

$$\log\Delta H_v = -(\frac{m}{2.303})t + \log\Delta H°_v \quad (19)$$

Where $\Delta H°_v$ is the heat of vaporization at some standard temperature and m is a constant. Using this relationship it is possible to estimate ΔH_v vapor at 298°K by calculating the heat of vaporization in the temperature range in which the Antoine constants are valid and fitting these values into Equation 18 to determine the slope m and $\Delta H°_v$ (Table6)

Table 6 : Effect of solution temperature on cohesive energy heat of vaporisation and cohesive energy density

	T(°K)	ΔHv(J/mol)	CED(J/cm^3)	E(J)
	404	169840,8	1664,7952	166479,52
	436	197479,2	1938,5168	193851,68
	445	205621,5	2019,191	201919,1
	455	214858,5	2110,729	211072,9
	460	219552	2157,248	215724,8
	473	231989,1	2280,5374	228053,74
ΔHv0	298	92916,6	904,3724	90437,24

The investigated vaporization time of the casted membrane was at (0, 10, 20, 30 min) for the finest blend polymer solution. The ΔHv was calculated according to equations (17) and (18), where log ΔHv0 was 5.0061 as shown in Fig 13 Table 7 illustrates calculated heat of vaporization; cohesive energy and cohesive energy density, where the results indicated that increasing in all these parameters were observed with increasing in vaporization time.

Table 7 : Effect of solution time on cohesive energy heat of vaporisation and cohesive energy density

Vaporisation time(min)	ΔHv(J/mol)	CED(J/cm^3)	E(J)
0	148413,159	1450,51879	2104004,763
10	153699,593	1500,72073	2252162,698
15	156413,009	1527,10609	2332052,999
20	159174,327	1553,88727	2414565,659
30	164844,071	1610,16871	2592643,26

Conclusions

In this work, thermogravimetric parameters were used to determine the kinetic parameters of three main membranes constructed from polymer base such as HDPE, LDPE, AB and AL The kinetics the parameters obtained were found to be very close to the values reported in the literature. It makes it possible to use single DTG curve to determine the kinetic parameters

Some other correlation be used to evaluted the enthalpy of vaporisation and give good value us compaired with our work

Abbreviations

E_1 membrane 1
E2 membrane 2
E 3 membrane 3
Highdensity polyethylene (HDPE)

Low-density polyethylene (LDPE)

Polypropylene (PP)

CED Cohesive energy density [J cm-3]

E Cohesive energy [J]

Tc Critical temperature [K]

Tb Normal boiling temperature[K]

ΣΔT Lyderson constant
ΔG Gibbs free energy change on mixing [J mole-1]

ΔH Enthalpy change on mixing [J mole-1]

ΔS Entropy change on mixing [J mole-1 K-1]

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Real-time Water Quality Monitoring and Control System for Fish Farms Based on IoT

Nadia Yaghoobi, Seyed Majid Esmaeilzadeh

***Abstract*—** Due to advancements in wireless communication, new sensor capabilities have been created. In addition to the automation industry, the Internet of Things (IoT) has been used in environmental issues and has provided the possibility of communication between different devices for data collection and exchange. Water quality depends on many factors which are essential for maintaining the minimum sustainability of water. Regarding the great dependence of fishes on the quality of the aquatic environment, water quality can directly affect their activity. Therefore, monitoring water quality is an important issue to consider, especially in the fish farming industry. The conventional method of water quality testing is to collect water samples manually and send them to a laboratory for testing and analysis. This time-consuming method is a waste of manpower and is not cost-effective. The water quality measurement system implemented in this project monitors water quality in real-time through various sensors (parameters: water temperature, water level, dissolved oxygen, humidity and ambient temperature, water turbidity, PH). The Wi-Fi module, ESP8266, transmits data collected by sensors wirelessly to ThingSpeak and the smartphone app. Also, with the help of these instantaneous data, water temperature and water level can be controlled by using a heater and a water pump, respectively. This system can have a detailed study of the pollution and condition of water resources and can provide an environment for safe fish farming.

***Keywords*—** dissolved oxygen, IoT, monitoring, ThingSpeak, water level, water quality, WiFi module

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Indigo-Reducing Activity by Microorganisms from the Fermented Indigo Dyeing Solution

Yuta Tachibana, Ayuko Itsuki

***Abstract*—** The three strains of bacteria (Lysinibacillus xylanilyticus, Bacillus kochii, and Enterococcus sp.) were isolated from the fermented Indigo (Polygonum tinctorium) dyeing solution using the dilution plate method and some fermentation conditions were determined. High-Performance Liquid Chromatography (HPLC) was used to determine the indigo concentration. When the isolated bacteria were cultured in the indigo liquid culture containing various sugars, starch, and ethanol, the indigo culture solutions containing galactose, mannose, ribose, and ethanol were remarkably decreased. Comparison of decreasing indigo between three strains showed that Enterococcus sp. had the fastest growth and decrease of indigo. However, decreasing indigo per unit micro biomass did not correspond to the results of decreasing indigo—Bacillus kochii had higher indigo-reducing activity than Enterococcus sp. and Lysinibacillus xylanilyticus.

***Keywords*—** fermentation condition, high-performance liquid chromatography (HPLC), indigo dyeing solution, indigo-reducing activity.

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Generation of Long-acting G-CSF Using Glycosylated Linkers

Abdulrahman Theyab

***Abstract*— Rationale:** The current therapeutic drugs of Granulocyte Colony-Stimulating Factor (G-CSF) are rapidly cleared from the body and require frequent injections, which are inconvenient and expensive. Several approaches to reducing therapeutic regimens clearance have been tried mainly through conjugation with another moiety. One such technology already being employed is PEGylation which has been shown to be non-biodegradable and toxic. therefore, there is a need for a safe technology that allow the half-life of GCSF to be extended without any toxic effect.

Hypothesis: The use of different glycosylated linkers between two GCSF ligands will generate a construct with high molecular weight and protect from proteolysis resulting in reduced clearance with out blocking bioactivity.

Methodology: G-CSF tandems with linkers containing between 2-8 NAT glycosylation motifs and their respective controls (Q replaces N in the sequence motif NAT so there is no glycosylation) were cloned, and sequenced. Following expression in Chinese Hamster Ovary (CHO) cells, expressed protein was analysed by SDS-PAGE to confirm molecular weights. In vitro bioactivity was tested using an AML-193 proliferation assay. Immobilised Metal Affinity Chromatography (IMAC) was used to purify the protein. Pharmacokinetic and pharmacodynamics properties of the purified GCSF tandem proteins were measured in normal Sprague Dawley rats with full ethical approval.

Results: Purified glycosylated tandems show increased molecular weight above that of controls when analysed by SDS-PAGE. All G-CSF tandems show increased bioactivity in comparison to native GCSF. Following intravenous administration to rats, G-CSF2NAT, G-CSF4NAT, G-CSF8NAT containing 2, 4 & 8 glycosylation sites respectively and G-CSF8QAT (non-glycosylated GCSF tandem control) showed approximately 3 □fold longer circulating half-life compared to that reported for the native GCSF (1.79 hours). Both G-CSF2NAT and G-CSF4NAT show a significant increase in the percentage of neutrophils over controls at 12 hours post injection. This effect however is short lived as the counts at 24+ hours are not significantly different to controls. G-CSF8NAT shows an increase in the percentage of neutrophils that is only significant at 48 hours.

Conclusion: Results show that the use of glycosylated linkers to generate GCSF tandems results in molecules with increased molecular weight, improved in vitro bioactivity, longer circulating half-lives and enhanced neutrophilic population when compared to both native GCSF and the non-glycosylated tandem protein.

***Keywords*—** G-CSF,NEUTROPENIA,CANCER,THERAPY.

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The Logical Perception of the Origin of Matter, the outside of the Universe, Consciousness and the Feasibility of Discontinues Traveling

Yosef Joseph Segman

***Abstract*—** The logical question what is outside the universe or into what the universe is expending or shrinking or doing both, is connected to the question, how matter exists out of total void? a void without description. Due to the existence of the void, one may conclude that the void has complementary. What would be the void complementary? The possibility that the void complementary is substance e.g. the universe is dismissed and the conclusion is the void complementary represents the total information about all potential scenarios, i.e., stories. Yet, stories are realized within universes and the question remains how the universe exists if the void complementary does not incorporate substance? The conclusion is that, matter is a logical state within the void complementary, wherein the universe has complementary such that the total matter of the universe and its complementary collapses timelessly into zero matter, i.e. null matter. The complementary universe cannot be void and therefore, it carries complementary matter such as negative matter. The universe is identified as the inner universe with positive matter having mass ≥ 0 (wherein mass = 0 is recognized as energy having zero mass in rest) and its complementary to carry negative matter with mass < 0. The complementary universe is everything which is not the inner universe incorporating the outside universe. The complementary universe carries particles that travel at speed higher than speed of light up to infinity and it has an open structure up to infinity. Particles of the complementary universe push each other in a velocity up to infinity. Particles of the inner universe attract each other and are bounded by speed of light resulting in universal close structure. The question: "into what the universe is expanding?" is now being clarified. The universe is expanding into its complementary universe. Furthermore, we conclude that the general relativity theory is not complete in the sense that the theory does not consider forces imposed on the inner universe from the outside by its complementary universe.

Following the logical perception that the total information exists timelessly we conclude that pure consciousness may represent a virtual replica of actual lives. That include for example, every cell and reaction of a biological body, every thought, desire or intention. An OBE 'Out of Body Experience' may provide a metaphysical sensation of the pure consciousness. Although, the brain is reacting to any phenomena including of an OBE, the pure consciousness may explore nonphysical dimensions outside the physical location where the body is laydown. The last part of the paper discusses the feasibility of discontinues traveling. Such idea may be feasible if there is a way to wrap the potential spaceship by shield protecting the spaceship from complementary matter. Traveling would be in the complementary universe at unbounded speed. Furthermore, the complementary universe may be joined to several spacetime universes and that may also provide the idea to visit other spacetime universes.

***Keywords*—** void, complementary, void complementary, universe, universe complementary, metaphysics, logic, brain, neural network, synchronization, synchronized groups, order, disorder, universe expansion, linear Schrödinger representation, frequency, phase, hologram surfaces, virtual, reality, consciousness, pure consciousness, discontinues traveling, spacetime, phase.

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Utilizing Universal Design for Learning in Order to Accommodate for Students with Disabilities

Kaycee Bills

***Abstract*—** Action research is a method of inquiry useful in solving social problems in higher education. This study seeks to address a significant problem: higher education's use of traditional instructional methods in higher education settings. Ineffective techniques, such as lecturing, fail to account for students' variable learning needs. In contrast to traditional pedagogy, universal design for learning (UDL) is robust framework that "[improves] and [optimizes] teaching and learning for all people" (CAST, 2018),

including students with disabilities. For this study a UDL & Accessibility Specialist at their institution was chosen for two reasons: (1) to learn how to implement UDL practices in their classrooms, and in turn, (2) motivate other faculty members at their institution to consider enacting UDL principles. A thematic analysis of the interview transcript reveals themes relevant to practicing UDL. Implications for future practice, as well as the researchers' reflections on the research process, are shared in the

discussion section.

***Keywords*—** higher education,Disability rights,special education,UDL,Universal Design for Learning,equality.

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Art as an Ideology Can Help People Understand Climate Change and Explore a Speculative Future

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Abstract

Climate change is impacting on all aspects of contemporary life. Many artists provide a compelling vision for speculative futures awakening a creative consciousness using imagined worldviews. This paper presents my practice-based research that aims to establish how visual art can engage with issues-based concepts and ideologies through presentation, re-presentation, and interpretation as a framework for engaging with issues of climate change and realigning society to sustainable futures. This paper takes theory and artistic practice as methods means to respond to themes and issues of climate change. In the context of practical research, arts-based approach and art theory research alternate between planning, theoretical research, practical action, reflection, and evaluation. Through digital art, this study creates a discursive space that relates to daily life, where people can deeply understand the interconnecting relationships between humans and the planet; simultaneously, it also shows people an achievable ecological future and encourages people to think and find an existence conducive to all. This existence is not the present, but a possibility for human beings to explore the future through the reshaping and re-imagining of the present.

Keywords: Climate change, digital art, sustainability, speculative future, practice-based research

1. Introduction

With the accelerated development of economic globalization, many GHG and pollutants produced by human activities have caused a serious climate crisis. They not only destroy the balance of natural ecological system and the symbiotic relationship between the earth and human beings, but also bring about negative socio-economic and political consequences to all countries in the world [41],[58], [93], [100]. The International Plant Protection Convention (IPPC), World Meteorological Organization (WMO), United Nations Sustainable Development (UNSD), United Nations Environment Programme (UNEP), and United Nations Development Programme (UNDP) all reveal the harm of climate change and its serious consequences [41], [92], [100], [93]. Climate pollutants impact on all aspects of the Earth such as food shortage, the decline of biodiversity, sea level rise, and extreme weather, destroying human life, national economy, and earth's ecological environment. The climate issue is very complicated because it involves politics, economics, culture, and society. It needs to be widely viewed and co-governed on a global scale, and it needs to go deeper into the social ecology and the human spiritual ecology to reimagine contemporary life for sustainable futures [92].

In view of the climate problem, more and more influential artists have constructed new ways to express ecological ideas within their practice and respond to the environmental crisis [4], [10]-[13], [40], [60], [66], [68], [83]. At the individual level, artists such as John Sabraw, Eve Mosher, Zaria Forman and Tomás Saraceno adapt art forms to express the consequences of human social activities on climate change [24], [47], [63], [86], [103]. These artists utilise creative expression in invoking emotional resonance for our global futures [29], [49]. Through their works audiences appropriate through a range of visual languages messages about coexistence and harmonious life with the planet and our natural resources. At the community level, through art activities, projects such as *Cape Farwall*, *GoodPlanet Foundation*, and *Aerocene* engage audiences in unique ways actively encouraging people to participate in solving environmental problems, changing people's behaviour and attitudes towards the environment [10], [85], [5]. At the social level, art can be combined with other disciplines to convey knowledge about climate change to people from a unique perspective. It informs and enagges relationships between humans and natural environment and builds ecological intelligence [48], [74]. Concisely, art as a visual language engages, informs, and transforms at a social level, community level, and individual level.

Through six case studies this paper critically engages on creative and artistic languages as transformative vehicles in the space of climate change and global environmental challenges. As rtist Bergit Arends proposes that "*environmental change can be identified by artists through the use of archives, its materials, structures and procedures*" [3]. Consequently, artists can develop narratives between events in time, between environmental space and creative archives thereby creating a new vision in the space of environmental issues and ecological concerns. Art making constructs narratives and metaphors that tell transformative stories within the space of climate change. Creative approaches affect people's values and feelings; ultimately, they may lead to a process of change at the individual level. Inspiration, as an incentive factor in the process of change, helps people make changes more excitingly and positively [3]. Creative narratives and metaphors influence people's thinking and values and deepen their understanding of key issues in the space of climate change. Due to the development of society and culture, the discourse on speculative futures has gradually attracted human attention. What is the future? It is a concept that does "not-yet-exist" but is about to appear [6]-[8]. Tomorrow is the future of today, while the present is the future of the past. Throughout the development of human history man has tried to attain a better life that is always becoming and revealing [1], [9], [39], [52], [54], [65], [69], [77], [79], [90]. Indeed, these possibilities are a state in which the world itself exists and a state of existence in the future of new things [7]-[8], [33].

This paper is practice-based research. At the early stage, it mainly focus on the representative work of influential artists, such as ***7000 Oaks*** by Joseph Beuys, ***Wheatfield — A Confrontation 1982*** by Agnes Denes, ***The Weather Project*** by Olafur Eliasson, ***the AMD conversion project*** by John Sabraw, ***HighWaterLine*** by Eve Mosher, ***Antarctica*** by Zaria Forman, ***the Nine Wave*** by Cai Guo-Qiang, ***the Aero-Solar Museum*** Tomás Saraceno, ***Underwater Sculpture Park*** by Jason deCaires Taylor, ***Waters***

of a lower register by Allison Janae Hamilton, ***Human Sensor*** by Kasia Molga and so on. The purpose is to deeply understand how they express and participate in environmental problems in the language of art; how to transmit knowledge or information related to ecological issues or sustainability through art; how to influence people's attitude, experience, morality, and values through artistic emotion; and how to influence and shape the audience's response to the concept of long-term sustainable development and ecological thought through artistic experience. Through in-depth reflection on the works of these artists, I believe that visual narration and visual metaphor play a great role in changing lives in the space of climate change. Specifically, the expression of art can be connected with other disciplines to explore materiality and deepen people's understanding of environmental or ecological problems such as climate change [2], [16], [20], [26], [34], [38], [48], [57], [70], [74], [102]. The emotional exchange of art can change people's attitudes towards the environment and natural ecology, change the relationship between humans and non-human, and shape sustainable values [51], [57], [66], [78], [87]. The transcendence of art can help people look back on the past, face the present, look forward to the future, redesign the current life and realize the future [6], [10], [15], [33], [43], [45], [57], [59]. Through art to build an environment that is related to human daily life, can promote communication between people and climate change, thereby shaping, changing, and promoting a speculative and sustainable future.

2. Materials and Methods

2.1. Research process

The theoretical and philosophical ground of this study encompasses the ecological thinking on '*hyperobjects*' of Timothy Morton and Ernst Bloch's concepts of '*speculative materialism*' and '*ontology of not-yet-being*'. Bloch believes that art as a unique way of life carries a core track of hope (Bloch & Plaice, 1986; Jin, 2018). It reveals current issues and reviews historical experience and lessons of the past. It is an infinite laboratory of potentiality. Morton believes that climate change is unfathomable; people can only experience parts or consequences of it as an object. The ambiguous metaphorical qualities of art express in sensual ways what is difficult to express in words. It gives a glimpse of what exists "beyond or between our normal categories" [56]. In a word, climate change is closely related to humans, and it is closely related to the present and future. Through a metaphorical visual language we can rethink the present and speculate the future.

2.2. Aesthetics research and interdisciplinary research

This project conducts simultaneously interdisciplinary theoretical perspectives and visual research on the representative works of artists engaging in climate change. The focus of aesthetic research is the language of artistic creation, artistic cognition, artistic emotion, and the aesthetic experience of artistic creation. The purpose is to better integrate multi-disciplinary issues to further explore and answer the research questions of this project thereby seeking an effective way to strengthen the communication

between humans and the natural ecosystem and improve people's understanding of the environment and future life.

Many scientists reveal climate change to people through meteorological data, but this data cannot give people an intuitive feeling. To narrow the gap between climate science and art a range of artists have developed interdisciplinary approaches to deepen an understanding of climate change. ***Atmospherics/Weather Works (2003)*** (figure 1) by Andrea Polli, ***Wind Map (2012-present)*** (figure 2) by Martin M. Wattenberg, and ***Wind of Boston: Data Paintings (2017)*** (figure 3) by Reflik Anadol create a perceptual language for emotional communication [35], [61], [68], [80]. They present new perspectives and new ways of understanding data that enhance the perception and consciousness of the changing climate.

Figure 1: ***Atmospherics/Weather (2003)*** Works by Andrea Polli collaborator Dr. Glenn Van Knowe. It aims at converting meteorological data collected in 1991 into sound using algorithms to convey emotional content or emotion, thereby improving human understanding of the power behind data and the impact of climate change. The advantage of this work is that it not only makes boring data interesting, but also integrates the artist's emotional content or emotion

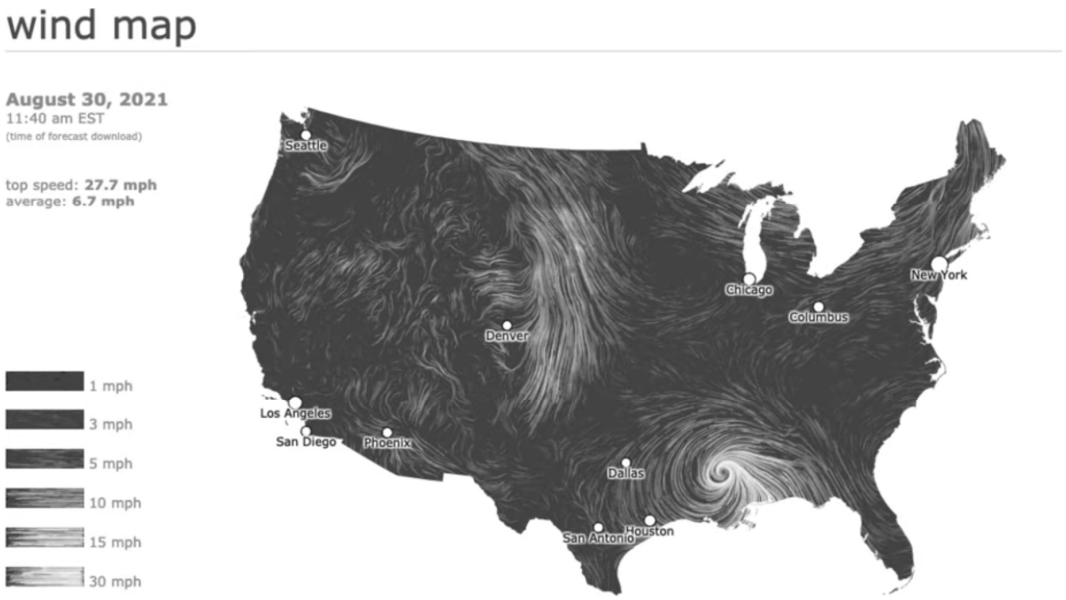

Figure 2: ***Wind Map (2012-present)*** by Martin M. Wattenberg. It visualizes the airflow data in the cold winter in the US, showing the impact of climate change on American daily weather

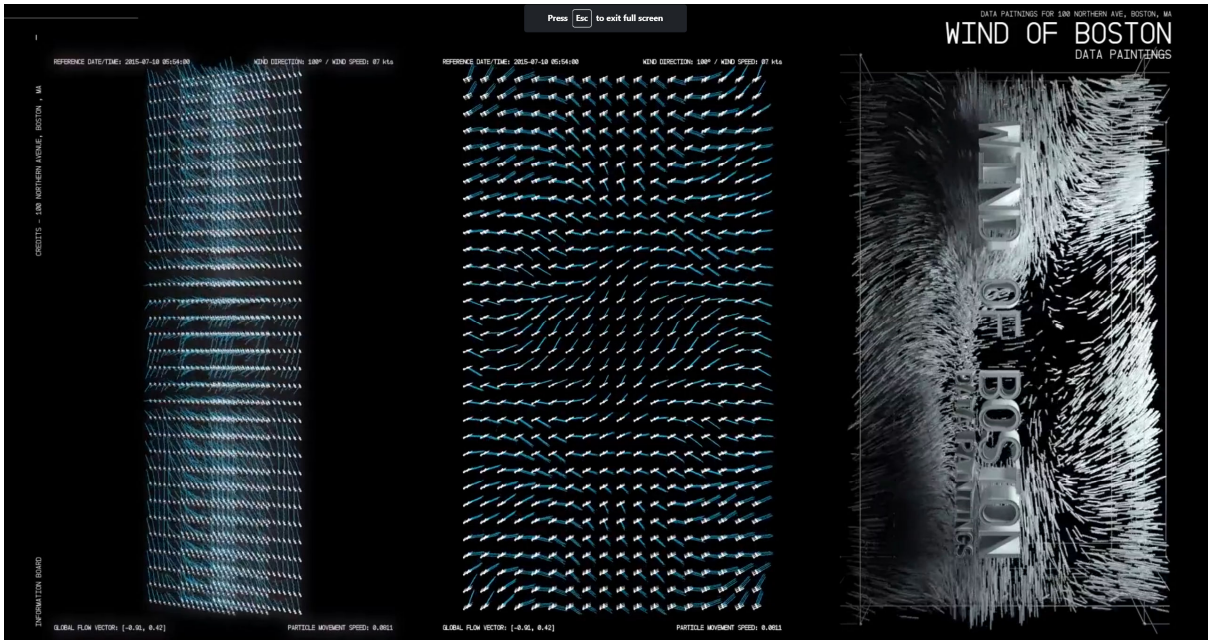

Figure 3: ***Wind of Boston: Data Paintings (2017)*** by Reflik Anadol. By developing a series of customized software and using algorithms, it visualizes the one-year data set collected from Boston Logan Airport. It triggered a series of works exploring climate change and the beauty of nature and conveyed the information about specific climate change

According to Laurie Frick's research, 25% of global emissions come from food. In ***What We Eat (2020)*** (figure 4), she intuitively shows the impact of dietary behaviour on climate change [30], [53]. In contrast, Paolo Cirio in his work state that the one hundred major oil, gas, and coal producers have generated over 70% of greenhouse gas emissions, causing huge problems in human society, ecosystems,

and their endangered species. His work ***Climate Tribunal (2021)*** (figure 5), represents the legal responsibilities of fossil fuel companies and asks for for public participation in this complex subject [72]. As a comparison with Frick and Cirio, Ursula Endlicher develops ***Light and Dark Networks (2020)*** (figure 6) to show her concerns with climate change from both human and natural factors [21], [36]. Frick, Endlicher and Cirio have established an environmental narrative using data to question global capitalism and economics and its effect on the global. All these artists encourage people to think about their relationship with climate change and seek solutions. Moreover, through their creative art practice, they explain the causes of climate change and dialectically effect people and transforming society through cultural transformation.

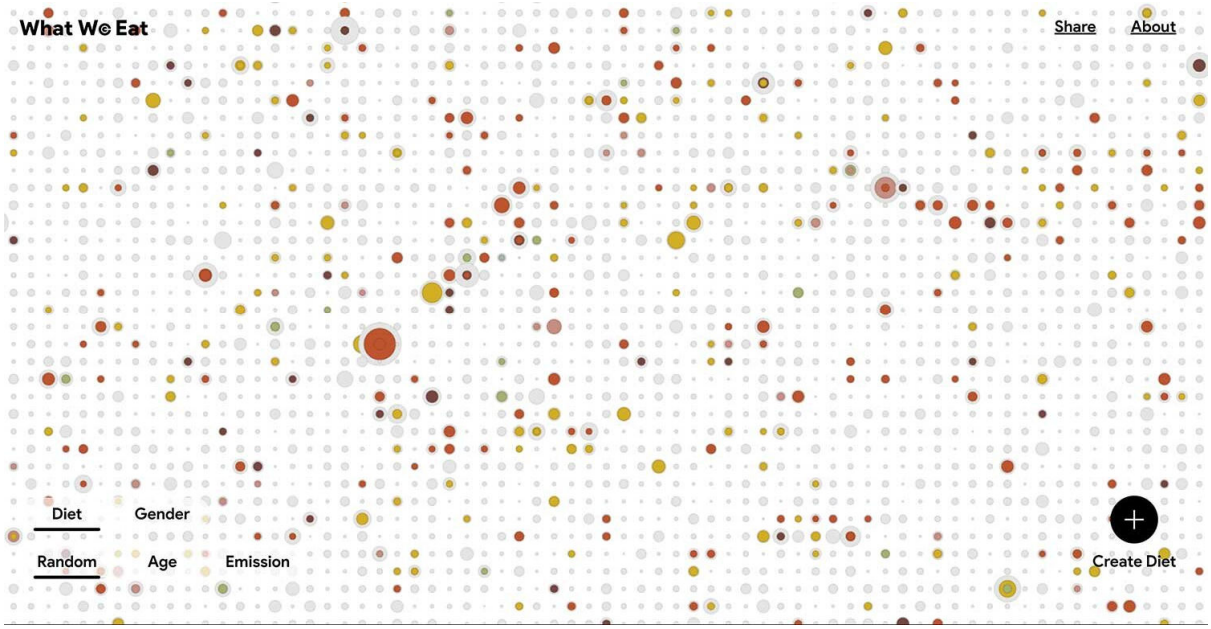

Figure 4: ***What We Eat (2020)*** by Laurie Frick. Through collecting the carbon dioxide content data of each food eaten by thousands of people from the United States, France, and Britain, Frick converts these data into colourful patterns to and converts these data into colourful patterns to design this work

Figure 5: ***Climate Tribunal (2021)*** by Paolo Cirio. It is designed through interventions on canvas, fabric, and paper and featuring scientific and economic data, legal documents, and biological research

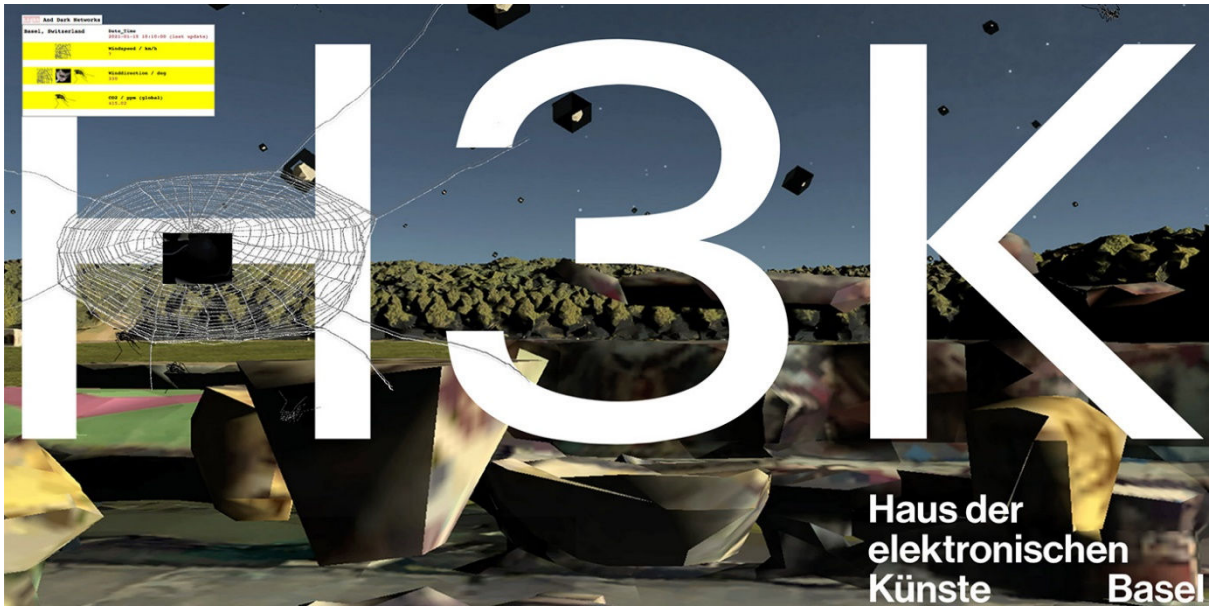

Figure 6: ***Light and Dark Networks (2020)*** by Ursula Endlicher. It shows two online "data performances" that change due to different artificial or natural parameters and transmit digital codes into materials such as spider's web and mushroom

Responding to climate change Jer Thorp designed the ***Herald/Harbinger (2018)*** (figure 7) to illustrate the interrelationship between human activity in Calgary and the natural system of the Bow Glacier in the Canadian Rockies, and let people realize how close they are to the impact of the climate crisis [46], [96]. In 2017, hurricane Maria destroyed power supply facilities in Puerto Rico, causing power cuts to at least 3.5 million people and about 3000 deaths. Based on this, Nathalie Miebach uses two narrative types from nature and human society in her work ***The Burden of Every Drop (2017)*** (figure 9), in which metaphor plays an important role. Through this work, Maibach explained the storm through materials, installation and colour that are not just visual but haptic affecting the viewer through the senses [14], [62]. Thorp and Miebach combine art and other disciplines to explore materiality and a deepening people's understanding of climate change and its ecological issues.

Figure 7: ***Herald/Harbinger (2018)*** by Jer Thorp cooperated with Ben Rubin, Shah Selbe, and Dr. Jeffrey Kavanuagh. By using the same method as a cardiotocograph to capture the sounds of the Bow Glacier to collect real-time data). Then, through algorithm coding, these data were visualized to create this public data sculpture

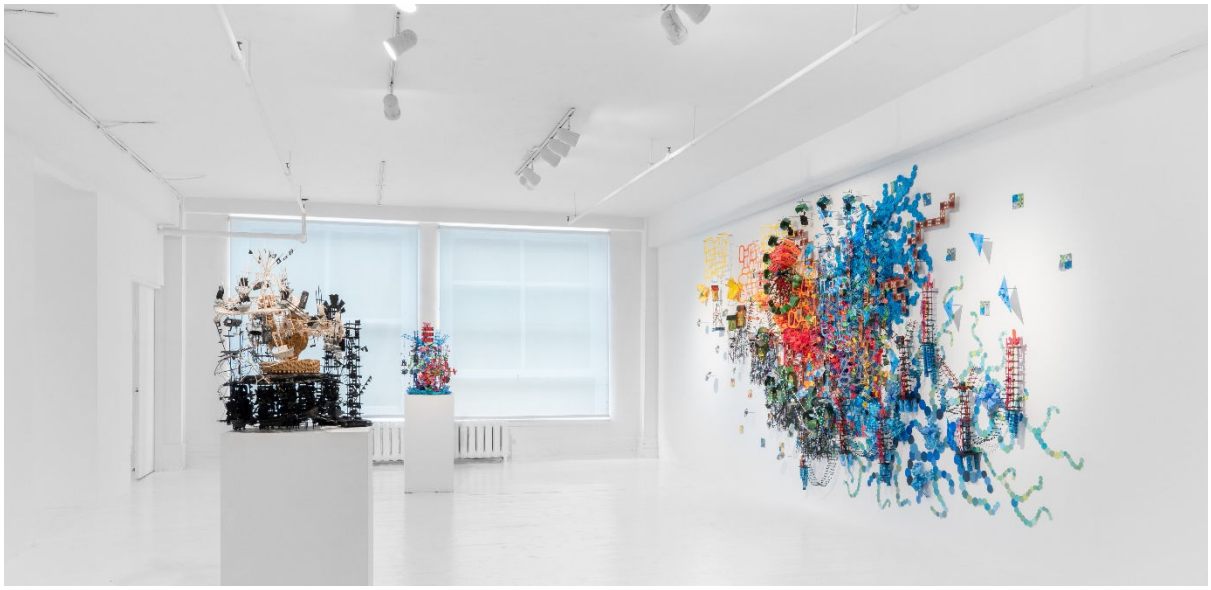

Figure 8: ***The Burden of Every Drop (2017)*** by Nathalie Miebach. It combines weather and other numerical data with anecdotal information from news reports about the aftermath of the storm, displaying the impact of climate change on human society and survival

Everything is interconnected, as Morton stated. Climate change is related not only to the present, but also to the future and the past (figure 9). ***Deep Sea (2011)*** created by Dr Kirell Benzi shows past history and envisages what the future will look like, thereby drawing people's attention to global warming [50]. Similarly, Cristina Tarquini's ***Diving into an Acidifying Ocean (2020)*** (figure 10) explore's the impact of climate warming on marine organisms from the past to the future [32], [84]. Timo Aho, Pekka Niittyvirta's work ***Coastline Paradox (2020)*** (figure 11) talks about how cities, countries, and continents are being affected by global warming [31]. In a sense, these three works show the responsible practices of the creative and the use of art to transform through the aesthetic experience; art as a creative tool with the function of education, communication, dissemination, and transformation concentrating creative expression towards positive and creative speculative futures.

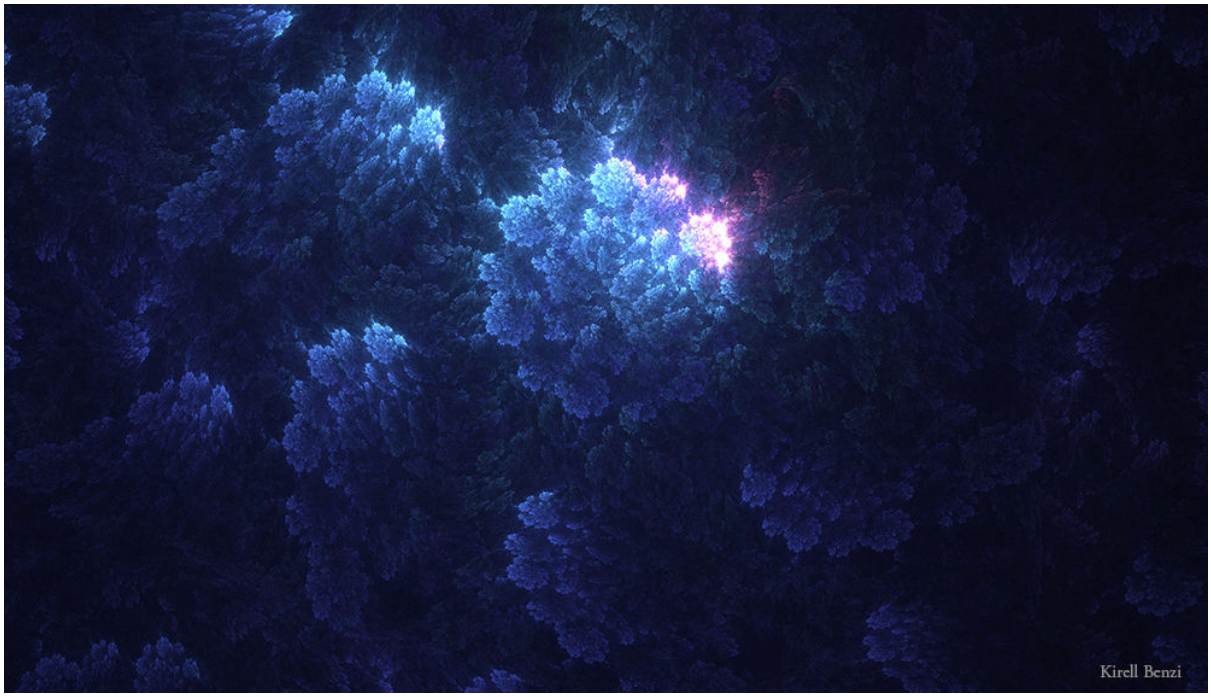

Figure 9: ***Deep Sea (2011)*** by Dr. Kirell Benzi. It use algorithms to visualize the data of the sea level from January 1993 to April 2018, proving that global warming is not a theory but a real fact

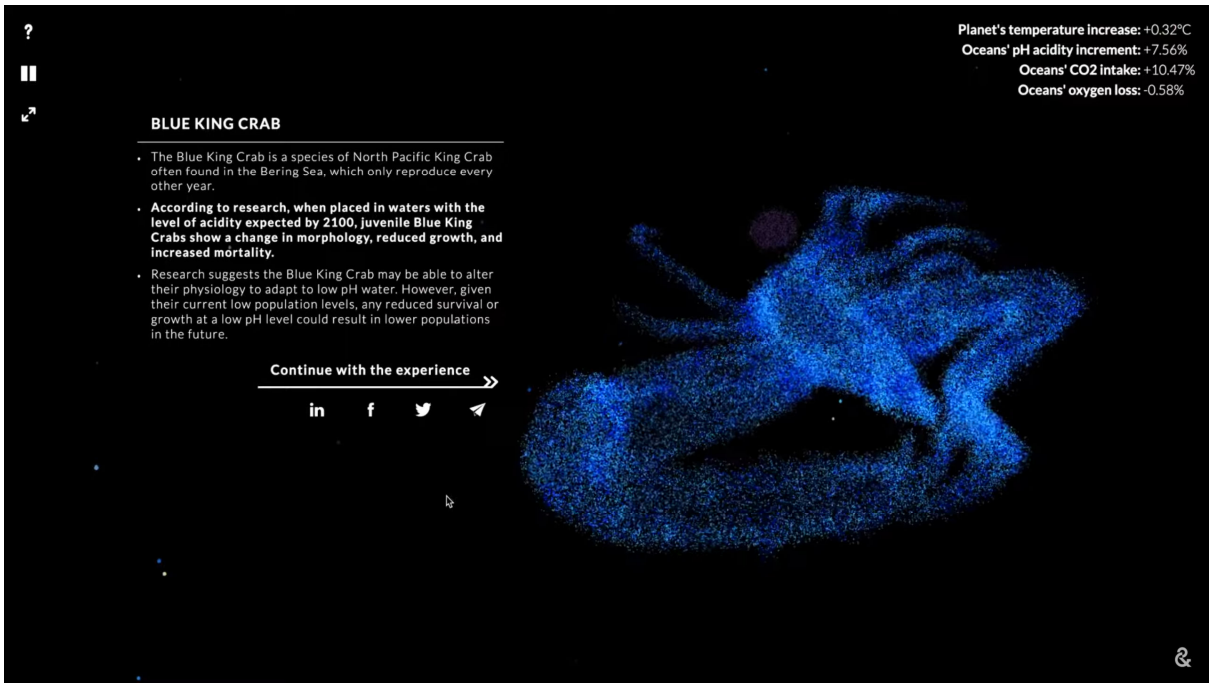

Figure 10: ***Diving into an Acidifying Ocean (2020)*** by Cristina Tarquini in collaboration with Google Arts & Culture, visualizing data obtained from National Oceanic and Atmospheric Administration to explore the explore the destructive impact of carbon dioxide levels on marine animals and species from before the industrial revolution to 2100, and a new marine organism born in the Anthropocene era.

Figure 11: ***Coastline Paradox (2020)*** by Timo Aho, Pekka Niittyvirta, in collaboration with Google Arts and Culture, Clare Brooks.

To fight against climate change, some artists use art to explore solutions. For instance, ***88 cores (2017)*** by Peggy Weil (figure 12) predicts future climate and environmental changes by detecting past climate and environmental changes [18], [71]. Moritz Stefaner's ***Project Ukko - Climate service for seasonal wind forecasts (2020)*** (figure 13) preents an understanding of the future variability of wind energy resources and bridges the gap between energy practitioners and the climate science community [73], [76]. In short, artists have integrated the concept of global thinking into art. Through art, they show a power beyond their own survival essence, as well as a possible world and a speculated future.

Figure 12: ***88 cores (2017)*** by Peggy Weil. By using the data of ice cores collected in the National Ice Core Laboratory, drilled between 1989 and 1993 as part of the Greenland ice sheet project. It emphasizes the key role of ice Nuclear Science in human exploration and understanding of the earth's past and future climate, and tells people that human beings will coexist with climate change in the foreseeable future

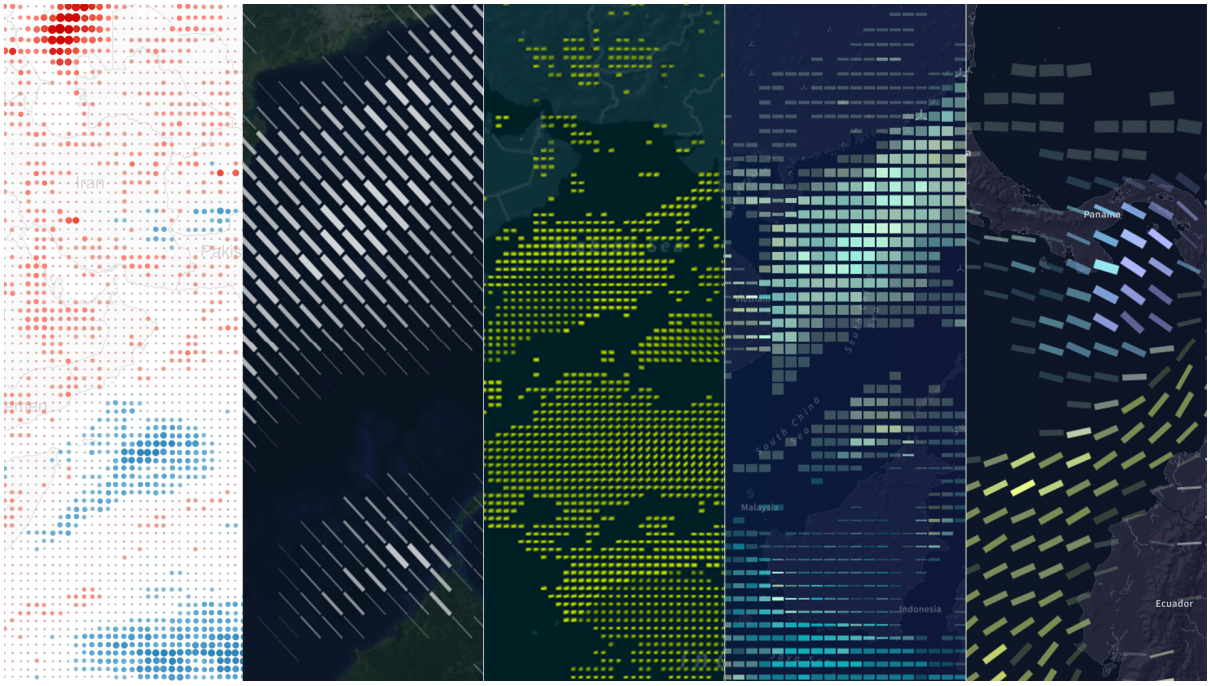

Figure 13: ***PROJECT UKKO - Climate service for seasonal wind forecasts (2020)*** by Moritz Stefaner. He believes that both the natural environment and human society are vulnerable to climate change, and the progress of climate science is creating an unprecedented potential to provide longer-term climate and weather forecasts in the coming months, seasons and decades. This work is created for users in the wind power industry to explore the probabilistic wind speed prediction of future seasons provided by the resilience prototype

3. Results and Discussion

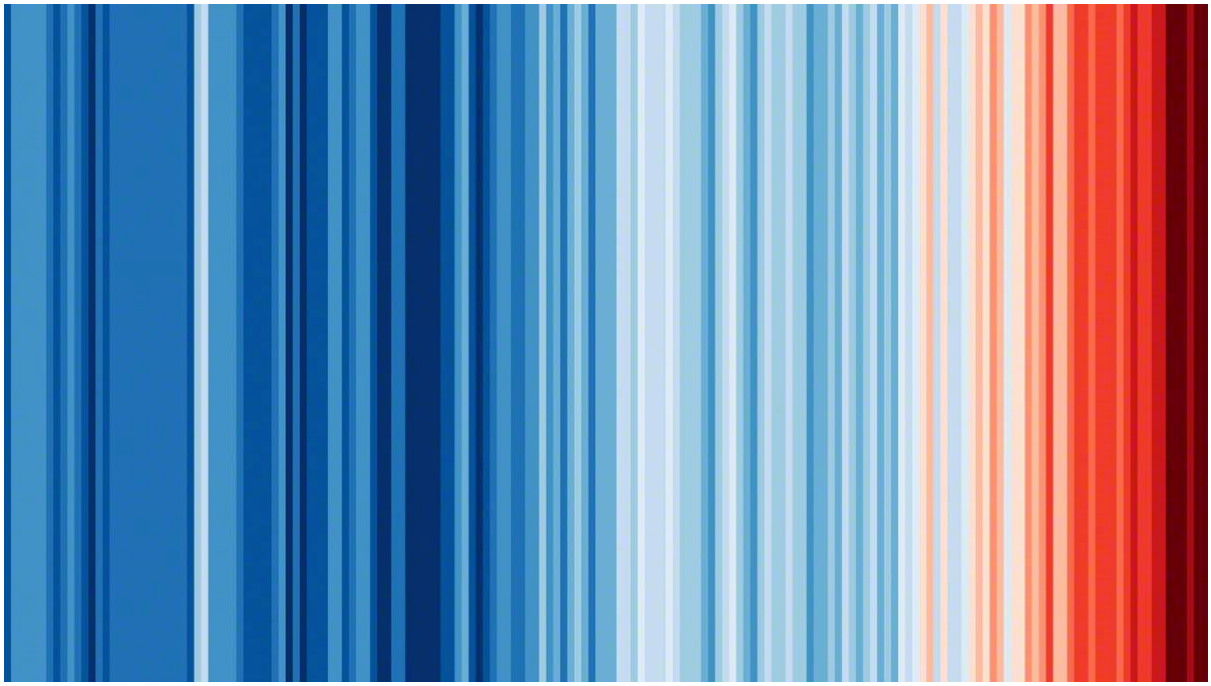

Figure 16: ***Climate Stripes: Warming Stripes (2018)*** by Ed Hawkins.

Figure 17: ***Pollution Pods (2017-present)*** by Michael Pinsky.

Climate Stripes: Warming Stripes (2018) (figure 16) and ***Pollution Pods (2017-present)*** (figure 17) are some of the projects that have made great contributions to climate change in recent years. This paper has brought together critical theory and contextual thinking within a visual framework. This method not only combines art with interdisciplinary thinking to expand multi-disciplinary questions but further explores how visual and creative narratives and metaphors engender creative transformation in the space of climate change. The power of climate education is brought into play through artistic practice. Creative intention combined with specific climate issues integrates personal and collective emotion transforming individuals and audiences shaping sustainable thinking within global societies. In summary, art as an ideological metaphor and new approaches to narrative visual storytelling when viewed through a methodological interdisciplinary lens can deepen the understanding of climate change and form new insights and positive visualisation for speculative futures. Through art, artists can build imaginative spaces to rethink and refigure that contemplatively reimagine daily life encourage people to reflect on their lives and behaviours and question their relationship to the planet, the climate and promote sustainable values; integrating global thinking into art asks one to review the past, face the present and look forward to the future in a process of re-imagining and re-worlding to realize a sustainable and speculative futures.

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Does Money Make an Effect? UK Monetary Policy with Quantitative Easing

Ziqing Wang, Vo Phuong Mai Le, David Meenagh, Patrick Minford

***Abstract*—** We investigate the economic impact of the quantitative easing conducted by the Bank of England in response to the Global Financial Crisis. This work is based on the new challenge for monetary policy during the aftermath of the financial crisis in 2008. Particularly when the interest rate with zero lower bound hampered the ability of the conventional monetary policy, the central banks sought to adopt unconventional monetary policy such as quantitative easing. The magnificent updates in the monetary policy motivate us to better understand the unconventional monetary tool, for instance, in light of their transmission mechanism through the financial intermediary. When money is injected through the QE, the private sector, including entrepreneurs, will hold more cash on the account, which can be treated as the collateral to increase their credit or lower the external finance premium required by the financial intermediary. This paper assesses the impact of the QE closely following the intuition of Le et al.(2016), where money is treated as the loadable liquidity and the cheapest type of collateral against bank lending. In this work, we estimate and test the model against the UK data to make sure it can explain the data dynamics for critical macroeconomic variables. The model framework is based on Smets and Wouters (SW, 2007), allowing for nominal and real rigidity and following Bernanke et al. (2000) to incorporate the banking sector. Overall, the model captures the significance of the unconventional monetary policy, revealing that the money supply needs to be controlled to maintain economic stability. Specifically, the monetary reform can help squash the enormous crisis and stabilize the economy with fewer significant fluctuations from the simulated output under different schemes.We discussed some possible alternatives to the inflation-targeted rule. By measuring the welfare loss and crisis times, we found that the monetary regime of nominal GDP targeting and monetary reform stands out with the lowest welfare cost and crisis frequency. Therefore, we propose that the single Taylor rule is not enough to fight the financial friction. A better-performed monetary regime like the combination of nominal GDP targeting with monetary reform could be considered.

***Keywords*—** Quantitative easing,Financial friction,SOE-DSGE,Zero lower bound.

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Self-serving Anchoring of Self-Judgments

Elitza Z. Ambrus, Bjoern Hartig, Ryan McKay

***Abstract*—**Individuals' self-judgments might be malleable and influenced by a comparison with a random value. On the one hand, self-judgments reflect our self-image, which is typically considered to be stable in adulthood. Indeed, people also strive hard to maintain a fixed, positive moral image of themselves. On the other hand, research has shown the robustness of the so-called anchoring effect on judgments and decisions. The anchoring effect refers to the influence of a previously considered comparative value (anchor) on a consecutive absolute judgment and reveals that individuals' estimates of various quantities are flexible and can be influenced by a salient random value. The present study extends the anchoring paradigm to the domain of the self. We also investigate whether participants are more susceptible to self-serving anchors, i.e., anchors that enhance participant's self-image, especially their moral self-image. In a pre-reregistered study via the online platform Prolific, 249 participants (156 females, 89 males, 3 other and 1 who preferred not to specify their gender; $M = 35.88$, $SD = 13.91$) ranked themselves on eight personality characteristics. However, in the anchoring conditions, respondents were asked to first indicate whether they thought they would rank higher or lower than a given anchor value, before providing their estimated rank in comparison to 100 other anonymous participants. A high and a low anchor value were employed to differentiate between anchors in a desirable (self-serving) direction and anchors in an undesirable (self-diminishing) direction. In the control treatment, there was no comparison question. Subsequently, participants provided their self-rankings on the eight personality traits with two personal characteristics for each combination of the factors desirable/undesirable and moral/non-moral. We found evidence of an anchoring effect for self-judgments. Moreover, anchoring was more efficient when people were anchored in a self-serving direction: the anchoring effect was enhanced when supporting a more favourable self-view and mitigated (even reversed) when implying a deterioration of the self-image. The self-serving anchoring was more pronounced for moral than for non-moral traits. The data also provided evidence in support of a better-than-average effect in general as well as a magnified better-than-average effect for moral traits. Taken together these results suggest that self-judgments might not be as stable in adulthood as previously thought. In addition, considerations of constructing and maintaining a positive self-image might interact with the anchoring effect on self-judgments. Potential implications of our results concern the construction and malleability of self-judgments as well as the psychological mechanism shaping anchoring.

***Keywords*—**Anchoring, Better-than-average effect, Self-judgments, Self-serving anchoring

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Exploring Pre-trained ASR Model HuBERT for Early Alzheimer's Disease and Mild Cognitive Impairment Detection in Speech

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***Abstract*—** Dementia disease is difficult to diagnose because of the lack of early physical symptoms. Early dementia recognition is key to improving the living condition of patients. Due to speech impairment being a common characteristic of early types of dementia, speech technology is considered a valuable biomarker for this challenge. Recent works have utilized conventional acoustic features and machine learning methods to detect dementia in speech. BERT-like classifiers have reported the most promising performance. One constraint, nonetheless, is that these studies are either based on human transcripts or on transcripts produced by automatic speech recognition (ASR) systems. Regarding the first case, transcripts have high quality but require a time-consuming processing. In the case of the ASR systems, transcription quality is poor because patients with dementia usually present agrammatical speech, which leads to a high word error rate.

This research contribution is to explore a method that does not require transcriptions nor feature extraction but is able to detect early Alzheimer's disease (AD) and mild cognitive impairment (MCI) based on raw speech files. This is achieved by fine-tuning a pre-trained ASR model for the downstream early AD and MCI task. To do so, a subset of the thoroughly studied Pitt Corpus is customized to provide a dataset containing early AD and MCI speech samples. The subset is balanced for class, age and, gender. Data processing also involves cropping the samples to 10-second segments. For comparison purposes, a baseline model is defined by training and testing a Random Forest with 20 extracted acoustic features using librosa library implemented in Python. These are: zero-crossing rate, MFCCs, spectral bandwidth, spectral centroid, root mean square, and short-time Fourier transform. The baseline model achieved a 58% accuracy.

To fine-tune HuBERT as a classifier, an average pooling strategy is employed to merge the 3D representations from audio into 2D representations, and a linear layer is added. The pre-trained model used is 'hubert-large-ls960-ft' downloaded from the HuggingFace Transformers library. Empirically, the number of epochs selected is 5 and the batch size defined is 1. Experiments show that our proposed method reaches a 74% accuracy. This suggests that the linguistic and speech information encoded in the self-supervised ASR-based model is able to learn acoustic cues of AD and MCI speech. The proposed method not only outperforms the baseline model but also provides a potential clinical application as it is content-independent, automatic, and transcription-free.

***Keywords*—** automatic speech recognition, early Alzheimer's recognition, mild cognitive impairment, speech impairment.

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Integrated Planning, Designing, Development and Management of Eco-Friendly Human Settlements for Sustainable Development of Environment, Economic, Peace and Society of All Economies

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Abstract -- This paper will focus on the need for development and application of global protocols and policy in planning, designing, development, and management of systems of eco-towns and eco-villages so that sustainable development will be assured from the perspective of environmental, economical, peace, and harmonized social dynamics. This perspective is essential for the development of civilized and eco-friendly human settlements in the town and rural areas of the nation that will be a milestone for developing a happy and sustainable lifestyle of rural and urban communities of the nation. The urban population of most of the town of developing economies has been tremendously increasing, whereas rural people have been tremendously migrating for the past three decades. Consequently, the urban lifestyle in most towns has stressed in terms of environmental pollution, water crisis, congested traffic, energy crisis, food crisis, and unemployment. Eco-towns and villages should be developed where lifestyle of all residents is sustainable and happy. Built up environment of settlement should reduce and minimize the problems of non ecological CO_2 emissions, unbalanced utilization of natural resources, environmental degradation, natural calamities, ecological imbalance, energy crisis, water scarcity, waste management, food crisis, unemployment, deterioration of cultural heritage, social, the ratio among the public and private land ownership, ratio of land covered with vegetation and area of settlement, the ratio of people in the vehicles and foot, the ratio of people employed outside of town and village, ratio of resources recycling of waste materials, water consumption level, the ratio of people and vehicles, ratio of the length of the road network and area of town/villages, a ratio of renewable energy consumption with total energy, a ratio of religious/recreational area out of the total built-up area, the ratio of annual suicide case out of total people, a ratio of annual injured and death out of total people from a traffic accident, a ratio of production of agro foods within town out of total food consumption will be used to assist in designing and monitoring of each eco-towns and villages. An eco-town and villages should be planned and developed to offer sustainable infrastructure and utilities that maintain CO2 level in individual homes and settlements, home energy use, transport, food and consumer goods, water supply, waste management, conservation of historical heritages, healthy neighborhood, conservation of natural landscape, conserving bio-diversity and developing green infrastructures. Eco-towns and villages should be developed on the basis of master planning and architecture that affect and define the settlement and its form. Master planning and engineering should focus in delivering the sustainability criteria of eco towns and eco village. This will involve working with specific landscape and natural resources of locality.

Key words; eco-town, ecological habitation, master plan, sustainable development

Objective of Technical Paper: This paper focusses in paying attention of developed, developing and under developed economies towards application of integrated protocols and Policy for planning, designing, development and management of system of eco towns and eco villages for sustainability of global human society.

Methodology of Research

(Assessing Correlation among Major Elements of Eco Town and Village Planning)
Key indicators of sustainable development are selected from considering of higher level of impact of sustainable development of mixed economies. **Key indicators of selected 15 global economies** (Each 5 from developed, developing and underdeveloped economies) are assessed from secondary survey. Multiple Co-relation are assessed and generalized in terms of among selected indicators of sustainable development.

Major elements of Eco Town and Village are co-related among each other. Major correlated elements of eco town and eco villages are zero-carbon in eco-towns; infrastructures of climate change adaptation, ecological housing, ecological transport, natural and historic Landscape development, biodiversity conservation of all flora and fauna, water resources management, waste management, air quality management, green Infrastructures development, ecological educational institutions, ecological health institutions, micro organic product/small cottage industry in rural community, macro organic farming/industry at adjoining/periphery of town, eco-tourism development, conservation of Cultural and religious phenomenon of locality, disaster management for potential natural calamities, water conservation, ecological commercial building, sports and recreation infrastructures, spiritual development centre, public infrastructures, centre for Protection and respect of Senior citizen/disable/excluded group and urban securities for all class of society specially for privileged class of society.

Major Strategy and approach of Planning and Development of Eco Town and Villages

1. Integrated Planning, designing and development approaches in development of sectors;
2. Ensure of Institutional capacity development in the sector,
3. Optimum utilization of Local resources mobilization,
4. Investment and Management of Urban system from Multi collaborative approaches
5. Ensure of Conservation of natural resources for future generation
6. Ensure of Ecological and environmental balance
7. Ensure of Cultural Preservation
8. Self-dependency in production of basic facilities and foods.
9. Development of economic activities for balanced demand and supply of employment.

10. Developing adequate physical infrastructure for Spiritual Development
11. Sustainability and good governance

Major Expected Impact of Eco Town and Village

The following outcome are expected by intervention of planning and development of eco town in the rural and town are.

1. Establishment of ecological and hygienic settlements/resident
2. Establishment of Ecological health, education, commercial facility
3. Pollution Management by Total Recycling of Waste (Waste Water and Solid Waste)
4. Optimum Utilization locally available Natural resources (Water, land, people, forest, waste)
5. Green infrastructure and conservation of biodiversity
6. Healthy neighborhoods by adequate open space as road, parking, recreation, plantation in eco town
7. Enhanced local employment and economy from holistic development in the eco community
8. Adequate opportunity of employment within town
9. More than 50% Food consumption from organic foods produced at local level.
10. Civilized culture and healthy life style with longer life span.
11. Establishment of urban and rural safety at heist level
12. Development of High level of spiritual feelings of the most people

Conclusion/Contribution of Research

This research will contribute to apply tools of holistic protocols and policy in planning, designing, development and management of system of Eco Towns and Villages for achieving the sustainable development of developing and developed economies.

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The Impact of International Financial Reporting Standards (IFRS) Adoption on Performance's Measure: A Study of UK Companies

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***Abstract*—** This study presents an approach of assessing the choice of performance measures of companies in the United Kingdom after the application of IFRS in 2005. The aim of this study is to investigate the effects of IFRS on the choice of performance evaluation methods for UK companies. We analyse through an econometric model the relationship of the dependent variable, the firm's performance, which is a nominal variable with the independent ones. Independent variables are split into two main groups: the first one is the group of accounting-based measures: Earning per share, return on assets and return on equities. The second one is the group of market-based measures: market value of property plant and equipment, research and development, sales growth, market to book value, leverage, segment and size of companies. Concerning the regression used, it is a multinomial logistic regression performed on a sample of 130 UK listed companies. Our finding shows after IFRS adoption, and companies give more importance to some variables such as return on equities and sales growth to assess their performance, whereas the return on assets and market to book value ratio does not have as much importance as before IFRS in evaluating the performance of companies. Also, there are some variables that have no impact on the performance measures anymore, such as earning per share. This article finding is empirically important for business in subjects related to IFRS and companies' performance measurement.

***Keywords*—** performance's Measure, nominal variable, econometric model, evaluation methods.

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Study of the Link Between Global Commodity Price Shocks and Financial Markets

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ABSTRACT

In this article, we provide an in-depth study of the link between global commodity price shocks and Financial markets. Our results suggest the existence of a time-varying causal relationship in the observed time period depending on the country's level of development and the position on the super-rotations of the shocks. These results will help the decision-making process of investors. Furthermore, the findings of this study are important for policymakers to strengthen the stock market to promote economic growth.

Keywords: financial crisis, global commodity, financial market, price shock, MIDAS

1. INTRDOCUTION

volatile commodity prices have impacted the global economy. Especially due to the expansion of the global economy after the 2000s, investors are paying more and more attention to commodity prices. Policymakers and market participants have focused on the dynamics of commodity price volatility because of its impact on economic growth and financial development (Saadi Sedik, 2011). On the other hand, the main research area in finance deals with the factors that affect stock prices and the sensitivity of stock prices to these factors. As a result, understanding the behavior of stock markets has become a primary goal of investors in emerging markets (Soenen & Johnson, 2009). The interaction of commodity markets with financial markets is an important area of study. There is growing evidence that fair markets and goods are interconnected and that the correlation between goods and equity has increased since the early 2000s, Vivian (2014). Many studies have found a strong relationship between the stock market and economic growth. Because of this strong relationship, we need to take a closer look at the many factors that affect the stock market. In particular, policymakers, with the contribution of these studies, have increased their interest in commodity prices because of the impact on inflation. The importance of commodity price volatility to the global economy was highlighted by the G20 at the summit in Pittsburgh in September 2009 (Anna Creti, Mignon, 2013). Despite the enormous importance of commodity prices, only a few studies have highlighted the impact on stock prices. For this reason, in this study, using time series analysis, the relationship between and the effects of commodity prices on stock markets will be examined. The aim of this study is to investigate the effect of commodity prices on stock prices in Iran. The main idea of this study is quite simple. Rising commodity prices affect stock prices. An increase in commodity prices is often accompanied by an increase in demand due to booming economic activity. Kilian (2009). If the price of raw materials used in the production process (energy, metals, raw materials) increases due to increased costs, the profits of companies will decrease and therefore there will be less profit to distribute distribution, Lombardi (2013). That will put pressure on stock prices and stock prices may drop. This study contributes to the

empirical literature on the relationship between the stock market and the commodity market. With the results of the study, we can assess the macroeconomic impact of commodity prices on the Iran economy. Significant fluctuations in commodity prices are a historical fact. Therefore, it is not surprising that many studies have investigated the impact of commodity prices on a country's macroeconomic situation. Such relationships are important for several reasons. From an economic development perspective, excessive exposure to commodities can reduce the "depth" and "width" of the domestic stock market. From a financial perspective, the monetization of commodity markets over the last few decades had opened up new opportunities for investors to diversify their portfolios (eg Domanski & Heath, 2007; Dwyer, Gardener & Williams, 2011; Silvennoinen & Thorp, 2013; Vivian & Wohar, 2012). Commodity and equity combinations can provide better risk returns than equity-only investments, as investing in commodities can help diversify risk (see Erb. & Harvey, 2006). But at the same time, Nissanke (2012) states that volatility and commodity price volatility (with the above developments and macroeconomic implications) are due to increased market-economic interconnections. Previous research on this topic has focused primarily on petroleum and non-petroleum commodities. In addition, these studies often focus on developed countries such as the United States and EU countries rather than low- and middle-income countries. The relationship between the global commodity market and the stock market varies from country to country throughout its stage of development. In fact, many countries have significantly improved their living standards and developed their domestic stock markets over the past few decades. Therefore, time analysis is especially important. This article contributes to the literature by providing an overview of the relationship between global commodity prices and the Tehran Stock Exchange. Start with a general index of global commodity prices, look at several price indexes, and then look at separate price levels for oil (supply and demand) and non-oil (metal) prices. Kindness). Then apply the mixed frequency vector autoregressive model (MFVAR) performed by Ghysel, Hill, and Motegi (2016). This helps solve potential problems that arise from time synthesis, leading to better size and higher performance causal testing. Third, analyze within a fluctuating time frame. It is necessary because the structure of the world economy and the dependence of each country on raw materials have changed significantly in recent decades. In anticipation of some important results, our findings suggest that the relationship between commodities and stock prices varies by commodities, income groups, and time periods. Broadly speaking, it distinguishes between three periods: the product crisis of the 1980s and 1990s, the product boom of the 2000s, and the global financial crisis (GFC). As for the total price index, it shows the penetration rate of commodity prices that caused stock market prices in the 2000s, and low-income and low-income countries in the 1980s. Global oil prices tend to strengthen our relationship with the stock market. However, the GFC shows that shocks from oil stock markets, primarily caused by high-income countries, are becoming less important. with distinguishing between oil supply and demand shocks, how the impact of the former diminishes globally over time (excluding high-income countries) and how the latter diminishes globally during the commodity price boom of the 2000s. In high-income countries, income has a huge influence on the role. Finally, evidence of metal prices shows that their relevance under the GFC increases in low- and middle-income countries and decreases in high-income countries. The rest of the paper is organized as follows: A brief review of the literature on the impact of global shocks on equity returns can be found in Section 2. Section 3 presents a form of a mixed frequency VAR model and a global connectivity index. Sections 4 and 5 explain the data, respectively, and provide empirical findings on the dynamics of global shock and stock market returns

2. LITERATURE REVIEW

There is an important literature on the relationship between commodity prices and many financial markets. This section presents a brief literature review of articles focusing on the dynamics between commodity prices and the stock market. Gorton and Rouwenhorst (2004) studied the interaction between stocks and commodities-related assets and analyzed commodity futures and average stock returns. They found a significant relationship between them. (Delatte & Lopez, 2013) (Gorton & Rouwenhorst, 2004). Sadorsky (1999) studied the relationship between oil prices and stock prices. Using a vector automatic regression (VAR) model, Sadorsky pointed out the importance of oil prices for industrial production (Chan, Treepongkaruna, Brooks, & Grey, 2011) (Sadorsky, 1999). Thuraisamy and Ali Ahmed (2013) experimented in their paper on the interaction between Asian stock market volatility, crude oil futures prices and gold. They found that stock market volatility shocks are related to crude oil and gold futures markets. (Thuraisamy, Sharma and Ali Ahmed, 2013). Rossi (2012) studied the relationship between equity markets, commodities, and exchange rates in more detail and found that the value of a country's stocks is likely to the raw material price index prediction of some raw material exporting countries (Rossi, 2012). Tang and Xiong (2010) found that investments poured into commodity markets between 2006 and 2010 led to an increase in commodity volatility by increasing their costs (Tang & Xiong, 2010). Soenen & Johnson, (2009) presents changes in commodity prices on the stock markets of South American countries (Soenen & Johnson, 2009). Kang, Hu and Chen (2013) studied the relationship between international food prices and stock prices in China. Empirical results show that the Chinese stock market interacts with many food futures contracts (Kang, Hu and Chen, 2013). Delatte & Lopez (2013), in their paper, studied the relationship between equity and commodity markets and found that the integration of some commodities with the equity index starts early 2000s (Delatte & Lopez, 2013). Chan et al. (2011) found that return on equity is affected by financial assets, commodities and real estate assets using a common Markov transformation model (Chan et al., 2011). Investigations into the relationship between commodity prices and stock returns have mainly focused on oil, using the single-frequency VAR method. UK and US and found that, with the exception of the UK, Granger oil prices boosted both activity resumption and output. Huang, Masulis, and Stoll (1996) used the VAR method and found no relationship between the daily oil futures yields and the daily returns for U.S. equities for the period from October 9, 1979 to March 16, 1990. The VAR method was also used by Sadorsky (1999), who confirmed that monthly oil prices and fluctuations in oil prices both play anwe important role in the economic performance of the United States. The authors find that changes in oil prices predict market inventories. Global profits and rising oil prices significantly reduce future equity returns. They also found that changes in oil prices did not predict future market returns in three of the 18 developed markets examined (Hong Kong, Japan, and Singapore), while oil prices predicted future market returns in 11 of the 30 emerging markets considered (Brazil, Finland, India, Ireland, Israel, Jordan, New Zealand, Portugal, South Korea, Taiwan, and Thailand). In addition, Cong, Wei, Jiao and Fan (2008) found no evidence of a relationship between oil prices and real equity return in China using the standard VAR framework. As mentioned in the introduction, several papers report evidence of a time-varying relationship between oil and the stock market. However, this document mainly focuses on developed economies. For example, Ciner (2001) uses a nonlinear Granger causality approach to examine the dynamic associations between future daily oil prices and the US stock market. The author uses two data samples for the periods from October 9, 1979 to March 16, 1990 (as Huang et al., 1996) and March 20, 1990 to March 2, 2000. The study showed a significant nonlinear Granger causality of the crude oil futures returns on the S&P 500 index returned in both samples. Park and Ratti (2008) use linear and nonlinear multivariable VAR specifications to estimate the impact of oil price shocks and oil price

movements on real equity return for a sample of 14 Developed Nation. They find that oil price shocks have a statistically significant effect of the same time or 1month lag on real equity returns. Apergis and Miller (2009) examine whether changes in oil prices affect stockpiles returns in a sample of eight developed countries between 1981 and 2007.7 Their results show that the shocks The real shock to oil prices temporarily caused stock gains in Germany, Italy, the United Kingdom and Germany. USA. In the case of Australia, only shocks in oil supply will temporarily boost stockpiles returns, while in the case of France, only shocks in global oil demand will temporarily boost returns. stock returns. For Canada and Japan, they are not causal. Yoon (2015) use a time-varying VAR model to examine the impact of oil price shocks on US stock market returns based on monthly data for the period January 1, 2015. They find that oil price shocks contain information to predict actual return on equity, while the coefficients and nature of the shocks vary over time. Several articles have investigated the link between commodity prices and stock market returns in developing economies. (Yang, 2012) (2013) found limited evidence for the effect of monthly oil prices on stock market returns for a group of 9 oil importers and 7 oil exporters over the period. Empirical tests show that oil shocks are more likely to affect stock market returns in oil exporting countries than in oil importing countries; however, there is no significant (non-linear) causal relationship between changes in oil prices and stock market returns for most of the countries in the sample. uses daily data to look at the co-volatility between commodity prices, i.e. gold and oil, and the BRICS stock market from September 29, 1997 to March 4, 2016. Their results, based on the wavelet method, show that BRICS equity returns vary with WTI crude oil prices in the long run. Furthermore, the authors find a stronger copper movement at the beginning of the GFC. No evidence of co-movement was detected between the BRICS stock market and gold prices over time and across frequencies (horizon). The latter implies that gold can act as a hedge or a haven for BRICS economies against extreme market movements. Although the authors provide a good overview of the commodity and stock market arbitrage coefficients for the five developing economies, directional predictability has not yet been discussed and remains to be seen. an open question. We extend the above material in a number of ways. First, we look at a broader set of price indices, ranging from general commodity price indexes to commodity-specific, such as the global metal price index and individual petroleum supply and demand shocks. separate. In addition to analyzing the overall role of commodities, specific prices may be more relevant to specific countries (e.g. oil prices for oil-dependent countries) or to specific points in time. Metals are also essential inputs in many industries and are therefore essential to consuming countries (Rossen, 2015). And investigate the nature of changes over time between global commodity prices and financial markets. and time series combinations at different sampling frequencies. As a result, we use more countries

3. ECONOMETRIC METHODOLOGY

In order to research the connection among international commodity fees and Iran inventory market, we make the most VAR and Granger causality checks in a time-various setting. As noted above, we depend specifically at the MF-VAR method proposed with the aid of using Ghysels et al. (2016), as in brief mentioned below. 3.1 Mixed frequency VAR The MF-VAR version is an observation-pushed version that immediately pertains to the usual VAR version settings and is appropriate for Granger causality checks (Ghysels, 2016). Using the notation of Ghysels et al. (2016), we denote m to be the *ratio of sampling frequencies*, that is, the number of high-frequency periods in each low-frequency period $\tau \in \mathbb{Z}$. Thus, let $\tau \epsilon \{1,2,...,T_L\}$ be the time sequence, here at the monthly frequency. Let $CP(\tau, j)$ denote the series

of commodity prices at the jth week of month τ with $j\varepsilon\{1, 2, 3, 4\}$ while $SP(\tau)$ denotes the series of stock prices at month τ. Section 4 provides further details on the data.

Assume that each series is sufficiently differenced to satisfy covariance stationarity. The variables are at weekly and monthly frequencies, so that $m = 4$. Then, the MF-VAR(p) model is specified as follows:

$$\underbrace{\begin{bmatrix} CP_{(\tau,1)} \\ CP_{(\tau,2)} \\ CP_{(\tau,3)} \\ CP_{(\tau,4)} \\ SP_{(\tau)} \end{bmatrix}}_{\equiv X_{(\tau)}} = \sum_{k=1}^{p} \underbrace{\begin{bmatrix} a_{11,k} & a_{12,k} & a_{13,k} & a_{14,k} & a_{15,k} \\ a_{21,k} & a_{22,k} & a_{23,k} & a_{24,k} & a_{25,k} \\ a_{31,k} & a_{32,k} & a_{33,k} & a_{34,k} & a_{35,k} \\ a_{41,k} & a_{42,k} & a_{43,k} & a_{44,k} & a_{45,k} \\ a_{51,k} & a_{52,k} & a_{53,k} & a_{54,k} & a_{55,k} \end{bmatrix}}_{\equiv A_k} \underbrace{\begin{bmatrix} CP_{(\tau-k,1)} \\ CP_{(\tau-k,2)} \\ CP_{(\tau-k,3)} \\ CP_{(\tau-k,4)} \\ SP_{(\tau)} \end{bmatrix}}_{\equiv X_{(\tau-k)}} + \underbrace{\begin{bmatrix} \varepsilon_{(\tau,1)} \\ \varepsilon_{(\tau,2)} \\ \varepsilon_{(\tau,3)} \\ \varepsilon_{(\tau,4)} \\ \varepsilon_{(\tau,5)} \end{bmatrix}}_{\equiv \varepsilon_{(\tau)}} \quad (1)$$

A_k is a square matrix of coefficients for $k = 1, \ldots, p$, where p is the lag length; $\varepsilon_{(\tau)}$is the vector of residuals, where $\varepsilon_{(\tau)} \sim (0, \sigma^2)$, $\sigma^2 > 0$. All weekly observations are stacked in each month τ to obtain $X(\tau) = [CP\ (\tau, 1).\ CP\ (\tau, 2)\ 'CP\ (\tau, 3), CP\ (\tau, 4), SP(\tau)']'$ Following Ghysels et al. (2016), the constant is not included in (1) and $X(\tau)$ is pre de-meaned.[9] The lag length is selected using the Bayesian Information Criterion (BIC). The MF-VAR(p) model in (1) can then be written as

$$X(\tau) = \sum_{k=1}^{p} A_k X(\tau - k) + \varepsilon(\tau) \quad (2)$$

In line with Ghysels et al. (**2016**), our model obeys the following assumptions.[10] First, all roots of

the polynomial $det\left(I_5 - \sum_{k=1}^{p} A_k z^k\right) = 0$ lie outside the unit circle, where *det*(.) is the determinant. This ensures that the MF-VAR is state stationary, hence all variables in the VAR are made stationary. Second, $\varepsilon(\tau)$ is a strictly stationary martingale difference sequence with finite second moment, which is ensured by choosing the lag length that leads to uncorrelated residuals.

Third, $\{X(\tau), \varepsilon(\tau)\}$ obey α-mixing that satisfy $\sum_{h=0}^{\infty} \alpha_{2^h} < \infty$. This is a standard assumption to ensure validity of the bootstrap for VAR models (see, for example, Kilian, **1998**; Paparoditis, **1996**). In fact, these assumptions ensure the consistency and asymptotic normality of least squares estimator $\hat{A}_k$. [11]

Next, we exploit Wald statistics based on the coefficients of the MF-VAR(p, h) at test horizon h (h = 1 in our study), $B(h) = \left[A_1^{(h)}, \ldots, A_p^{(h)}\right]'$. For example, CP does not Granger-cause SP given a mixed-frequency information set equal to $a_{51,1} = \ldots = a_{52,1} = \ldots = a_{53,1} = \ldots = a_{54p} = 0_{1\times m}$ whereas SP does not Granger-cause CP given a mixed-frequency information set equal to $a_{15,1} = \ldots = a_{25,1} = \ldots = a_{35,1} = \ldots = a_{45p} = 0_{m\times 1}$. Therefore, the null hypothesis of non-causality is a linear restriction defined as:

$$H_0 : Rvec[B(h)] = r \quad (3)$$

where R is a selection matrix of full row rank q. The complete details of the construction of R can be found in Ghysels et al. (2016). r is a restricted vector and zeros are always chosen when performing Granger causality tests. Thus, the null hypothesis of (p, h) MF Granger causality test can be expressed via the following Wald statistic:

$$W_{T_L^*}[H_0(h)] \equiv T_L^* \left(Rvec\left[\hat{B}(h)\right] - r\right)' \times \left(R\hat{\sum}_p(h)\mathrm{R}'\right)^{-1} \times \left(Rvec\left[\hat{B}(h)\right] - r\right) \quad (4)$$

where $T_L^* \equiv T_L - h + 1$ is the effective sample size of the MF-VAR(p, h) model; $\hat{B}(h)$ is the least square estimator of the MF-VAR(p, h) model; $\hat{\sum}_p(h)$ is the positive-definite covariance with the assumptions given in Ghysels et al. (2016), and $W_{T_L^*}[H_0(h)] \xrightarrow{d} \chi_q^2$ under $H_0(h)$.

In addition, we apply a time-varying approach to explain the structural changes that may occur during the considered historical period, especially in fast-growing emerging markets. To this end, according to Chen, Rogoff and Rossi (2010), we use rolling rather than recursive window estimation to adapt more quickly to possible structural changes. The rolling method is relatively robust to the presence of time-varying

parameters and does not require explicit assumptions about the nature of the time-varying data. Agreement with Chen et al. (2010) Use a rolling window that is equal to half the total sample size. Finally, Hyselsetal. (2016) Parametric bootstrap alaGonçalves and Kilian (2004), 12 p-values of Wald statistics based on a non-robust covariance matrix and N = 499 iterations to avoid size bias in a small sample τε {50,100}. To use. Finally, we use the kernel-based HAC covariance estimator from Newey and West (1987) and the automatic lag selection from Newey and West (1994). Therefore, calculate the p-value of the result of (4) defined as follows.

$$\hat{p}_N\left(W_{T_L^*}[H_0(h)]\right) = \frac{1}{N+1} \times \left(1 + \sum_{i=1}^{N} I\left(W_i[H_0(h)] \geq W_{T_L^*}[H_0(h)]\right)\right) \quad (5)$$

where the null hypothesis $H_0(h)$ is rejected at level α if $\hat{p}_N\left(W_{T_L^*}[H_0(h)]\right) \leq \alpha$.

3.2 TIME-VARIYING GLOBAL CONNECTIVITY

Two defined as the ratio of the number of identified Granger causal links to the total number of possible links in each rolling window to assess the overall level of connectivity between global commodity prices and the domestic stock market. Use the global connectivity index. Build the Global Commodities Connectivity Index (GCCI) to monitor the temporal propagation of Granger causality from commodities to the stock market.

$$GCCI_{t_L^*} = \left[\frac{\sum_1^{N^*} C(\omega)\left(t_L^*\right)}{N_{t_L^*}^*}\right],$$

$$\text{If} \begin{cases} \hat{p}_\omega\left(W_{t_L^*}[H_0(h)]\right) \leq \alpha, then\ C(\omega) = 1 \\ \hat{p}_\omega\left(W_{t_L^*}[H_0(h)]\right) > \alpha, then\ C(\omega) = 0 \end{cases} \quad (6)$$

where N^* is the total number of countries at time period t_L^*, where $N^* \in \mathbb{N}$ and $t_L^* \in \left\{1, 2..., \frac{T_L^*}{2}\right\}$; ω is a given country, where $N^* \subset \omega$; α is the significance level, where $\alpha = 0.1$. Analogously, we construct the Global Stock Connectivity Index (GSCI) that depicts the prevalence over time of Granger-Causality from stocks returns to commodity markets. In the next sections, we outline the data used in the analysis and then discuss the results.

4. DATA

The empirical analysis uses mixed monthly and weekly financial and commodity markets data from 61 countries from January 1951 to March 2018. The start date is determined by the availability of the data. Over time, stock market data will become unavailable daily or weekly, especially in developing and developing countries. Eventually, I decided to use monthly stock market data. More countries than impossible. Instead, weekly data on global shocks will be provided.

Appendix B provides a detailed list of online string definitions and a set of summary statistics.

Global shocks are measured by five variables: global oil prices, global oil demand, global oil supply, global commodity prices (including all prices), and global metal prices. The sample period is considered long enough to explain regional and international economic events, and it is important to consider time-dependent relationships. According to Kilian and Park (2009), stock index returns are calculated as logarithmic returns.

We use weekly crude oil price data from West Texas Intermediate (WTI) to represent global oil prices. WTI's oil prices are widely used as a benchmark for oil prices and are highly correlated with the other two benchmark oil prices, Brent and Dubai (see Kilian & Park, 2009; Phan,narayan, 2015). .. Price data for

WTI is displayed in US dollars and is collected on a daily average from Datastream. In addition, we use two different approaches to get an estimate of global oil supply and global oil demand (Kilian, 2009). According to Bakshi, Panayotov and Skoulakis (2010), we use weekly global oil production data (from Datastream) as a substitute for offers. BDI is strongly and consistently correlated with the global oil demand plot developed by Kilian (2019).

The BDI is nominally used to maintain consistency with the stock index series. Use the Commodity Research Bureau (CRB) Weekly Spot Index as a substitute for global commodity prices. This index is often used in the literature as an estimate of global commodity prices (see Silvennoinen & Thorp, 2013). In addition, the weekly CRB Metals sub-index is considered a substitute for global non-energy commodity prices. The choice of metal price index as a substitute for global non-energy prices is consistent with recent literature on commodity exchanges (see (Joscha Beckmann, Belke, Czudai, 2014). Finally, the above series are all denominated in US dollars and are calculated as logarithmic returns. Factors have been modified using Augmented DickeyFuller (ADF) and PhillipsPerron (PP) unit root tests. Figure A.1 of 14 Online Appendix A shows the temporal movement of the above series. The results focus on the period from January 1986 to compare the results of different products. In total, the data contains three sub-periods. The commodity recession of the 1980s and 1990s, the supercycle of the 2000s, and the period of sharp decline after GFC, which characterizes all indicators.

Considering the complete sample, we then consider a group of three possible countries: high-income countries, high-middle-income countries, low-income countries and low-income countries. Country grouping was carried out based on the World Bank's June 2020 analytical classification. Low and middle income countries are grouped due to the limited data available. 5 empirical results

The methods described in Section 3 have been applied nationwide, both over time and in settings that change over time. As you can imagine, this analysis provides highly fragmented evidence. This can be roughly summarized by the fact that a particular shock to a particular product is considered important at one point and not at another. Given the role of stock market shocks on commodities, the same is true in other directions. We do not report this extensive evidence here, but will gladly provide it on request. Instead, use the Connectivity index described in Section 3 to summarize and report. These allow you to explain and comment on the general trends in Granger causality over time. Also, as mentioned earlier, the report here is limited to the period since 1986, which sampled at least 20 countries. As you can see from Figure B.1 of the online annex, the total number of countries at the end of the sample is 61. Figure 15 shows the Time-Changing Global Commodity Connectivity Index (GCCI) and the Global Equity Connectivity Index (GSCI). All five price indexes were described in Section 3.2. These include the World Commodity Index (WCI), the World Oil Price Index (WOI), the World Oil Supply Index (WOSI), the World Oil Demand Index (WODI) and the World Metals Index (WMI). Due to the different commodity price indexes and available times by country, we will standardize the start date from January 1986, the earliest date in the world oil price series. Country samples increase over time from 24 to 61 during this Period. 15

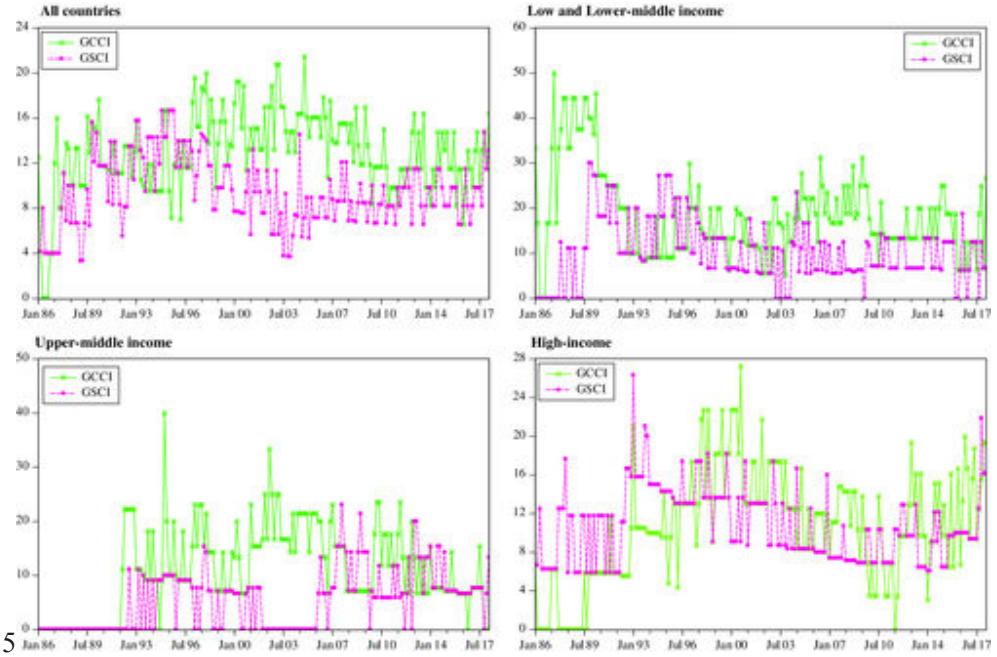

FIGURE 1

World commodity prices (WCI)

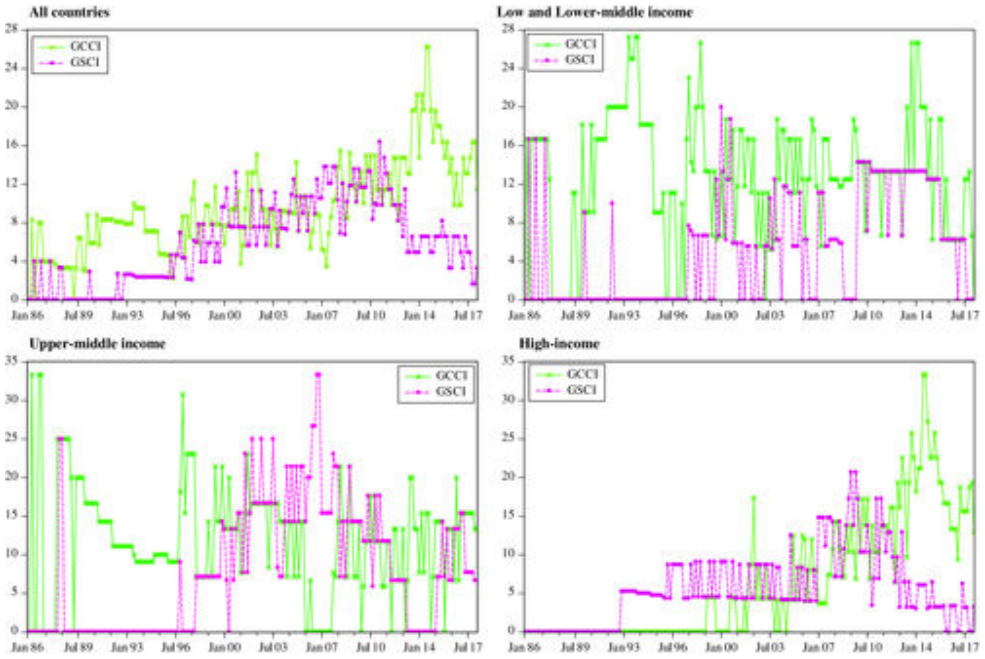

FIGURE 2

World oil prices (WOI)

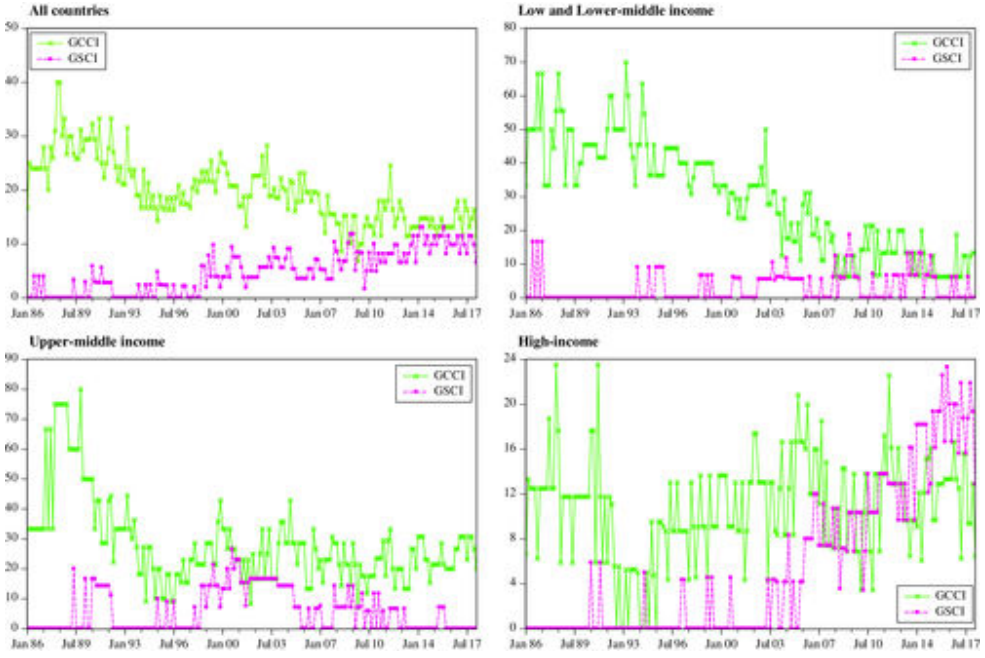

FIGURE 3

World oil supply (WOSI)

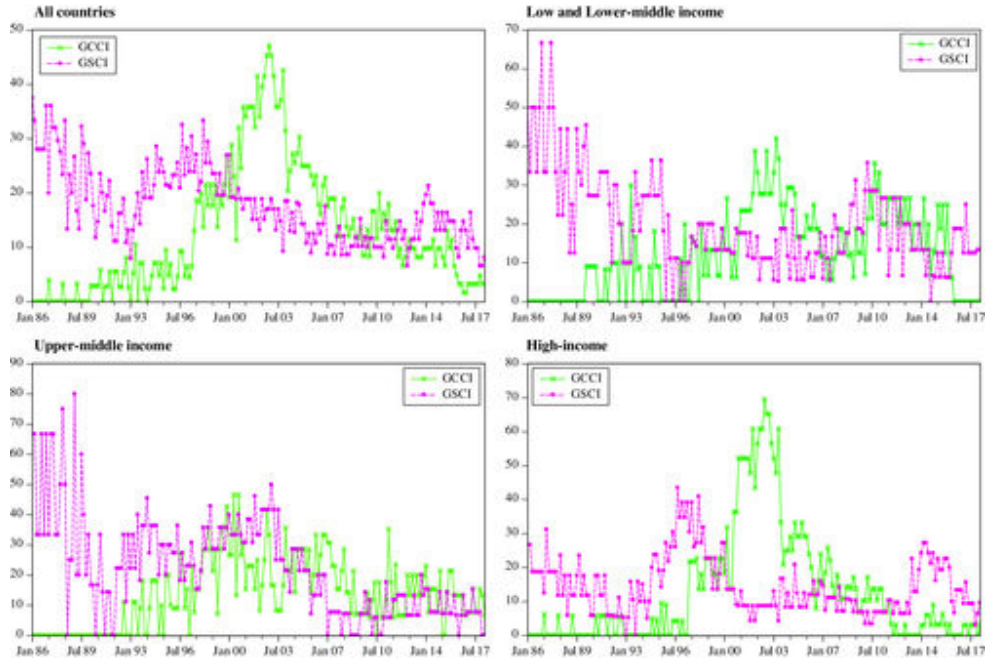

FIGURE 4

World oil demand (WODI)

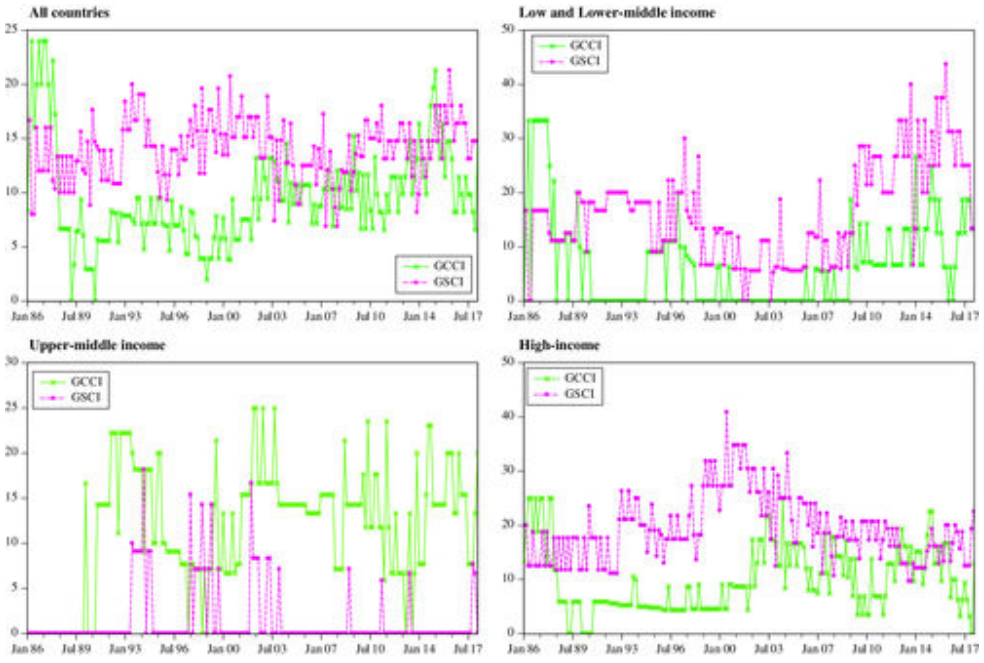

FIGURE 5

World metal prices (WMI)

5.1 WORLD COMMUNITY INDEX

Figure 1 shows WCI's GCCI and GSCI. In all countries, evidence shows a period average of about 12% rejection of Granger causality in both directions, and Granger causality is more common from commodities to the stock market and vice versa. However, from the late 1990s to the 2000s, there was more evidence of a commodity-to-stock price causal relationship, with a peak of 20% of cases, compared to less than 4% in the other direction. Interestingly, this period coincides with the so-called resource boom that followed the "massive resource recession" of the 1980s and 1990s. Other panels in the same figure show how significant Granger causality cases are distributed across different income groups. Causality extends primarily from commodities to the stock markets of low and middle income countries in the 1980s and late 2000s. Granger causality is widespread in high- and middle-income countries, from the early 1990s to the onset of the financial crisis, from commodities to the stock market. Since then, there has been a lack of causality in either direction, suggesting a separation between the commodity and stock markets. High-income stock markets dominated commodity prices until the mid-1990s, after which the opposite is true.

5.2 WORLD OIL PRICE INDEX

Figures 2, 3 and 4 separate the global price index and the oil supply and demand index, taking into account oil prices. For a complete sample, Figure 2 shows greater evidence of Granger causality from oil to the stock market until the mid-1990s. Since then, there has been increasing evidence of Granger causality in both directions up to GFC. This increase is in line with the increase in monetization of commodity markets. However, the GFC has cut off the oil-to-stock market causality, which is still rising, and the stock market-to-oil causality seems to be declining. The results in Figure 2 show that this evidence is shared by all income groups, but is primarily borne by high-income countries. Looking at the shocks of oil supply and demand, as shown in Figures 3 and 4, it is interesting to further examine the above evidence. Again, we find a clear difference that reinforces the interpretation of Figure 2. Figure 3 shows a decrease in evidence of oil supply shock causality to stock prices during the observation period (30/40% to 10% of cases) and an increase in evidence of oil supply stock price causality (about 10%). This result is consistent with the low historical importance of oil producers in determining oil prices during this period. Subdivided income group statements help shed light on these trends. In particular, the reduced reliance on oil supply shocks is primarily characteristic of low- and middle-income countries. Evidence that the stock market's role in oil supply has increased since the mid-2000s comes as groups of high-income countries grow from no evidence of causality to about 20% of cases. In these countries, the role of oil supply shocks in the stock market changes over time in an average of 12% of cases. It is interesting to compare this evidence with the role of oil demand. Figure 4 shows an interesting pattern. From the beginning to the end of the observation period, evidence of Granger causality from the stock market to oil demand has historically diminished. By 2000, the stock market will impact oil demand more than vice versa. In the 2000s, evidence tends to reverse and commodity prices dominate the stock market, in line with the surge in oil demand often associated with the BRICS. The first half of the decade peaks at about 50% of the Granger causality from the oil demand shock to the stock market. In the next part of the decade, the role of shocks in oil demand will be much smaller, with stock market shocks more prevalent than oil demand shocks. Subgroup evidence shows that these general trends are shared by high-income countries. At the same time, the stock market epidemic to the oil demand shock is a more prominent feature of low- and middle-income countries in the 1980s and 1990s. The prevalence of oil demand shocks in the stock market is a more prominent feature of high-income countries.

5.3 WORLD METAL INDEX

Finally, in Figure 5, we will look at global metal prices. Overall, there is a 10% to 15% chance of stable evidence of Granger causality from the stock market to metal prices. Evidence of Granger causality from metal prices to the stock market increases over a period of review, especially from the early 2000s and shortly after the global financial crisis. However, this evidence diminishes towards the end of the sample if the stock market is more dominant than metal prices. The panel in Figure 5 also shows the clear differences between income groups. Stock markets are common not only in low- and middle-income countries, but also in high-income countries. Instead, metal prices clearly dominate the middle-income stock market. Since the early 2000s, evidence of a causal link from high-income stock markets to metal prices has also diminished, and evidence in the opposite direction has increased. From the GFC, we can also observe the growing importance of the stock market to metal prices in low- and middle-income countries.

6. CONCLUSION

This article explores the global causal relationship between commodity prices and stock returns in the context of changes over time. Use a new method like Ghysel et al. Developed the MFVAR method. (2016) and a combination of time series at different sampling rates. This allows you to use more frequent data that may be lost in the aggregation over time. We use two global connectivity indexes, the Global Commodity Connectivity Index (GCCI), to assess the overall connectivity between global commodity prices and the domestic stock markets.

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Vision and Reading Readiness

Karren Timmermans

***Abstract*—** Readers may be able to identify when they cannot see the text written at a distance or when the material projected to a screen is out of focus. Or they may find text written on a page to be blurry. Unless prompted or given the opportunity to express when text is not clear to them, children may assume that the blurry text they see is "normal" or just the same as what everyone else sees. Sight issues such as blurriness may be corrected with corrective lenses. However, there are other aspects of vision and oculomotor eye movements that may go virtually unnoticed by teachers, parents, and children. Beyond word recognition, automaticity and comprehension, oculomotor deficiencies can cause the most experienced, as well as inexperienced, reader problems. Three main indicators of oculomotor deficiencies are tracking problem, binocular coordination, and convergence insufficiency. I address the fundamentals of vision function and its relationship to literacy and literacy development: what our eyes do as we read, how our eyes contribute to reading success, and how oculomotor deficiencies can impact reading. I also consider ways to help children sharpen their visual accuracy to enhance their reading and writing skills.

***Keywords*—** early childhood, reading readiness, vision and literacy, visual function.

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Preparing Preservice Teachers to Teach Computational Thinking and Computer Science: A Literature Review

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***Abstract*—** Within the past decade, computer science (CS) has become an important element in strengthening existing education models and preparing students for the future. CS education has been linked with higher rates of college enrollment (Brown & Brown, 2020). A number of CS educators have suggested computational thinking (CT) as an approach to expand access to CS in K-12 (e.g., Yadav, Hong, Stephenson, 2016). CT has been defined as "breaking down complex problems into more familiar/manageable sub-problems (problem decomposition), using a sequence of steps (algorithms), reviewing how the solution transfers to similar problems (abstraction), and finally determining if a computer can help us more efficiently solve those problems (automation)" (Yadav et al., 2016, p. 565). CT forms the key pillar for the AP CS Principles (CSP) course, which includes six practices to help students understand how computational ideas influence our world (College Board, 2014). The six practices are: connecting computing, creating computational artifacts, abstracting, analyzing problems and artifacts, communicating, and collaborating. However, in spite of these efforts, the expansion of CS in K-12 schools faces many challenges. One of the main challenges in expanding CT/CS within K-12 schools is educating teachers to either integrate computing into their subject areas or to teach standalone computing courses.

A recent report on growing computer science in schools of education highlighted the need to educate preservice teachers to be prepared to think computationally and incorporate computer science in their instruction (Delyser et al., 2018). The report argued that "there needs to be a sustainable pipeline of K-12 educators, teachers, and leaders who can provide and support rigorous and inclusive instruction in computer science for all students... [and] without the support of schools of education, the computer science education teaching force will be difficult to create at scale and continue to be a challenge for K-12 schools and principals" (p. 6). However, this is easier said than done given that computer science teacher certification and licensure in the United States is deeply flawed as highlighted by the Computer Science Teachers Association report (Lang et al., 2013). The report recommended that teacher preparation institutions and organizations need to develop models to prepare computer science teachers. However, there is little that we know on how to educate preservice teachers to teach computer science and embed CT ideas and practices into their future classrooms (DeLyser et al., 2018).

However, one of the challenges to educate preservice teachers in CS/CT is that adding new content and/or requirements into teacher education programs is difficult as there are already overwhelming number of accreditation/licensure requirements to meet (DeLyser et al., 2018). Given the number of required courses to achieve teacher licensure, we need to find opportunities and means to embed CT within the existing structures of teacher education curriculum. Within teacher education, there seem to be two main options for incorporating CT/CS: (1) integration into educational technology, educational psychology courses, or other methods courses, and/or (2) supplementary or stand-alone CS programs (e.g., DeLyser et al., 2018).

Yadav, Hong, and Stephenson (2016) provided a framework for integrating CT into educational technology and required methods courses to develop preservice teacher competencies in computational thinking. Specifically, the authors suggested that educational technology courses could provide an experience where preservice teachers learn about core CT concepts and practices and then develop how those concepts could be applied in a disciplinary way as a part of their subject-specific methods courses. They argued that education faculty and computer science faculty need to collaborate to create plugged and unplugged activities that will incorporate best practices from both domains to introduce computational thinking ideas to preservice teachers. Some teacher education programs have begun to focus on either embedding small chunks of computational thinking through modules or redesign their educational technology courses (e.g., Mouza, Yang, Pan, Ozden, & Pollock, 2017; Yadav, Zhou, Mayfield, Hambrusch, & Korb, 2011; Yadav, Hambrusch, Korb, & Gretter, 2014).

To inform how we can prepare preservice teachers to teach computer science and computational thinking (CS/CT) ideas, we need to investigate current efforts in integrating CS/CT in teacher education and their influence on teacher outcomes. We will follow Torraco's (2016) integrative literature review framework to examine how CS/CT is being addressed at the preservice level through empirical studies from 2006 to 2021. We seek to investigate (1) What curriculum/ interventions are being used with preservice teachers to learn about CT/CS? and (2) What methods do scholars use to evaluate these interventions?

We use databases where a majority of peer-reviewed publications on teacher education and computer science are published, such as EBSCO, ERIC, ACM Digital Library, and Google Scholar, as well as targeting one specific journal: Journal of Computer Science Education. We used a combination of search terms encompassing our desired population (preservice teachers or teacher education programs) and the content (computational thinking or computer science). We used boolean combinations (AND/OR) of these terms to conduct our literature search and eliminated overlapping articles. We, specifically, focused our search from 2006 onward given that Wing's article on computational thinking was published then and served as an impetus for CT/CS in K-12 setting.

Our review of literature on preparing preservice teachers in CT/CS will help identify how relevant articles as well as the strengths and weaknesses of the current research in preservice teacher education. In addition, the review could help us investigate the two research questions on the types of interventions/curriculums being used, and how researchers were investigating the impact of those interventions/curriculums on preservice teachers.

We are currently at the stage of data analysis and will report the results at the conference.

***Keywords*—** computational thinking,preservice teacher,computer science education,elementary teacher,teacher education.

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Changes in Vocational Teacher Training in Hungary: Challenges and Possibilities

Anetta Bacsa-Bán

***Abstract*—** The training of vocational education teachers in Hungary was a special training system before the Bologna system, but under the influence of the Bologna system, the structure and content of the training changed significantly. The training of vocational teachers, including engineering teachers and vocational trainers, is considerably different when compared to the training of public education teachers. This study aims to present these differences and peculiarities, problems and issues of the training as well as to outline the possibilities of further development. During the study, the following methods were implemented: empirical research among students and graduates of vocational teacher training, as well as analysis of the relevant literature. The study summarizes the research and theoretical results related to vocational education and training (VET) teacher training over the past 15 years, with the aim of developing the training and mapping new directions in the field.

***Keywords*—** vocational teacher, technical instructors, technical vocational instructors, theoretical aspects.

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Presenting Internals of Networks Using Bare Machine Technology

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***Abstract*—** Bare Machine Internet is part of the Bare Machine Computing (BMC) paradigm. It is used in programming application ns to run directly on a device. It is software that runs directly against the hardware using CPU, Memory, and I/O. The software application runs without an Operating System and resident mass storage. An important part of the BMC paradigm is the Bare Machine Internet. It utilizes an Application Development model software that interfaces directly with the hardware on a network server and file server. Because it is "bare," it is a powerful teaching and research tool that can readily display the internals of the network protocols, software, and hardware of the applications running on the Bare Server. It was also demonstrated that the bare server was accessible by laptop and by smartphone/android. The purpose was to show the further practicality of Bare Internet in Computer Engineering and Computer Science Education and Research. It was also to show that an undergraduate student could take advantage of a bare server with any device and any browser at any release version connected to the internet. This paper presents the Bare Web Server as an educational tool. We will discuss possible applications of this paradigm.

***Keywords*—** bare machine computing, online research, network technology, visualizing network internals.

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Effects of E-Learning Mode of Instruction and Conventional Mode of Instruction on Student's Achievement in English Language in Senior Secondary Schools, Ibadan Municipal, Nigeria

Ibode Osa Felix

***Abstract*—** The use of e-Learning is presently intensified in the academic world following the outbreak of the Covid-19 pandemic in early 2020. Hitherto, e-learning had made its debut in teaching and learning many years ago when it emerged as an aspect of Computer Based Teaching, but never before has its patronage become so important and popular as currently obtains. Previous studies revealed that there is an ongoing debate among researchers on the efficacy of the E-learning mode of instruction over the traditional teaching method. Therefore, the study examined the effect of E-learning and Conventional Mode of Instruction on Students Achievement in the English Language. The study is a quasi-experimental study in which 230 students, from three public secondary schools, were selected through a simple random sampling technique. Three instruments were developed, namely, E-learning Instructional Guide (ELIG), Conventional Method of Instructional Guide (CMIG), and English Language Achievement Test (ELAT). The result revealed that students taught through the conventional method had better results than students taught online. The result also shows that girls taught with the conventional method of teaching performed better than boys in the English Language. The study, therefore, recommended that effort should be made by the educational authorities in Nigeria to provide internet facilities to enhance practices among learners and provide electricity to power e-learning equipment in the secondary schools. This will boost e-learning practices among teachers and students and consequently overtake conventional method of teaching in due course.

***Keywords*—** e-learning, conventional method of teaching, achievement in english, electricity.

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The Practice of Culturally Responsive Pedagogy Implementation Focused on Socio-Economics Students Among Science Teachers

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ABSTRACT

In Malaysia, Science Education has been introduced as a core subject since the primary school level. However, this subject is not favoured among students at higher levels. Since science subjects require high-level thinking skills, students assume that it is difficult to master and their interest diminish to delve into it. To overcome this problem, teachers need to play a key role in restoring the interest of students of various backgrounds towards science learning. Culturally Responsive Pedagogy (CRP) which emphasizes the strengths of students' backgrounds is the best pedagogical method to be implemented in schools with diverse backgrounds. Therefore, this survey study was conducted to identify the implementation of CRP among science teachers. This study involved a sample of 230 science teachers who teach students from the B40 socioeconomic group in the district of Petaling Utama, Selangor. In this study, a questionnaire was used for data collection. A pilot study was conducted on 30 teachers to determine the reliability of the research instrument, and the results of the pilot study showed that the instrument used has high reliability. Descriptive statistics used mean and standard deviation, while inferential statistics were conducted to test the linear relationship between years of experience the teacher teaching science with the implementation of PRB. The results of the study were analysed using SPSS 26.0 program. From the descriptive analysis, it was found that the implementation of CRP among science teachers was on a scale of 'sometimes' with a mean value of 3.35 (sp = 0.83), while Spearman's Rho Correlation test showed no linear relationship between the teaching experience of Science teachers with the implementation of PRB [r (228) = .058, p> .05]. PRB among science teachers who teach students in the city should be practiced to foster the socioemotional formation of students towards the attitude of the 21st century.

Keywords: Culturally Responsive Pedagogy, low socioeconomic students, science teachers, science teaching

INTRODUCTION

Science Education was introduced in Malaysia to create a culture of Science and Technology in every student as well as to develop higher order thinking skills (HOTS). The ability of students to apply HOTS in decision making and solving real life problems is like a double-edged sword approach in National Science Education. Science has been introduced as a core subject since the primary school level. However, this subject is not favoured among students at higher levels. The percentage of students majoring in Science in institutions of higher learning still has yet to reach 60% policy. This policy has been introduced by the government since 1967, but until 2018, only 44% of students majored in Science in institutions of higher learning (Wan Faizal Ismayatim, 2019). Since Science subjects require high-level thinking skills, students assume that it is difficult to master and their interest diminish to delve into it.

This statement is also supported by Gough (2015) stating that students have less interest in science-based subjects as they lack scientific and high thinking skills to master the subject.

Lack of interest in subjects involving Science, Technology, Engineering and Mathematics is more pronounced among students from low socioeconomic families (Mckinney & Grant, 2017; Taylor & Francais Group, 2020). In Malaysia, the low socioeconomic group is categorized as the lowest 40% household income group (B40) (Ministry of Economic Affairs, 2019). Students from this B40 group are often claimed to have various problems particularly lack of financial resources to access quality education (UNICEF, 2018). This has become one of the cultures ingrained in their daily lives (Jensen, 1998b; Nor Azrul & Noordeyana, 2018). They barely perceive education as an equally important aspect to other basic needs such as food and financial resources in survival. Consequently, students from this group are not interested in learning Science subjects in particular (Mckinney & Grant, 2017; Taylor & Francais Group, 2020).

Therefore, teachers should play a key role in restoring students' interest in learning, especially students from low socioeconomic status groups. According to Butler (2019), every student has the right to receive a quality and equitable education regardless of their race, ethnicity, gender or socioeconomic status. The Principles of Education for All (EFA) implemented by UNESCO (2012) also emphasized that all citizens of the world are entitled to equal educational rights regardless of their social status. Although teachers recognise the importance of teaching and learning based on students' backgrounds, they do not practice this method (Nurhijrah Zakaria et al., 2017; Siti Zuraida Maaruf, 2017). Due to student background diversity, teachers prefer one-way teaching to further accelerate the teaching, learning and facilitating (TLF) process (Cheung et al., 2020).

Teachers' teaching should be delivered dynamically based on students' backgrounds to ensure that learning objectives can be achieved (Gay, 2010; Ladson-Billings, 1995). Teachers need to master teaching strategies relevant to students' culture to integrate the existing curriculum with their background (Ladson-Billings, 1995; Rajagopal, 2011). According to Aguilera & Perales-Palacios (2020) and Cheung et al. (2020), teachers find it difficult to implement teaching strategies that are interesting and appropriate based on students' backgrounds especially in classrooms with diverse backgrounds. Therefore, teachers need to use pedagogy responsive to students' culture to gain their attention and in turn make the curriculum responsive to their backgrounds. According to Richards et al. (2006), CRP is a student-centered pedagogy method using the strengths of students' background such as culture, ethnicity, race and socioeconomic status to be nurtured and then used to increase their interest and achievement in the classroom. CRP's approach is to incorporate students' backgrounds into teaching and instructional strategies in schools (Ladson-Billings, 1995).

Recent studies have proven that CRP is highly effective in reducing academic achievement gaps and promoting positive ethnic identity among diverse students (Dickson & Fermandez 2015; Sleeter 2012 in Yong Li Wah & Nurfaradilla 2019). The use of CRP has been shown to encourage students to engage in learning while improving their academic achievement (Christianakis, 2011; Rodriguez et al., 2004 in Yong Li Wah & Nurfaradilla, 2019). In addition, a teacher's teaching experience in identifying students' achievement and background also influences the effectiveness of their TLF (Kaviza, 2018). Experienced teachers should be more aware of the best methods to identify the background of students as well as be able to form a positive relationship between teachers and students (Syed Kamaruzaman Syed Ali et al., 2017). This positive teacher-student relationship can create an active learning environment among students (Gay, 2010).

However, research related to CRP in Science subjects is still lacking and needs more in-depth research as students' interest in Science is declining (Ministry of Education Malaysia 2019). Teachers' awareness and the relationship between teachers' teaching experience to the

implementation of teaching strategies based on students' backgrounds is still low (Muhammad Zakwan Abdul Rahim et al., 2020). Studies related to teachers' awareness of the use of PRB in Science subjects are also still declining both globally and locally. Teachers and education administrators have insufficient references due to few research in the field of PRB in the Science subject especially in countries such as Malaysia with various society backgrounds in terms of race or socioeconomic status. Teachers have less understanding of the importance of Science teaching strategies based on students' backgrounds to ensure learning objectives are achieved while attracting their interest in Science subject (Hernandez et al., 2013, Noor Erma Binti Abu & Leong Kwan Eu, 2014, Suppiah Nachiappan et al., 2017).

Therefore, this study was conducted to identify the implementation of CRP among Science teachers. In particular, this study was conducted to answer two research questions, namely:

I. What are the CRP practices that are often and poorly implemented by Science teachers?
II. Is there a relationship between the experience of teaching with the implementation of CRP of Science teachers?

LITERATURE REVIEW

This study focuses only on the cultural aspects in terms of socioeconomic status of the student. The household income will be the main determinant factor used throughout this research. The term poverty and low income is the basic concept discussed beside the CRP.

Poverty and Student Learning

According to Moon Heum Cho et al. (2015), Hafzan Omar et al. (2016), Dotson et al. (2016), Nor Azrul bin Mohd Zin & Noordeyana binti Tambi (2018) and A.Ghani et al. (2019), the socioeconomic background of the student's family influences the student's academic achievement. The findings of this study are in line with the Poverty Cycle Theory which stated that parents have financial resource constraint due to poverty, thus they are unable to provide the best education to their children. This situation in turn will shape emotion, cognitive and unbalanced attitudes in children from the very beginning. As a result, children's academic achievement is disrupted, thus changing their interest and attitude towards learning (Jensen, 1998b; Mckinney & Grant, 2017; Nor Azrul bin Mohd Zin & Noordeyana binti Tambi, 2018; Taylor & Francais Group, 2020).

Studies conducted by Brien et al. (1997), Payne (2005), Samat (2018), Nor Azrul Mohd Zin (2018), Siti Masayu & Narimah Samat (2018) and Zuraidah Abdullah et al. (2019) found that the tendency of children to inherit family poverty is very high. Findings of previous studies also have shown that family poverty is a major factor contributing to the low level of education among children. This finding is also supported by Vantassel-baska (2018) that the poverty environment has a negative impact on the cognitive of talented smart students. This can reduce the interest of these students to continue learning and will eventually cause them to quit learning.

Attitudes of B40 Group Students Towards Science Subject

The National Science Curriculum includes a curriculum of core and elective Science subjects. Core Science subjects are offered in primary, lower secondary and upper secondary schools, while elective Science subjects consisting of Biology, Physics, Chemistry and Additional Science are offered at the upper secondary level (Ministry of Education Malaysia, 2016). The

core Science subjects are designed to produce students who are science literate, have high-level thinking skills and the ability to apply Science knowledge to make decisions and solve problems in real life. Elective Science subjects focus on empowering and strengthening students' knowledge, skills and competencies about Science, Technology, Engineering and Mathematics (STEM) for use at higher levels (Nur Amelia & Lilia Halim, 2019). The Ministry of Education Malaysia (MOE) intends that students who pursue this elective Science subjects will have career in STEM and be able to play an active role in community and national development (Ministry of Education Malaysia, 2016).

According to Gough (2015) and Mckinney et al. (2017), the attitude of poor students towards Science subjects is extremely lower compared to students from other socioeconomic groups. The need to use high-level thinking skills in Science subjects reduces the interest of students from this group towards the subjects (Suppiah Nachiappan et al., 2017). Due to this perception, their academic achievement in this subject is lower than other subjects (Aad et al., 2012). In addition, students from the poor group are also unable to see the importance of the science learning experience in their daily lives causing their socioemotional development towards 21st century skills to be disrupted as well.

In Malaysia, educational opportunities are wider, especially for B40 students. However, due to their lack of interest in Science subjects, the percentage of B40 students who achieved 6A in the Primary School Assessment Test (UPSR) offered to Science secondary schools was lower compared to M40 and T20 group students (Ministry of Education Malaysia, 2018). Only 36.3 per cent of B40 students with 6A in UPSR were offered to Science secondary schools compared to 63.7 per cent of M40 and T20 students (Ministry of Education Malaysia, 2018).

Culturally Responsive Pedagogy (CRP) and Its Impact on Poor Students

According to Richards et al. (2006), CRP is a student-centered pedagogy method based on the strengths of students' backgrounds such as culture, ethnicity, race and socioeconomic status to be nurtured and then used to increase their interest and achievement in the class. CRP encompasses three dimensions, namely institutional, personal and teaching strategies (Boon & Lewthwaite, 2015). The institutional dimension reflects its administration, policies and values, while the personal dimension refers to the cognitive and emotional processes of teachers that should be involved in this pedagogy. The teaching strategy dimension includes materials, methods and activities that form the basis of teaching. All these dimensions significantly interact in the teaching and learning process to achieve the effectiveness of outcomes through this pedagogy (Nurhijrah Zakaria et al. 2017).

CRP was introduced by Gloria Ladson-Billings over two decades ago. According to Ladson-Billings (1995), this pedagogy is related to a teaching culture that encourages students to learn and build understanding through their experiences, cultures and socioeconomic backgrounds. Based on the study, three goals were suggested in the implementation of this pedagogy, namely teaching must lead to academic success; teaching must help students develop their ethnic, cultural or background identity in a positive direction; and teaching must support students' ability to recognize, understand and critique current and social inequalities. Through this goal, a teacher who is responsive to students is able to empower students not only intellectually but also socially, emotionally and politically (Ladson-Billings, 1995).

According to Samuels et al. (2017), through the use of PRB, trainee teachers have agreed that the relationship between teachers and students of different backgrounds could be strengthened. This good relationship causes students to be more interested in continuing to learn while improving their achievement (Brown et al., 2018). Through this pedagogy as well, students are encouraged to use their own methods to solve problems during teaching and learning sessions through the sharing of ideas and opinions with peers from different backgrounds (Paulk et al.,

2014). This strategy causes students from different cultures and socioeconomic statuses to communicate with each other. The existence of positive communication will cause the thinking skills of poor students will be more open and broaden (Warren, 2018; Yasmin Ahmad & Najeemah Mohd Yusof. 2015), thus aiding students improve their academic achievement (Yong Li Wah & Nurfaradilla Binti Mohamad Nasri, 2019).

Implementation of Culturally Responsive Pedagogy Among Teachers

The implementation of CRP among teachers is very important to ensure that this pedagogical impact is accepted by students (Laughter & Adams, 2012). Teachers need to create an CRP-based learning environment so that students can adapt the knowledge acquired in their daily lives (Johnson et al., 2019). Through the mastery and implementation of CRP by teachers, the effectiveness of this pedagogy can be measured based on the improvement of student achievement in the classroom (Barnes & Mccallops, 2019).

According to Boon & Lewthwaite (2015), teachers with students from various backgrounds should use CRP in their teaching & learning. Without CRP, teachers are unable to assist students from various backgrounds especially those from low socioeconomic groups to increase their interest and academic achievement (Yasmin Ahmad & Najeemah Mohd Yusof, 2015 & Suresh Kumar N Vellymalay, 2016). According to Iilhavenil Narinasamy & Wan Hasmah (2010), teachers are agents of change to students in schools. Teachers' teaching strategies in the classroom can change students' perceptions of a subject as well as help improve student achievement (Paulk et al., 2014). This clearly proves that only through effective teaching strategies, positive changes of students can be seen (Wachira & Mburu, 2017, Siti Hendon Sheikh Abdullah & Faizah Md Ghazali, 2017 & Bonner et al., 2018).

Experienced teachers are also seen to be more likely to have good relationships with students, which form understanding in the classroom as well as help students better understand teaching and learning. Based on a study conducted by Pressley et al. (2020), there are significant differences between experienced teachers, intermediate teachers and new teachers in building good relationships with students. Experienced teachers are more likely to approach students more closely than intermediate and new teachers. This approach fosters better comfort and understanding between teachers and students as well as encouraging students to pay more attention in their learning sessions.

METHODOLOGY

Research Design

This study was conducted quantitatively in the form of survey through Cross Sectional Study. This approach was selected because the data collection was made at the same time period and involved different respondents (Creswell, 2012). The survey was conducted using a questionnaire instrument distributed online assisted by several administrators in the Petaling Utama district. This study received ethical approval by Universiti Kebangsaan Malaysia (UKM) and permission was given by school administrators in the district.

Study Sample

The population of this study involved secondary school Science teachers in the urban area in Selangor. They teach students from various backgrounds of socioeconomic status. However based on the data from the Ministry of Education Malaysia, only two districts in Selangor, namely Petaling Perdana and Petaling Utama districts, are categorised as urban areas having several secondary schools with many urban poor students. For the purpose of this study, only

Science teachers in Petaling Utama district were selected as the study population based on the majority of students from low socioeconomic groups (B40) in schools in the area.

The total population of secondary school Science teachers in the Petaling Utama district was almost 450 people. Based on the table of Krejcie & Morgan (1970), the number of samples involved based on the total population should be at least 210 people. However, the total sample involved in this study was 230 people. Purposive sampling was employed for study sampling.

Data Collection Methods

The research instrument used in this study involved a set of questionnaires which included two parts, namely Part A (Respondent Demographics) and Part B (CRP Implementation Items). According to Creswell (2012), the questionnaire method has advantages due to its lower implementation cost, practicality and takes less time compared to other data collection methods. The instrument of this study involved a closed-ended questionnaire with choice of answers in the form of a Likert scale as follows:

- Never - I have never done this at any time or never tried to do it
- Rarely - I have tried to do this, but only once (1) or two (2) times (in one (1) school term)
- Sometimes - I have done this before, but only once (1) or twice (2) a month
- Always - I do this regularly (two (2) or more per week)
- Frequent - I do this consistently (at each TnL session)

In this study, researchers used instruments adopted and modified accordingly from Silva (2017) involving four main constructs, namely student family background (items 1, 2 and 13), learning according to student family background (item 3, 4, 6, 9 and 15), positive teacher-student relationships (items 5, 10, 11 and 12) and high expectations of all students (items 7, 8 and 14).

To determine the reliability of the instrument, a pilot study was conducted at five secondary schools in the district of Petaling Perdana, Selangor. This pilot study involved a sample of 30 Science teachers in those schools. According to Mohd Majid (2000), a pilot study is important to be implemented to determine the reliability of the instrument. The data of the pilot study showed that the overall reliability of the instrument was in the high category (a = .892). According to Mohd Majid (2000), Cronbach's Alpha values above 0.60 are categorised as items with high reliability.

Data Analysis Methods

This study used Statistical Package for the Social Science (SPSS) Version 26.0 for data analysis. The data and information obtained were analysed based on the research questions. The data was analysed using descriptive statistics (using mean and standard deviation methods) for the first research question and inferential statistics for the second research question.

RESULTS AND DISCUSSION

TABLE 1. Number of Frequency and Percentage of Science Teachers Based on Demographic Factors

Demographic Characteristics	Frequency	Percentage (%)
Gender		
Male	59	25.7
Female	171	74.3
Total	230	100
Race		
Malay	151	65.7
Chinese	31	13.5

Indian	31	13.5
Others	17	7.4
Total	230	100
Education Level		
PhD	4	1.7
Master	19	8.3
Degree	204	88.7
Diploma	3	1.3
Total	230	100
Teaching experience		
>31 years	26	11.3
20-30 years	49	21.3
10-19 years	74	32.2
5-9 years	36	15.7
<5 years	45	19.6
Total	230	100

Table 1 shows the number of frequencies and percentages based on demographic factors. The sample of this study consisted of 230 Science teachers teaching students from B40 families in urban areas. From Table 1, 25.7% (n = 59) of the sample were male, while 74.3% (n = 171) were female. Of this total, 65.7% (n = 151) of the sample were Malays, 13.5% (n = 31) were Chinese and Indians, respectively, while 7.4% (n = 17) were others. The majority of the sample, 88.7% (n = 204) have a Bachelor's degree, while only 8.3% (n = 19) of the sample were Master's degree holder, 1.7% (n = 4) have Doctoral degree and only 1.3% (n = 3) were diploma graduates.

Table 1 also shows the total years of teaching experience of Science teacher. The majority of respondents (32.2%; n = 74) had teaching experience of around 10 to 19 years, while 21.3% (n = 49) had teaching experience of 20 to 30 years. A total of 45 samples (19.6%) had teaching experience of less than 5 years, 36 samples (15.7%) had teaching experience between 5 to 9 years and only 26 sample (11.3%) had teaching experience of more than 31 years.

What are the CRP practices that are often and poorly implemented by Science teachers?

TABLE 2. Mean and Standard Deviation of CRP Implementation Practice among Science Teachers

Item	CRP constructs	Mean	Standard deviation
1, 2, 13	Student family background information	2.96	.88
3, 4, 6, 9, 15	Learning according to students' backgrounds	3.23	.88
5, 10, 11, 12	Positive teacher-student relationships	3.57	.84
7, 8, 14	High expectations to all students	3.64	.70
	Overall	3.35	.83

Based on Table 2, it was found that the entire sample performed CRP on ‘sometimes’ scale. The overall mean value of CRP implementation among Science teachers was 3.35 with a standard deviation of .83. This indicated that the majority of Science teachers teaching students from B40 group families in the urban areas have implemented CRP but only once or twice a month. The findings of this study are in line with a study conducted by Silva (2017) where teachers in Central Illinois elementary schools implemented CRP on ‘sometimes’ scale. A study by Samuels & Cook (2017) also proved that the majority of trainee teachers who have been given knowledge related to CRP still implement this pedagogy at a low level even though their students come from various backgrounds.

TABLE 3 (i). Mean and Standard Deviation of Science Teacher for CRP Implementation Practice for Student Background Information Construct

Item	Construct: Student Background Information	Mean	Standard Deviation
1.	I used information obtained from the data collected (on student interests and learning) to guide the communication styles and examples used in teaching Science	2.90	.98
2.	I handled at least two data collection methods (i.e., phone calls, conferences, surveys) in the first month of schooling that only related to the socioeconomic status of the student's family	2.29	1.04
13.	I identified that the ways and cultures of students in school were different from their culture at home (culture based on the background of students' socioeconomic status)	3.68	.63
	Overall	2.96	.88

TABLE 3(ii). Mean and Standard Deviation of Science Teacher for PRB Implementation Practice for Learning According to Student Background Construct

Item	Construct: Learning According to Student Background	Mean	Standard Deviation
3.	I analysed the Science curriculum and teaching materials to suit a minority group of students (from a minority socioeconomic status in the class)	2.77	1.07
4.	I used additional materials to address misconceptions regarding groups of students from various socioeconomic statuses in the Science curriculum and teaching materials	2.85	1.00
6.	I consistently assessed the suitability of the assessment tools used for students according to their socioeconomic status	3.43	.92
9.	I used models and taught students how they can actively work to create social justice and equal opportunity for everyone in their school and community	3.44	.71
15.	I developed Science learning activities that were consistent with student standards covering content in the community (such as the socioeconomic status of individuals in the community)	3.67	.69
	Overall	3.23	.88

TABLE 3(iii). Mean and Standard Deviation of Science Teacher for CRP Implementation Practice for Positive Teacher-Student Relationship Construct

Item	Construct: Positive Teacher-Student Relationship	Mean	Standard Deviation
5.	I explicitly facilitated conversations on unpopular/sensitive topics related to Science subjects	3.69	.65
10.	I assisted students (according to their socioeconomic status background) and identify how they were different and similar from their past as well as their experience and identity strengths	3.25	1.00
11.	I assessed how my socioeconomic status practices were different or similar to my students'socioeconomic status practices	3.30	1.00
12.	I gave attention and support fairly and duly to each student	4.04	.70
	Overall	3.57	.84

TABLE 3(iv). Mean and Standard Deviation of Science Teacher for CRP Implementation Practice for High Expectations to All Students Construct

Item	Construct: High Expectations to All Students	Mean	Standard Deviation
7.	I used a variety of assessment tools in addition to tests (such as portfolios, projects and presentations) to determine how well students have learned Science subjects	3.47	.70
8.	I evaluated my Science subject teaching each week to determine which was successful and which was not according to my student's learning style to improve my Science teaching	3.41	.74
14.	At the beginning of the school year, I set and conveyed high expectations to be achieved in Science subjects by each of my students	4.04	.65
	Overall	3.64	.70

To answer the first research question, analysis for each CRP item was performed and the results of the study are summarised in Tables 3(i), 3(ii), 3(iii) and 3(iv). Four aspects have the lowest mean values indicating that the CRP implementation was least practiced by teachers, while two aspects have the highest mean values indicating that CRP implementation was often practiced by teachers. The lowest mean values were items 1 and 2 (constructs of student family background information) of 2.90 and 2.29 (sp = .16), respectively and items 3 and 4 (constructs of learning according to student background) of 2.76 and 2.84 (sp = .16), respectively. These four items were CRP implementation practices that were 'rarely' implemented by Science teachers with indicators of once or twice in a single school term.

Among the CRP implementation practiced only once or twice in a school term are as follows:

I. Data collection process on the student background directed to their interests and learning for use in Science TnL;

II. Implementation of at least two data collection methods related to the socioeconomic status of the student's family in the first month of schooling;

III. Analysis of Science curriculum and teaching materials to suit minority groups of students (in terms of socioeconomic status) in the classroom; and

IV. Use of additional materials in the curriculum and TnL to address students' misconceptions regarding the diversity of socioeconomic status existed among them.

This clearly showed that Science teachers in the urban areas rarely performed data collections related to the student background particularly socioeconomic status. Thus, the TnL delivery is less effective as teachers are unable to identify appropriate teaching materials to use according to their students' background (Hernandez et al., 2013). According to Ladson-Billings (1995), teaching strategies that are appropriate to students' needs can help increase students' interest in learning. Based on the Poverty Cycle Theory by Holman (1973), poor students have low interest in learning which creates unhealthy socioemotions as well as becoming a culture in their lives. Therefore, teachers need to play a key role in helping students from this low socioeconomics to build healthier socioemotions through education (Holman 1973).

Moreover, the two highest mean values were item 12 (construct of positive teacher-student relationship) and item 14 (construct of high expectations to all students) with mean value of 4.04 and standard deviation of .70 and .65, respectively. These two items indicated that CRP implementation was 'always' practiced by Science teachers periodically (two or more per week). This indicated that appropriate attention and support were given to students regardless of their socioeconomic background. Apart from that, Science teachers also 'always' set high expectations on students in Science subjects regardless of their socioeconomic status and academic achievement. The results were conveyed to the students at the beginning of the school year. According to UNESCO (2012), every student has the right to equal education regardless of their academic or personal background, including setting targets for each student, while teachers act as a catalyst to achieve these targets.

Is there a relationship between the teaching experience of Science teachers with the implementation of CRP?

TABLE 4. Normality Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Overall CRP Items	.109	230	.000	.960	230	.000

To answer the second research question, the normality test (Kolmogorov-Smirnov Test) was conducted first and the test results are summarised in Table 4.

TABLE 5. Spearman's Rho Correlation Test

			Teaching experience	Implementation of CRP
Spearman's rho	Teaching experience	Correlation Coefficient	1.000	.058
		Sig. (2-tailed)	.	.384
		N	230	230
	Implementation of PRB	Correlation Coefficient	.058	1.000
		Sig. (2-tailed)	.384	.
		N	230	230

Based on Table 4, it was found that the data of this study were significant ($p < .05$) and not normal. Therefore, the researcher performed a non-parametric test (Spearman's Rho Correlation Test) to answer the question of this study. Based on Spearman's Rho Correlation Test (Table 5), it was found that the value of $rho(228) = .058$, $p > .05$, signifying that the data of this study were not significant. Therefore, there was no linear relationship between the number of years of Science teachers teaching experience with the implementation of CRP. In other words, data collected of teacher experience in teaching Science subject was not enough to show the significant linear relationship between the implementation of CRP in the classroom. This is similar to that of Silva (2017) where a weak relationship was observed between the demographic characteristics of teachers with the implementation of CRP by primary school teachers in Central Illinos. The demographic characteristics of teachers studied were the number of years of teacher teaching experience. According to Warren (2018), a teacher's mastery of CRP was not dependent on a teacher's teaching experience but rather the teacher's attitude and empathy towards students that influenced the implementation of CRP in the classroom.

CONCLUSION

Based on this study, the implementation of CRP among Science teachers teaching students from B40 socioeconomic families in the urban areas was still in the 'sometimes' scale (once or twice a month). This infrequent implementation indicated that Science teachers may have low initiative to identify the student backgrounds before teaching sessions. It is a practice in Malaysian school the student demographic data are collected by the school counsellor. However, this data was not used to assist them in teaching and learning. There should be more communication and discussion between subject teacher and counsellor. The implementation of CRP among Science teachers in the urban areas is important for Science's learning and to build student socioemotional to shape 21st century attitudes. The findings of this study help teachers and administrator to realise where they should improve towards effectively implement CRP in Science TnL. To further strengthen the implementation of CRP in Science TnL, a qualitative

study related to the limitation of CRP implementation among Science teachers can be performed to further improve the quality of Science teaching in Malaysia.

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Integrating Computational Thinking into Classroom Practice – A Case Study.

Vassallo D. and Busuttil, L.

Abstract **-** Recent educational developments have seen increasing attention attributed to Computational Thinking (CT) and its integration into primary and secondary school curricula. CT is more than simply being able to use technology but encompasses fundamental Computer Science concepts which are deemed to be very important in developing the correct mindset for our future digital citizens. The case study presented in this article explores the journey of a Maltese secondary school teacher in his efforts to plan, develop and integrate CT within the context of a local classroom. The teacher participant was recruited from the Malta EU Codeweek summer school, a pilot initiative that stemmed from the EU Codeweek Team's Train the Trainer programme. The qualitative methodology involved interviews with the participant teacher as well as an analysis of the artefacts created by the students during the lessons. The results shed light on the numerous challenges and obstacles that the teacher encountered in his integration of CT, as well as portray some brilliant examples of good practices which can substantially inform further research and practice around the integration of CT in classroom practice.

Keywords**—**Computational Thinking, digital citizens, digital literacy, technology integration.

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Cyber-Bullying Beyond Parental Control in High Schools

Eke Chidi Idi

***Abstract*—** School violence is a global phenomenon that affects one of the core institutions of modern society to some degree across many countries, and on a global scale. Within this context, this study explores the impact of parental control on perpetrators of cyber bullying as a form of school-based violence in high schools in uMgungundlovu district of KwaZulu-Natal province in South Africa. Insights for this study were drawn from 18 in-depth interviews and two (2) focus group forums. The key themes that emerged from the findings include: (1) Parents are ignorant of their children involvement in cyber-crimes (2) Parents cannot adequately monitor what their children do on their cell phones (3) Female learners are the most affected as victims of cyber-crime.

***Keywords*—** school, violence, parental control, cyber bullying.

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Developing an Edutainment Game for Children with ADHD Based on SAwD and VCIA Model

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***Abstract*—**This paper analyzes how the Socially Aware Design (SAwD) and the Value-oriented and Culturally Informed Approach (VCIA) design model can be used to develop an edutainment game for children with Attention Deficit Hyperactivity Disorder (ADHD). The SAwD approach seeks a design that considers new dimensions in human-computer interaction, such as culture, aesthetics, emotional and social aspects of the user's everyday experience. From this perspective, the game development was VCIA model-based, including the users in the design process through participatory methodologies, considering their behavioral patterns, culture, and values. This is because values, beliefs, and behavioral patterns influence how technology is understood and used, and the way it impacts people's lives. This model can be applied at different stages of design, which goes from explaining the problem and organizing the requirements, to the evaluation of the prototype and the final solution. Thus, this paper aims to understand how this model can be used in the development of an edutainment game for children with ADHD. In the area of education and learning, children with ADHD have difficulties both in behavior and in school performance, as they are easily distracted, which is reflected both in classes and on tests. Therefore, they must perform tasks that are exciting or interesting for them, once the pleasure center in the brain is activated, it reinforces the center of attention, leaving the child more relaxed and focused. In this context, serious games have been used as part of the treatment of ADHD in children aiming to improve focus and attention, stimulate concentration, as well as be a tool for improving learning in areas such as math and reading, combining education and entertainment (edutainment). Thereby, as a result of the research, it was developed, in a participatory way, applying the VCIA model, an edutainment game prototype, for a mobile platform, for children between 8 and 12 years old.

***Keywords*—**ADHD, edutainment, SAwD, VCIA

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Teaching English As a Foreign Language to Hearing-Impaired Students-a Preliminary Study

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***Abstract*—** This research aims to identify the issues and challenges of teaching English as Foreign Language to Japanese university students who have special learning needs.

This study will focus on a consideration of the methods available to support those with hearing impairments.

***Keywords*—** inclusive learning, special needs, hearing impairments, teaching strategies.

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Determining the Effectiveness of Dialectical Behavior Therapy in Reducing the Psychopathic Deviance of Criminals

Setareh Gerayeli

***Abstract*—** The present study tries to determine the effectiveness of dialectical behavior therapy in reducing the psychopathic deviance of employed criminals released from prison. The experimental method was used in this study, and the statistical population included employed criminals released from prison in Mashhad. Thirty offenders were selected randomly as the samples of the study. The MMPI-2 was used to collect data in the pre-test and post-test stages. The behavioral therapy was conducted on the experimental group during fourteen two and a half hour sessions, while the control group did not receive any intervention. Data analysis was conducted by using covariance. The results showed there is a significant difference between the post-test mean scores of the two groups. The findings suggest that dialectical behavior therapy is effective in reducing psychopathic deviance.

***Keywords*—** criminals, dialectical behavior therapy, psychopathic deviance, prison.

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From an Abandoned Village to A Living Museum: The case of Yim Tin Tsai village in Hong Kong

Ho Chui-fun, Selina

***Abstract*—**The concept of living heritage that has been increasingly recognised in the field of heritage conservation in the 21st century, is inextricably linked to the concept of continuity, and in particular: 1) primarily the continuity of the heritage's original function; 2) the continuity of community's connection with heritage; 3) the continuity of the care of heritage by the community as expressed through (traditional) knowledge, management systems, and maintenance practices; and 4) the continuous process of evolving tangible and intangible heritage expressions in response to changing circumstances (Poulios 2021). This paper negotiates how a core community adopts the living heritage approach to develop its abandoned village into a living museum at Yim Tin Tsai, an offshore island in Sai Kung District of Hong Kong. This paper argues for the importance of creative and curatorial agencies in articulating and expanding the concept of living heritage/museum in the four domains.

***Keywords*—**living heritage, living museum, community, creative and curatorial agencies

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Irish Film Tourism, Neocolonialism and Star Wars: Charting a Course Towards Ecologically and Culturally Considered Representation and Tourism on Skellig Michael

Rachel Gough

***Abstract*—** In 2014, Skellig Michael, an island off Ireland's western seaboard and UNESCO world heritage site became a major setting in Disney's Star Wars franchise. The subsequent influx of tourists to the site has proven to be a point of contention nationally. The increased visitor numbers have uplifted certain areas of the local economy, the mainland, but have caused irreparable damage to historic monuments and to endangered bird populations who breed on the island. Recent research carried out by a state body suggests far-reaching and longterm negative impacts on the island's culture and environment, should the association with the Star Wars franchise persist. In spite of this, the film has been widely endorsed by the Irish government as providing a vital economic boost to historically marginalised rural areas through film tourism. This paper argues quite plainly that what is taking place on Skellig is neocolonialism. Skellig Michael's unique resources, its aesthetic qualities, its ecosystem, and its cultural currency have been sold by the state to a multinational corporation, who profit from their use. Meanwhile, locals are left to do their best to turn a market trend into sustainable business at the expense of culture ecology and community. This paper intends to be the first dedicated study into the psychogeographic and cultural impact of Skellig Michael's deterioration as a result of film tourism. It will discuss the projected impact of this incident on Irish culture more broadly and finally will attempt to lay out a roadmap for more collaborative filmmaking and touristic approach, which allows local cultures and ecosystem's to thrive without drastically inhibiting cultural production. This paper will ultimately find that the consequences of this representation call for a requirement to read tourism as a split concept — namely into what we might loosely call "eco-tourism" and more capital-based "profit-bottom-line tourism."

***Keywords*—** ecology, film tourism, neocolonialism, sustainability.

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An Injectable Hydrogel from a Hydrophobically Modified Collagen for the Encapsulation and Delivery of Fetal Cardiac MSCs

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Statement of Purpose: The development of a hydrogel that could be injected and cured in vivo has gained increasing attention. Collagen has been widely investigated as a thermogel in which there are a lot of ionic interaction, hydrophobic interaction, and hydrogen bonding; however, it must be chemically crosslinked also. Diels-Alder cycloaddition occur under mild conditions without the need for any catalyst, toxic solvent or external activation like UV-irradiation which makes it a pragmatic choice for biomedical application and in particular for developing in situ crosslinked injectable gels. Hence, taking into account the kinetic characteristics of the Diels–Alder reaction, hydrophobic diene-terminated collagen was synthesized and then injectability experiments were performed on fabricated gels to investigate its potential applications in minimally invasive surgery.

Methods: Diene-terminated collagen was prepared employing the nucleophilicity of the ε-amino group of the lysine and arginine side chain. Hydrogels were then fabricated by mixing modified collagen stock solution with PEG maleimide in which the final concentration of modified collagen in the gel was considered to be 2% (w/v) To evaluate the injectability/shear-thinning properties of the hydrogels, viscosity under continuous flow was measured with increasing the shear rate (from 0.01 to 100 s^{-1}), using 20 mm stainless steel parallel plate geometry on hydrogels extruded directly on the rheometer plate from a syringe. Shear-thinning experiments were performed immediately, 4h and 48h after mixing all the hydrogel components. Furthermore, cardiac fetal stromal cells (CFSCs) were encapsulated in the gel network and cytocompatibility of the gels investigated with live/dead viability kit.

Results: Based on our experiments, all modified collagen gels were found to be extrudable (extrusion from a syringe) and injectable (extrusion through a 27G needle), whereas with increasing the shear rate, viscosity decrease (Figure 1A). It should also be noted that linkage between diene and dienophile in Diels-alder reaction have dynamic nature. By increasing the temperature, the reaction rate of retro Diels-alder reaction increase, shifting the equilibrium towards the breaking of the reversible bonds. Additionally, instead of thermal energy, mechanical energy also makes the reversible polymer network becomes more dynamic, leading to retro Diels-alder reaction of cycloadducts into polymer chains. Our hypothesis is that injecting with needle act as a force-actuator, resulting in a mechanochemical coupling. From this point onward, the Diels-alder adduct should be coupled to the mechanical force which eventually trigger the retro Diels-alder reaction to release diene-terminated collagen and PEG-maleimide.

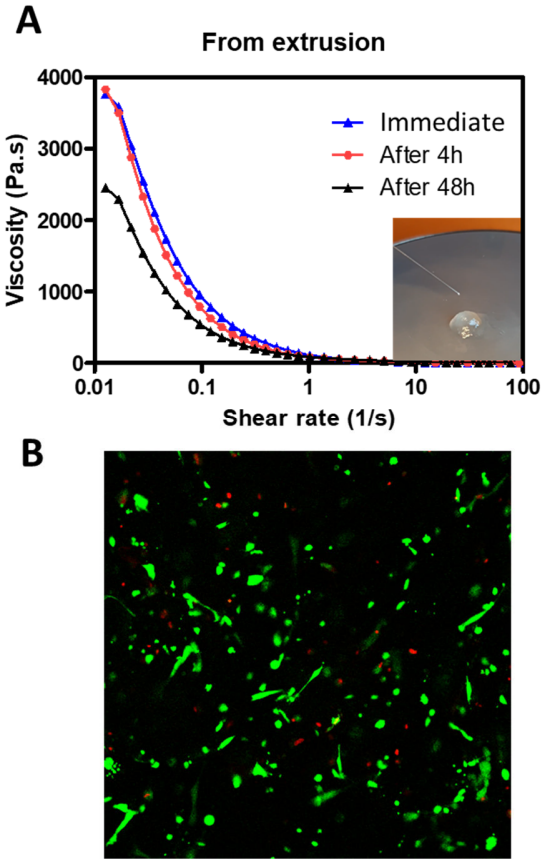

Figure 1. Injectability and cytocompatibility of modified collagen gels. **A.** viscosity versus shear rate demonstrated injectability of fabricated gels immediately, 4h and 48 h after mixing gel component. It also showed injectability of the gel through a 27G needle. **B.** Cells encapsulated in the gels after live/dead staining on Day 7 at 10X magnification, green = live cells, red = dead cells.

Given details mentioned above, the slow crosslinking of Diels-alder reaction and force-induced retro Diels-alder allows modified collagen gels to be injectable at least up to 48 hours post mixing of the gel components when stored at room temperature. Hence, this property is highly beneficial for potential clinical applications in terms of handling and administration given than the hydrogel could then be prepared prior to the surgery and then brought into the surgical room. Additionally, cell viability was higher than 80% for fabricated hydrogels for up to at least 7 days after cell encapsulation (Figure 1B), suggesting that the engineered modified collagen gels had no cytotoxicity with CFSCs.

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Relevance Of Cognitive Rehabilitation Amongst Children Having Chronic Illnesses – A Theoretical Analysis

Pulari C. Milu Maria Anto

***Abstract*—** Background: Cognitive Rehabilitation/Retraining has been variously used in the research literature to represent non-pharmacological interventions that target the cognitive impairments with the goal of ameliorating cognitive function and functional behaviors to optimize the quality of life. Along with adult's cognitive impairments, the need to address acquired cognitive impairments (due to any chronic illnesses like CHD - congenital heart diseases or ALL - Acute Lymphoblastic Leukemia) among child populations is inevitable. Also, it has to be emphasized as same we consider the cognitive impairments seen in the children having neurodevelopmental disorders. Methods: All published brain image studies (Hermann, B. et al,2002, Khalil, A. et al., 2004, Follin, C. et al, 2016, etc.) and studies emphasizing cognitive impairments in attention, memory, and/or executive function and behavioral aspects (Henkin, Y. et al,2007, Bellinger, D. C., & Newburger, J. W. (2010), Cheung, Y. T., et al,2016, that could be identified were reviewed. Based on a systematic review of the literature from (2000 -2021) different brain imaging studies, increased risk of neuropsychological and psychosocial impairments are briefly described. Clinical and research gap in the area is discussed. Results:30 papers, both Indian studies and foreign publications (Sage journals, Delhi psychiatry journal, Wiley Online Library, APA PsyNet, Springer, Elsevier, Developmental medicine, and child neurology), were identified. Conclusions: In India, a very limited number of brain imaging studies and neuropsychological studies have done by indicating the cognitive deficits of a child having or undergone chronic illness. None of the studies have emphasized the relevance nor the need of implementingCR among such children, even though its high time to address but still not established yet. The review of the current evidence is to bring out an insight among rehabilitation professionals in establishing a child specific CR and to publish new findings regarding the implementation of CR among such children. Also, this study will be an awareness on considering cognitive aspects of a child having acquired cognitive deficit (due to chronic illness), especially during their critical developmental period.

***Keywords*—** cognitive rehabilitation, neuropsychological impairments, congenital heart diseases, acute lymphoblastic leukemia, epilepsy, and neuroplasticity.

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Public Perception and Willingness to Undergo Cosmetic Procedures during COVID-19 Pandemic: A Questionnaire-Based Study Applied to Asymptomatic Individuals

Ibrahim Alreshidi, Aseel Albrekeit, Ruaa Alharthi

***Abstract*—** Background: As a result of the spread of COVID-19 at the beginning of 2020, many governments, including Saudi Arabia, have suspended operations in many agencies. Most dermatologists have restricted their practice, including cosmetic procedures, to ensure social distancing. On the 7th of May 2020, Saudi authorities reduced the restriction of COVID-19 virus preventative measures, allowing clinics to start accepting patients following the ministry of health protocols. Objectives: Evaluation of the public's perception and willingness to undergo cosmetic procedures during COVID-19 outbreaks in Saudi Arabia. Materials and methods: A descriptive, cross-sectional, questionnaire-based study was carried out among the individuals who lack typical symptoms of COVID-19 infection in Saudi Arabia. A self-designed web-based questionnaire was developed; content face validity and a pilot study were done. The questionnaire was distributed electronically from the 8th of May until the 31st of May 2020. Results: A total of 656 individuals who lack typical symptoms of COVID-19 infection were included in this analysis. Only 10.5% of participants expressed their will to do cosmetic procedures during the COVID-19 pandemic. More than 90% of the participants believed that the COVID-19 pandemic was either somewhat serious (52.9%) or very serious (38.7%). The willingness to do cosmetic procedures during the COVID-19 pandemic remained unaltered when the price was discounted ($p<0.001$) and when infection control measures were ensured ($p<0.001$). Conclusion: The COVID-19 pandemic had a negative impact on the practice of cosmetic dermatology. Fear of transferring the infection to a beloved home member is the main reason to avoid these procedures. Generating well-structured safety guidelines to decrease the risk of this unusual virus transmission in dermatology practice and creating financial incentives may help increase the public willingness to do these cosmetic procedures during this pandemic.

***Keywords*—** COVID-19 pandemic, cosmetic procedures, questionnaire, dermatology.

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Clinical and Chemokine Profile in Leprosy Patients During Multidrug Therapy (MDT) and Their Healthy Contacts: A Randomized Control Trial

Rohit Kothari

***Abstract*—** Background: Leprosyis a chronic granulomatous diseasecaused by Mycobacterium leprae (M. Lepra). Reactions may interrupt its usual chronic course.Type-1 (T1R)and type-2 lepra reaction(T2R) are acute events and signifytype-IV and type-III hypersensitivity responses, respectively. Various chemokines like CCL3, 5, 11, and CCL24 may be increased during the course of leprosy or during reactions and may serve as markers of early diagnosis, response to therapy, and prognosis. Objective: To find correlation of CCL3, 5, 11, and CCL24 in leprosy patients on multidrug therapy and their family contacts after ruling out active disease during leprosy treatment and during periods of lepra reactions. Methodology: This randomized control trial was conducted in 50 clinico-histopathologically diagnosed cases of leprosy in a tertiary care hospital in Bengaluru, India. 50 of their family contacts were adequately examined and investigated should the need be to rule out active disease. The two study-groups comprised of leprosy cases, and the age, sex, and area of residence matched healthy contactswho were given single-dose rifampicin prophylaxis, respectively. Blood samples were taken at baseline, six months, and after one yearin both the groups (on completion of MDT in leprosy cases)and also during periods of reaction if occurred in leprosy cases. Results: Our study found that at baseline, CCL5, 11, and 24 were higher in leprosy cases as compared to the healthy contacts, and the difference was statistically significant.CCL3 was also found to be higherat baseline in leprosy cases, however, the difference was not statistically significant. At six months and one year, the levels of CCL 5, 11, and 24 reduced, and the difference was statistically significant in leprosy cases, whereas it remained almost static in all the healthy contacts. Twenty patients of leprosy developed lepra reaction during the course of one year, and during reaction, the increase in CCL11 and 24 was statistically significant from baseline, whereas CCL3 and 5 did not rise significantly. One of the healthy contacts developed signs of leprosy in the form of hypopigmented numb patch and was clinico-histopathologically, and CCL11 and 24 were found to be higher with a statistically significant difference from the baseline values. Conclusion: CCL5, 11, and 24 are sensitive markers of diagnosing leprosy, response to MDT, and prognosis and are not increased in healthy contacts. CCL11 and 24 are sensitive markers of lepra reactions and may serve as one of the early diagnostic modalities for identifying lepra reaction and also leprosy in healthy contacts. To the best of our knowledge, this is the first study to evaluate these biomarkers in leprosy cases and their healthy contacts with a follow-up of upto one year with one of them developing the disease, and the same was confirmed based on these biomarkers as well.

***Keywords*—** chemokine profile, healthy contacts, leprosy, lepra reactions.

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Management of Diabetics on Hemodialysis

Souheila Zemmouchi

***Abstract*—** Introduction: Diabetes is currently the leading cause of end-stage chronic kidney disease and dialysis, so it adds additional complexity to the management of chronic hemodialysis patients. These patients are extremely fragile because of their multiple cardiovascular and metabolic comorbidities. Clear and complete description of the experience: the management of a diabetic on hemodialysis is particularly difficult due to frequent hypoglycaemia and significant inter and perdialyticglycemic variability that is difficult to predict. The aim of our study is to describe the clinical-biological profile and to assess the cardiovascular risk of diabetics undergoing chronic hemodialysis, and compare them with non-diabetic hemodialysis patients. Methods: This cross-sectional, descriptive, and analytical study was carried out between January 01 and December 31, 2018, involving 309 hemodialysis patients spread over 4 centersThe data were collected prospectively then compiled and analyzed by the SPSS Version 10 software The FRAMINGHAM RISK SCORE has been used to assess cardiovascular risk in all hemodialysis patients Results: The survey involved 309 hemodialysis patients, including 83 diabetics, for a prevalence of 27% The average age 53 ± 10.2 years. The sex ratio is 1.5. 50% of diabetic hemodialysis patients retained residual diuresis against 32% in non-diabetics. In the group of diabetics, we noted more hypertension (70% versus 38% non-diabetics P 0.004), more intradialytichypoglycemia (15% versus 3% non-diabetics P 0.007), initially, vascular exhaustion was found in 4 diabetics versus 2 non-diabetics. 70% of diabetics with anuria had postdialytichyperglycemia. The study found a statistically significant difference between the different levels of cardiovascular risk according to the diabetic status. Conclusion: There are many challenges in the management of diabetics on hemodialysis, both to optimize glycemic control according to an individualized target and to coordinate comprehensive and effective care.

***Keywords*—** hemodialysis, diabetes, chronic renal failure, glycemic control.

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Retrospective Study on the Prognosis of Patients with New-Onset Atrial Fibrillation to Evaluate the Risk of Developing Occult Cancer in Absence of Concurrent Chronic Inflammatory Disease

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***Abstract*—** Background: Cancer favors both the pro-inflammatory state and autonomic dysfunction, two important mechanisms in the genesis of AF. Atrial remodeling might be caused as a result of paraneoplastic conditions or the result of direct expression of neoplasia. Here, we hypothesize that cancer, through inflammatory mediators, may favor the appearance of AF and patients with the first episode of AF could have a higher risk of developing cancer. Method: Data was collected from patients who attended the emergency department of our hospital for the first episode of AF, diagnosed electrocardiographically, between 2010-2015 (n = 712). The minimum follow-up was 2 years, recording the appearance of cancer, total mortality, recurrences of AF and other events. Patients who developed cancer and those who did not during the 2 years after the onset of AF were compared, as well as with the incidence of cancer in Spain in 2012. Results: After 2 years, 35 patients (4.91%) were diagnosed with cancer, with an annual incidence of 2.45%. Hematological neoplasms were the most frequent (34.28%). The cancer group was older (76.68 +/-12.75 years vs 74.16 +/-12.71; $p < 0.05$) and had fewer typical symptoms (palpitations) (33.38% vs 14.28% , $p < 0.05$). The incidence of cancer in Spain during 2012 was 0.46%, much lower than our sample. When comparing the incidence by age, these differences were maintained both in those over 65 years of age and in those under 65 years of age (2.17% vs. 0.28%; 0.28% vs. 0.18% respectively). Discussion: Therefore, a high incidence of cancer in patients with the first episode of AF was observed (the annual incidence of 2.45% after the onset of AF is 6.1 times that of the general population). After the evaluation of patients with AF in their first detected episode, surveillance of the appearance of cancer should be considered in clinical practice.

***Keywords*—** cancer, cardiovascular outcomes, atrial fibrillation, inflammation.

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Improving Access to Palliative Care for Heart Failure Patients in England Using a Health Systems Approach

A. Hughes

***Abstract*—** Patients with advanced heart failure develop specific palliative care needs due to the progressive symptom burden and unpredictable disease trajectory. NICE guidance advises that palliative care should be provided to patients with both cancer and non-cancer conditions as and when required. However, there is some way to go before this guidance is consistently and effectively implemented nationwide in conditions such as heart failure.

The Ambitions for Palliative and End of Life Care: A national framework for local action in England provides a set of foundations and ambitions which outline a vision for what high quality palliative and end of life care looks like in England. This poster aims to critically consider how to improve access to palliative care for heart failure patients in England by analysing the foundations taken from this framework to generate specific recommendations using Soft Systems Methodology (SSM).

The eight foundations analysed are: 'Personalised care planning', 'Shared records', 'Evidence and information', 'Involving, supporting and caring for those important to the dying Person', 'Education and training', '24/7 access', 'Co-design' and 'Leadership'. A number of specific recommendations have been generated which highlight a need to close the evidence-policy gap and implement policy with sufficient evidence.

These recommendations, alongside the creation of an evidence based national strategy for palliative care and heart failure, should improve access to palliative care for heart failure patients in England. Once implemented, it will be necessary to evaluate the effect of these proposals to understand if access to palliative care for heart failure patients actually improves.

***Keywords*—** Access, Health Systems, Heart Failure, Palliative Care.

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A Study Investigating Whether Core Biopsy Could Negate the Need for Surgical Treatment in DCIS

Aisling Eves, Andrew Pieri, Ross McLean, Nerys Forester

***Abstract*— Background**

DCIS accounts for 20% of malignancies diagnosed by the breast screening programme and is primarily managed by surgical excision. This study aims to investigate how often DCIS is fully removed via core biopsy, thereby negating the need for surgery.

Methods

This was a single-centre retrospective cohort study of 101 consecutive breast screened patients diagnosed with DCIS who underwent surgical excision. All patients diagnosed with DCIS had radiological abnormalities <15mm. Clinical, radiological, and histological data were collected from patients who had been diagnosed within a 5 year period, and a complete excision by core biopsy was defined as 0mm of DCIS found in the surgical specimen.

Results

Complete DCIS excision following core biopsy was 21.8% (n=22). The median mammographic size of DCIS was 8mm (range: 4-14mm), median number of cores was 8(3-16) and median biopsy weight was 1.82 grams (1.1-7.5g). There were no significant differences in mammographic size (10mm, p=0.06), number of cores (9, p=0.14), or biopsy weight (2.73, p=0.26) for those who had incomplete excision. Complete excision was seen in 40% of low-grade DCIS cases, 29% of intermediate-grade, and 16% of high grade DCIS (p=0.19).

Conclusion

There are no clear factors which predict complete excision by core biopsy in screen-detected DCIS. It is possible that DCIS <15mm could be excised with VAE techniques but further investigations are needed to determine this. In low-grade DCIS further work could be considered due to higher rates of complete excision with core-biopsy. We would recommend following relevant guidelines to proceed to surgical excision where appropriate.

***Keywords*—** DCIS, core biopsy, breast radiology, complete excision, de-escalation.

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Clinical Outcomes for Patients Diagnosed with DCIS Through the Breast Screening Programme

Aisling Eves, Andrew Pieri, Ross McLean, Nerys Forester

***Abstract*—** Background: DCIS accounts for 20% of malignancies diagnosed by the breast screening programme and is primarily managed by surgical excision. There is variable guidance on defining excision margins, and adjuvant treatments vary widely. This study aimed to investigate the clinical outcomes for patients following surgical excision of small volume DCIS. Methods: This single-centreretrospective cohort study of 101 consecutive breast screened patients diagnosed with DCIS who underwent surgical excision. All patients diagnosed with DCIS had radiological abnormalities <15mm. Clinical, radiological, and histological data were collected from patients who had been diagnosed within a 5 year period, and ASCO guidelines for margin involvement of <2mm was used to guide the need for re-excision. Outcomes included re-excision rates, radiotherapy usage, and the presence of invasive cancer. Results: Breast conservation surgery was performed in 94.1% (n=95). Following surgical excision, 74(73.27%)patients had complete DCIS excision (>2mm margin), 4(4.0%) had margins 1-2mm, and 17(16.84%)had margins <1mm. The median size of DCIS in the specimen sample was 4mm. In 86% of patients with involved margins (n=18), the mammogram underestimated the DCIS size by a median of 12.5mm (range: 1-42mm). Of the patients with involved margins, 11(10.9%)had a re-excision, and 6 of these (50%) required two re-excisions to completely excise the DCIS. Post-operative radiotherapy was provided to 53(52.48%)patients. Four (3.97%) patients were found to have invasive ductal carcinoma on surgical excision, which was not present on core biopsy – all had high-grade DCIS. Recurrence of DCIS was seen in the same site during follow-up in 1 patient (1%), 1 year after their first DCIS diagnosis. Conclusion: Breast conservation surgery is safe in patients with DCIS, with low rates of re-excision, recurrence, and upstaging to invasive cancer. Furthermore, the median size of DCIS found in the specimens of patients who had DCIS fully removed in surgery was low, suggesting it may be possible that total removal through VAE was possible for these patients.

***Keywords*—** surgical excision, breast conservation surgery, DCIS, Re-excision, radiotherapy, invasive cancer.

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An Audit of Local Guidance Compliance for Stereotactic Core Biopsy for DCIS in the Breast Screening Programme

Aisling Eves, Andrew Pieri, Ross McLean, Nerys Forester

***Abstract*—** Background: The breast unit local guideline recommends that 12 cores should be used in a stereotactic-guided biopsy to diagnose DCIS. Twelve cores are regarded to provide good diagnostic value without removing more breast tissue than necessary. This study aimed to determine compliance with guidelines and investigated how the number of cores impacted upon the re-excision rate and size discrepancies. Methods: This single-centre retrospective cohort study of 72 consecutive breast screened patients with <15mm DCIS on radiological report underwent stereotactic-guided core biopsy and subsequent surgical excision. Clinical, radiological, and histological data were collected over 5 years, and ASCO guidelines for margin involvement of <2mm was used to guide the need for re-excision. Results: Forty-six (63.9%) patients had <12 cores taken, and 26 (36.1%) patients had ≥12 cores taken. Only six (8.3%) patients had 12 cores taken in their stereotactic biopsy. Incomplete surgical excision was seen in 17 patients overall (23.6%), and of these patients, twelve (70.6%) had fewer than 12 cores taken (p=0.55 for the difference between groups). Mammogram and biopsy underestimated the size of the DCIS in this subgroup by a median of 15mm (range: 6-135mm). Re-excision was required in 9 patients (12.5%), and five patients (6.9%) were found to have invasive ductal carcinoma on excision (80% had <12 cores, p=0.43). Discussion: There is poor compliance with the breast unit local guidelines and higher rates of re-excision in patients who did not have ≥12 cores taken. Taking ≥12 cores resulted in fewer missed invasive cancers lower incomplete excision and re-excision rates.

***Keywords*—** stereotactic core biopsy, DCIS, breast screening, Re-excision rates, core biopsy.

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An Investigation of Tetraspanin Proteins' Role in UPEC Infection

Fawzyah Albaldi

***Abstract*—** Urinary tract infections (UTIs) are the most prevalent of infectious diseases and > 80% are caused by uropathogenic E. coli (UPEC). Infection occurs following adhesion to urothelial plaques on bladder epithelial cells, whose major protein constituent are the uroplakins (UPs). Two of the four uroplakins (UPIa and UPIb) are members of the tetraspanin superfamily. The UPEC adhesin FimH is known to interact directly with UPIa. Tetraspanins are a diverse family of transmembrane proteins that generally act as "molecular organizers" by binding different proteins and lipids to form tetraspanin enriched microdomains (TEMs). Previous work by our group has shown that TEMs are involved in the adhesion of many pathogenic bacteria to human cells. Adhesion can be blocked by tetraspanin-derived synthetic peptides, suggesting that tetraspanins may be valuable drug targets. In this study, we investigate the role of tetraspanins in UPEC adherence to bladder epithelial cells. Human bladder cancer cell lines (T24, 5637, RT4), commonly used as in-vitro models to investigate UPEC infection, along with primary human bladder cells, were used in this project. The aim was to establish a model for UPEC adhesion/infection with the objective of evaluating the impact of tetraspanin-derived reagents on this process. Such reagents could reduce the progression of UTI, particularly in patients with indwelling catheters. Tetraspanin expression on the bladder cells was investigated by q-PCR and flow cytometry, with CD9 and CD81 generally highly expressed. Interestingly, despite these cell lines being used by other groups to investigate FimH antagonists, uroplakin proteins (UPIa, UPIb and UPIII) were poorly expressed at the cell surface, although some were present intracellularly. Attempts were made to differentiate the cell lines, to induce cell surface expression of these UPs, but these were largely unsuccessful. Pre-treatment of bladder epithelial cells with anti-CD9 monoclonal antibody significantly decreased UPEC infection, whilst anti-CD81 had no effects. A short (15aa) synthetic peptide corresponding to the large extracellular region (EC2) of CD9 also significantly reduced UPEC adherence. Furthermore, we demonstrated specific binding of that fluorescently tagged peptide to the cells. CD9 is known to associate with a number of heparan sulphate proteoglycans (HSPGs) that have also been implicated in bacterial adhesion. Here, we demonstrated that unfractionated heparin (UFH)and heparin analogs significantly inhibited UPEC adhesion to RT4 cells, as did pre-treatment of the cells with heparinases. Pre-treatment with chondroitin sulphate (CS) and chondroitinase also significantly decreased UPEC adherence to RT4 cells. This study may shed light on a common pathogenicity mechanism involving the organisation of HSPGs by tetraspanins. In summary, although we determined that the bladder cell lines were not suitable to investigate the role of uroplakins in UPEC adhesion, we demonstrated roles for CD9 and cell surface proteoglycans in this interaction. Agents that target these may be useful in treating/preventing UTIs.

***Keywords*—** UTIs, tspan, uroplakins, CD9.

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Mycophenolate versus Methotrexate in Non-infectious Ocular Inflammatory Disease: A Systematic Review and Meta-Analysis

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Authors Contributions

Mohammad Karam and Abdulmalik Alsaif contributed equally to the paper as joint first authors in the study concept and design as well as data analysis and interpretation. Abdulrahman Al-Naseem and Amrit Hayre contributed to the data acquisition. Ahmad Aldubaikhi and Narvair Kahlar were responsible for quality and bias assessment of the included studies. All the aforementioned authors were responsible for drafting the manuscript. Abdurrahman Al Jabbouri and Salem Almutairi contributed to the supervision of the study and critical review. All authors read and approved the final manuscript.

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Abstract

Purpose

To compare the outcomes of mycophenolate mofetil (MMF) versus methotrexate (MTX) in non-infectious ocular inflammatory disease (NIOID). Methods: A systematic review and meta-analysis were performed as per the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) Guidelines and an electronic search was conducted to identify all comparative studies of MMF versus MTX in NIOID. Treatment result and side effects were primary outcome measures. Secondary outcome measures included visual acuity and resolution of macular oedema. Fixed and random effects models were used for the analysis. Results:

Four studies enrolling 905 patients were identified. There was no significant difference between MMF and MTX groups in overall treatment success (Odds Ratio [OR] = 0.97, P = 0.96) and failure (OR = 0.86, P = 0.85) of NIOID. Although treatment success of uveitis showed no significant difference for

anterior and intermediate uveitis cases (OR = 2.33, P = 0.14), MTX showed a significantly improved effect in cases involving posterior uveitis and panuveitis (OR = 0.41, P = 0.003). However, the median dose required for treatment success was lower for MTX whereas MMF was associated with a faster median time to treatment success. Further to this, MMF showed a reduced rate of side effects when compared to MTX, but MTX failed to reach statistical significance, most notably for liver enzyme elevation (OR = 0.65, P = 0.16), fatigue (OR = 0.84, P = 0.49) and headache (OR = 0.81, P = 0.37). For secondary outcomes, no significant difference was noted in visual acuity and resolution of macular oedema. Conclusions

MMF is comparable to MTX in the treatment of NIOID as there was no significant difference in the outcome of treatment success and side effect profiles.

Keywords— Mycophenolate mofetil; Methotrexate; Non-infectious ocular inflammation; Uveitis; Scleritis

Highlights

- No significant difference between MMF and MTX in the overall treatment success and failure at 6 months in non-infectious ocular inflammation.
- MTX improved treatment success in posterior and panuveitis cases.
- MMF showed less side effects than MTX but failed to reach statistical significance.
- MMF and MTX are comparable in visual acuity and resolution of macular oedema.
-

1 Introduction

Non-infectious ocular inflammatory disease (NIOID) is a broad term that can be classified based on the anatomical structures involved [1]. It usually arises secondary to an underlying systemic disease breaching the blood-ocular barrier. Such autoimmune conditions include Behçet's disease, rheumatoid arthritis and ankylosing spondylitis [1]. Although relatively rare, medications such as anti-vascular endothelial growth factor agents and tumor necrosis factor-α inhibitors can cause ocular inflammation [2]. Uveitis is a common type of NIOID and can be further classified into anterior, iridocyclitis, intermediate, posterior and panuveitis. Scleritis, keratitis and mucous membrane pemphigoid are also other examples of NIOID [1].

Patients with NIOID are at greater risk of conditions such as cataract, glaucoma, retinal detachment, visual disturbance and complete vision loss. Because NIOID poses an increased risk of visual morbidity and vision loss.[3]. Treatment regimens aim to reduce intra-ocular inflammation and preserve vision. High dose Corticosteroid therapy is currently considered the first step in managing ocular inflammation. Unfortunately, long term use of corticosteroids is associated with a range of side effects and poor response in some patients. Consequently, corticosteroid sparing therapy using other immunosuppressive drugs such as Methotrexate (MTX) or Mycophenolate mofetil (MMF) has become increasingly needed and utilized. [1].

MTX is an antimetabolite and folate antagonist that was initially used for NIOID in 1965[4]. MTX is helpful in unresponsive cases and reduces the dose of corticosteroids needed thus minimising steroidal side effects [1, 5]. In ocular inflammation, it is used at low doses of 7.5-25mg/kg/week orally along with folic acid supplementation [1]. MTX is usually started simultaneously with high dose corticosteroids. Following reduction of inflammation, dosage of corticosteroids is gradually reduced. About 6-8 weeks are needed for MTX to become fully effective[6]. MTX is generally safe and well tolerated especially at

the low doses used for NIOID [7]. Most common side effects are gastrointestinal disturbance, bone marrow suppression, raised liver enzymes and allergy[8].

Just like MTX, MMF is an antimetabolite that stops DNA synthesis and hence cell replication[9]. It was first used for refractory uveitis in 1998 by Kilmartin et al [10]. It is used at a dosage of 500mg-2g along with corticosteroids. Side effects at these low dosages are primarily gastrointestinal [7]. More severe complications are seen with dosages above 3g. Leukopenia is a detrimental side effect causing lymphomas, skin cancers and infections to develop [11].

MTX and MMF have both shown positive results in the treatment of NIOID. Several studies have compared the effectiveness of these treatments but there has been no meta-analysis conducted to date [12-15]. This study aims to combine data from multiple studies to assess and clarify the significance of the treatment results of MTX and MMF.

2 Methods

A systematic review and meta-analysis were conducted as per the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[16].

2.1 Eligibility Criteria

All randomised control trials and observational studies comparing MMF with MTX for patients with NIOID were included. MMF was the intervention group of interest and MTX was the comparator. All patients were included irrespective of age, gender or co-morbidity status reconstructed if they belonged to either a study or control group. Case reports and cohort studies where no comparison was conducted, and studies not written in English were excluded from this meta-analysis.

2.2 Primary Outcomes

The primary outcome measures included treatment outcomes and side effects. Treatment outcomes measures included overall treatment success, treatment failure, anterior and intermediate uveitis treatment success as well as posterior uveitis and panuveitis treatment success. Treatment success was determined by the amount of corticosteroid-sparing effect of both interventions to control the ocular inflammation and to taper the prednisone dose to 10mg or less daily. Side effects of the respective treatments evaluated were divided into laboratory, systemic and ocular events.

2.3 Secondary Outcomes

The secondary outcomes included visual acuity and resolution of macular oedema.

2.4 Literature search strategy

Two authors (Abdulmalik Alsaif and MK) independently searched the following electronic databases: MEDLINE, EMBASE, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL). The last search was run on the 26th February 2021. Thesaurus headings, search operators and limits in each of the above databases were adapted accordingly to optimise the search results. In addition, World Health Organization International Clinical Trials Registry, ClinicalTrials.gov, and ISRCTN Register were searched for details of ongoing and unpublished studies (Appendix 1). No language restrictions were applied in our search strategies. The search terminologies included “methotrexate”, “amethopterin”, “antimetabolite”, “mycophenolate”, “mycophenolic acid”, “uveitis” and “scleritis”. All

terms were combined with adjuncts of “and” as well as “or”. To extend the screening for eligible articles, the bibliographic lists of all relevant studies were reviewed.

2.5 Selection of Articles and the Associated Studies

The title and abstract of articles identified from the literature searches were assessed independently by two authors (Abdulmalik Alsaif and MK). The full texts of relevant reports were retrieved and those articles that met our eligibility criteria were selected (Section 2.1). Any uncertainty in study selection were resolved by discussion between the authors.

2.6 Data Extraction and Management

An electronic Microsoft Excel data extraction spreadsheet was created in line with Cochrane’s data collection form for intervention reviews. The spreadsheet was pilot tested in randomly selected articles and adjusted accordingly. Two authors (Abdulrahman Alnaseem and AH) cooperatively collected and recorded the results.

2.7 Data synthesis

Data synthesis was conducted using the Review Manager 5.3 software. The extracted data was entered into Review Manager by two independent authors (Abdulmalik Alsaif and MK). The analysis was based on fixed and random effect modelling. The results were displayed in forest plots with 95% Confidence Intervals (CIs).

For dichotomous outcomes, the Odds Ratio (OR) was calculated between the two groups. (The OR is the odds of an event in the MMF group compared with the MTX group). An OR of greater than 1 would favour the MMF group, an OR of less than 1 would favour the MTX group and an OR equal to 1 would favour neither groups.

2.8 Assessment of Heterogeneity

Heterogeneity among the studies was assessed using the Cochran Q test ($\chi 2$). Inconsistency was quantified by calculating I^2 and interpreted using the following guide: 0% to 25% may represent low heterogeneity, 25% to 75% may represent moderate heterogeneity, and 75% to 100% may represent high heterogeneity.

2.9 Methodological Quality and Risk of Bias Assessment

Two authors (Ahmad Aldubaikhi and NK) independently assessed the methodological quality as well as the risk of bias for articles matching the eligibility criteria (Section 2.1). The Newcastle-Ottawa Scale[17] (which uses a star system scaling from 0 to 9 across the following domains: selection, comparability and exposure) was used to assess the quality of included studies. The overall rating of either good, fair or poor quality was based on the Agency for Healthcare Research and Quality (AHRQ) standards[17]. A third author was used as an adjudicator if consensus was required.

3 Results

3.1 Literature search results

The search strategy retrieved 382 studies and after a thorough screening of the retrieved articles the authors identified four studies which met the eligibility criteria (Section 2.1; Figure 1).

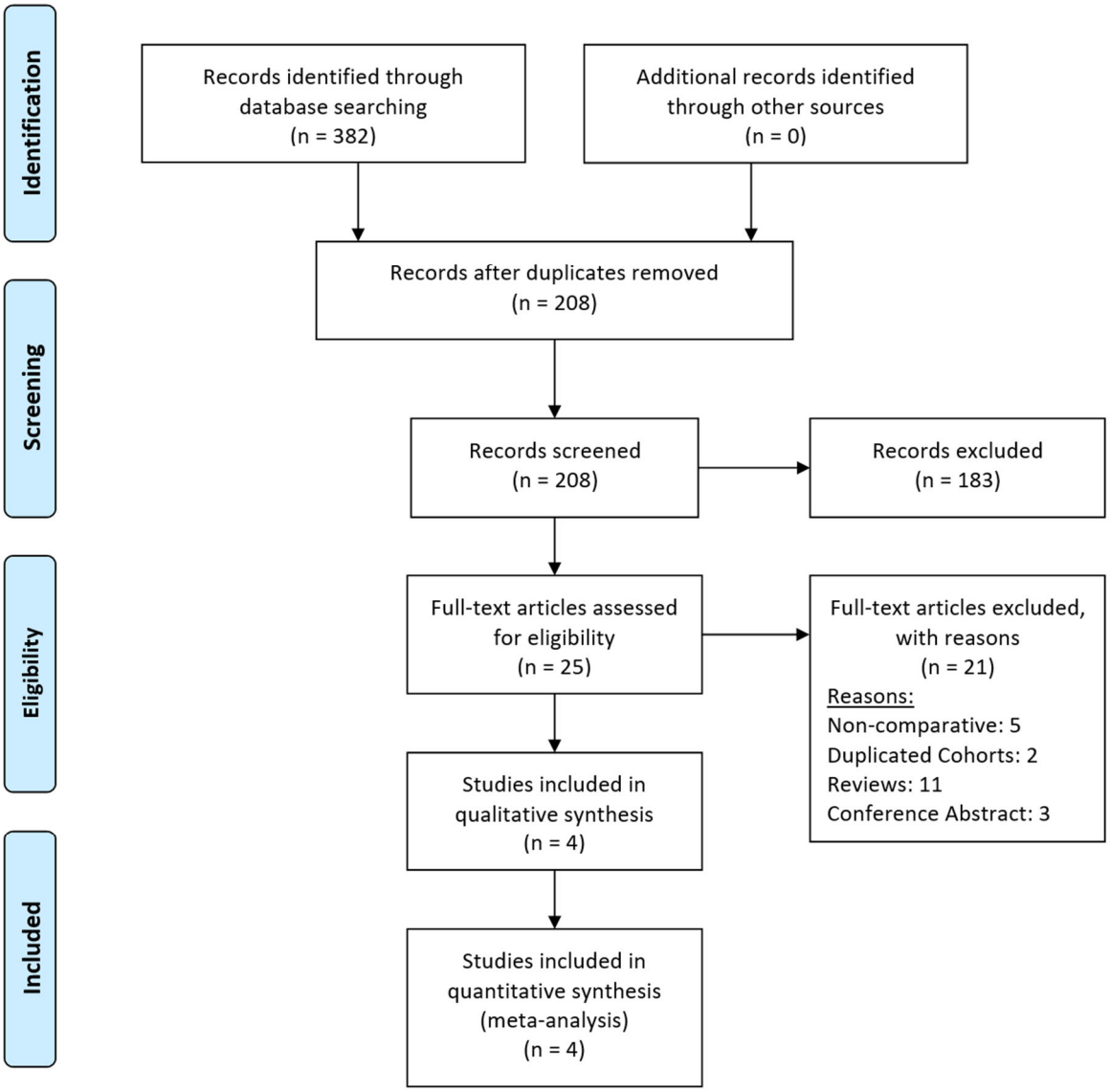

Figure 1: Prisma Flow Diagram. The PRISMA diagram details the search and selection processes applied during the overview. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

3.2 Description of Studies:

Study (Year)	Journal, Country	Study Design	Age [mean ± SD, median (range) year]	Sex (M:F)	Total Sample (MMF:MTX)
Galor et al. (2008)	American Academy of Ophthalmology, USA	Retrospective Cohort	MMF: NR, 49 (13-80) MTX: NR, 42 (6-87)	MMF: 48:81 MTX: 31:59	257 (129:90)
Rathinam et al. (2014)	American Academy of Ophthalmology, USA	RCT	MMF: 40.2 ± 14.2 MTX: 36.8 ± 10.3	MMF: 19:22 MTX: 13:26	80 (41:39)
Gangaputra et al. (2019)	American Journal of Ophthalmology, USA	Retrospective Cohort	MMF: 46.49, NR MTX: 41.26, NR	124:228	352 (130:222 with 227:384 eyes)
Rathinam et al. (2019)	Journal of the American Medical Association, USA	RCT	MMF: NR, 41 (31-51) MTX: NR, 36 (26-50)	81:135	216 (109:107)

Table 1. Baseline Characteristics of the Included Studies.

Table 1 summarises the baseline characteristics of included studies [12-15].

3.2.1.1 Galor et al. (2008)

Galor et al. conducted a single centre retrospective cohort study from July of 1984 to December of 2006 that included 257 patients (90 were treated with MTX and 129 with MMF) with NIOID. The most common diagnosis was uveitis (comprising 67% of MTX group and 68% of MMF group) followed by scleritis (comprising 23% of MTX group and 17% of MMF group) [12].

3.2.1.2 Rathinam et al. (2014)

Rathinam et al. performed a multicentre randomised control trial study that included 80 patients (39 were treated with MTX and 40 MMF) with non-infectious intermediate, posterior, or panuveitis NIOID requiring corticosteroid sparing therapy. The study targeted all patients above 16 years with active non-infectious intermediate uveitis, posterior uveitis, or panuveitis in one or both eyes. Patients were randomly treated with MTX or MMF using permuted blocks sizes of 4 and 6 [13].

3.2.1.3 Gangaputra et al. (2019)

Gangaputra et al. conducted a multicentre retrospective cohort study that included 352 patients (222 were treated with MTX and 40 MMF) with NIOID. The most common diagnosis was uveitis (comprising 73.9% of MTX group and 65.3% of MMF group) followed by scleritis (comprising 15.8% of MTX group and 18.5% of MMF group) and mucous membrane pemphigoid (comprising 7.2% of MTX group and 7.7% of MMF group) [14].

3.2.1.4 Rathinam et al. (2019)

Rathinam et al. performed a centre multicentre randomised control trials study that included 216 patients (107 were treated with MTX and 109 MMF) with NIOID. The study targeted all patients above 16 years with active non-infectious intermediate uveitis, posterior uveitis, or panuveitis in at least 1 eye. Patients were randomly treated with MTX or MMF using permuted blocks sizes of 4 and 6 [15].

3.3 Primary Outcomes:

3.3.1.1 Treatment outcome

Treatment outcome was assessed in terms of treatment success and treatment failure. Treatment success was also evaluated by anatomic location, namely anterior and intermediate uveitis as well as posterior uveitis and panuveitis.

3.3.1.2 Treatment success

In *Figure 2*, overall treatment success of non-infectious ocular inflammation at 6 months was reported in four studies with a combined total of 854 patients. Although there was no statistically significant difference seen in the OR analyses, there was a trend favouring MTX over MMF treatment group (OR = 0.97, CI = 0.32 to 2.92, P = 0.96). A high level of heterogeneity was found amongst the studies (I^2 = 93%, P < 0.00001).

Additionally, the rate of corticosteroid-sparing effect was reported by three studies involving 689 patients. Galor et al. defined this as the ability to taper prednisolone dose to ≤10 mg daily and found a lower incidence rate of 0.90 for MTX (CI = 0.61-1.28) versus 1.68 for MMF (CI = 1.31-2.10) with a significant difference (P = 0.002). However, Gangaputra et al. found MMF corticosteroid-sparing success rate to be 32% higher compared to MTX, with a statistically significant difference (hazard ratio 0.68, 95% CI = 0.46-0.99). In addition, Rathinam et al. showed that the rate of corticosteroid-sparing control of inflammation was not statistically significant between the control and intervention groups (P = 0.44) with 22 patients (33%) not achieving corticosteroid-sparing control at months 5 and 6 (15 with MMF [47%] and 7 with MTX [20%]).

According to *Table 2***,** the median time taken to reach treatment success was generally faster in the MMF treatment group than MTX; however, the latter group required less dosage to reach treatment success.

3.3.1.3 Treatment success by anatomic location

In *Figure 3,* treatment success of anterior and intermediate uveitis at 6 months was reported in two studies with a combined total of 53 patients. There was no statistically significant difference seen in the OR analyses, however a trend favouring MMF group was shown (OR = 2.33, CI = 0.75 to 7.21, P = 0.14). A moderate level of heterogeneity was found amongst the studies (I^2 = 38%, P = 0.20).

In *Figure 4,* treatment success of posterior uveitis and panuveitis at 6 months was reported in two studies with a combined total of 208 patients. There was a statistically significant difference seen in the OR analyses showing a higher rate of treatment success for the MTX group (OR = 0.41, CI = 0.23 to 0.74, P = 0.003). A low level of heterogeneity was found amongst the studies (I^2 = 0%, P = 0.003).

3.3.1.4 Treatment failure

In *Figure 5***,** treatment failure of non-infectious ocular inflammation at 6 months was reported in three studies with a combined total of 502 patients. There was no statistically significant difference seen in the odds ratio analyses showing a lower rate of failure for the MMF group (OR = 0.86, CI = 0.18 to 4.10, P = 0.85). In addition, the incidence of treatment failure due to drug intolerance was reported to be insignificant by Galor et al, Rathinam et al 2014 and Gangaputra et al. A high level of heterogeneity was found amongst the studies (I^2 = 93%, P < 0.00001).

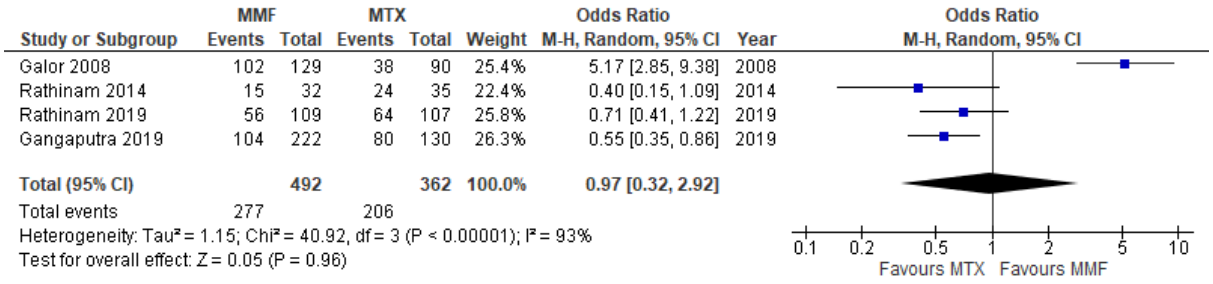

Figure 2: Forest Plot for Odds Ratio of Mycophenolate versus Methotrexate – Overall Treatment Success of Non-Infectious Ocular Inflammation at 6 Months. Quantitative analysis showing no significant difference in the overall treatment success at 6 months in the mycophenolate group compared with the methotrexate group.

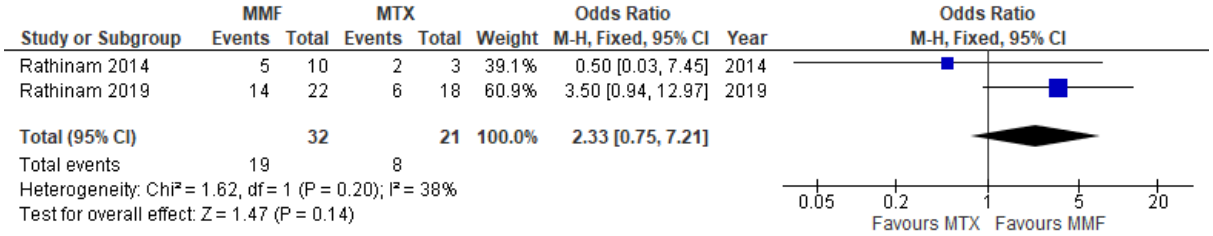

Figure 3: Forest Plot for Odds Ratio of Mycophenolate versus Methotrexate – Treatment Success of Anterior and Intermediate Uveitis at 6 months. Quantitative analysis showing no significant difference in the treatment success of anterior and intermediate uveitis at 6 months in the mycophenolate group compared with the methotrexate group.

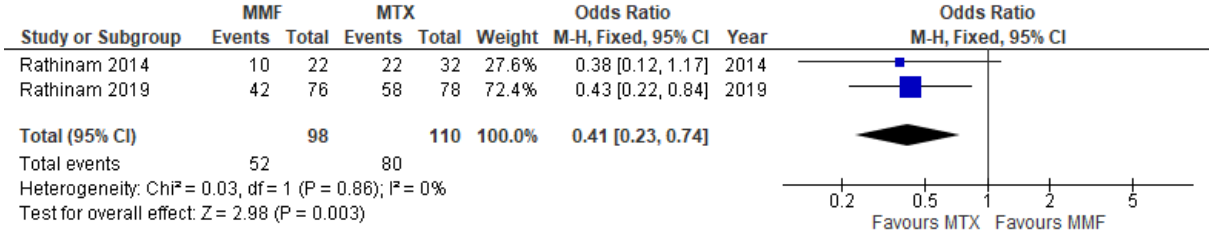

Figure 4: Forest Plot for Odds Ratio of Mycophenolate versus Methotrexate – Treatment Success of Posterior Uveitis and Panuveitis at 6 months. Quantitative analysis showing a statistically significant lower rate of treatment success of posterior uveitis and panuveitis at 6 months in the mycophenolate group compared with the methotrexate group.

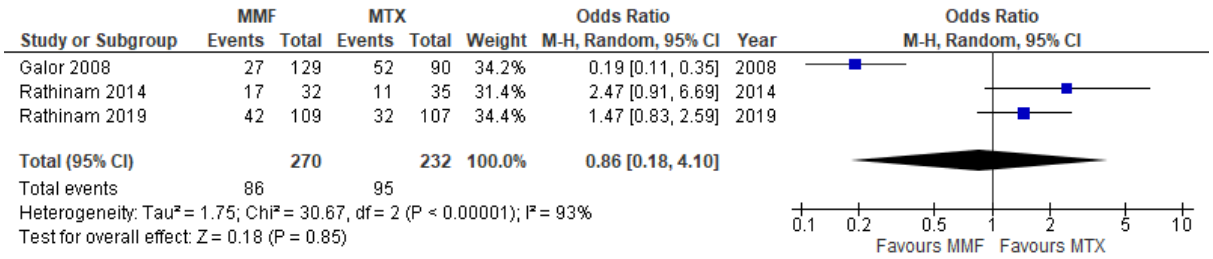

Figure 5: Forest Plot for Odds Ratio of Mycophenolate versus Methotrexate – Treatment Failure of Non-Infectious Ocular Inflammation at 6 Months. Quantitative analysis showing no significant difference in the treatment failure at 6 months in the mycophenolate group compared with the methotrexate group.

Study	Median Time		Median Dose	
	MMF	MTX	MMF	MTX
Galor et al. (2008)	4 Months	6.5 Months	2g/day	15 mg/week
Rathinam et al. (2014)	124 Days	139 Days	NR	NR
Gangaputra et al. (2019)	8.2 Months	9.9 Months	2g/day	12.5 mg/week
Rathinam et al. (2019)	NR	NR	3g/day	25 mg/week

Table 2. Mycophenolate versus Methotrexate – Median Time to Treatment Success and Median.

3.3.1.5 Treatment Side Effects

Side effects of the treatment evaluated were divided into laboratory (e.g. elevated liver enzymes and bone marrow suppression), systemic (e.g. fatigue, headache, fever, gastrointestinal upset and systemic infection) and ocular events (e.g. ocular hypertension, glaucoma, cataract, vitreous haemorrhage, retinal detachment, eye pain and decreased vision).

3.3.1.5.1 Laboratory Complications

In *Figure 6,* liver enzyme elevation was reported in three studies with a combined total of 515 patients. There was no statistically significant difference seen in the OR analyses showing a lower rate of elevated liver enzymes for the MMF group (OR = 0.65, CI = 0.36 to 1.18, P = 0.16). A low level of heterogeneity was found amongst the studies ($I^2 = 0\%$, P = 0.16). Additionally, Galor et al. reported one patient in each group having experienced bone marrow suppression.

3.3.1.5.2 Systemic Complications

In *Figure 7,* fatigue was reported in three studies with a combined total of 515 patients. There was no statistically significant difference seen in the OR analyses showing a lower rate of fatigue for the MMF group (OR = 0.84, CI = 0.53 to 1.36, P = 0.49). A low level of heterogeneity was found amongst the studies ($I^2 = 0\%$, P = 0.95). In *Figure 8*, headache was reported in two studies with a combined total of 296 patients. There was no statistically significant difference seen in the OR analyses showing a lower rate of headache for the MMF group (OR = 0.81, CI = 0.50 to 1.29, P = 0.37). A moderate level of heterogeneity was found amongst the studies ($I^2 = 55\%$, P = 0.14). Other important systemic complications that had no significant differences included fever, gastrointestinal upset and systemic infection.

3.3.1.5.3 Ocular Side Effects

According to Rathinam et al., there were no significant differences reported in terms of the ocular side effects between the two medications. This included ocular hypertension, glaucoma, cataract, vitreous haemorrhage, retinal detachment, eye pain and decreased vision.

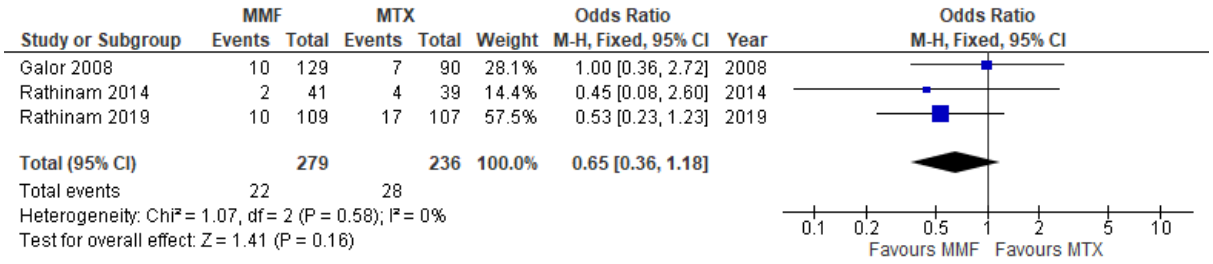

Figure 6: Forest Plot for Odds Ratio of Mycophenolate versus Methotrexate – Elevated Liver Enzymes. Quantitative analysis showing no significant lower rate of elevated liver enzymes in the mycophenolate group compared with the methotrexate group.

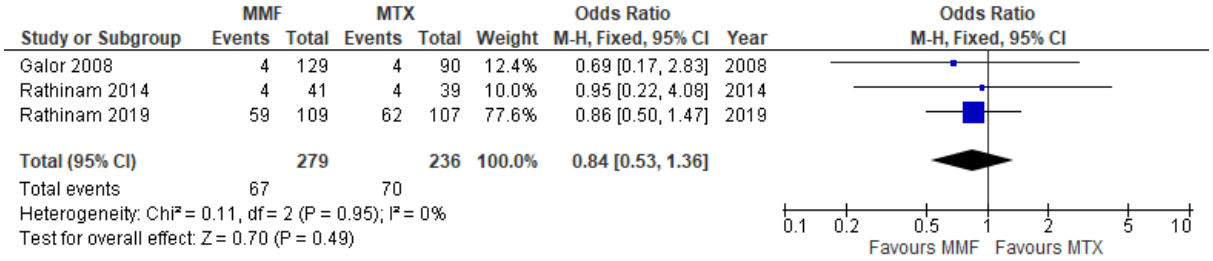

Figure 7: Forest Plot for Odds Ratio of Mycophenolate versus Methotrexate – Fatigue. Quantitative analysis showing no significant lower rate of fatigue in the mycophenolate group compared with the methotrexate group.

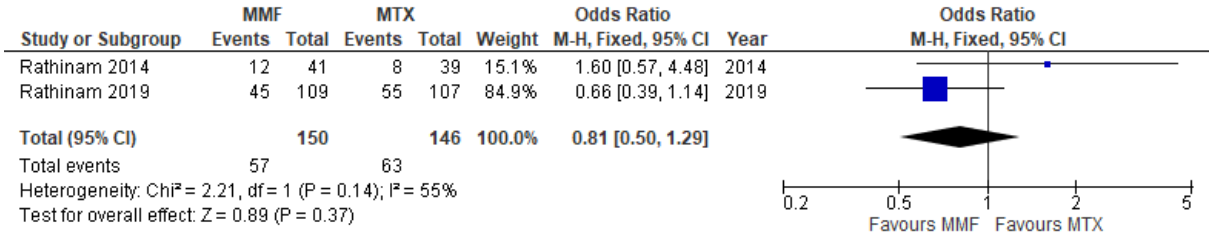

Figure 8: Forest Plot for Odds Ratio of Mycophenolate versus Methotrexate – Headache. Quantitative analysis showing no significant lower rate of headache in the mycophenolate group compared with the methotrexate group.

3.4 Secondary outcomes:

3.4.1.1 Visual Acuity

Rathinam et al. reported the effects of MTX and MMF on visual acuity in both of their studies included in this meta-analysis. In both studies patients were required to read off of a tumbling 'E' chart at 4 metres; spectacle-corrected visual acuity was measured using a logarithm of the minimum angle of resolution (logMAR). In Rathinam et al.s 2014 study a mean change in logMAR of -0.26 in the MTX treatment group compared to -0.19 in the MMF control group was reported. In their 2019 study, Rathinam et al. reported a median change in logMAR of -0.10 in the MTX treatment group compared to -0.12 in the MMF control group, both were not statistically significant.

3.4.1.2 Resolution of Macular Oedema

According to Rathinam et al. 2014 and 2019, there were no significant differences in the resolution of macular oedema and change in macular thickness between the MTX & MMF.

3.5 Methodological Quality and Risk of Bias Assessment

The Cochrane Collaboration's Tool was used to assess the quality of the RCTs included in the study (*Table 3*). The Newcastle-Ottawa scale[17] was used to assess the quality of the non-randomised studies (*Table 4)* which offers a star system for analysis. The quality of the included non-randomized study was deemed to be high in selection and outcome but low in comparability. Overall, both studies were good quality based on the AHRQ standards[17].

First Author	Bias	Authors' Judgement	Support for Judgement
Rathinam et al. (2014)	Random sequence generation (selection bias)	Low risk	Participants were selected by the principal statistician using the statistical software R
	Allocation concealment (selection bias)	Unclear risk	No information given.
	Blinding of participants and personnel (performance bias)	High risk	Patients and study coordinators were unmasked, but the personnel responsible for outcome were masked.
	Blinding of outcome assessment (detection bias)	Unclear risk	No information given.
	Incomplete outcome data (attrition bias)	Low risk	No missing data
	Selective reporting (reporting bias)	Low risk	All outcome data reported.
	Other bias	Low risk	Similar baseline characteristics in both groups.
Rathinam et al. (2019)	Random sequence generation (selection bias)	Low risk	Participants were selected by the principal statistician using the statistical software R
	Allocation concealment (selection bias)	Low risk	Allocation was concealed until after enrolment.
	Blinding of participants and personnel (performance bias)	Unclear Risk	No information given
	Blinding of outcome assessment (detection bias)	Unclear Risk	No information given
	Incomplete outcome data (attrition bias)	Low risk	No missing data
	Selective reporting (reporting bias)	Low risk	All outcome data reported.
	Other bias	Low risk	Similar baseline characteristics in both groups.

Table 3. Bia analysis of the Randomised Trials using the Cochrane Collaboration's Tool

Study (Year)	Selection	Comparability	Outcome
Galor et al. (2008)	☆☆☆	☆	☆☆☆
Gangaputra et al. (2019)	☆☆☆	☆	☆☆

Table 4. Newcastle-Ottawa Scale to Assess the Quality of Non-Randomised Studies.

4 Discussion:

MMF showed a comparable effect to MTX in the treatment of non-infectious ocular inflammation. The overall treatment success was not significantly different (P = 0.96) between MMF & MTX (*Figure*

2). Although the overall median time to treatment success was shorter in MMF, the median dose at which treatment success was observed was generally lower for the MTX group (*Table 2*). For uveitis by anatomic location, no significant difference (P = 0.14) was noted in the treatment success of anterior and intermediate uveitis at 6 months, however MTX was associated with a significantly higher rate of treatment success in posterior uveitis and panuveitis cases (P = 0.003); (*Figures 3 & 4*). Furthermore, no significant difference was noted in treatment failure at 6 months (P = 0.85); (*Figure 5).* In regard to treatment side effects, no statistical significance was reached, MMF was associated with a lower side effect profile particularly for liver enzyme elevation (P = 0.16), fatigue (P = 0.49) and headache (P = 0.37); (*Figures 6 &8*). In reference to the between-study heterogeneity, it was moderate to high for the majority of outcomes (I^2 = 38-93%). Except for the treatment success of posterior uveitis and panuveitis at 6 months, elevated liver enzymes and fatigue, which both had low levels of heterogeneity (I^2 = 0%), based on the assessment as mentioned in Section 2. As for the secondary outcomes, no significant difference was noted in terms of visual acuity and resolution of macular oedema.

There is a current debate in literature on the ideal treatment of NIOID 12,13. The findings of this meta-analysis suggest that MMF is comparable to MTX in the treatment of NIOID. The effectiveness of MMF in controlling inflammation is also supported by Daniel et al., who highlighted that amongst the treated 236 patients (397 eyes) with MMF therapy, 53% and 73% of patients achieved complete control of inflammation within 1 year and 6 months. Similarly, Chang et al. revealed that following 2 months of MMF monotherapy, 73.1% (out of 52 patients) of paediatric patients with autoimmune uveitis achieved inflammation control [19]. In support of the above, a retrospective case series of patients with non-infectious posterior, intermediate and panuveitis by Lowder et al. highlighted a trend favouring MMF group over MTX in terms of steroid sparing effect (60% vs. 22% respectively, P = 0.069) and the ability to taper antimetabolite (55% vs. 17% respectively, P = 0.06) [20]. This study also reported a statistically significant (P = 0.002) higher median duration of sustained clinical efficacy in the MMF group (48 months) compared to MTX group (20 months) [20]. Associated studies conducted by Sobrin et al. and Bom et al. demonstrated that the overall median time to achieve treatment success was shorter in MMF in patients who failed to reach inflammation control with MTX [21,22]. To support this finding further, a retrospective cohort study by Truong et al. found that MMF achieved faster control of inflammation than MTX at 6 to 9 months. However, the two drugs were equal at a treatment term of 1 year and above [23]. It was also reported that patients experienced minimal side effects with both drugs. This is also in line with a study by Daniel et al. also demonstrated that treatment-limiting side effects were only seen in 12% of the subjects treated with MMF, which were typically reversible [18]. This is particularly important to consider because while antimetabolite therapy for uveitis improves visual outcomes, it is reported that their side effect profile can negatively impact patients' health and quality of life, particularly mental health. [24]. Given the findings from the available evidence, MMF could be considered as an alternative agent to MTX for the treatment of NIOID as both agents have comparable clinical outcomes.

A systemic approach was used in this review to provide a detailed conclusion of the best available evidence and to understand the risk of bias of relevant trials. However, this review should be interpreted in the context of inherent limitations. Only four studies were analysed enrolling 905 patients. This limited sample size questions how representative these statistical outcomes are in relation to a wider population suffering from NIOID, therefore limiting the power of this meta-analysis. The authors of this meta-analysis suggest the need for further randomised trials to be able to confidently determine the most effective treatment for NIOID.

5 Conclusions

The findings of this meta-analysis have concluded that the application of MMF as a treatment for NIOID is not significantly different from the treatment of MTX. However, MTX produced improved treatment success when used in posterior and panuveitis cases, which could potentially be due to ….?????. The authors suggest that further clinical studies need to be performed in order to conclude the comparative effectiveness of both MTX & MFF in treating NIOID.

6 Declarations

6.1 Ethics Approval and Consent to Participate

Not Applicable.

6.2 Consent for Publication

Not Applicable.

6.3 Availability of Data and Materials

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

6.4 Competing Interests

The author(s) declared that they have no competing interests.

6.5 Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

6.6 Author Contributions

Mohammad Karam and Abdulmalik Alsaif contributed equally to the paper as joint first authors in the study concept and design as well as data analysis and interpretation. Abdulrahman Al-Naseem and Amrit Hayre contributed in the data acquisition. Ahmad Aldubaikhi and Narvair Kahlar were responsible for quality and bias assessment of included studies. All the aforementioned authors were responsible for drafting the manuscript. Abdurrahman Aljabouri and Salem Almutairi contributed in the supervision of the study and critical review. All authors read and approved the final manuscript.

6.7 Acknowledgements

Not Applicable.

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Appendix 1. Website Links

Title	Website
World Health Organization International Clinical Trials Registry	http://apps. who.int/trialsearch/
ClinicalTrials.gov	http://clinical- trials.gov/
ISRCTN Register	http://www.isrctn. com/

The Effectiveness of Non-Surgical Treatment for Androgenetic Alopesia in Men: A Systematic Review and Meta-Analysis

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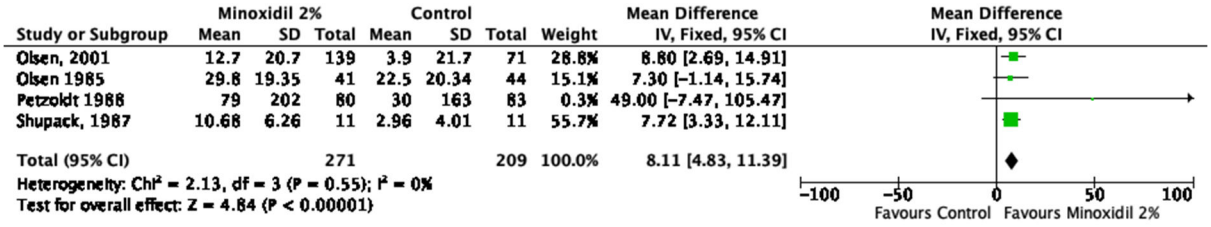
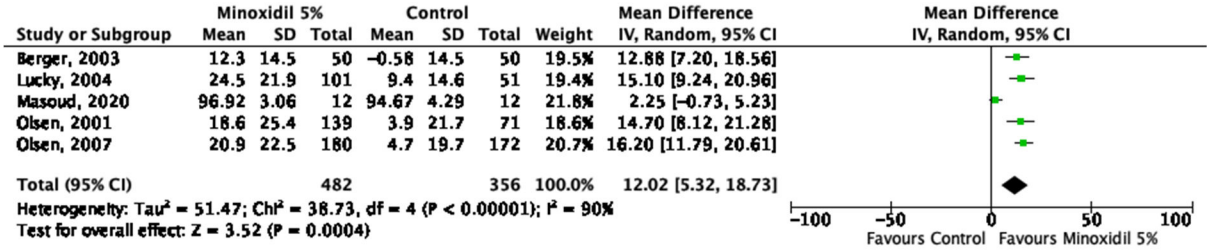
Abstract

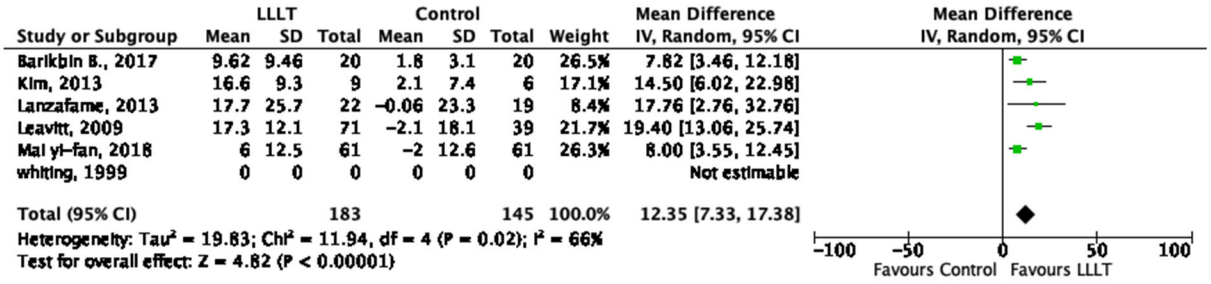
Introduction: Androgenetic alopecia (AGA), is a genetically predetermined disorder due to an excessive response to dihydrotestosterone (DHT). Currently, non-surgical treatment of androgenetic alopecia is more in demand by patient. There are many non-surgical treatments, ranging from topical treatments, oral medications, and procedure treatments.
Objective: We aim to assess the latest evidence of the efficacy of non-surgical treatments of androgenetic alopecia in men comparison to placebo for improving hair density, thickness, and growth.
Method: We performed a comprehensive search on topics that assesses non-surgical treatments of androgenetic alopecia in men from inception up until November 2021.
Result: There were 24 studies out of a total of 2438 patients divided into five non-surgical treatment groups to assess the effectiveness of hair growth, namely: minoxidil 2% (MD: 8.11 hairs/cm^2), minoxidil 5% (MD: 12.02 hairs/cm^2), *low-level laser light therapy*/LLLT (MD: 12.35 hairs/cm^2), finasteride 1mg (MD: 20.43 hairs/cm^2), and *Platelete-Rich Plasma*/PRP with microneedling (MD: 26.33 hairs/cm^2). All treatments had significant results for increasing hair growth particularly in cases of androgenetic alopecia in men ($P<0.00001$).
Conclusion: From the results, it was found that the five non-surgical treatment groups proved to be effective and significant for hair growth, particularly in cases of androgenetic alopecia in men. In order of the best non-surgical treatment for hair growth starting from PRP with microneedling, Finasteride 1mg, LLLT, minoxidil 5%, to minoxidil 2%.

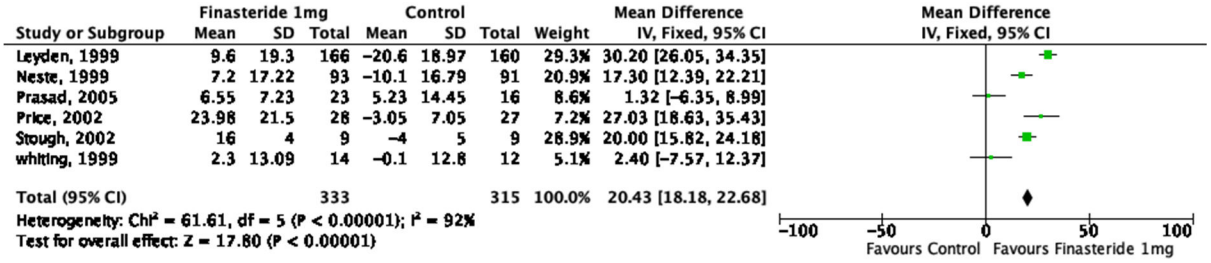
Keywords: Androgenetic Alopesia, Non-surgical, Men, Meta-analysis, Systematic Review

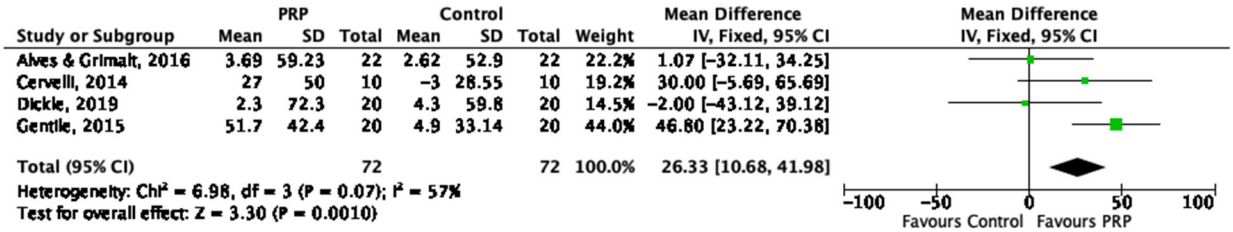
RESULT (FIGURE)











Limb Ischaemia and Multisystem Dysfunction as a Consequence of Cholesterol Embolization Syndrome

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ABSTRACT

Following a Coronary artery bypass graft and insertion of an intra-aortic balloon pump, the 63 year-old male patient developed signs of progressive multi-organ dysfunction and ischaemic changes in both of his lower limbs. The diagnosis of cholesterol embolization syndrome was made. This condition has been noted to be a complication of invasive procedures and endovascular therapies, and is often overlooked and difficult to treat. While the patient's renal function and pancreatitis showed improvement, the lower limb ischaemia was progressing. Eventually, the patient underwent a bilateral below knee amputation.

Keywords: Cholesterol emboli, Cholesterol crystal embolization, Digital ischaemia, Intra-aortic balloon pump, Plaque rupture.

INTRODUCTION

Cholesterol embolization syndrome (CES) is a rare and often overlooked consequence of advanced atherosclerotic disease. The underlying pathology is that plaque disruption occurs, leading to the contents of the plaque embolizing throughout the vascular sys- tem[1]. Plaque disruption can occur spontaneously but is said to be iatrogenic in >70% of cases[2]. The treatment of CES is largely symptomatic[3]. Interventions include surgical resection and endovascular approach[3]. Here we present a case with typical features of CES.

CASE SUMMARY

A 63-year-old male patient, with diabetes mellitis and smoking history, underwent coronary artery by-pass grafting. In an attempt to improve his faltering ejection fraction, an intra-aortic balloon pump (IABP) insertion was done with great difficulty. On the first post-operative day, the patient began to develop dusky and cold extremities in the lower limbs bilaterally. He had bilateral ankle edema and his distal pulses were not palpable despite audible arterial signals on hand- held doppler. However, a detailed duplex scan of the lower limbs indicated there was nearly normal blood flow. His total leukocyte count was high (14.8 x 103), as was creatinine phosphokinase level (1531 U/L). On the Second post-operative day, his platelet count decrea- sed to 57,000 and signs of renal impairment surfaced.

In the days to follow, the limb ischemia and renal impairment worsened. There was a persistent leuko-cytosis with thrombocytopenia of 22,000. On the 10th

post-op day, the patient developed abdominal pain and distension. Investigations revealed amylase level of 1600 U/L; suggestive of acute pancreatitis. The C- reactive protein level was persistently elevated. In the light of the patient's history, the prior insertion of an IABP, characteristic findings, and the diagnosis of exclusion was found to be CES.

With the diagnosis of CES and thrombocytopenia, anticoagulation was not started. While the patient's renal function began to improve and abdominal symp- toms regressed, he failed to show improvement in the lower limbs with regards to the ischemia and event- ually underwent a bilateral below knee amputation, however the limbs were not sent for histopathology as it would not have changed the outcome and further treatment.

Figure: The patient's lower extremities on the 16th post- operative day.

DISCUSSION

CES was first described in an autopsy in 1862 by Fenger and Panum[5]. CES consists of advanced athero- sclerotic plaques in large caliber vessels rupturing, rel-

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easing cholesterol crystals into the circulation, resul- ting in gradual ischemic changes and multiorgan dys- function by building up in smaller vasculature[1]. Mor- tality ranges between 5-16%[6].

Male gender, age over 60 years, heavy smoking, with diabetes mellitus, hyperlipidemia, abdominal aor- tic aneurysms, cardiovascular surgery, endovascular therapy and anticoagulation have all been stated as risk factors[2]. More than 70% of the cases are iatroge- nic[2]. CES as a complication of an intra-aortic balloon pump occurs in 0.1% as reported by a review article[6].

The clinical manifestations of CES most comm- only occur in the skin in the form of livedo reticularis, skin discoloration, gangrenous digits[6]. Pancreatitis has also been reported as a rare complication of CES which was seen in our patient[7]. The definitive diagnosis for CES is made by biopsy[8]. C-reactive protein is raised and 80% of cases show elevated eosinophil counts[4,8].

Treatment is symptomatic. Statins and corticoste- roids have been have resulted in clinical improvement in some cases[2,4]. The use of anticoagulants in patients with CES is a controversial topic[8]. Some suggest anti- coagulants should be avoided, as they have been assu- med to promote plaque disruption[8]. A study showed 7% of confirmed CES cases with no previous endovas- cular or operative history could be attributed to anti- coagulant therapy[1].

This condition can be prevented through risk factor modification in the form of control of tight control of co-morbid conditions and limitation of intra- vascular procedures and techniques[1]. Preventing CES with specific emphasis to the IABP, can be done by using smaller sized catheters with a sheathless techni- que[9].

CONCLUSION

Cholesterol embolization syndrome (CES) is a complication of invasive procedures involving large

caliber vessels. For this reason, if a patient begins to develop ischemic extremities and show signs of prog- ressive renal shutdown after an invasive procedure, it is very important to consider CES. Although the com- plication rate for CES following intra-aortic balloon pump is only 0.1%, these are only the cases that were confirmed to be CES, the actual figure may be much higher and need to be recognized. This topic is beco- ming increasingly significant with the advances and increased use of endovascular treatment and inter- ventional radiology.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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Fatty Acid Metabolism in Hypertension

Yin Hua Zhang

***Abstract*—** Cardiac metabolism is essential in myocardial contraction. In addition to glucose, fatty acids (FA) are essential in producing energy in the myocardium since FA-dependent beta-oxidation accounts for > 70-90% of cellular ATP under resting conditions. However, metabolism shifts from FAs to glucose utilization during disease progression (e.g. hypertrophy and ischemic myocardium), where glucose oxidation and glycolysis become the predominant sources of cellular ATP. At advanced failing stage, both glycolysis and beta-oxidation are dysregulated, result in insufficient supply of intracellular ATP and weakened myocardial contractility. Undeniably, our understandings of myocyte function in healthy and diseased hearts are based on glucose (10 mM)-dependent metabolism because glucose is the "sole" metabolic substrate in most of the physiological experiments. In view of the importance of FAs in cardiovascular health and diseases, we aimed to elucidate the impacts of FA supplementation on myocyte contractility and evaluate cellular mechanisms those mediate the functions in normal heart and with pathological stress. In particular, we have investigated cardiac excitation-contraction (E-C) coupling in the presence and absence of FAs in normal and hypertensive rat left ventricular (LV) myocytes. Our results reveal that FAs increase mitochondrial activity, intracellular $[Ca^{2+}]i$, and LV myocyte contraction in healthy LV myocytes, whereas FA-dependent cardiac inotropyis attenuated in hypertension. FA-dependent myofilament Ca^{2+} desensitization could be fundamental in regulating $[Ca^{2+}]i$. Collectively, FAs supplementation resets cardiac E-C coupling scheme in healthy and diseased hearts.

***Keywords*—** hypertension, fatty acid, heart, calcium.

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Effect of Farsi gum (Amygdalus Scoparia Spach) in Combination with Sodium Caseinate on Textural, Stability, Sensory Characteristics and Rheological Properties of Whipped Cream

Samaneh Mashayekhi

***Abstract*—**Cream (whipped cream) is one of the dairy products that can be used in desserts, pastries, cakes, and ice creams. In this product, some parameters such as taste and flavor, quality stability, whipping ability, and stability of foam after whipping are very important. The objective of this study is applicable of Farsi gum and sodium caseinate in 3 biopolymer ratios (1:1, 1:2, and 2:1) and 0.15, 0.30, and 0.45 %wt. concentrations in whipped cream formulation. Sample without hydrocolloids was considered as a control. Before whipping, viscosity of all creams was increased continuously with increasing shear rate. In addition, the viscosity was increased with the increasing hydrocolloids addition (in constant shear rate). Microscopic observations showed that polydispersity of systems before whipping. Overrun of F, FC11, and FC21 samples were increased (with increasing total hydrocollid concentration 0.15 to 0.30 % wt.); then decreased this parameter with increasing to 0.45 % wt. concentration. However, mean comparison of FC12 samples overrun showed that this value was increased with increasing total hydrocolloids concentration. 0.45FC21 sample had significantly ($P<0.05$) highest overrun (118.44±9.11). Synersis of whipped cream samples are reduced with hydrocolloid addition. B sample had significantly ($P<0.05$) highest serum separation (16.66±0.80%), and 0.45FC12 had a low one (5.94±0.19%) in compered with others synersis. Mean comparison of hardness and adhesiveness of whipped cream revealed that Farsi gum addition alone and in combination with sodium caseinate increased the previous textural characteristics. Results exhibited that 0.4FG12 had significantly ($P<0.05$) highest hardness (267.00±18.38 g).Mean comparison of droplet size of cream sample before whipping displaced that hydrocolloid addition had no significant effect ($P>0.05$), and mean droplet size of the samples ranged between 1.93-2.16 µm. Generally, the mean droplet size of whipped cream increased after whipping with increasing hydrocolloid concentration (0.15-0.45 % wt.). Color parameter analysis showed that Farsi gum addition alone and in combination with sodium caseinate had no significant effect ($P>0.05$) on these parameters (Lightness, Redness, and Yellowness). Based on sensory evaluation results, appearance, color, flavor, and taste of whipped creams not influenced by hydrocolloids addition; but 0.45FC12 sample had higher value. Based on the above results, Farsi gum had suggested to potential application in a whipped cream formulation; however, further research need to foundingof their functionality.

***Keywords*—**whipped cream, farsi gum, sodium caseinate, overrun, droplet size, texture analysis, sensory evaluation.

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Comparative Study of OFDM Performance Improvements Using Wavelet Filters

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***Abstract*—The study of comparison OFDM systems with wavelet filters is very useful in developing next-generation wireless communication technology, i.e. 4G, 5G, which allows for faster transmission and reception of different frequency signals with a small bandwidth cost. The Adoption of modern digital technologies can assist in this process. Using digital wavelet filters, high-speed digital signal processors can produce a very sharp frequency response. However, the circuit complexity leads to power loss (PL) of the signal and the system. This can be avoided when using VLSI (very-large--scale integrated) circuits with modern technology of multiplexing. A Multi-input Multi-output OFDM technique increases transmission capacity for intense situations [2]. One of the advantages of the modern OFDM technology is its cost - effectiveness. There are a number of communication standards that use OFDM, such as IEEE 802.11a and IEEE 802.11b. This paper is focused on improving the performance of wireless communication systems by applying OFDM technology with various wavelet filters.**

Keywords—*4G,5G, OFDM, IEEE, MIMO-OFDM, PAPR, PL, Communication System.*

I. Introduction

OFDM is a highly flexible and efficient modulation technique, one of the most widely used today. It is at the core of all major wireless and wired standards used or being developed today. In 1980, the European Union began carrying out second-generation research on mobile communication. The technology was first used in the public sphere in 1990. At the same time, research work has already begun for the next-generation of mobile communications systems, 3G, aiming to provide much higher data rates in the range of 64 to 384 k bit/s, with large bandwidth cost as compared to GSM (Global system for mobile) network. In the downlink, with High-Speed Packet Access (HSPA), the maximum rate is 7.2 Mbit/s. Using 3G technologies, the maximum data rate is 2 Mbit/s for indoor use, and 1.2 Mbit/s for indoor use. Researchers have developed new technologies such as "Long Term Evolution" (LTE) and Wi-max to improve the speed performance during ongoing research.There are three types of frequency division multiplexing: frequency division multiplexing (FDM), multicarrier communication (MC) and orthogonal frequency division multiplexing. A long time of research led to the development of 4G technology. A system's 4G capabilities are defined by two main requirements: a very high data rate and very efficient bandwidth utilization.

II. An overview of OFDM's state-of-the-art and background

OFDM is a digital modulation or multiplexing technique. This is a technique of encoding the input data on multiple sub-carrier frequencies. It is similar to Frequency Division Multiplexing (FDM), but the difference lies in the way in which the signals are modulated and demodulated.

The information sequence is transmitted using some subcarriers which are orthogonal to each other and preserving the precious bandwidth. OFDM is more robust as compared to FDM as it suffers from frequency-selective fading. In FDM, due to interference, the single carrier transmission fails then the entire data has to be transmitted again. But in multicarrier there isno need to transmit the whole data again, only a small number of sub-carriers have to be transmitted which is affected by the interference. Different error detection and correction techniques can be used to remove these errors. Due to the transmissionof multiple carriers, OFDM can be treated as a modulation technique as well as a multiplexing.

Therefore these N sub-carriers occupy the whole bandwidth, leading to inefficient use of bandwidth [4].To effectively use the whole bandwidth parallel data with FDM and overlapping of the sub-carriers is used. These sub-carriers have a signalling rate r symbols/sec and are placed r apart in the frequency domain to maintain the Orthogonality among the sub-carriers. In this way, these sub-carriers become orthogonal to each other and according to the Orthogonality principle, thesesignals are more robust against multipath fading.

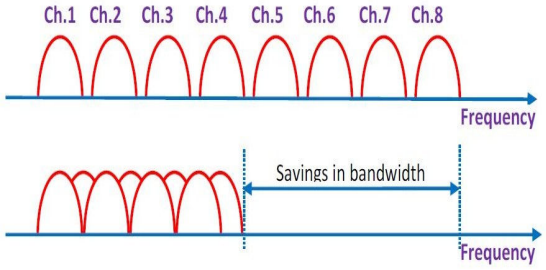

Figure1. OFDM with multi carrier scheme

FIGURE 1 shows both the techniques for transmission of data using non-overlapping technique as well as overlappingtechnique. Hence approximately 50% of the total transmission bandwidth is saved by using multicarrier overlapping technique.

III. OFDM: A mathematical description

A. *Orthogonality*

Two signals are said to be orthogonal if their dot product is zero. That is, if you take two signals multiply them together and if their integral over an interval is zero, then two signals are orthogonal in that interval. Mathematically, suppose we have a set of signals Ψ then,

$$\int_a^{a+T} \varphi(t)_p \, \varphi(t)_q^* = \begin{cases} K & for\ p = q \\ 0 & for\ p \neq q \end{cases} \quad \text{..... (i)}$$

The signals are orthogonal if the integral value is zero over the interval [a, a+T], where T is the symbol period. This way of transmitting information helps in handling the effects of multipath propagation efficiently. The transmission is efficient because of the spectral overlap of narrow-band sub-carriers. OFDM supports various modulations techniques like BPSK, QAM, and QPSK etc. QAM is further divided in 16, 32 and 64 QAM techniques by using digital wavelets filters.

IV. OFDM PERFORMANCE ANALYSIS WITH DIGITAL WAVELET FILTERS

1. Fourier Transformation

The Fourier spectrum of unit step signal is the graph between magnitude |F(jω)| and frequency (ω). The time domain information is not available about the signal. So any discontinuity in input signal cannot be determined by Fourier Transform and this is the limitation of FT.

Limitation of Fourier Transform

At what time frequency components occur? Fourier transform cannot tell!!

2. Short Time Fourier Transform

To deal with the problem of Fourier transform one more approach is used that is "Short – Time Fourier Transform (STFT)". To analyze only a small section **(Window)** of the signal at a time is known as STFT. **This technique is called *windowing the signal.***

Alternative form of STFT (based on change of variables) is:

$$STFT_x^w(t', w) = \int_t [x(t).W(t-t')].e^{-jwt}dt \text{..... (ii)}$$

How to Window a Signal

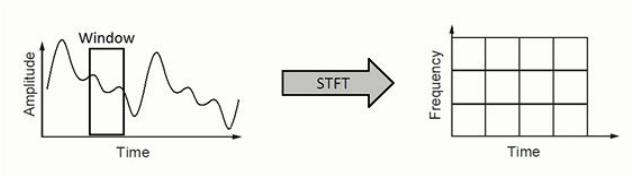

Figure2. Windowing the signal by using STFT

Drawback of STFT: A Short time Fourier transform has two major drawbacks

(i) Unchanged Window
(ii) Dilemma of Resolution
(a) Narrow Window (good time resolution) -> Poor frequency resolution (b) Wide Window (Poor time resolution) -> Good frequency resolution

Uncertainty?

Cannot know what frequency exists at what time intervals.

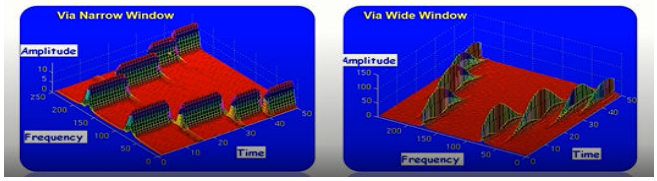

Figure 3.STFT representation of a signal in x, y and z direction.

3. Wavelet Transform

A wavelet is waveform of limited duration that has an average value Zero.

It is defined as

$$\varphi_{a,b}(t) = \frac{1}{\sqrt{a}}\varphi\left(\frac{t-b}{a}\right) \; a, b \in R \text{..... (iii)}$$

Where a and b are known as dilation (Scale) and translation (position) parameter. An example of wavelet is shown below

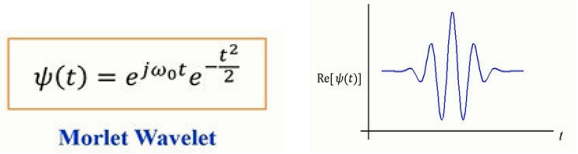

Figure4. Morlet transformation

Types of Wavelet

(a)Continuous wavelet transform

A Continuous wavelet Transform (CWT) of a signal f(t) is then given by the equation

$$CWT(a,b) = (f, \varphi_{(a,b)}) = \frac{1}{\sqrt{a}}\int_{-\infty}^{\infty} f(t).\varphi * \left(\frac{t-b}{a}\right)dt \text{.....(iv)}$$

Where, (f, ψ a, b) is the inner product.

(b)Discrete wavelet Transform

In CWT, calculating wavelet coefficient at every possible scale is a fair amount of work and it generates an awful lot of data. If scale a and position b are chosen to be discrete then analysis will be much easier and will not generate huge data.
This idea of choosing discrete value of dilation' a' and translation 'b' parameter is implemented in Redundant Wavelet Transform (Frames) and Ortho-normal bases for wavelets or Multi Resolution Analysis.
For a given function f(k), the inner product (f , $\psi_{m,n}$) then gives the discrete wavelet transform as given as

$$DWT(m,n) = a_0^{-m/2}\sum_{k=-\infty}^{\infty} f(k).\varphi^*(a_0^{-m}k - nb_0) \text{.....(v)}$$

4. Wavelet Filter Banks

Multilevel Decomposition

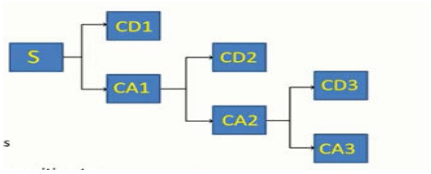

Figure5. Diagram of multilevel Decomposition of signal

Where
S is signal, CD= detailed coefficient,
CA= Approximation coefficient

Maximum Number of Decomposition Levels: $log_2 N$;
Where, N is the length of signal S.
Example of Multi step decomposition and reconstruction

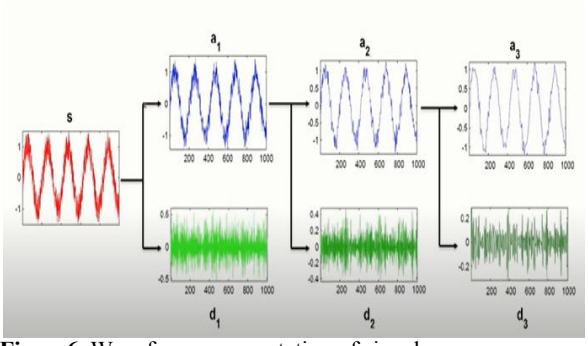

Figure6. Waveform representation of signal

Analysis and Synthesis

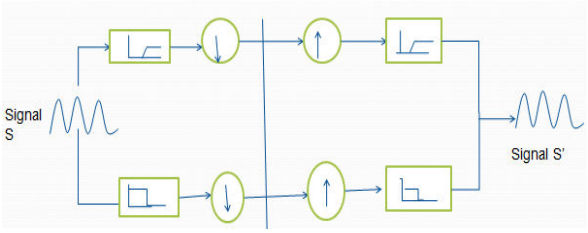

Figure7. Analysis and Synthesis of signal

V. BLOCK DIAGRAM OF OFDM TRASMITTER AND RECEIVER

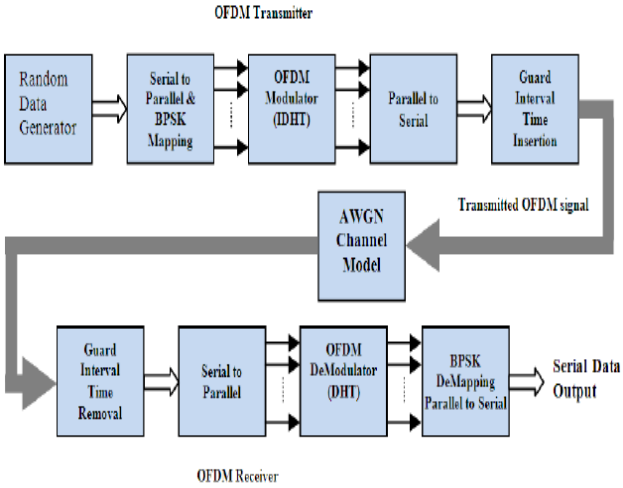

Figure8. OFDM Transmitter and Receiver

An OFDM System consist mainly three block elements transmitter, receiver and channel.

Bandwidth: Occupied bandwidth is of course directly related to the data rate to transmit. However, the question is, what is the minimum bandwidth to take in order to obtain enough diversity and avoid the loss off the entire signal in frequency selective fading environments. On the other hand much bandwidth means also much transmitting power. There is a trade off between bandwidth and transmitted power.

By using digital wavelet filters it is easier to select the desired bandwidth. The optimal bandwidth is found by channel simulations and field test trials. In DAB, for example, a bandwidth of 1,5 MHz is a good compromise for the type of propagation conditions that apply. The inter symbol interference (ISI) and inter carrier interference (ICI) within an OFDM symbol can be avoided completely with a small loss of transmission energy using the concept of a cyclic prefix (using pilot tones of 16 bits).

Number of carriers:

We have seen that the greater the number of carriers, the greater the symbol period on each carrier and so lees equalization is needed and the greater the diversity offered by the system. However, with differential modulation, it is important that the channel not vary too much during one symbol period. This is not the case when the receiver is moving because of Doppler Effect and short term fading. Then a great number of carriers will limit the moving speed. This is another trade off of OFDM [3]. Another problem is the complexity in the implementation increase when carrier number increases because large FFT are needed. To continue with the DAB example, 1536 carriers have been found to be a good compromise. That led to a carrier spacing of 1 kHz and a symbol period of 1ms. Moving speed of mobiles shouldn't get over 160 km per hour.

Guard interval:

The trade-off of guard interval is to set it large enough to avoid inter-symbol interference depending on the memory of channel and transmitter position spacing in a single frequency network. On the other hand, we want it to be as small as possible as it carries no information and can be seen as a spoil of bandwidth. In wireless systems, a guard interval of 25% of symbol period is often met and seems to be a good compromise. That is the value taken for DAB; it allows a maximum distance of about 80 kilometres between transmitters.

At the reception, it is very important to distinguish the starting point of FFT to avoid wrong demodulation. And so synchronization has to be precise. It explains the use of special symbols (pilot) for synchronization in transmission. Hardware design of transmitter and receiver is important because of high peak to average ratio which causes distortions if dynamic range of amplifier and converters is not high enough. OFDM is very sensitive to carrier frequency offsets. Such offsets are mainly the cause of receiver local oscillator's instability and Doppler Effect when mobile is moving.

The main advantages of using digital wavelet filter is that they despite having irregular shape are able to perfectly reconstruct functions with linear and higher order polynomial shapes, such as, rectangular, triangle, 2nd order polynomials[8].

VI. WAVELETS FILTERS AND THEIR TYPES

The basic steps involve for filtering a signal using wavelets are:

Step1: *Decompose* the incoming signal by using the Discrete Wavelet Transform (DWT).

Step 2 : Filter the signal in the wavelet space using Threshold.

Step 3: Invert the output filtered signal to regain the original signal, for this tae the Inverse Discrete wavelet transform (IDWT).

Coding technique of above three steps

```
// Choose wavelet, the Daubechies 4 wavelet
  var wavelet = new FloatWavelet(
Wavelet.Wavelets.D4 );

  // Build DWT object using our wavelet & data
  var dwt = new FloatDWT( data, wavelet );

  // Decompose signal with DWT to level 5
  dwt.Decompose( 5 );

// Find Universal threshold & threshold all detail
levels

 double lambdaU = dwt.ComputeThreshold(
FloatDWT.ThresholdMethod.Universal, 1 );

dwt.ThresholdAllLevels(
FloatDWT.ThresholdPolicy.Soft, new double[] {
lambdaU, lambdaU, lambdaU, lambdaU, lambdaU } );

  // Rebuild the filtered signal.
```

a complex-valued wavelet, such as the Morlet wavelet, with the wave number k_ψ denoting the barycenter of the wavelet support in Fourier space computed a

$$\varphi(x) = (1 - x^2)e^{\left(\frac{-x^2}{2}\right)} \quad \text{..... (vi)}$$

$$\boldsymbol{k_\varphi} = \frac{\int_0^\infty k|\varphi(k)|dk}{\int_0^\infty |\varphi(k)|dk} \quad \text{..... (vii)}$$

Denoising of Signal

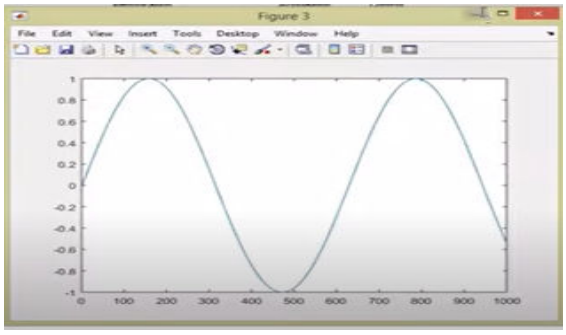

Figure9. Graph of pure Sine wave

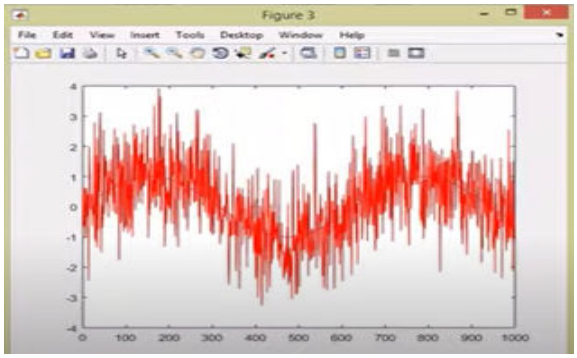

Figure10. Graph2-after adding noise in signal sine wave

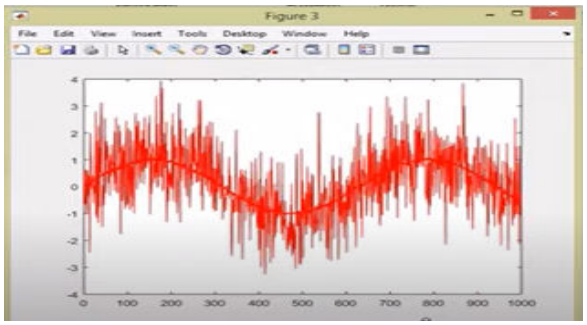

Figure11. Graph3- Scaling of noise signal

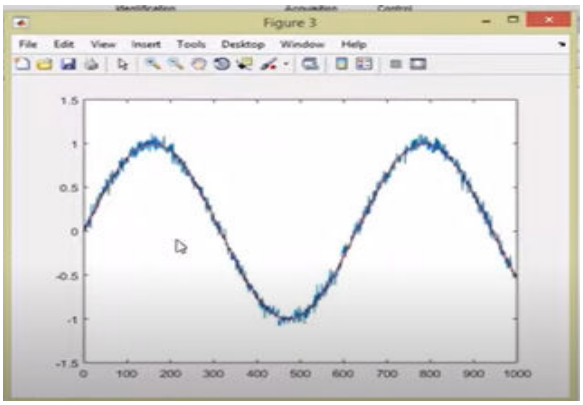

Figure12. Graph4- Denoising the signal

A. **Various types of Wavelet functions**

TABLE 1.1

Sr. No.	Wavelet	Abbreviaion
1	Haar Wavelet	Haar
2	Daubechies wavelet	Db
3	stmlets	Sym
4	coiflets	Coif
5	biorthogonal wavelet	Bior
6	meyer wavelet	Meyr
7	gaussian wavelet	Gaus
8.	morlet wavel	Morl

B. **Various wavelet functions based on their properties**

Table 1.2

Wavelets with filters			Wavelets without filters	
With compact support		With non-compact support	Real	Complex
Orthogonal	Biorthogonal	Orthogonal	gaus, mexh, morl	cgau, shan, fbsp, cmor
Db, haar, sym, coif	bior	meyr, dmey, btlm		

VII. CONCLUSION

In this research paper, we have discussed the basic principle of OFDM like Orthogonality among the sub-carriers, cyclic exten-sion, cyclic prefix, cyclic suffix, guard interval etc. The block diagram of OFDM is discussed in detail. The theoretical and practical application of different wavelet filters with OFDM to improve BER of the various modulation techniques used in an OFDM. By applying various wavelet filters the final resonse of OFDM system improved the response and Denoising of signal is easy as compared to conventional filters. A new approach required for PAPR of OFDM signals, because of their easy processing by digital Signal based approaches, excellent Orthogonality, High transmission rate, low interference and increase the number of users at each base station. As a proposed work, to analysethe family of pulse shaping filters and digital wavelet filters to reduce PAPR of OFDM signal.

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Comparing the Effects of Ondansetron and Acupressure in PC6 Point on Postoperative Nausea and Vomiting in Patients Undergone Elective Cesarean Section: A Randomized Clinical Trial

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***Abstract*—** Background and aim:Nausea and vomiting are complications of cesarean section. The pharmacological and non-pharmacological approaches were applied to decrease postoperative nausea and vomiting. The aim of the present study was to compare the effects of Ondansetron and acupressure on postoperative nausea and vomiting in patients undergone an elective cesarean section. Materials and method: The study was designed as a randomized clinical trial. A total of 120 patients were allocated to two equal groups. Four mgs of Ondansetron was administered for the Ondansetron group after clamping the umbilical cord. The acupressure bracelets were fastened in the PC6 point for acupressure group for 15 minutes. The patients were monitored in terms of incidence, severity, and episodes of nausea and vomiting. The data obtained were analyzed by SPSS software version 18 with a significance level of 0.05. Results: There was no significant statistical difference in nausea severity among the groups intra-operatively, in the recovery and surgery wards. The incidence and episodes of vomiting were significantly higher in patients undergone acupressure intra-operatively, in the recovery and surgery wards ($P< 0.05$). No significant effect of acupressure was reported in reducing postoperative nausea and vomiting. Conclusion: No significant effect of acupressure was reported in reducing postoperative nausea and vomiting. Thus, it is suggested to perform the studies with larger size and comparing the effects of acupressure with other antiemetic medications.

***Keywords*—** ondansetron, acupressure, nausea, vomiting.

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Edible and Ecofriendly Packaging –A Trendsetter of the Modren Era – Standardisation and Properties of Films and Cutleries from Food Starch

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***Abstract*—**The edible packaging is a new trendsetter in the era of modern packaging. The researchers and food scientist recognise edible packaging as a useful alternative or addition to conventional packaging to reduce waste and to create novel applications for improving product stability. Starch was extracted from different sources that contains abundantly like potato, tapioca, rice, wheat and corn. The starch based edible films and cutleries are developed as an alternative for conventional packages providing the nutritional benefit as when consumed along with the food. The development of starch based edible films, by the extraction of starch from various raw ingredients at lab scale level. The films are developed by the employment of plasticiser at different concentrations of 1.5ml and 2ml. The films developed using glycerol as plasticiser in filmogenic solution to increase the flexibility and plasticity of film. It reduces intra and intermolecular forces in starch and it increases the mobility of starch based edible films. The films developed are tested for its functional properties such as thickness, tensile strength, elongation at break, moisture permeability, moisture content and puncture strength. The cutleries like spoons and cups are prepared by making into dough and rolling the starch along with water. The overall results showed that starch based edible films absorbed less moisture and they also contributed to the low moisture permeability with high tensile strength. Food colorants extracted from red onion peel, pumpkin and red amaranth adds on the nutritive value, colour and attraction when incorporated in edible cutleries and it doesn't influence the functional properties. Addition of low quantity of glycerol in edible films and colour extraction from onion peel, pumpkin and red amaranth enhances biodegradability and provides good quantity of nutrients when consumed. Therefore, due to its multiple advantages, food starch can serve as best response for eco-friendly industrial products aimed to replace single use plastics at low cost.

Keywords: edible films, edible cutleries, plasticizer, glycerol, starch, functional property

Biological Activities of Flaxseed Peptides (Linusorbs)

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Abstract: Flaxseed (*Linum usitatissimum* L.) is gaining popularity in the food industry as a superfood due to its health-promoting properties. The flax plant synthesizes an array of biologically active cyclic peptides or linusorbs (LOs, *a.k.a.* cyclolinopeptides) from three or more ribosome-derived precursors. [1–9-NαC]-linusorb B3 and [1–9-NαC]-linusorb B2, suppress immunity, induce apoptosis in human epithelial cancer cell line (Calu-3) cells, and inhibit T-cell proliferation, but the mechanism of LOs action is unknown. Using gene expression analysis in nematode cultures and human cancer cell lines we have observed that LOs exert their activity, in part, through induction of apoptosis. Specific LOs' properties include: 1) distribute throughout the body after flaxseed consumption; 2) induce heat shock protein (HSP) 70A production as an indicator of stress and addressed the issue in *Caenorhabditis elegans* (exposure of nematode cultures to [1–9-NαC]-linusorb B3 induced a 30% increase in production of the HSP 70A protein); 3) induce apoptosis in Calu-3 cells; and 4) modulate regulatory genes in microarray analysis. These diverse activities indicate that LOs might induce apoptosis in cancer cells or act as versatile platforms to deliver a variety of biologically active molecules for cancer therapy.

Keywords: flaxseed; linusorb; cyclic peptide; orbitides; heat shock protein; apoptosis; anti-cancer

Stability of Novel Peptides (Linusorbs) in Flaxseed Meal Fortified Gluten-free Bread

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[c] *Department of Integrative Biotechnology, College of Biotechnology and Bioengineering, Sungkyunkwan University, Suwon, Korea*
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Abstract: Flaxseed meal is rich in water-soluble gums and, as such, can improve texture in gluten-free products. Flaxseed bioactive-antioxidant peptides, linusorbs (LOs, *a.k.a.* cyclolinopeptides), are a class of molecules that may contribute health-promoting effects. The effects of dough preparation, baking, and storage on flaxseed-derived LOs stability in doughs and baked products are unknown. Gluten-free (GF) bread dough and bread were prepared with flaxseed meal and the LO content was determined in the flaxseed meal, bread flour containing the flaxseed meal, bread dough, and bread. The LO contents during storage (0, 1, 2, and 4 weeks) at different temperatures (−18 °C, 4 °C, and 22−23 °C) were determined by high-performance liquid chromatography-diode array detection (HPLC-DAD). The content of oxidized LOs like [1–9-NαC],[1(R_s,S_s)-MetO]-linusorb B2 (LO**14**) were substantially constant in flaxseed meal and flour produced from flaxseed meal under all conditions for up to 4 weeks. However, during GF-bread production LOs decreased. Due to microbial contamination dough could not be stored at either 4 or 21°C, and bread could only be stored for one week at 21°C. Up to 4 weeks storage was possible for bread and dough at −18 °C and bread at 4 °C without the loss of LOs. The LOs change mostly from processing and less so from storage. The concentration of reduced LOs in flour and meal were much higher than measured in dough and bread. There was not a corresponding increase in oxidized LOs. The LOs in flaxseed meal-fortified bread were stable for products stored at low temperatures. This study is the first of the impact of baking conditions on LO content and quality.

Keywords: flaxseed; *Linum usitatissimum* L., linusorb, stability, gluten-free, peptides, antioxidant

NovelVegan Food Ingredient Extracted from Korean Soybeans

Youn Young Shim, Martin J.T. Reaney

***Abstract*—**Legumes (soybeans, chickpeas, lentils) are usually soaked in water to moisten the seeds and then boil or pressure cook the seeds to soften the seeds and improve digestibility. However, this process creates a large amount of liquid waste that needs to be disposed of before it can be disposed of. This viscous liquid waste has found new utility as an egg replacement product now called aquafaba (AQ). AQ is a potential green by-product containing a variety of nutrients. AQ has also been described as an egg substitute in a wide range of food emulsions due to its excellent emulsifying properties. In this study, we intend to develop a functional food material containing AQ as a new material for resolving the nutritional imbalance of vegan food using chickpeas, which are standard products of AQ reported, and three Korean soybeans (ver. Backtae, Seoritae, and Jwinunikong). The treatment technique was implemented using a small number of efficient steps. AQ from Backtae (yellow soybean) had the best emulsion properties (90%) and has the potential to produce more stable food oil emulsions. In this study, a functional food material containing AQ was developed as a new material for resolving the nutritional imbalance of vegan food using chickpeas, a standard product of AQ reported in previous studies, and three types of Korean functional high protein.

***Keywords*—**Aquafaba; soybean; chickpea; emulsifiers; egg replacer; egg-free products

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Co-Developing an Effective Electronic Prescribing and Medicines Administration (EMPA) to Maturity in an Acute NHS Trust

Geeth Silva, Gang Xu, Shriyam Patel, Qasim Rauf, Graeme Hall, Tim Bourne, Aaron Vogel, Andrew Carruthers

***Abstract*—** Introduction: University Hospitals Leicester (UHL) has co-developed, with Nervecentre, an Electronic Prescribing and Medicines Administration (EPMA) that meets specific clinical demands and NHS interoperability standards. Methods: The EPMA was created through a bottom-up approach with a project team consisting of frontline clinicians, IT specialists and vendors representatives. The project team piloted the system 'eMeds' across three Renal wards at Leicester General Hospital. After implementation, the team assessed the perspectives of frontline staff through self-administered questionnaires and semi-structured interviews. Results: The EPMA was deployed successfully during the COVID-19 pandemic, with more than a thousand transcriptions during roll-out. Despite the increasing caseload, there was no increase in error rates within the first three months. Healthcare professionals perceived the EPMA as more efficient through improving workflow and safer through an alerts system and creating an audit trail. Discussion: Creating an NHS-focused EPMA has the potential to allow for smoother implementation. This project provides an important case study in understanding how NHS trusts can work with vendors and use gradual integration to develop and deploy new IT systems.

***Keywords*—** health informatics, quality improvement, health information systems, leadership, change management, software design, decision support systems.

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Effect of Fibrates on Albuminuria: A Systematic Review and Meta-analysis

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Abstract

Background: Diabetes is a global problem with huge implications. The efforts aim to reduce the burden of diabetes through investigating therapeutic agents targeting cardiovascular and diabetic nephropathy complications. Fibrates are gaining momentumas one of these agents that can play a significant role in diabetic nephropathy prevention.
Objectives: This systematic review and meta-analysis aimed to evaluate the clinical benefits and harms of fibrates versus placebo or standard care or fibrates plus other lipid-lowering drugs versus other lipid-lowering drugs alone on the progression or regression of albuminuria.

Methods: The search process included the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE (Ovid), Embase (Ovid), ClinicalTrial.gov, and ISRCTN (allfrom 1990 to 10 July 2017). We searched two clinical trial registers (last searched on 10July 2017). We searched the databases to identify randomized controlled trials evaluating the clinical effects of fibrate therapy on albuminuria for diabetic patients. We searched the grey literature using Google and Google Scholar. Only studies in theEnglish language were considered.

Results: The systematic review of the current evidence indicates favourable results in the studies included. The Meta-analysis results show that the pooled Risk Ratio of the studies suggest a protective effect of fibrates in delaying the albuminuria when compared to either placebo arms or statin without fibrates. The overall Risk Ratio 0.89 (0.85, 0.94) suggests a decrease in albuminuria risk in the fibrates group by an averageof 11%.
Conclusion: Evidence suggests that fibrates lower the risk of developing albuminuria moderately. The pooled Risk Ratio proposes an overall reduction of risk by 11%.

Keywords: Fenofibrate, fibrates, diabetes, cardiovascular, albuminuria

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Nawaf Alokeil, Bandar Alsulaiman, Abdulaziz Bin Rsheed. Effect of fibrates on albuminuria: A systematic review and meta-analysis. American Journal of Research Communication, 7(11): 1-22} www.usa-journals.com, ISSN: 2325-4076.

Introduction

When the protein albumin is present in urine in significant levels, then this condition is called Albuminuria.[1] Albuminuria is a type of proteinuria. Albumin is an essential plasma protein circulating in blood in normal circumstances, only trace amounts of it are present in urine. Larger amounts occur in the urine of patients with kidney disease.
Clinical terminology is changing to focus on albuminuria more than proteinuria.[1] Albuminuria is an insensitive biomarker for kidney disease. That means it is usually asymptomatic until the kidney experienced considerable deterioration. Microalbuminuriais when the level of albumin is ≥ 30 mg/g.[3] The symptoms that may occur at the later stage of albuminuria are swelling of ankles, hands, abdominal area, or in the face, if the loss of albumin is high and produce low serum protein levels.[3] Chronic Kidney Disease (CKD) is an increasingly leading cause of mortality and loss of disability- adjusted life-years worldwide.[6] Diabetic nephropathy remains the single largest causeof CKD and end-stage renal disease (ESRD) in many countries and one of the most causes of ESRD worldwide.[2, 7] It is estimated that 20% of diabetic patients develop ESRD within 20 years of showing the first signs of diabetic nephropathy.[3] Cardiovascular complications start early in renal disease. Current therapies may not stop renal function deterioration. Therefore, there is an urgent need for new targets and interventions, since renal failure and associated cardiovascular disease increase mortality rates.[8]

Fibrates are classified pharmacologically as a class of amphipathic carboxylic acids.

They are used for different metabolic disorders, such as Hyperlipidemia, and are therefore hypolipidemic agents.[9, 10] Fibrates has been shown to decrease

albuminuria in a mouse model of type 2 diabetes, and in humans.[11] Although there is a potential renal benefit, there are possible safety concerns arising from the rise in plasma creatinine.[12] Currently available fibrates in North America and/or Europe include gemfibrozil, fenofibrate, fenofibric acid, bezafibrate, etofibrate, and ciprofibrate. Clofibrate is no longer in use due to excess mortality.[13] Potential side effects or adverse effects from fibrate therapy are "increased venous thrombotic events, pancreatitis, reversible rise in creatinine (described with all fibrates except gemfibrozil),rise in homocysteine, and elevations in transaminases, gallbladder disease (since fibrates increase the cholesterol content of bile), and myositis/rhabdomyolysis, in particular for combinations of gemfibrozil with statins".[14, 15]

Recently, integrative therapies have been introduced using intensive glucose- lowering treatment and advanced therapies for cardiovascular risk factors. However, despite these efforts diabetes mellitus with the accompanying macro- and microvascular complications remains a major, health problem. Diabetic nephropathy is a dominant cause of morbidity and mortality with increasing prevalence globally.[1, 6] Peroxisome proliferator-activated receptor-α (PPAR-α) manifests in several tissues including the kidney.[9, 16] The recent evidence from experimental data have indicated PPAR-α activation has a critical role in the modulation of fatty acid oxidation, lipid metabolism, inflammatory and vascular responses, and potentially modulate various metabolic and intracellular signaling pathways that lead to diabetic microvascular complications, Fibrates activate PPAR-α.[9, 16, 17] This review examines the role of fibrates in diabeticnephropathy and summarizes data from experimental and clinical studies on the

therapeutic potential of fibrates in diabetic nephropathy using the effect of albuminuria as a manifestation.

This systematic review and meta-analysis aimed to evaluate the clinical benefits andharms of fibrates class drugs on albuminuria versus placebo or standard care among diabetic patients in randomized control trials.

Materials and Methods

The search protocol initiated in the first week of February 2017 and ended on the 10th of July 2017. Last search was conducted on February 2019. The search process was restricted to English language only. The search protocol used a searching strategy that is recognized for excellent performance, a strategy that minimizes the difference between sensitivity and specificity in the search for treatment studies according to Wong.[18] In other words, we used a strategy reduces the duplication of results within the same databases and grant

The following sources were targeted in the search process: Medline; EMBASE; Cochrane central register of controlled trials (central); clinical trials registration databases (clinicaltrial.gov); and ISRCTN. The search process used the followingsearch protocol in all article database.

The following words solely or as part of combination(s) were used in the searching process: fibrate or "fibric acid" or fibrates or "fibric acid derivatives" or fenofibrate or clofibrate or bezafibrate or gemfibrozil or ciprofibrate or etofibrate. Study types used were randomized controlled trial, or randomized controlled trial, or random or random allocation, or placebo, or placebos. Grey literature searching was done using Googleand Google Scholar.

We just included randomized controlled trials and parallel or cross-over design. We excluded the Non-randomized trials, and all types of Observational studies. Patients with Albuminuria, microalbuminuria, macro-albuminuria, kidney disease, and end-stage kidney disease. In adult humans with or without diabetes according to the study design.

Studies with uncommon conditions: e.g. familial dyslipidemias, kidney disease, liver disease, HIV infection or other condition that could potentially confound the outcome of interest. Or pediatric trials were excluded. We in duplicate chose studies that discussedthe Fibrates class or similar compared with a non-exposed control group, including placebo, or fibrates and active comparator for at least one year of follow up. The main outcome is the incidents of developing albuminuria, risk ratio, hazard ratio, odds ratio, incidence rate, or the data is sufficient to estimate risk or odds ratios. A random effect meta-analysis for the aggregated study-level data was used. The quality assessment were done using Cochrane method on the proper used of randomization, blinding and concealment of allocation, completeness of follow up and other biases[i].

Results

Our literature search for articles, editorials, and reviews on the topic yielded 953 without duplication hits (Figure 1). After exclusion of articles based on titles and abstracts, we reviewed 11 publications in full-text. We identified a total of 5 primary prevention trials which fulfilled our inclusion criteria, but only 3 studies included sufficient data for the

quantitative analysis. Therefore, the final dataset included the following studies (Nagai 2000[19], Gaede 2003[20], DAIS 2005[21], Davis 2011[8], ACCORD 2010[22]). The 3 studies that are included in the quantitative part are DAIS (2005), Davis (2011), and ACCORD (2010).

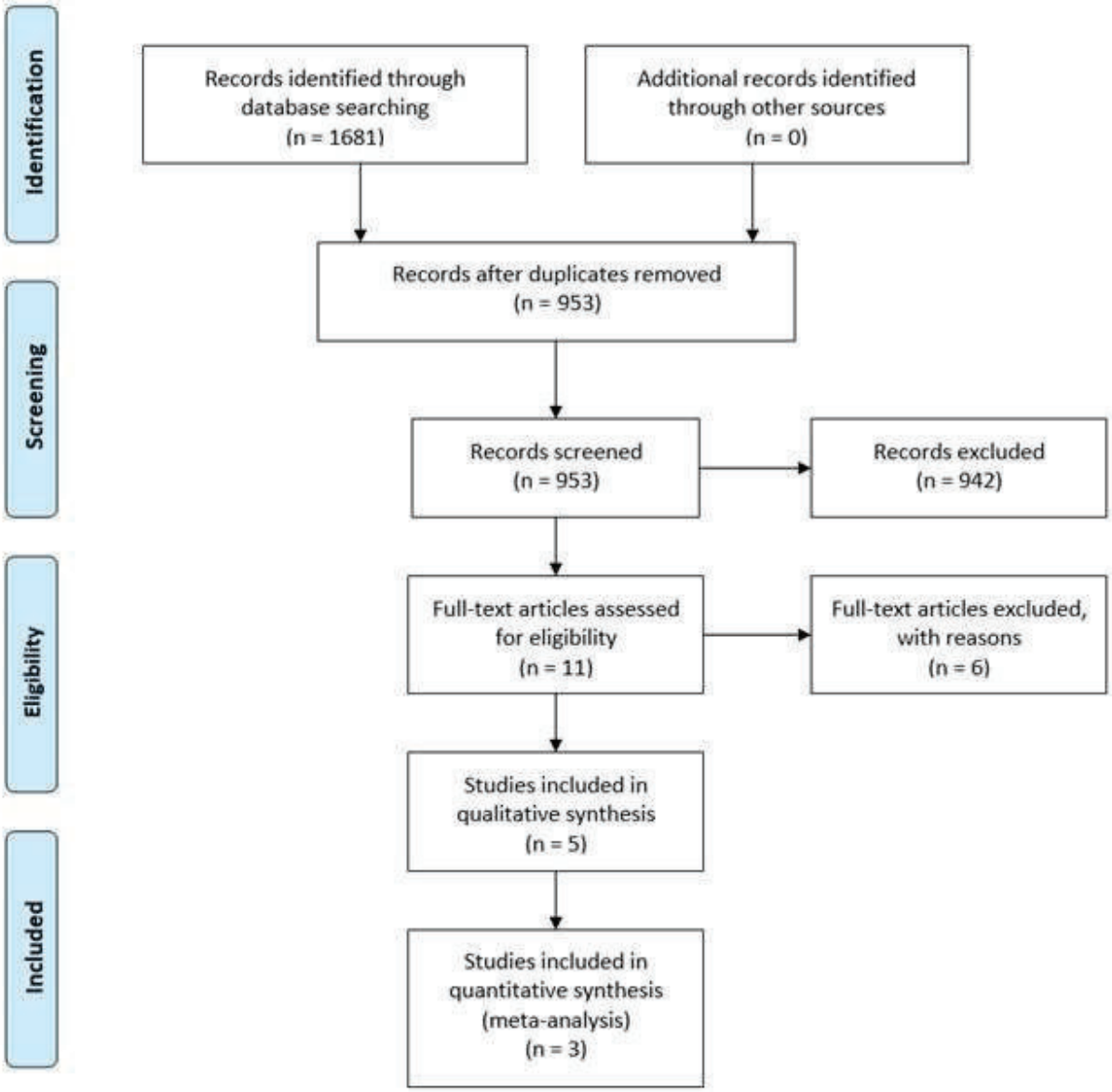

Fig 1: Identification of Eligible Studies.

The characteristics of the included studies are provided in Table 1. The studies included a total of 15848 participants. The average age varied from 55.1 – 66.4 years inthe primary studies included in systematic review part, and 56.7 – 62.3 years in the quantitative part. The percentages of male participants ranged from 61.5% – 100% in the systematic review part, and 61.5% – 77.6% in the quantitative part. All studies recruited patients with type 2 diabetes mellitus (T2DM).

Table 1: Characteristics of included studies

Study	Design	Sample size & Average age	Intervention:	Control:	Endpoint:	Follow-up	Main Findings
Nagai 2000[19]	RCT	71 T2DM patients with hypercholesterolaemia; 66.4 years Men (%): 100	37 patients Bezafibrate with Pravastatin	34 patients Pravastatin	effect on cholesterol content of apolipoprotein AI, B100 containing particles or remnant-like particles, as well as on urinary albumin excretion	4 years.	No significant change between the two arms in urinary albumin excretion rate after 4 years

Study	Design	Sample size & Average age	Intervention:	Control:	Endpoint:	Follow-up	Main Findings
Gaeda 2003[20]	RCT	160 T2DM patients Average age of participants: 55.1 Men (%): 74.3	80 patients Conventional treatment	80 patients Intensive treatment (behaviour modification, aspirin, angiotensin converting enzyme inhibitor and aggressive treatment for hyperglycaemia, hypertension, dyslipidaemia and microalbuminuria):	effect of intensive treatment on cardiovascular risk	7.8 years.	Intensive treatment: reduced risk of cardiovascular and microvascular events by about 50%. The number of patients treated by Fibrates was 3 in the intensive arm with no effect reported on albuminuria.
DAIS 2005[21]	RCT	304 T2DM patients Average age of participants: 56.7 years Men (%): 77.6	155 T2DM patients Fenofibrate	159 T2DM patients Placebo	Fibrates effect of albuminuria Average	3 years	Fenofibrate: reduced progression of urinary albumin excretion (8% vs. 18% on placebo, $p<0.05$); delayed progression from normoalbuminuria to microalbuminuria: 3/101 patients vs. 20/113 patients on placebo ($p <0.001$)

Study	Design	Sample size & Average age	Intervention:	Control:	Endpoint:	Follow-up	Main Findings
Davis 2011[8]	RCT	9795 T2DM patients Average age of participants: 61.5 years Men (%): 61.5	4895 T2DM patients Fenofibrate.	4900 T2DM patients Placebo,	Fibrates effect on albuminuria nd eGFR	5 years	Fenofibrate: reduced progression of albuminuria in T2DM by 24% vs. 11% with placebo ($p<0.001$) with a mean difference of 14% ($p<0.001$); 14% less progression and 18% more regression of albuminuria ($p<0.001$); improved preservation of estimated GFR ($p<0.001$)
ACCORD 2010[22]	RCT	5518 T2DM patients Average age of participants: 62.3 years Men (%): 69	155 T2DM patients Fenofibrate.	159 T2DM patients Placebo	Fibrates effect of albumiuria	3 years	Fenofibrate: increase in mean serum creatinine from 0.93 to 1.10 mg/dL at 12 months ($p<0.05$); reduced development of microalbuminuria (38.2% vs.41.6% with placebo, $p= 0.01$); reduced development of macroalbuminuria (10.5% vs. 12.3% with placebo, $p= 0.04$); no difference in end-stage renal disease (fenofibrate: 75 patients, placebo: 77 patients)
* RCT: Randomized Controlled Trial, T2DM: Type 2 Diabetes Mellitus, eGFR: estimated glomerular filtration rate							

Three studies (DAIS 2005, Davis 2011, ACCORD 2010) used fenofibrate as an intervention.[8, 21, 22] Gaede (2003) reported the use of fenofibrate partially of some patients.[20] Nagai (2000) used Bezafibrate as an intervention.[19]

In the first study, Nagai et al. reported no significant change with either Bezafibrate or the placebo in urinary albumin excretion rate after 4 years.[19] The second study by Gaede et al. concluded that intensive treatment reduced the risk of cardiovascular and microvascular events by about 50%. The number of patients treated by Fibrates was 3 in the intensive arm with no effect reported on albuminuria. There is no particular data outcome for fibrates in this study.[20] In the DAIS study, fenofibrate reduced progression of urinary albumin excretion (8% vs. 18% on placebo, $p<0.05$); delayed progression from normoalbuminuria to microalbuminuria: 3/101 patients vs. 20/113 patients on placebo ($p<0.001$).[21] The results from FIELD study by Davis and colleagues reported that Fenofibrate: reduced progression of albuminuria in T2DM by 24% vs. 11% with placebo ($p<0.001$) with a mean difference of 14% ($p<0.001$); 14% less progression and 18% more regression of albuminuria ($p<0.001$); improved preservation of estimated GFR ($p<0.001$).[8] The ACCORD group results indicated that fenofibrate increased mean serum creatinine from 0.93 to 1.10 mg/dL at 12 months ($p<0.05$); reduced development of microalbuminuria (38.2% vs. 41.6% with placebo, $p=0.01$); reduced development of macroalbuminuria (10.5% vs. 12.3% with placebo, $p=0.04$); no difference in end-stage renal disease (fenofibrate: 75 patients, placebo: 77 patients).[22]

The meta-analysis of the DAIS (2005), Davis (2011), ACCORD (2010) is summarized in Figure 2. The pooled RR of the studies suggest that an overall result favours fibrate in delaying the albuminuria when compared to either placebo arms or statin without fibrates. The overall RR 0.89 (0.85, 0.94) suggests a decrease in albuminuria risk in the fibrates group by an average of 11%. This reduction ranges from 6% - 15 % as indicated by the 95% confidence interval of the RR. The heterogeneity measured by Cochran's Q-test (p-value = 0.07) and I2 (53%). The heterogeneity result is statistically significant which indicates inconsistency in the results of the studies.
Random effects model was employed to reduce the effect of heterogeneity over the total results; however, we will not extend the analysis to stratified because of the small number of studies. The quality assessment showed a high quality studies included in the quantitative analysis. The assessment of publication bias was not produced due to the small number of included studies.

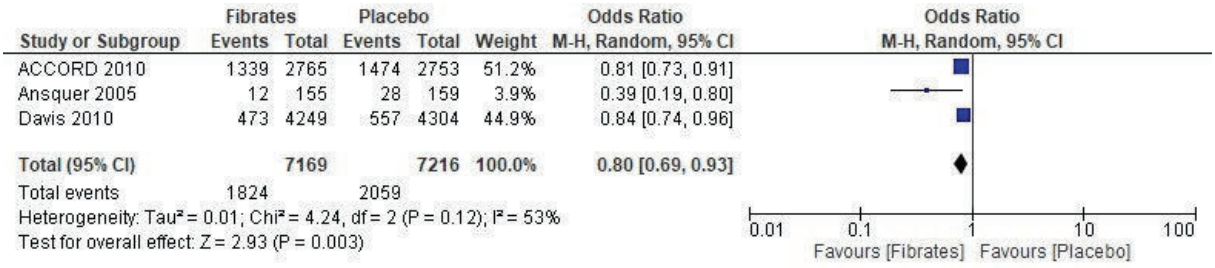

Fig 2: Forest plot showing the effect of fibrates on albuminuria (n=3 studies).

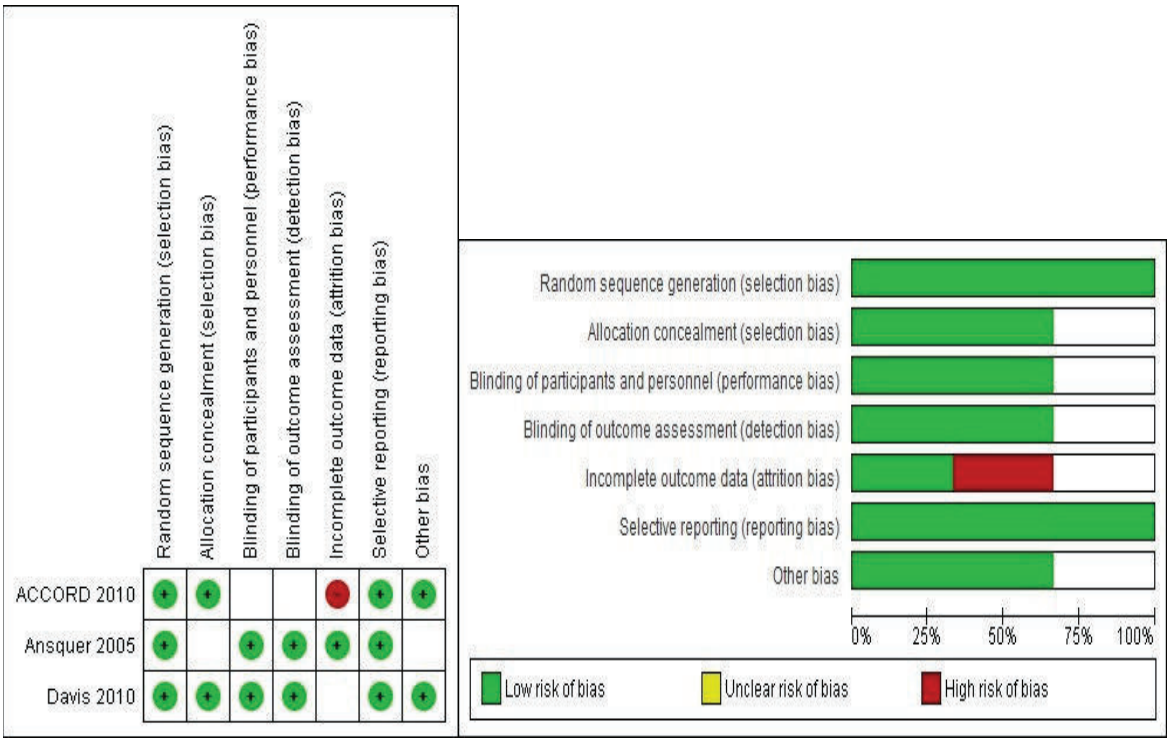

Fig 3: Quality assessment of the included studies in the quantitative analysis.

Discussion

This study proves that fibrates reduces the Albuminuria with sugnificant difference whithin a large number of patients >14000. Those results correspond with the older systematic review conducted by Jun et al. on 2012[ii]. The study proved that the use of fibrates reduce albuminuria within type 2 diabetes patients.

Fibrates have been used in clinical practice for decades in reducing hyperlipidemia.[16] The evidence although scarce in comparison to the statin, it suggests that fibrates may play a role in reducing the risk of cardiovascular disease.[23-26] Patients with T2DM may derive the greatest benefit. In these patients, who typically

present with the combined mixed dyslipidemia, fibrates may be the most appropriate treatment.[10]

Diabetic nephropathy is characterized by thickening of glomerular basement membrane, glomerulosclerosis, glomerular hypertrophy, podocyte loss, expansion of mesangial cells, and tubulointerstitial fibrosis.[3, 27] It is associated with consistently elevated albuminuria, declining GFR, high blood pressure, and fluid retention.[3] The cause of diabetic nephropathy remains not fully understood, but the structural and functional kidney changes may occur due to the chronic hyperglycemia in diabetes and the exposure to hypertension persistently.[28] Additionally, the critical role of the inflammatory process in the development of diabetic nephropathy as suggested by accumulated data indicates that "chronic subclinical inflammation is a common mechanism in the pathogenesis of diabetic vascular complications."[29, 30] Triglyceride elevation has been suggested as an independent risk factor and a major determinant of the progression of nephropathy in T2DM.[31, 32] Fibrates are effective lipid-lowering agents, especially in obese subjects with T2DM and mixed dyslipidemia.[33] Moreover, fibrates utilize beneficial effects in diabetic nephropathy; a potential explanation is the through fibrates' pleiotropic, lipid-unrelated actions.[34, 35] PPAR-α activation plays a critical role in the inhibition of several mediators of vascular damage, fibrates act as a PPAR-α activator, and their pleiotropic effects are getting recognition as a potential preventer of diabetic nephropathy with an advantage that fenofibrate apply a uric acid lowering effect.[36]

This review has limitation due to the small number of included studies. Also the difference method of clinical outcome presentation lead to the moderate hetrogenietythat might affect the degree of confidence in the results of the pooled results.

Conclusion

Diabetes has reached very alarming levels globally, and diabetic nephropathy has become a significant health burden. Numerous efforts have been channeled towards further understanding the underlying mechanisms and developing novel therapeutic agents to target diabetic nephropathy. There is some evidence that activation of PPAR-α might play a role in slowing the progression of diabetic nephropathy. The current evidence favors fibrates in slowing the progression of diabetic nephropathy. In spite of the current evidence, data from large clinical trials is still scarce, especially when compared with other therapeutic agents like the statin. Therefore, there is a huge necessity for large randomized trials with the aim to assess the efficacy of fibrates on diabetic nephropathy. There is a need for using diabetic nephropathy as a primary outcome, not just a secondary one.

Conflicts of interest

We declare no conflict of intrest. This review was not funded by any source.

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