Citizen Diplomacy Action Fund (CDAF)
Scientific Caribbean Foundation (SCF)

Virtual Spring 2022
CDAF Research Symposium

Biological Sciences – Neurosciences - Engineering

Biomathematics - Computer Science - Astronomy-Physics
Artificial Intelligence

Saturday, March 12, 2022

Puerto Rico-Dominican Republic-Russia

CITIZEN DIPLOMACY ACTION FUND (CDAF)
AND THE
SCIENTIFIC CARIBBEAN FOUNDATION (SCF)

ARE PROUD TO HOST THE

CITIZEN DIPLOMACY ACTION FUND RESEARCH SYMPOSIUM

SHOWCASING UNDERGRADUATE AND HIGH SCHOOL STUDENTS' MENTORED RESEARCH

Leadership at

SCIENTIFIC CARIBBEAN FOUNDATION AND MOSCOW STATE UNIVERSITY

Juan F. Arratia, Ph. D.
President and Founder
Research Professor and Mentor

Leonid Zotov, Ph. D.
Research Professor and Mentor
Astronomy Professor

PUERTO RICO-DOMINICAN REPUBLIC-RUSSIA

MARCH 12, 2022

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CITIZEN DIPLOMACY ACTION FUND SYMPOSIUM AND THE SCIENTIFIC CARIBBEAN FOUNDATION

MISSION

Scientific Caribbean Foundation (SCF) was founded by Dr. Juan F. Arratia, a 2006 US Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring recipient, with the idea to continue the success of the Model Institutions for Excellence (MIE), a grant awarded by the National Science Foundation (NSF) to transform Universidad Metropolitana (UMET) into a nationally recognized undergraduate research institution, and a model in science, technology, engineering and mathematics (STEM). Mentoring of undergraduates and pre-college students by research mentors was the cornerstone of the MIE Project. Dr. Arratia was the Principal Investigator of the MIE grant at UMET. We believe that creative research is one of the best ways to prepare students to become persistent and successful in college, graduate school and professional careers. Today, the Student Research Development Center (SRDC), which is part of the SCF, is the entity that will continues the MIE strategy by impacting pre-college and university students from institutions in Puerto Rico, across the nation and abroad.

EXECUTIVE SUMMARY

The MIE ended in 2009 at UMET. The outcome of the program was over 280 UMET STEM-C majors completed their BS degrees and 175 were transferred to graduate school, with 65 achieving doctoral status (PhD, MD, VVM, Pharm D). To increase the number of BS degrees transferred to graduate school, we will continue with the strategy of an early research program and partnership with key research institutions in Puerto Rico, the US mainland and abroad. Research mentoring will be the principal component of the knowledge transfer and creative thinking activities at SCF. Project based learning, collaborative learning strategies, presentations at scientific conferences, scientific writing and co-authorship, technology literacy, and preparation for graduate school are activities that are transforming the philosophy of competitive institutions.

GOALS

The main goal of the Citizen Diplomacy Action Fund Research Symposium is to encourage pre-college and undergraduate researchers to work with research mentors, develop students' written and oral communication skills, provide a forum in the Caribbean for students to foster interest in undergraduate education, particularly in STEM-C fields, and set national research standards for pre-college research presentations.

CITIZEN DIPLOMACY ACTION FUND
AND THE
SCIENTIFIC CARIBBEAN FOUNDATION

RESEARCH SYMPOSIUM

CONFERENCE AT A GLANCE

SATURDAY, MAY 12, 2022		**Virtual**
8:30–9:00 a.m.	**Judges Meeting**	**Virtual**
	Opening Ceremony	**Virtual**
	Dr. Juan F. Arratia, Research Professor and Mentor	**Virtual**
	Dr. Leonid Zotov, Research Professor and Mentor	
9:00–11:20 a. m.	**Poster Session** **Biological Sciences-Engineering-Astronomy**	**Virtual**
11:20 am-12:00m	**Award Ceremony and Closing Remarks**	**Virtual**
12:00 m	**Symposium Adjourns**	

MESSAGE FROM THE FOUNDER

Dr. Juan F. Arratia – President of the Scientific Caribbean Foundation

March 12, 2022

Dear Students:

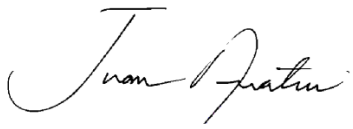
The Virtual Spring 2022 CDAF Research Symposium is the culmination of the activities and dissemination process of the Virtual Saturday Research Academy. For a period of four months, since October 2021, students from private and public high schools from Puerto Rico, Dominican Republic and Russia worked long hours using Internet with the guidance of faculty mentors in research projects in science, technology, engineering, mathematics, and computer science (STEM-C) fields.

One of the objectives of the Virtual Spring 2022 CDAF Research Symposium is to offer young, motivated student researchers the opportunity to gain experience and to practice their English communication skills in a formal professional scientific meeting. A second objective is to give students from Dominican Republic, Puerto Rico, and Russia a forum for the presentation of the outcomes and findings of their research projects to research mentors, family members, and the educational community at large.

Citizen Diplomacy Action Fund and Scientific Caribbean Foundation are proud of the results obtained by the students and their research mentors in the Virtual Spring 2022 Saturday Research Academy Program. I hope your experience inspires you and your peers to select STEM-C as your field of study soon.

My sincere appreciation goes to CDAF staff, research mentors and pre-college and undergraduate research students for their effort and commitment to implement the Virtual Spring 2022 CDAF Research Symposium.

Sincerely yours,



Juan F. Arratia, Ph. D.
Founder and President
Research Professor and Mentor
Scientific Caribbean Foundation, Inc.

Research Mentors' Bio Sketches

Juan F. Arratia, PhD
Research Professor and Mentor
Scientific Caribbean Foundation

Dr. Juan F. Arratia was born in Pomaire, Chile. He graduated from Universidad Técnica del Estado with a BS in Electrical Engineering in 1973. He was awarded a MSc in Engineering from Louisiana Tech University, Ruston, Louisiana, in 1979 and a Ph.D. in Electrical Engineering from Washington University, St. Louis, Missouri in 1985. He has taught and conducted research at universities in Chile (Universidad Técnica del Estado and Universidad Austral de Chile), Puerto Rico (Universidad Interamericana de Puerto Rico and the University of Puerto Rico-Mayaguez), and in the US mainland at Washington University, St. Louis, and Louisiana Tech University, Ruston, Louisiana. He has lectured and given conferences on advanced automation, robotics, vision systems, artificial intelligence, total quality management and science and engineering education in Chile, Bolivia, Ecuador, Guatemala, Panama, Mexico, Brazil, Nicaragua, Perú, Canada, Spain, the Netherlands, Turkey, Japan, Philippines, Singapore, Australia, China, Puerto Rico and in the US mainland. He was the Advanced Manufacturing Manager for Medtronic, Inc., a leading pacemaker company, and is a consultant in advanced automation for pharmaceutical and medical devices companies in Puerto Rico. From 1998 to 2008, he was the Director and Principal Investigator of the Model Institutions for Excellence (MIE) Project, a National Science Foundation sponsored program based at Universidad Metropolitana in San Juan, Puerto Rico. From 2008 to 2018, he was the Executive Director of the Ana G. Méndez University System (AGMUS) Student Research Development Center, designed to disseminate MIE best practices at Universidad del Turabo and Universidad del Este. For twenty year he was part of AGMUS and during his tenure he wrote proposal to NSF and was awarded more than 85 million USD for MIE, CCCE, AGMUS Institute of Mathematics, MRI-AMISR, MRI-Puerto Rico Laser, Administration of Arecibo Observatory, among others. Since 2018 to present he is the President of Scientific Caribbean Foundation in San Juan Puerto Rico. In November 2007, he was awarded the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring at a ceremony in the White House in Washington DC.

Leonid Zotov, PhD
Astronomy Professor and Mentor
Moscow State University

Dr. Leonid Zotov is the Deputy Director of the Virtual Saturday Research Academy at the Moscow, Russia site of the Citizen Diploma Action Fund Grant. He is a senior researcher at Sternberg Astronomical Institute, Lomonosov Moscow State University, and associate professor of Higher School of Economics, Moscow, Russia. His research field includes Earth rotation, climate change, filtering methods. He has published over 50 papers and reads several lecture courses at Moscow University and Higher School of Economics. He worked at Wuhan University, The Ohio State University, Shanghai, and Paris observatory. He was a Fulbright scholar in the USA in 2009, a nominee of President of Russia Grant in 2010, Chinese Academy of Sciences Young Visiting Scientist in 2011-2012, participant of Wuhan university's innovation and talent introduction "111" program in China since 2017. He defended his thesis "The study of links between the Earth rotation and Geophysical processes" at Lomonosov Moscow State University, Russia in 2019.

Fabiola D. Pagán Torres is currently a rising senior at the University of Puerto Rico at the "Bayamón" Campus pursuing a bachelor's degree in Biology. She has passed through enrichment opportunities in different areas of science. During her senior year of high school, she started to get involved in research. Everything started by attending to the Pre-College Saturday Academy of the Ana G. Méndez System sponsored by the National Science Foundation. Here she was able to complete two pre-college level scientific investigations. After that, she had the opportunity to attend an internship at the University of Vermont, where she worked with Dr. Jim Vigoreaux. Over time, the opportunity of mentoring was given in the Saturday Research Academy. She applied the skills learned from her past mentors to the new generation of researchers. From that time through now, she has mentored over 30 students on what research is. Later on, another opportunity arrives to participate in the SNURF Program of the University Of Vermont under the guidance of Dr. Ballif. Here the research was focused on being able to study the protein called TLT1 more thoroughly. During this process, she acquired skills that are essential in molecular biology. From learning how to culture cells, do immunoprecipitation, SDS-Gels, and western blots. She also worked three years as a NASA Teacher Assistant in STARBASE, P.R., a STEM focus program of the Department of Defense. Her long-time goal in science is to acquire an M.D /Ph.D.

Natalia M. Rosado-Díaz is an undergraduate student majoring in Electrical Engineering with minors in Music and Project Management at the University of Puerto Rico - Mayagüez Campus. Having participated five consecutive semesters in the Saturday Research Academia, she got the opportunity to participate in two summer internships, MIT Haystack with the research tittle "New 68-cm Lunar Measurements Using the Millstone Hill Radar" and NC State University with the research tittle "Recommendations for Better Use of Formulas on Spreadsheets." As an undergraduate, Natalia has been part of different programs at University of Puerto Rico Mayagüez Campus such as the Coki Racing Team, Musicorum and the Student Council. She also has participated in a Neuroscience online program given at Ohio State University, in addition with her engineering courses in Puerto Rico. On September 2021, she received a NOAA Fellowship. Since October 2021, she is one of the research mentors for the Citizen Diplomacy Action Fund Grant.

Ángel M. Márquez Otero is currently in his last year as an undergraduate student pursuing studies in Biology at Interamerican University of Puerto Rico in Bayamón. He has always wanted to pursue a STEM career since he was young. He participated in the Saturday Research Academy Program (SRAP) since 2014. Furthermore, he's been trained and has conducted projects in Biology, Biostatistics, Bioinformatics, Ecology and Evolution in the academy and two internships in United States. The first internship was at University of Vermont (Summer 2015) conducting research with Drosophila melanogaster and see how exercise may influenced them. The second internship was at the University of Kansas (Summer 2017) where he conducted research with Geographic Information Systems to determine if climate change may have an effect on the species on the genus Lynx based on prediction models to 50 and 70 years from now. This is his third as mentor. Also, he had under his mentorship a summer group in the two weeks intensive program from SRAP. He wants to empower young students to pursue studies in STEM fields and to become researchers. As a future scientist Angel wants to pursue a Master's in Educational Neuroscience and a Ph.D. in Geology or Evolutionary Biology to pursue a career as a Vertebrate Paleontologist. Through mentorship and research experience Angel wants to be an example of perseverance for future generations of scientists and enable these the capacity to find the answers to the most pressing problems in our modern world.

Jade Peralta graduated from the Institute San Juan Bautista, Santo Domingo, Dominican Republic and during the Spring 2019, she was part of the Saturday Research Academy in Disaster Risk Management, implementing the research project "Structure Vulnerability of Housing Buildings of the Terrenas, Samana Province." Since 2020, she is an Early Childhood Education student at Universidad Iberoamericana (UNIBE), Santo Domingo, Dominican Republic. She has experiences working with kids from 3 to 7 years. She is an outgoing person who enjoys researching and learning new things. She feels fortunate to be part again of the Saturday Research Academy but this time as the assistant and coordinator of the Dominican Republic site of the Citizen Diplomacy Action Fund Grant, funded by the US State Department. Also, she enjoys being part of big projects, different studies, help others and put in practice all the knowledge that she acquires. Her future plan is to become a Neurodiverse Education Specialist in North America or Europe, because there are one of the leading continents in terms of innovation, training and research in this area. She likes to play sports and to read books.

Olesia V. Marchukova was born in Barnaul, Russia. She graduated from Saint Petersburg State University with an Oceanologist qualification in 2013. She worked as an engineer at the Marine Hydrophysical Institute (Sevastopol, Ukraine) from 2013 to 2015. In the fall of 2015, she completed an internship at the Shirshov Institute of Oceanology (Moscow, Russia). Now, Olesia Machukova is a junior researcher at the Institute of Natural and Technical Systems (Sochi, Russia). She has been working at this institute from 2015 to the present. She is planning to finish her dissertation work on the topic "La Niña events: its classification, physical mechanism and climatic responses in the Atlantic-European Region" by May 2022. In a free time, Olesia studies IT-technologies and the programming. She also teaches practice in statistical hydrometeorology to students of Moscow State University

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Denis Gusev is an Associate Professor in Graduate School of Business / Department of Operations Management and Logistics HSE University, Russia. Professor Gusev has published several research articles and books on risk management, inventory management, and economic-mathematical methods. He received his PhD in Economic Sciences from the Plekhanov Russian University of Economics in 2005 in Moscow, Russia. His research interests include mathematical modelling and multiple criteria decision-making in the field of supply chain management. His recent papers are dedicated of problems of accounting risk factors and uncertainty according to optimization of supply chain

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Andrey Rimashevskii, is a graduated of the High School # 734 in Moscow, Russia (2011). He is an assistant of the Citizen Diplomacy Action Fund Grant at the Moscow's site, supporting project management, communication and administration, computers, distant learning. He is a computer wizard. Self-educated in songwriting. Spends free time on composing music. Speaks Russian and English.

Diego E. García Ortiz is an undergraduate student majoring in Natural Sciences with concentration in Biology at the Universidad Ana G. Mendez, Recinto de Gurabo. He participated 4 semester as a neurocircuitry student in the Saturday Research Academy, experience that give him the opportunity to participate in the Puerto Rico Institute for Microbial Ecology Research (P.R.I.M.E.R.) where with Dr. Lisandro Cunci he acquire knowledge on electrochemistry, developing a research about using Electrochemical Impedance Spectroscopy for the detection of neuropeptide Y. On the second semester of his second year he become an assistant mentor with Alexa Pérez in the area of Biological Sciences at Universidad Ana G. Mendez, Recinto de Gurabo research site. Diego is now working on a research proposal on how to use Electrochemistry to improve Alzheimer's Diagnosis and plans to continue his studies on Master Degree on Pathological Sciences and a Doctorate on Neurobiology aiming to become a researcher to develop and improve treatments for Alzheimer's and other neurodegenerative diseases.

Melissa S. Rivera Narvaez is currently a graduate student at the Ana G Mendez University Cupey Campus pursuing a master's in environmental risk management. He bachelor's degree was done in General Biology with a minor in environmental science. During her early start in STEM related academic events Melissa was a pre-college student in the Saturday Research Academy by Ana G Mendez in the Arecibo Observatory in which she conducted small research about CubeSats. She was sent on an internship to NASA Ames Research Center in San Jose California along with five other students and group research was conducted on the development of designing "Ardulabs" with different sensors and plants to send to the ISS.

After the internship she continued being an assistant mentor to various research mentors around different Pre-College Research Sites in the island. She currently is an assistant mento to the talented Fabiola D. Pagan. Melissa is also a participant on a program funded by Syracuse University along with Puerto Rico Recycling Partnership - PRRP, called GREEN-PR I which has as main objective to allow students to develop leadership skills Working with environmental non-profit organizations creating environment friendly solutions for schools, communities and more. Her long-term goals include finishing her master's degree and conduct research specializing in atmospheric topics and continue pursuing more post graduate studies in related areas.

Research Presenters' Bio Sketches

Dr. Leonid Zotov's Group, Russia

Vladlena Afanaseva is a student of Lomonosov Moscow State University. She studies at the Faculty of Natural Sciences, the direction of Geography 4th year. She was born in Russia and is currently 21 years old. At university, she became interested in oceanology and meteorology and decided to devote herself to studying developments in this field. Over time, she became interested in ENSO events and their connection with meteorological, oceanic and geophysical phenomena. She is currently involved in the SRA project, and her study consists of analyzing the relationship between ENSO events and the Earth's rotation speed. In the future, she plans to get closer to understanding the mechanism by which ENSO events occur, which is currently unknown.

Oksana Batonova is a student at National Research University Higher School of Economics, Russian Federation. She was born in Stavropol, Russia, and is now twenty years old. She is really interested in technology, especially in geoinformation technology, and she has a special interest in mathematics, engineering, artificial intelligence, and programming. Her passions include learning languages, reading non-fiction books, and painting. She is currently part of the Basealt Education program and her project consists of digital processing of geospatial data, based on IT instruments of Russian OS, and implementation research and development of Russian operating systems. Her future plan is to become a software engineer programmer and to be able to create a project that will have a huge effect on most industries, open up new avenues and be able to change the way we live through revolutionary ideas.

Elina Boldova is a second-year student of the University of Higher School of Economics. She is studying the program "Applied Mathematics". Her passion is music and classical literature. She also loves programming. At a certain point, she's learning how to develop mobile applications. She is currently part of the SRA program. Her project is to develop a medical crosssplat application that can help a lot of people.

Andrey Borodin is a student at the Higher School of Economics, Moscow. He is 19 years old. He is interested in modern technologies and innovations. His hobby is 3d printing and additive technologies in general. He is currently participating in the SRA program. His project is to develop a mobile application that can help treat people with eating disorders. His plan for the future is to keep up with the development of modern technology and find a place where it can be useful to people and bring something new to the world.

Leonid Chashkin is a high school student in Moscow Institute of Electronics and Mathematics, Higher School of Economics. He was born in Zhukovskiy, Moscow Region, and is now twenty years old. He is really interested in working with geographic information systems like QGIS, and he also has a special interest in mathematics, technology, and programming. His hobby is to work with Russian operation system Alt Linux Education and adapt different programs for it. He is currently part of the Basealt Education program, which is aimed at gaining skills in working with the Russian OS Alt Linux. His project consists of Digital processing of geospatial data, based on IT instruments of Russian operation systems. His future plan is to join to Alt Linux Team in order to develop Russian OS and distribute them all over the world.

Khoroshunova Darya was born in the Krasnodar Territory in the city of Labinsk. At the moment, she is studying in the 2nd year of the Geography course of the Faculty of Natural Sciences of the Lomonosov Moscow State University Branch in the city of Sevastopol. She is most interested in such a field of science as geography, in particular such areas as glaciology, climatology, and landscape studies. Her hobbies include reading books, playing sports, and participating in orienteering competitions. Currently, she is a participant in the Saturday Research Academy Program, considering the topic "Changes in the distribution of glaciers in the modern climatic era and the relationship with the rotation of the Earth."

Dmitry Dubina is a student at the Higher School of Economics University, Russian Federation. Born in Nefteyugansk, Russian Federation, he is now twenty-three years old. He has a real interest in science, especially information technology, and a particular interest in mathematics, technology, engineering, and information technology. His hobbies include playing tennis, playing video games, writing code, and soldering small devices. His plans for the future are to become a software engineer and be able to create applications that will change the world.

Ivan Gevorkov is a third-year student inv HSE Tikhonov Moscow Institute of Electronics and Mathematics. He is interested in computer science, engineering, and bioinformatics. His passions include skiing, hiking, and rafting. He is currently part of the Research and training group of operational geomonitoring and his project consists of monitoring dangerous situations using geomonitoring. His future plan is to develop this project, using new technologies of geomonitoring.

Maxim Kosovich is a student at the High School of Economics, Moscow. He was born in Russia, Moscow, and is now twenty years old. He is really interested in computer science and IT technologies, especially in mobile development, and he has a special interest in innovation. Also, in addition to programming, Maxim likes to assemble electronic equipment and likes to play sports in his free time. He is currently participating in the SRA program, and his project is to develop a mobile application for people with nutritional problems related to their psychological characteristics. This project is based on the latest programming technologies and complies with new trends in the IT field. His plans for the future are to become a modern developer to make life easier for those around him.

Osipov Aleksandr is a 3th-year student in Higher School of Economics, Tikhonov Moscow Institute of Electronics and Mathematics. He was born in Russia and is now twenty years old. He is interested in computer science, especially in everything, which is related to FPGA, but he cares about ecology, so geography interests him. Her passions include both active sports like running and skiing and quiet rest like reading books. He is currently a member of the research group of operational geomonitoring and is involved in the project, which develops the database to control planes' waste. His future plan is to improve the world.

Ekaterina Shalina is in the 10th grade of the «Moomin-Troll School». I was born in Russia, in the city of Moscow and now I am sixteen years old. My interests include physics, astronomy, and chemistry. Also, in my free time, I like to read and draw. Now I am engaged in my project at the Saturday Virtual Research Academy, which includes the study of the selected area of the sky and the selection of stars of interest using GAIA space mission, the compilation of diagrams with their distance and motion in space, coordinates, photometry, and other parameters. For me, this will be the first experience of research, so I hope that in the future I will continue to make similar projects on topics of my interest.

Dr. Juan F. Arratia's Group
Puerto Rico-Dominican Republic

Marysol Alape Toro is a sophomore student in Escuela Superior Petra Mercado Bougart, Humacao, and P.R. She was born in Caguas, Puerto Rico, and is now fifteen years old. She is really interested in science, especially in genetics, and she has a special interest in mathematics, biochemistry, engineering, and physics. Her passions include coding, reading books, helping abandoned animals find their new home, and watching documentaries. She is currently part of the SRA program, and her project consists of The Development Of A New Era: Personalized Medicine And Stem Cells, implementing a new alternative that could benefit many lives alongside animals. Her future plan is to become a scientist and to be able to create many extraordinary projects that will motivate others to do the same and make various changes in society while helping minorities.

Bryan J. Aponte-Caraballo is a sophomore student in the Secondary School Specialized in Science, Mathematics, and Technology, CIMATEC, of Caguas, Puerto Rico. He was born in Caguas, Puerto Rico, and is now sixteen years old. He is interested in science, especially in geochemistry, and particularly likes mathematics and microbiology. In addition, his passions include collecting minerals, reading books, hanging out with his friends, and working on his final Eagle Scout project. He is currently part of the SRA program, and his project consists of Developing a New Technique for The Detection of The Bacteria E. coli using luminol. He plans to become a scientist and to be able to create an extraordinary project that will change the economy and mortality rate all around the world.

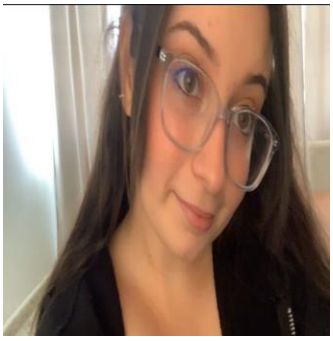
Adrián N. Escalera-Rivera is a junior student at the "Centro Residencial de Oportunidades Educativas de Villalba" (CROEV), Puerto Rico. He was born in Aibonito, Puerto Rico, and is now 16 years old. He is extremely interested in what the field of science is, especially investigative neuroscience. The passions directed him to play soccer, to lead, to seek rational answers to questions, but above all to be committed to everything he proposes. He is currently part of the SRA program, where he is conducting research in translational medicine. This consists of designing a pre-diagnosis of chronic stress related to unbalanced levels of cortisol. His future goal is to turn his research into an experimental one, taking a large sample of participants so that the results have more validity. Adrian is sure that his research will help to solve most of the problems in the people that surround this pathology.

Layla E. López-Morales is a sophomore student in the Secondary School Specialized in Science, Mathematics, and Technology, CIMATEC, of Caguas, Puerto Rico. She was born in San Juan, Puerto Rico and is now fifteen years old. She is very interested in science, especially in neuroscience, and has a special interest in mathematics, robotics, and innovation. Her passions include writing, singing, and musical composition. She is currently part of the SRA program, and her project focuses on the analysis of negative effects produced by lack of sleep on students' academic performance, learning ability, and memory, and identifying the ways these could negatively affect a student's academic career. Her future goal is to be able to achieve and live a fulfilling life by becoming a neuroscientist or neurosurgeon to aid in the investigation of the nature of neurological diseases and disabilities, in addition to possibly helping people in vulnerable situations.

Normarie Martinez Flores is a freshman at the CIMATEC, which is a specialized high in Science, Math, and Technology located in Caguas Puerto Rico. She was born in Caguas, Puerto Rico. Actually, she is fourteen years old. She is really interested in environmental science and has a special interest in mathematics, technology, finance, and economics. Her hobbies or passions include drawing, playing tennis, playing video games, spend quality time with friends and family. She is currently part of the SRA program, and her project is about the relationship between household detergents and plant growth, spreading awareness of the dangerous chemicals inside detergents. Her future plans consist of becoming an entrepreneur in the fields of environmental science.

Abraham E. Mejías-Ortiz is a senior high school student in "Centro Residencial de Oportunidades Educativas de Villalba" also known as CROEV. He is majorly interested in neuroscience, psychology, engineering, and robotics. His passions are majorly invested in acting, basketball, ping-ping, reading, writing, and analysis. He is part of the SRA program, and his project is creating a strategy for increasing the cognitive skills of students with special conditions of public schools of Puerto Rico. This method is called: Multi-Sensory and Integral Associative Method (MIAM). One of his future goal is to apply this same method to students with autism and become a psychologist or a neuropsychologist and help the people of his nation.

Exiel Y. Rodríguez-Colón is a freshman student in High School Specialized in Science, Mathematics and Technology. The school is in Caguas, Puerto Rico. He was born in Caguas, Puerto Rico, and is currently fourteen years old. He is interested in science, especially in meteorology, and he has a special interest in technology, mathematics, and astronomy. His passions include playing basketball with friends, riding bicycles with friends, tracking storms and reading books. He is currently part of the SRA program, and his project consists of Isolation and identification of fungal endophytes in medicinal plants and implementing basic instruments of microbiology. His future goal is to become a meteorologist to analyze and study storm systems while alerting the population to follow the necessary preparation protocols.



Carolina I. Ferrer Angulo is a senior student in Academia Maria, Puerto Rico. She was born in San Juan, Puerto Rico and is currently seventeen years old. Her passions lie in biology and biomedical sciences, especially in the areas of specialized immunotherapy against viruses. She is also focused on the gene expression and manipulation of viral genetic material. Her hobbies include, reading, spending time with friends and family, taking care of her pet bunnies and skeet shooting with her father. At the SRA program, she has completed a total of four projects and is developing her fifth. Mostly have been focused on immunity against a virus. However, she has successfully developed an eco-friendly engine, as she is an advocate for environmental sustainability. Currently, she is working on organ transplants, specifically tackling the problem most patients find themselves in: waiting for an available, healthy organ. Furthermore, she aims to earn an M.D/PhD and continue her research on these fields of medicine.

María Alejandra Jové Valerio is a Junior Student in Colegio Puertorriqueño de Niñas in San Juan, Puerto Rico. She was born in San Juan, PR and is currently 16 years old. Her main interests are found in the areas of science and math, especially in the areas of biology and neuroscience. Her passions include playing soccer, competitive running, and being with friends and family. She is currently part of the SRA program and her project consists of the relation between the brain and gut and how E.Coli has a crucial role in Alzheimer's Disease by producing an excess of amyloid protein. In the future, María Alejandra would like to practice medicine and contribute to new discoveries in the scientific field.

Carolina D. López Caraballo is a junior student in Colegio Puertorriqueño de Niñas, Puerto Rico. She was born in San Juan, Puerto Rico, and is now sixteen years old. She is really interested in science, especially in biology and neuroscience. Her hobbies include playing piano, reading poetry and sunbathing. She is currently part of the SRA program and her project consists of investigating the brain-gut microbiota interaction and how that communication between microorganisms in the gastrointestinal tract, specifically the *E. coli* bacteria, and the nervous system can affect the development of neurodegenerative diseases, specifically Alzheimer's. Her future plan is to immerse herself further into the different fields of science and learn how she can influence her local community and, on a wider spectrum, communities around the world.

Carlos M. López Valcárcel is a sophomore student in the Secondary School Specialized in Science, Mathematics, and Technology of Caguas, located in Puerto Rico. He was born in San Juan, Puerto Rico, and is now fifteen years old. He is really interested in business and law, especially taxes and bookkeeping, Carlos also has a special interest in politics, securities, negotiation, and public relations. His passions include playing double bass, reading books, talking with people, and playing board games. He is currently part of the SRA program, and his project consists of studying tax avoidance strategies and how accountants implement them to save their clients' money in Puerto Rico. Carlos plans to become a corporate tax lawyer and finance projects that will help Puerto Ricans grow and develop economically in the international market.

Gabriela N. Molina Rodríguez is a junior student in a School Specialized in Science, Mathematics, and technology (CIMATEC), Caguas, Puerto Rico. She was born in San Juan, Puerto Rico, and is now seventeen years old. She is really interested in engineering, especially in robotics, and she has a special interest in mathematics, technology, science, and innovation. Her passions include robotics, reading books, drawing, playing with her dog, and writing. She is currently part of the SRA program, and her project consists of Determining the optimal placement for muscle sensors on amputees as part of a cost-effective rehabilitative device. Her future is to become a mechanical engineer and to be able to develop devices for the betterment of society.

Briana G. Pérez-López is a senior in University Gardens High School, San Juan, Puerto Rico. Briana Pérez is currently 17 years old. She is interested in science, such as biology, chemistry, microbiology, neuroscience, biomedical studies, and others. She also enjoys math, technology, and the arts. Her passions include dancing, working on her business of crochet items, working with her rescued dogs, working with children, and having a good time with her friends and family. She is currently part of the SRA program, and her project consists of *The Relationship Of Tobacco Use On Children And The Development Of Cerebral Endovascular Aneurysms In Adulthood.* Her future is to have a bachelor's degree in biomedical sciences and later become a pediatric neurosurgeon specializing in epilepsy. Briana hopes to be a great scientist that will be able to have influence in the world.

Eva Méndez Astwood is a senior student at Colegio Cardenal Sancha, Santo Domingo, Dominican Republic. She was born in Santo Domingo, Dominican Republic, and is now seventeen years old. She is extremely interested in the humanities and social sciences, especially psycology and human development. Her passions include the arts, spsending time with her family and hanging out whit her friends. She is currently part of the SRA program and her project is about how chromosomes affect physical sexual characteristics in people, and raising awareness of the issue at the national level within the Dominican Republic. Her future plan is to become a clinical psycologist and be able to créate a Project that raises awareness in a general way and can change the perspective worldwide.

Yanira Nuñez Ramírez is a senior student in San Juan Bautista Institute, Santo Domingo, D.R. She was born in Santo Domingo, Dominican Republic, and is now seventeen years old. She has shown a great interest in neuroscience and biological sciences since she was a child. She is the founder and current president of her high school book club. Her passions include playing volleyball, drawing, reading books, and playing the piano. She is currently part of the VSRA program, and her project consists of investigating the prevalence of all reported adverse effects of alemtuzumab infusion in patients with active relapsing-remitting multiple sclerosis at the Father Billini Teaching Hospital in the Dominican Republic from 2017 to 2021. Her future is to become a neurosurgeon and to be able to participate in innovative research that will help increase medical knowledge for diseases that currently have no cure.

Jorge Luis Vásquez Cruz is a high school student in Colegio La Altagracia, San Francisco de Macoris, Dominican Republic. He was born in San Francisco de Macoris, DR, and is now seventeen years old. He is really interested in biology, numbers, finances and health care. His passions include working out, eating healthy, playing soccer, doing researchers online, reading books and studding. He is currently doing a curse in big data and finance, also he is currently part of the SRA program and his project consists of how the climate has benefited humans to evolve to the way we are today. His future plan is to become an entrepreneur and specialize in more areas as well to make economy better.

Deborah Wu Ramírez is a senior student in Instituto San Juan Bautista, Santo Domingo, D.R. She was born in Santo Domingo, Dominican Republic and is now sixteen years old. She is very interested in neuroscience and the whole functioning of the brain and has a special interest in humanistic disciplines with a focus on philosophy. Her passions include playing tennis, playing the bamboo flute, reading books, spending time with her family and exploring tourist sites in her country. She is currently part of the SRA program and her project consists of the impact of Alzheimer's disease on its non-professional caregivers. Her future plan is to become a doctor and a scientist who can discover findings that will help her patients get better.

Alexander Rey Zambrano Tapia is a student at La Escuela Especializada en Ciencias, Matemáticas y Tecnología CIMATEC, in Caguas, Puerto Rico. He is very interested in science; his goal is to be an Equine Veterinarian. He has participated in several internships in Puerto Rico and outside the Island, all with a focus on Science and Biology. His bases in Research have been developed for 4 years with the Saturday program of the Ana G. Méndez University. Thanks to the Saturday program led by Dr. Juan Arratia, he has been able to present a wide variety of research projects in poster format with extraordinary results and achieving the highest scores. One of these posters was a winner at the state level of the SIWI (Stockholm International Water Institute) award with the opportunity to represent Puerto Rico at the national level. In 2019, he was a student of the STAR Academy program at the Arecibo Observatory, consolidating his passion for research and gaining knowledge about the importance of research programming. Since 2020 he is part of the select group of students from Puerto Rico working with the internationally renowned Dr. María Dainotti, this work earned him his first publication as an acknowledgment on astronomy called "T Optical luminosity of Gamma-Ray Burst, the most explosive events in the Universe" and as a co-author on the publication called ""The Optical Two and ThreeDimensional Fundamental Plane Correlations for More than 180 Gamma-Ray Burst Afterglows with Swift/UVOT, RATIR, and the SUBARU Telescope". His passion for Veterinary Medicine has led him to get involved with the different public health needs that involve the different animal species on the Island, actively participating in the non-profit organization Horses and Ponies, whose purpose is to rescue abandoned and mistreated equines. He is co-founder of the I Have a Pet initiative established with the purpose of raising awareness about the importance of caring for different species of animals to maintain health in the community. His vacations are dedicated to working as an observer and facilitator in a veterinary medical office.

SCHEDULE OF EVENTS

SATURDAY, MARCH 12, 2022 VIRTUAL

9:00 – 11.10 a.m. POSTER SESSION

Chairperson: Dr. Angel Arcelay

Dr. Leonid Zotov's Group, Russia

9:00 – 9:05 a.m. **Vladlena Afanaseva,** Faculty of Natural Sciences of the Lomonosov Moscow State University Branch, Russia.

Relationship between LOD and ENSO anomalies

9:05 – 9:15 a.m. **Oksana Batonova, Leonid Chashkin** National Research University Higher School of Economics, Moscow Institute of Electronics and Mathematics, Russia.

Digital processing of geospatial data, based on IT instruments of Russian OS.

9:15 – 9:30 a.m. **Andrey Borodin, Elina Boldova**, **Maxim Kosovich**, National Research University Higher School of Economics, Moscow Institute of Electronics and Mathematics, Russia.

Mobile Application Development

9:30 – 9:35 a.m. **Kroroshunova Darya,** Faculty of Natural Sciences of the Lomonosov Moscow State University Branch, Russia.

Changes in the distribution of glaciers in the modern climatic era and the relationship with the rotation of the Earth.

9:35 – 9:45 a.m. **Ivan Gevorkov, Aleksandr Osipov** National Research University Higher School of Economics, Moscow Institute of Electronics and Mathematics, Russia.

Methods of Structuring and Indexing Information in the Data Base on the Example of Crawlers.

9:45 – 9:50 a.m. **Ekaterina Shalina**, Moomin-Troll School, Moscow, Russia

Study of the group of selections star from the catalog of the astrometric space Gaia mission.

9:50 – 9:55 a.m. **Dmitry Dubina**, National Research University Higher School of Economics, Moscow Institute of Electronics and Mathematics, Russia.

Software module for processing the EEG signal for the software-hardware Complex.

Dr. Juan F. Arratia's Group
Puerto Rico-Dominican Republic

9:55 – 10:00 a.m. **Marisol Alape Toro,** Petra Mercado Bougart, Humacao, Puerto Rico

The Development of A New Era: Personalized Medicine And Stem Cells

10:00 – 10:05 a.m. **Bryan Aponte Caraballo**, CIMATEC, Caguas, Puerto Rico

Developing A New Technique for The Detection of The Bacteria E. coli

10:05 – 10:10 a.m. **Adrián Escalera Rivera,** CROEV**,** Villalba, Puerto Rico

Pre-Diagnosis of Chronic Stress Related to Increased Cortisol Levels

10:10 – 10:15 a.m. **Layla E. López Morales,** CIMATEC, Caguas, Puerto Rico

Lack of Sleep and Its Effects on Students Academic Performance, Learning Ability and Memory

10:15 – 10:20 a.m. **Normarie Martínez Flores,** CIMATEC, Caguas, Puerto Rico

The Effects of Household Detergents in Plant Growth

10:15 – 10:20 a.m. **Abraham E. Mejías Ortiz,** CROEV**,** Villalba, Puerto Rico

Innovating Special Minds

10:20 – 10:25 a.m. **Exiel Rodríguez Colon,** CIMATEC, Caguas, Puerto Rico

Identification and Insolation of Fungal Endophytes in Medicinal Plants

10:25 – 10:30 a.m. **Carolina I. Ferrer Angulo,** Academia María Reina, San Juan, Puerto Rico

Regeneration of the Liver with Stem Cells

10:30 – 10:40 a.m. **María A. Jove Valero, Carolina López Caraballo**, Colegio Puertorriqueño de Niñas, San Juan, Puerto Rico

Brain-gut microbiota interaction: the role of *E. coli* in Alzheimer's Disease

10:40 – 10:45 a.m. **Carlos López Valcárcel,** CIMATEC, Caguas, Puerto Rico

Making Tax Season in Puerto Rico Worry-Free

10:45 – 10:50 a.m. **Gabriela Molina Rodríguez,** CIMATEC, Caguas, Puerto Rico

Determining the optimal placement for muscle sensors on amputees as part of a cost-effective rehabilitative device

10:50 – 10:55 a.m. **Briana G. Pérez López,** University Gardens High School, San Juan, Puerto Rico

Relationship of Tabacco Use in Children and the Development of Cerebral Endovascular Aneurysms in Adulthood

10:55 – 11:00 a.m. **Eva Mendez Astwood,** Colegio Cardenal Sancha, Santo Domingo, Dominican Republic.

How Chromosomes Affect Physical Sexual Characteristics in People

11:00 – 11:05 a.m. **Yanira Núñez Ramírez,** Instituto San Juan Bautista, Santo Domingo, Dominican Republic

Adverse Effects of *Alemtuzumab* infusion in patients with Active Relapsing-Remitting Multiple Sclerosis

11:05 – 11:10 a.m. **Jorge Vazquez Cruz,** Colegio La Altagracia, San Francisco de Macoris, Dominican Republic

How has Paleoclimate affected Human's Evolutionary Process

11:10 – 11:15 a.m. **Deborah Wu Ramirez,** San Juan Bautista Institute, Santo Domingo, Dominican Republic

Impact of Alzheimer's Disease on its Non-Professional Caregivers

11:15 – 11:20 a.m. **Alexander Zambrano Tapia,** CIMATEC, Caguas, Puerto Rico

Acidic Rain Impact and its Prevalence Over the Years in USA Territory

Posters of Research Presenters
Dr. Leonid Zotov's Group, Russia

Vladlena Afanaseva

LOD and ENSO anomalies

V. Afanaseva, Moscow State University M.V. Lomonosov, Moscow, Russian Federation., O. Marchukova, Branch Institute of Natural and Technical Systems, Sochi, Russian Federation., L. Zotov, Sternberg Astronomical Institute Moscow University, The Higher School of Economics University, Moscow, Russian Federation

Abstract

In 2016, after a strong El Niño event, the Earth began to rapidly accelerate. Earth's rate of rotation and the equivalent length of day (LOD) vary in response to a wide range of geophysical processes [1]. The atmosphere has an influence on the Earth's spin rotation, by the exchanges of angular momentum between the solid Earth and the atmosphere. The oscillation amplitudes grow exponentially with altitude in the rarefied gas. The exchanges are generated by atmospheric tides and also by winds and global circulation currents in the atmosphere. The atmospheric interactions also have timescales of years, as in the case of El-Niño–Southern–Oscillation (ENSO). The purpose of our work is to analyze the LOD, ENSO anomalies and identify possible relationships. The topic is underdeveloped and at the moment is advanced in the scientific community.

Results

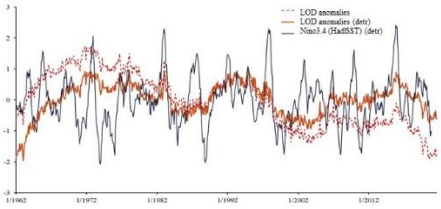


Fig. 1. Comparison of monthly mean LOD anomalies and SST anomalies according to the Nino 3.4 index from HadISST data

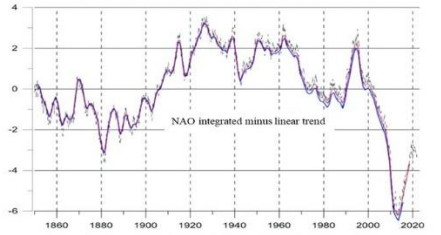


Fig. 2. Integrated NAO index without linear trend

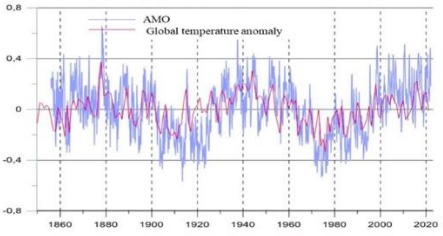


Fig. 3. Atlantic Multidecadal Oscillation in relation to the global temperature anomaly

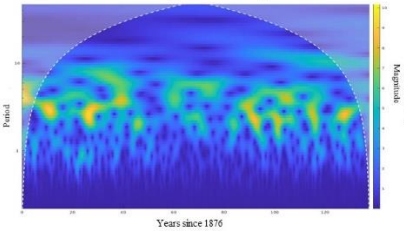


Fig. 4. Wavelet-scalogram of the SOI Index

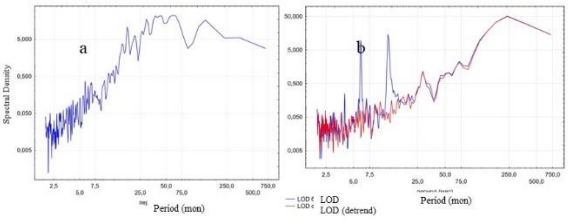


Fig. 5. Spectra (a) Nino 3.4 (b) LOD

Data and Methods

For this study, we used data of average monthly LOD values, Nino3.4, NAO, SOI, and AMO indices, taken from IERS and NCDC websites. Software, used in our research, - Matlab, STATISTICA.

Conclusions

The monthly average LOD anomalies were calculated for comparison with the HadISST SST anomalies in the Nino 3.4 index, excluding the seasonal trend. A graph was created for comparing the monthly average LOD anomalies with and without excluding the trend seasonal and the monthly average SST anomalies in the Nino 3.4 index with the exclusion of the seasonal trend according to HadISST data (Fig. 1). The graph shows the coincidence of LOD peaks with the Nino 3.4 index in 1983, 1998 and 2016. There may be interdecadal fluctuations that affect ENSO and LOD. The wavelet spectrogram of the SOI index (Fig. 4) shows fluctuations that occur every 10, 20 years. The same fluctuations, with a period of 20.8 years, were noted in the spectra of Nino 3.4 and LOD (Fig.5). Also we looked at the NAO index. Although the North Atlantic is far from the ENSO region, there are suggestions that they have close ties. The graph (Fig. 2.) shows that since 2000 there has been a whole series of negative NAO indexes, which reached its peak in 2016. Coincidence? We don't think so. The graph (Fig. 3) shows the AMO in relation to the global water temperature. It can be seen that the fluctuations occur in a sequence of about 60 years. In 2016, there was a peak in temperature and at this point in time, in accordance with the previous fluctuation, the temperature should go down. This may indicate that the pace of global warming will slow down. There is an assumption that LOD and ENSO have a 20-year periodicity of oscillations and may be related to Sidorenkov's Theory [2] of the relationship with lunar precession. Our research indicates that all global fluctuations are interconnected. However, this remains within the framework of theory and requires more careful study.

Acknowledgments

We thank the Scientific Caribbean Foundation and the Citizen Diplomacy Action Fund for their support of our research!

References

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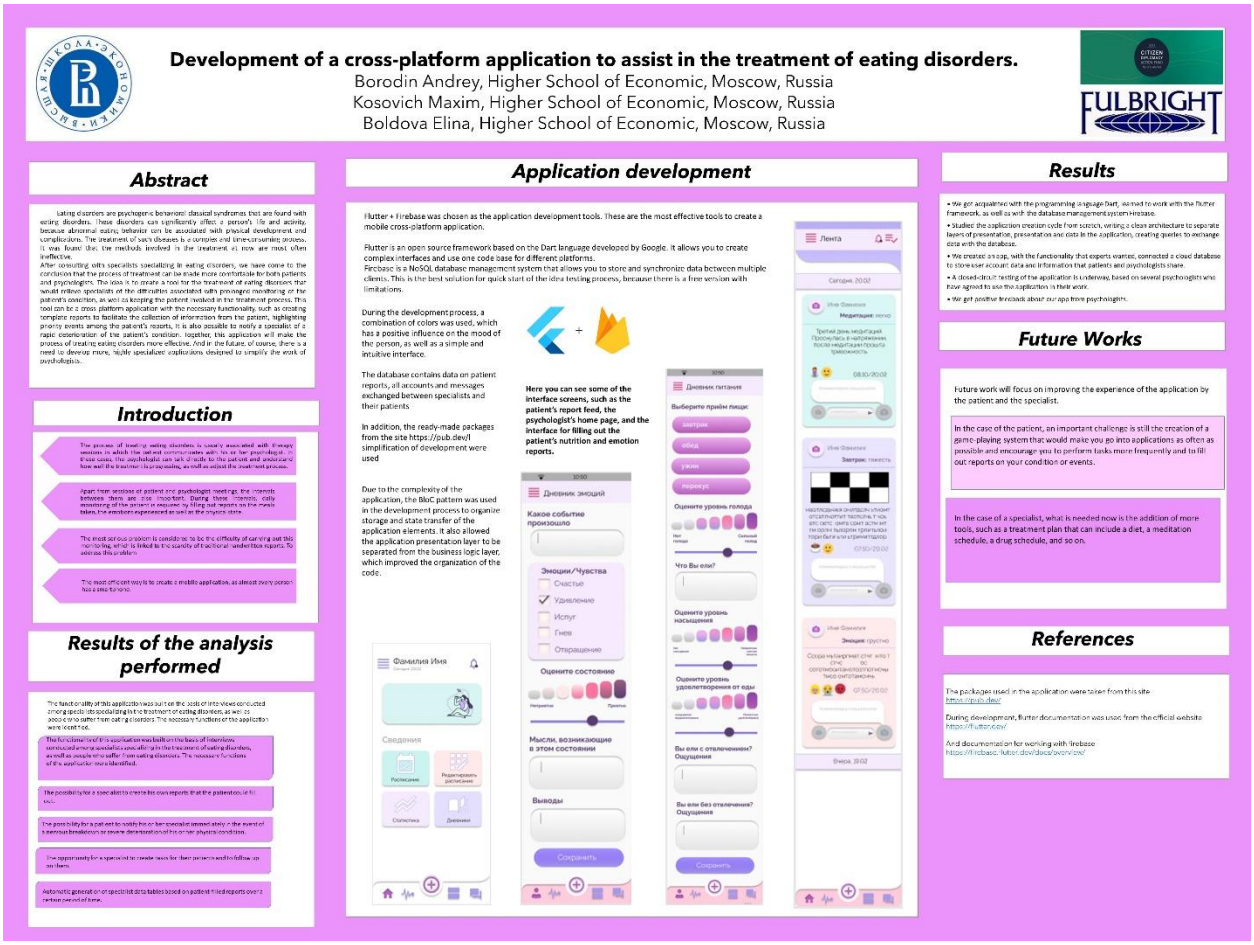
2. Sidorenkov N.S. Physics of instabilities of the Earth's rotation., 2001

Andrey Borodin
Maxim Kosovich
Elina Boldova



Development of a cross-platform application to assist in the treatment of eating disorders.

Borodin Andrey, Higher School of Economic, Moscow, Russia
Kosovich Maxim, Higher School of Economic, Moscow, Russia
Boldova Elina, Higher School of Economic, Moscow, Russia

FULBRIGHT

Abstract

Eating disorders are psychogenic behavioral classical syndromes that are found with eating disorders. These disorders can significantly affect a person's life and activity, because abnormal eating behavior can be associated with physical development and complications. The treatment of such diseases is a complex and time-consuming process. It was found that the methods involved in the treatment of now are most often ineffective.
After consulting with specialists specializing in eating disorders, we have come to the conclusion that the process of treatment can be made more comfortable for both patients and psychologists. The idea is to create a tool for the treatment of eating disorders that would relieve specialists of the difficulties associated with prolonged monitoring of the patient's condition, as well as keeping the patient involved in the treatment process. This tool can be a cross platform application with the necessary functionality, such as creating template reports to facilitate the collection of information from the patient, highlighting priority events among the patient's reports. It is also possible to notify a specialist of a rapid deterioration of the patient's condition. Together, this application will make the process of treating eating disorders more effective. And in the future, of course, there is a need to develop more, highly specialized applications designed to simplify the work of psychologists.

Introduction

The process of treating eating disorders is usually associated with therapy sessions in which the patient communicates with his or her psychologist. In these cases, the psychologist can talk directly to the patient and understand how well the treatment is progressing, as well as adjust the treatment process.

Apart from sessions of patient and psychologist meetings, the intervals between them are also important. During these intervals, daily monitoring of the patient is required, by filling out reports on the meals taken, the emotions experienced as well as the physical state.

The most serious problem is considered to be the difficulty of carrying out this monitoring, which is linked to the quantity of factors of undertitive reports. To address this problem

The most efficient way is to create a mobile application, as almost every person has a smartphone.

Results of the analysis performed

The functionality of this application was built on the basis of interviews conducted among specialists specializing in the treatment of eating disorders, as well as people who suffer from eating disorders. The necessary functions of the application were identified.

The functionality of this application was built on the basis of interviews conducted among specialists specializing in the treatment of eating disorders, as well as people who suffer from eating disorders. The necessary functions of the application were identified.

The possibility for a specialist to create his own reports that the patient would fill out.

The possibility for a patient to notify his or her specialist immediately in the event of a serious breakdown or severe deterioration in his or her physical condition.

The opportunity for a specialist to create tests for their patients and to follow up on them.

Automatic generation of specialist data tables based on patient filled reports over a certain period of time.

Application development

Flutter + Firebase was chosen as the application development tools. These are the most effective tools to create a mobile cross-platform application.

Flutter is an open source framework based on the Dart language developed by Google. It allows you to create complex interfaces and use one code base for different platforms.
Firebase is a NoSQL database management system that allows you to store and synchronize data between multiple clients. This is the best solution for quick start of the idea testing process, because there is a free version with limitations.

During the development process, a combination of colors was used, which has a positive influence on the mood of the person, as well as a simple and intuitive interface.

The database contains data on patient reports, all accounts and messages exchanged between specialists and their patients

In addition, the ready-made packages from the site https://pub.dev/l simplification of development were used

Due to the complexity of the application, the BloC pattern was used in the development process to organize storage and state transfer of the application elements. it also allowed the application presentation layer to be separated from the business logic layer, which improved the organization of the code.

Here you can see some of the interface screens, such as the patient's report feed, the psychologist's home page, and the interface for filling out the patient's nutrition and emotion reports.

Results

- We got acquainted with the programming language Dart, learned to work with the Flutter Framework, as well as with the database management system Firebase.
- Studied the application creation cycle from scratch, writing a clean architecture to separate layers of presentation, presentation and data in the application, creating queries to exchange data with the database.
- We created an app, with the functionality that experts wanted, connected a cloud database to store user account data and information that patients and psychologists share.
- A closed-circuit testing of the application is underway, based on several psychologists who have agreed to use the application in their work.
- We got positive feedback about our app from psychologists.

Future Works

Future work will focus on improving the experience of the application by the patient and the specialist.

In the case of the patient, an important challenge is still the creation of a game-playing system that would make you go into applications as often as possible and encourage you to perform tasks more frequently and to fill out reports on your condition or events.

In the case of a specialist, what is needed now is the addition of more tools, such as a treatment plan that can include a diet, a meditation schedule, a drug schedule, and so on.

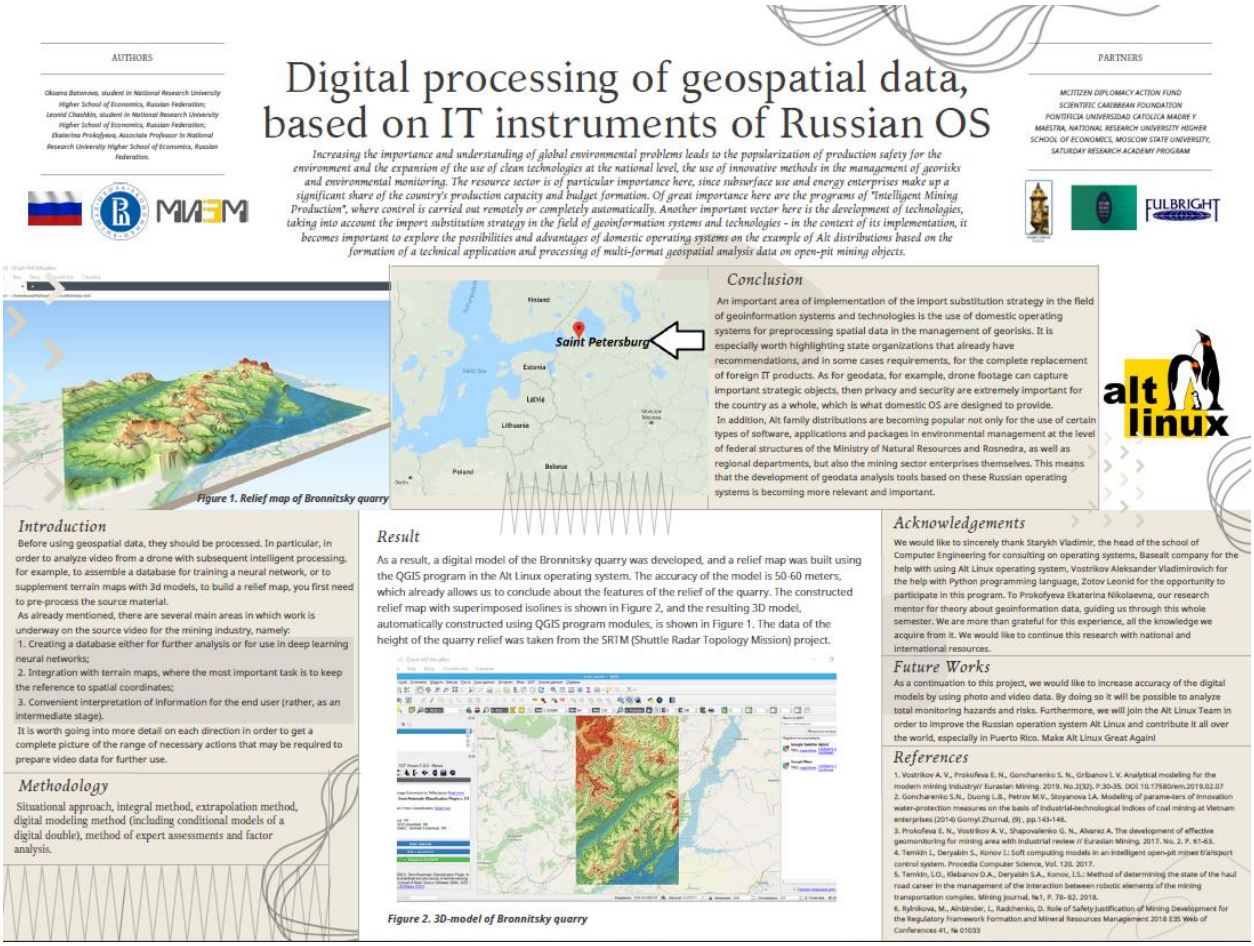
References

The packages used in the application were taken from this site
https://pub.dev/

During development, flutter documentation was used from the official website
https://flutter.ru/

And documentation for working with firebase
https://firebase.flutter.dev/docs/overview/

Oksana Batonova
Leonid Chashkin



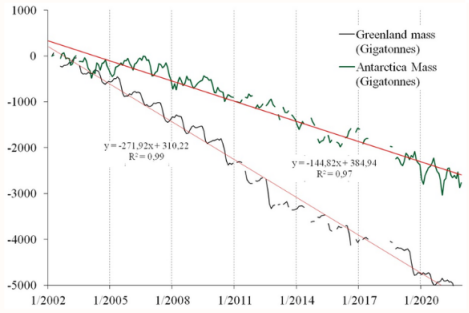
Kroroshunova Darya,

INFLUENCE OF CHANGES IN THE GREENLAND AND ANTARCTICA GLACIER DISTRIBUTION ON THE EARTH ROTATION RATE DURING MODERN CLIMATIC ERA

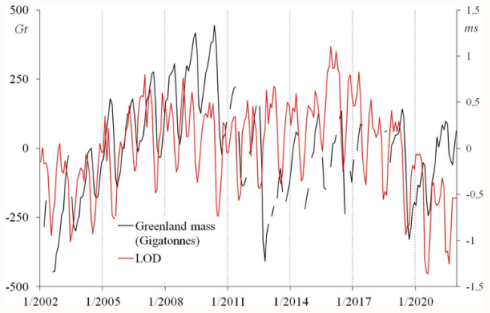
D. Khoroshunova, Moscow State University M.V. Lomonosov, Moscow, Russian Federation; O. Marchukova, Branch Institute of Natural and Technical Systems, Sochi, Russian Federation

Abstract

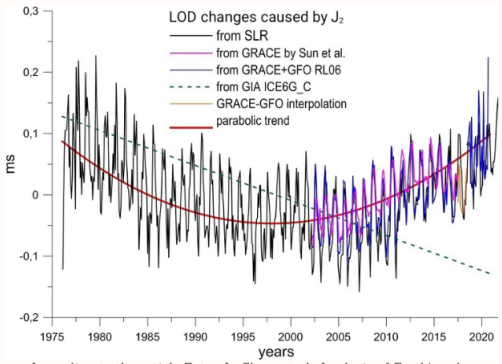
The data of the GRACE and GRACE-FO satellites register anomalies of the Earth's gravitational field (mass anomalies), including using them to determine changes in the mass of ice on the planet. For the study, monthly grids of arrays TELLUS_GRACE_L3_CSR_RL06_LND_v04 were taken, which contain recalculated anomalies of the Earth's gravitational field into an equivalent water thickness. Based on these data, the impact of the degradation of the Greenland and Antarctica ice cover on the change in LOD (length of day) is considered.



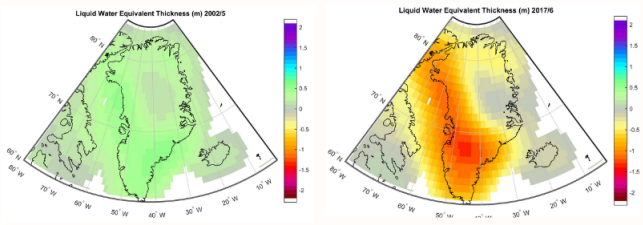
The average annual mass changes of Greenland (black line) and Antarctica (green line) in gigatons from 2002 to 2021 according to GRACE and GRACE-FO data from the JPL RL06Mv2 and liner tred (red line).

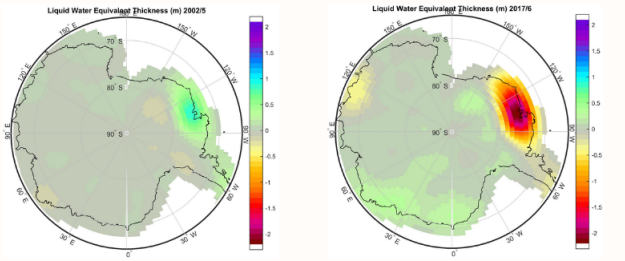


Monthly average values of LOD and Greenland mass with the exception of a linear trend



According to the article Zotov L., Shum et al., Analysis of Earth's polar motion and length of day trends in comparison with estimates using second degree stokes coefficients from satellite gravimetry, 2021





Change in the equivalent water thickness of Greenland and Antarctica from 5.2002 to 5/2017

Conclusion

The Greenland and Antarctica ice sheets have undergone marked changes over the past two decades as a result of the global warming effects. The liquid water equivalent thickness of Greenland and Antarctica has increased by one meter in average from 2002 to 2017. Using the GRACE and GRACE-FO data sets the obtained results are demonstrated that Greenland Mass linear trend is -271.9 Gt/yr and Antarctica Mass linear trend is -144.8 Gt/yr. The contribution of the linear trend to the total dispersion variability is large and amounts to 98%. After the trend is removed, annual fluctuations remain that are in-phase with changes of the length of the day (LOD). The post-glacial uplift model indicates that the Earth's compression (J2) should decrease, so the length of the day should become shorter by hundredths of a millisecond. However, after 2005 the situation was changed: the Earth's compression began to increase, and the length of the day began to grow. This is due to global warming trends, including the melting of the glaciers of Greenland and Antarctica, whose melt water, entering the ocean, changes the redistribution of masses on Earth.

Acknowledgement

We express our great gratitude to the Scientific Caribbean Foundation and Citizen Diplomacy Action Fund for U.S. Alumni

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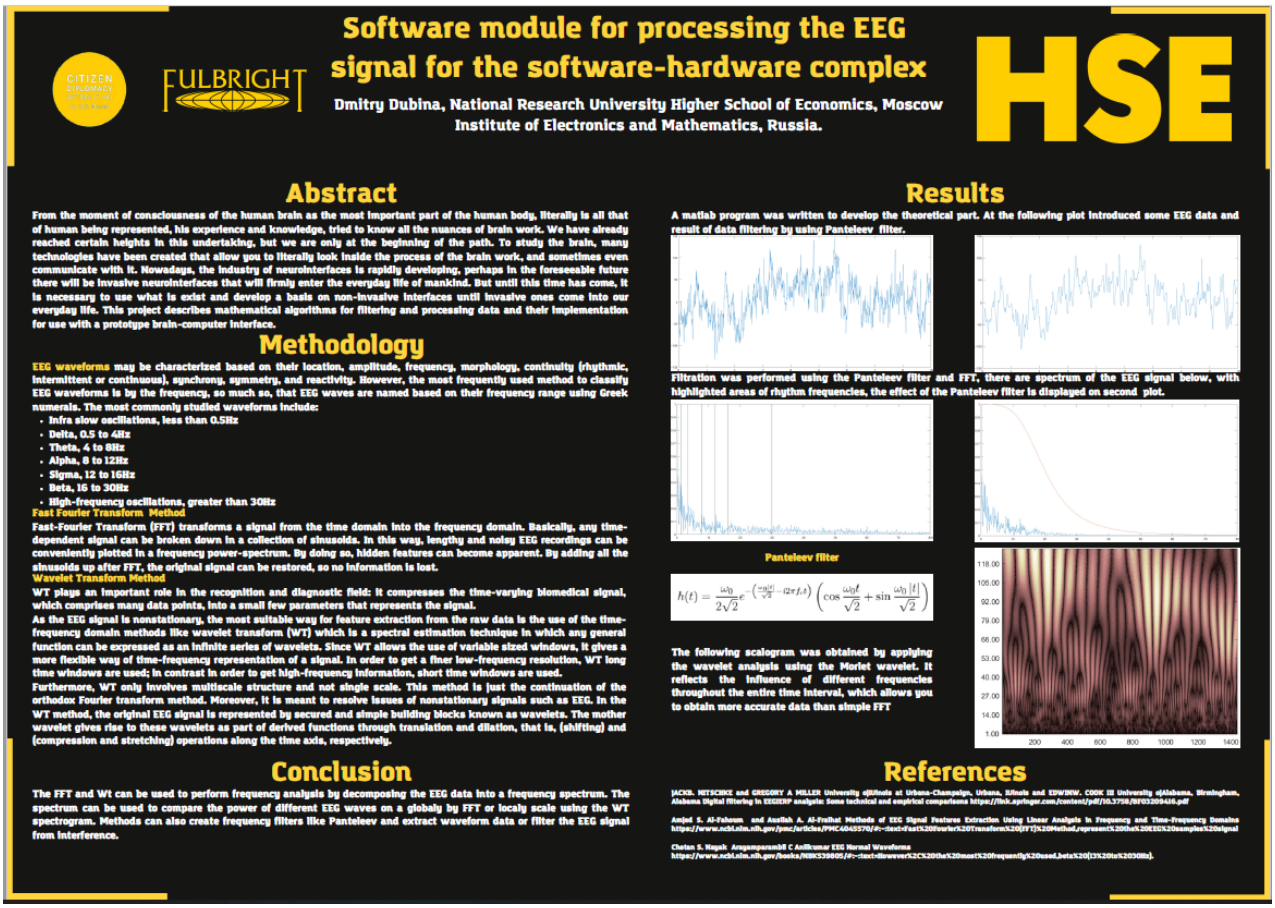
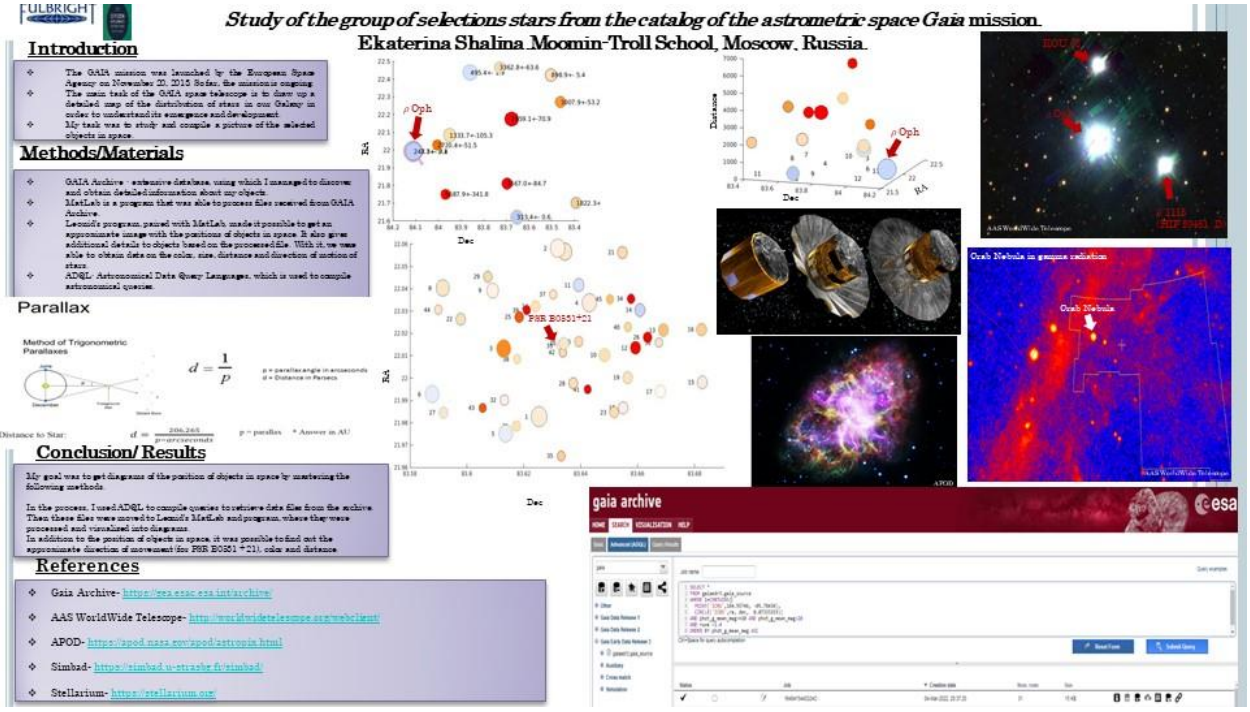
Dimitry Dubina



Ivan Gevorkov
Aleksandr Osipov

Ekaterina Shalina



Dr. Juan F. Arratia's Group
Puerto Rico-Dominican Republic

Marisol Alape Toro

The Development of a New Era: Personalized Medicine and Stem Cells

Marysol Alape-Toro[1], Escuela Superior Petra Mercado Bougart, Humacao, 00791
Fabiola D. Pagán-Torres[2] University of Puerto Rico, Bayamon PR 00959

Abstract

Technology has become an undeniable advantage to medicine, which we've learned to utilize throughout history to our power. This investigation aims to propose a new approach consisting of the use of the genome sequence to create a drug design to them and using stem cells in the process of testing the drug to ensure the patients' safety; evaluates its effects and determine whether it should be developed. The condition of interest will be targeting cancer cells. To develop this research it took 11 references, using the 2018-2022 timeline with keywords that were necessary to find the exact information. Implementing this new approach would bring an end to a never-ending cycle of unnecessary drug use, as well as animal testing. The economic industry would also benefit from this since the funding that goes towards animals in research would be less and with this alternative possibly becoming the new normal the numbers would keep dropping in the scientific field. Medicine constantly evolves and it's up to us to decide how we want to innovate change.

Introduction

- Over 100 million animals get killed because of animal testing, yet we continue to ignore this issue while having solutions at reach.
- Before being able to use an animal in research, you need to identify what animal is the fit for your research and follow certain regulations by *The Animal Welfare Act (IACUC)* and *The Institutional Animal Care and Use Committee (IACUC)* in which they do their best to ensure the animals' wellbeing in research, some examples would be examining where the animal would be living and making sure that they get checked by veterinarians provided by the *IACUC*. However, The Animal Welfare Act excludes %95 of the animals used for testing.
- When testing on an animal, they force them to inhale, eat or inject substances to see their reactions while on most occasions they hear other animals suffer that causes high levels of stress leading them to possibly mutilate themselves. After monitoring and some more testing, they kill the animal to see the effects on their tissues and organs.
- Studies show that a staggering 90% of basic research, most of which involves animals, fails to treatments for humans. Yet the biggest funder of research in the U.S., the National Institutes of Health (NIH) spends nearly half its annual budget on animal studies. That's $19.6 billion down the drain every year.

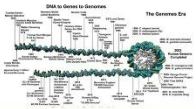


Figure 1. Timeline of the Genome era. (Prokop, J. W., May, T., Strong, K., Bilinovich, S. M., Bupp, C., Rajasekaran, S., Worthey, E. A., Lazar, J., & Genome, L. J. (2018). Genome sequencing in the clinic: the past, present, and future of genomic medicine. *REVIEW Translational Physiology Physiol Genomics*, *50*, 563-579. https://doi.org/10.1152/physiolgenomics.00046.2018 (Genomic))

Methodology

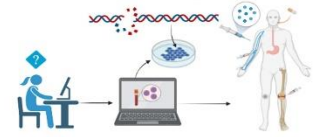


Figure 2. Research process

A. Searched on *PubMed*, Google *Scholar*, and *JSTOR* databases.
B. Recompile all the necessary information and develop questions about the topic. Restriction was made in 2018-2022 timeline, along with keywords such as: *genomic sequences, animal testing alternatives, personalized medicine, stem cells & drug development.*
C. Establish a hypothesis.
D. Analyze the problem, search for resources to provide answers and conclude the findings.

Results

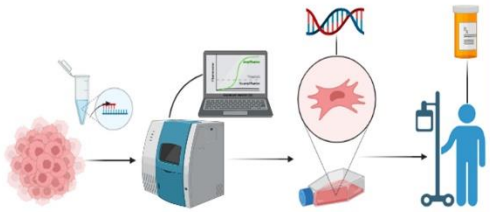


Figure 3. Process to develop personalize medicine.

For a development of a new drug, it needs to be tested for it to be safe, which is why they test on animals. Something worth mentioning is that animals used in research doesn't limit to scientific use, they're also used for testing vaccines, cosmetics, pesticides, industrial chemicals, and so many others. We started from no testing to animal testing, but we can take a much safer and healthier approach thanks to todays' advancements in technology and brilliant scientists. This new alternative would be isolating the patients' stem cells and treating them with "reprogramming" factors until they're able to produce a variety of cell types in which you could test the safety and efficiency of the drug in development.

When targeting cancer cells for example, there are two ways personalized medicine can interfere. For medicine to be personalized the patient needs to have access to health care, this will lead to an ongoing cycle to obtain the necessary information. The Immunotherapy and Pathway-based targeted treatment submits the patient through a tumor cell extraction that leads to tumor biomarker studies, meaning, there will be a tumor genetic test that will help doctors choose an according cancer treatment based on *your* results. From there on they can decide the perfect fit for their patient whether it be with a new drug development or making more tests to get a closer look while in therapy. If it were to be a new drug development, instead of it being tested on animals as per usual, a new approach would be taken. It would be tested on the patients' stem cells making it safer for the patient when they're given the drug. Created with BioRender.com

Discussion

- When in critical health personalize medicine is a more precise way to treat a condition. The drug will be developed with the genome's individuals', and it will test on their own. After this, a detail examination must be done to see how the individual response to the treatment. The graphics presented can help us understand and visualize how stem cells would be tested on, the percentage of animals used in research, and the process behind the making of personalized medicine. We can conclude that, in order to save a life, we shouldn't take a life when it's something completely avoidable.

Future Works

- Making it accessible for others to study how genomics are used in personalized medicine, especially to those in Latin America.
- Explore the types of genome mapping

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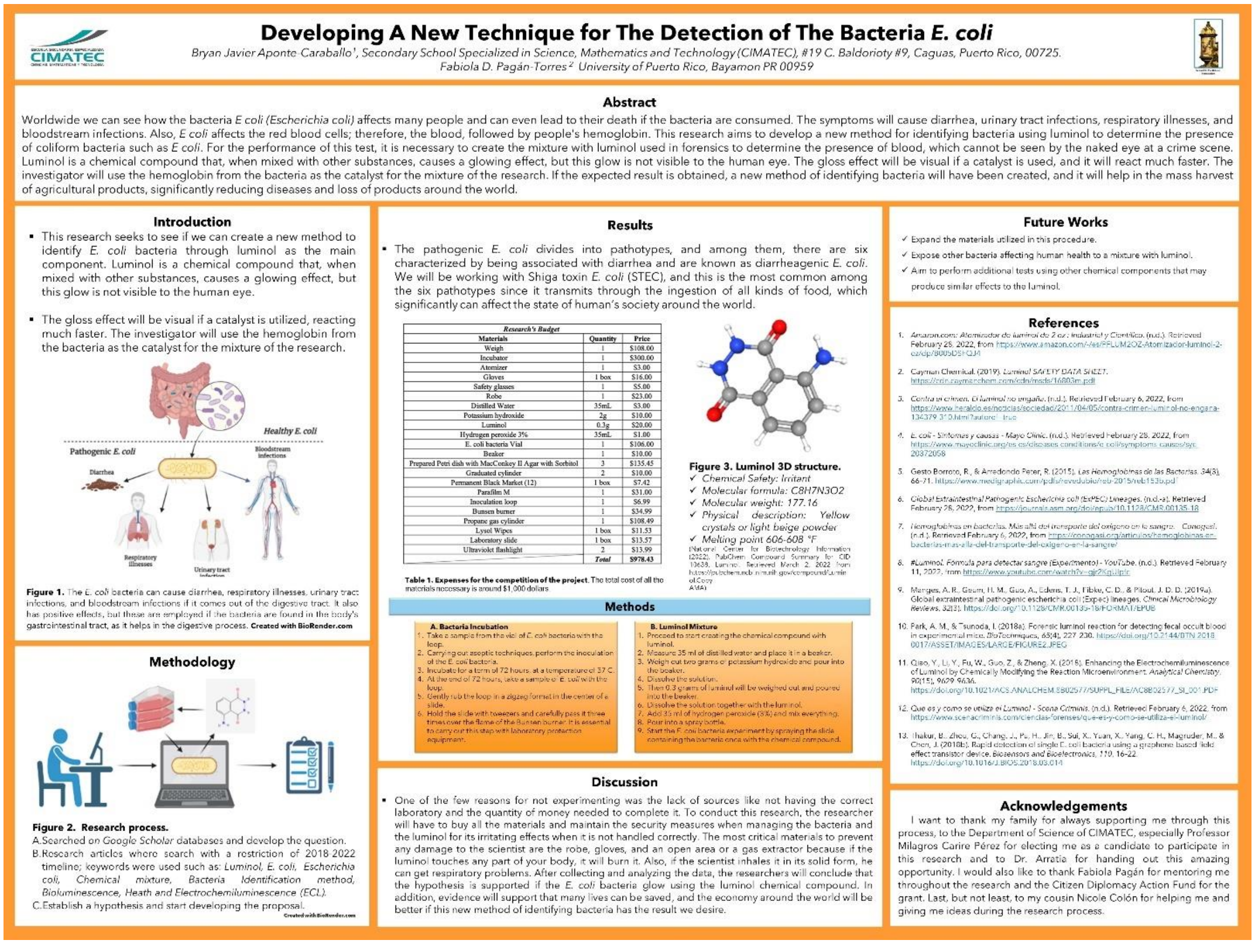
Bryan Aponte Caraballo



Developing A New Technique for The Detection of The Bacteria *E. coli*

Bryan Javier Aponte-Caraballo[1], Secondary School Specialized in Science, Mathematics and Technology (CIMATEC), #19 C. Baldorioty #9, Caguas, Puerto Rico, 00725.
Fabiola D. Pagán-Torres[2] University of Puerto Rico, Bayamon PR 00959

Abstract

Worldwide we can see how the bacteria *E coli (Escherichia coli)* affects many people and can even lead to their death if the bacteria are consumed. The symptoms will cause diarrhea, urinary tract infections, respiratory illnesses, and bloodstream infections. Also, *E coli* affects the red blood cells; therefore, the blood, followed by people's hemoglobin. This research aims to develop a new method for identifying bacteria using luminol to determine the presence of coliform bacteria such as *E coli*. For the performance of this test, it is necessary to create the mixture with luminol used in forensics to determine the presence of blood, which cannot be seen by the naked eye at a crime scene. Luminol is a chemical compound that, when mixed with other substances, causes a glowing effect, but this glow is not visible to the human eye. The gloss effect will be visual if a catalyst is used, and it will react much faster. The investigator will use the hemoglobin from the bacteria as the catalyst for the mixture of the research. If the expected result is obtained, a new method of identifying bacteria will have been created, and it will help in the mass harvest of agricultural products, significantly reducing diseases and loss of products around the world.

Introduction

- This research seeks to see if we can create a new method to identify *E. coli* bacteria through luminol as the main component. Luminol is a chemical compound that, when mixed with other substances, causes a glowing effect, but this glow is not visible to the human eye.
- The gloss effect will be visual if a catalyst is utilized, reacting much faster. The investigator will use the hemoglobin from the bacteria as the catalyst for the mixture of the research.

Figure 1. The *E. coli* bacteria can cause diarrhea, respiratory illnesses, urinary tract infections, and bloodstream infections if it comes out of the digestive tract. It also has positive effects, but these are employed if the bacteria are found in the body's gastrointestinal tract, as it helps in the digestive process. **Created with BioRender.com**

Methodology

Figure 2. Research process.
A. Searched on *Google Scholar* databases and develop the question.
B. Research articles where search with a restriction of 2018-2022 timeline; keywords were used such as: *Luminol, E. coli, Escherichia coli, Chemical mixture, Bacteria Identification method, Bioluminescence, Heath and Electrochemiluminescence (ECL).*
C. Establish a hypothesis and start developing the proposal.
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Results

- The pathogenic *E. coli* divides into pathotypes, and among them, there are six characterized by being associated with diarrhea and are known as diarrheagenic *E. coli*. We will be working with Shiga toxin *E. coli* (STEC), and this is the most common among the six pathotypes since it transmits through the ingestion of all kinds of food, which significantly can affect the state of human's society around the world.

Research's Budget		
Materials	**Quantity**	**Price**
Weigh	1	$108.00
Incubator	1	$300.00
Atomizer	1	$3.00
Gloves	1 box	$16.00
Safety glasses	1	$5.00
Robe	1	$23.00
Distilled Water	35mL	$3.00
Potassium hydroxide	2g	$10.00
Luminol	0.3g	$20.00
Hydrogen peroxide 3%	35mL	$1.00
E. coli bacteria Vial	1	$106.00
Beaker	1	$10.00
Prepared Petri dish with MacConkey II Agar with Sorbitol	3	$135.45
Graduated cylinder	2	$10.00
Permanent Black Market (12)	1 box	$7.42
Parafilm M	1	$31.00
Inoculation loop	1	$6.99
Bunsen burner	1	$34.99
Propane gas cylinder	1	$108.49
Lysol Wipes	1 box	$11.53
Laboratory slide	1 box	$13.57
Ultraviolet flashlight	2	$13.99
	Total	**$978.43**

Table 1. Expenses for the competition of the project. The total cost of all the materials necessary is around $1,000 dollars.

Figure 3. Luminol 3D structure.
✓ *Chemical Safety: Irritant*
✓ *Molecular formula: C8H7N3O2*
✓ *Molecular weight: 177.16*
✓ *Physical description: Yellow crystals or light beige powder*
✓ *Melting point 606-608 °F*
(National Center for Biotechnology Information (2022). PubChem Compound Summary for CID 10638, Luminol. Retrieved March 2, 2022 from https://pubchem.ncbi.nlm.nih.gov/compound/Luminol.Copy AMA)

Methods

A. Bacteria Incubation
1. Take a sample from the vial of *E. coli* bacteria with the loop.
2. Carrying out aseptic techniques, perform the inoculation of the *E. coli* bacteria.
3. Incubate for a term of 72 hours, at a temperature of 37 C.
4. At the end of 72 hours, take a sample of *E. coli* with the loop.
5. Gently rub the loop in a zigzag format in the center of a slide.
6. Hold the slide with tweezers and carefully pass it three times over the flame of the Bunsen burner. It is essential to carry out this step with laboratory protection equipment.

B. Luminol Mixture
1. Proceed to start creating the chemical compound with luminol.
2. Measure 35 ml of distilled water and place it in a beaker.
3. Weigh out two grams of potassium hydroxide and pour into the beaker.
4. Dissolve the solution.
5. Then 0.3 grams of luminol will be weighed out and poured into the beaker.
6. Dissolve the solution together with the luminol.
7. Add 35 ml of hydrogen peroxide (3%) and mix everything.
8. Pour into a spray bottle.
9. Start the *E. coli* bacteria experiment by spraying the slide containing the bacteria once with the chemical compound.

Discussion

- One of the few reasons for not experimenting was the lack of sources like not having the correct laboratory and the quantity of money needed to complete it. To conduct this research, the researcher will have to buy all the materials and maintain the security measures when managing the bacteria and the luminol for its irritating effects when it is not handled correctly. The most critical materials to prevent any damage to the scientist are the robe, gloves, and an open area or a gas extractor because if the luminol touches any part of your body, it will burn it. Also, if the scientist inhales it in its solid form, he can get respiratory problems. After collecting and analyzing the data, the researchers will conclude that the hypothesis is supported if the *E. coli* bacteria glow using the luminol chemical compound. In addition, evidence will support that many lives can be saved, and the economy around the world will be better if this new method of identifying bacteria has the result we desire.

Future Works

✓ Expand the materials utilized in this procedure.
✓ Expose other bacteria affecting human health to a mixture with luminol.
✓ Aim to perform additional tests using other chemical components that may produce similar effects to the luminol.

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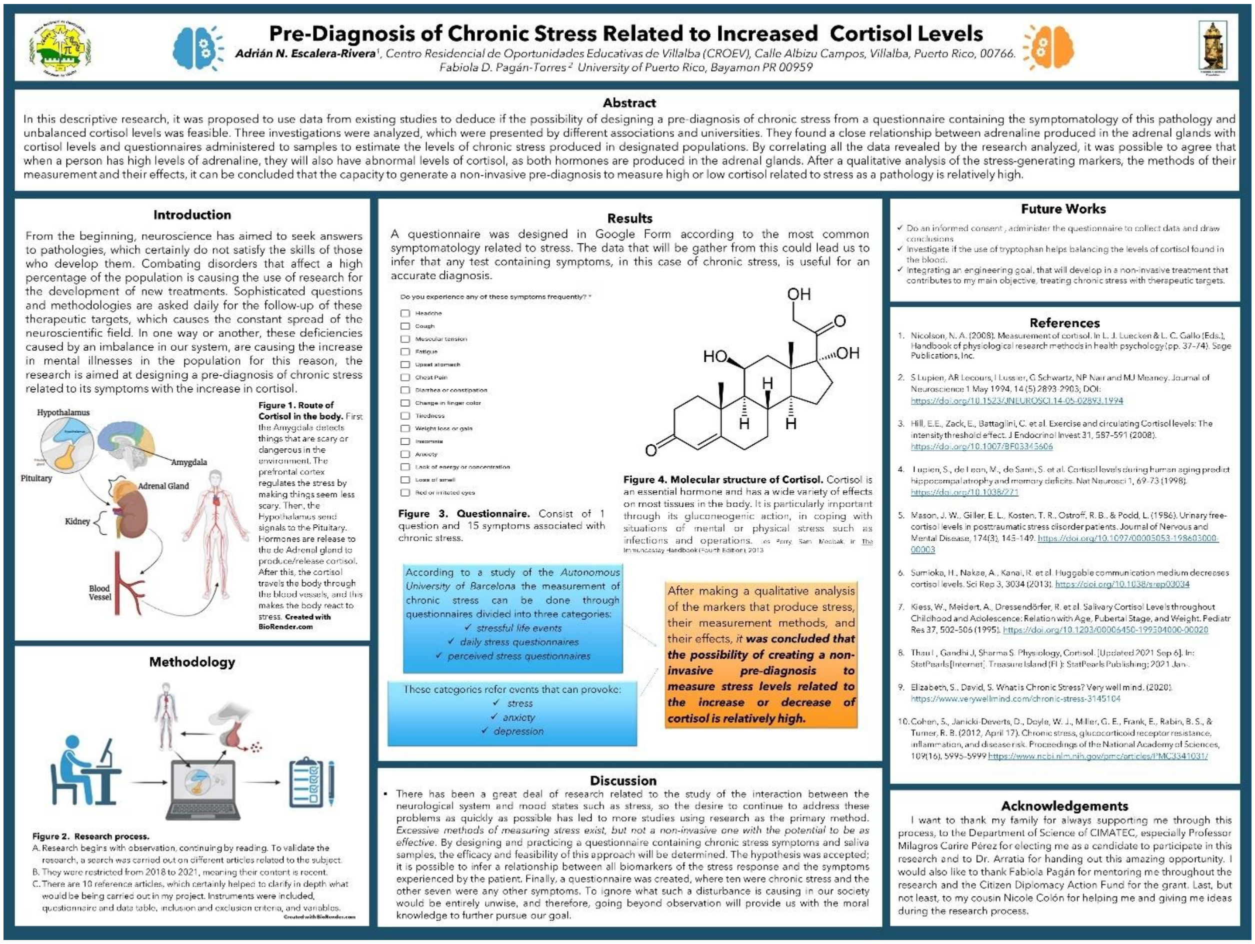
Acknowledgements

I want to thank my family for always supporting me through this process, to the Department of Science of CIMATEC, especially Professor Milagros Carire Pérez for electing me as a candidate to participate in this research and to Dr. Arratia for handing out this amazing opportunity. I would also like to thank Fabiola Pagán for mentoring me throughout the research and the Citizen Diplomacy Action Fund for the grant. Last, but not least, to my cousin Nicole Colón for helping me and giving me ideas during the research process.

Adrián Escalera Rivera



Pre-Diagnosis of Chronic Stress Related to Increased Cortisol Levels

Adrián N. Escalera-Rivera[1], Centro Residencial de Oportunidades Educativas de Villalba (CROEV), Calle Albizu Campos, Villalba, Puerto Rico, 00766.
Fabiola D. Pagán-Torres[2] University of Puerto Rico, Bayamon PR 00959

Abstract

In this descriptive research, it was proposed to use data from existing studies to deduce if the possibility of designing a pre-diagnosis of chronic stress from a questionnaire containing the symptomatology of this pathology and unbalanced cortisol levels was feasible. Three investigations were analyzed, which were presented by different associations and universities. They found a close relationship between adrenaline produced in the adrenal glands with cortisol levels and questionnaires administered to samples to estimate the levels of chronic stress produced in designated populations. By correlating all the data revealed by the research analyzed, it was possible to agree that when a person has high levels of adrenaline, they will also have abnormal levels of cortisol, as both hormones are produced in the adrenal glands. After a qualitative analysis of the stress-generating markers, the methods of their measurement and their effects, it can be concluded that the capacity to generate a non-invasive pre-diagnosis to measure high or low cortisol related to stress as a pathology is relatively high.

Introduction

From the beginning, neuroscience has aimed to seek answers to pathologies, which certainly do not satisfy the skills of those who develop them. Combating disorders that affect a high percentage of the population is causing the use of research for the development of new treatments. Sophisticated questions and methodologies are asked daily for the follow-up of these therapeutic targets, which causes the constant spread of the neuroscientific field. In one way or another, these deficiencies caused by an imbalance in our system, are causing the increase in mental illnesses in the population for this reason, the research is aimed at designing a pre-diagnosis of chronic stress related to its symptoms with the increase in cortisol.

Figure 1. Route of Cortisol in the body. First the Amygdala detects things that are scary or dangerous in the environment. The prefrontal cortex regulates the stress by making things seem less scary. Then, the Hypothalamus send signals to the Pituitary. Hormones are release to the de Adrenal gland to produce/release cortisol. After this, the cortisol travels the body through the blood vessels, and this makes the body react to stress. **Created with BioRender.com**

Methodology

Figure 2. Research process.

A. Research begins with observation, continuing by reading. To validate the research, a search was carried out on different articles related to the subject.

B. They were restricted from 2018 to 2021, meaning their content is recent.

C. There are 10 reference articles, which certainly helped to clarify in depth what would be being carried out in my project. Instruments were included, questionnaire and data table, inclusion and exclusion criteria, and variables.

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Results

A questionnaire was designed in Google Form according to the most common symptomatology related to stress. The data that will be gather from this could lead us to infer that any test containing symptoms, in this case of chronic stress, is useful for an accurate diagnosis.

Do you experience any of these symptoms frequently? *

- [ ] Headche
- [ ] Cough
- [ ] Muscular tension
- [ ] Fatigue
- [ ] Upset stomach
- [ ] Chest Pain
- [ ] Diarrhea or constipation
- [ ] Change in finger color
- [ ] Tiredness
- [ ] Weight loss or gain
- [ ] Insomnia
- [ ] Anxiety
- [ ] Lack of energy or concentration
- [ ] Loss of smell
- [ ] Red or irritated eyes

Figure 3. Questionnaire. Consist of 1 question and 15 symptoms associated with chronic stress.

Figure 4. Molecular structure of Cortisol. Cortisol is an essential hormone and has a wide variety of effects on most tissues in the body. It is particularly important through its gluconeogenic action, in coping with situations of mental or physical stress such as infections and operations. Les Perry, Sam Mesbak, in The Immunoassay Handbook (Fourth Edition), 2013

According to a study of the *Autonomous University of Barcelona* the measurement of chronic stress can be done through questionnaires divided into three categories:

- ✓ *stressful life events*
- ✓ *daily stress questionnaires*
- ✓ *perceived stress questionnaires*

These categories refer events that can provoke:

- ✓ *stress*
- ✓ *anxiety*
- ✓ *depression*

After making a qualitative analysis of the markers that produce stress, their measurement methods, and their effects, *it* ***was concluded that the possibility of creating a non-invasive pre-diagnosis to measure stress levels related to the increase or decrease of cortisol is relatively high.***

Discussion

- There has been a great deal of research related to the study of the interaction between the neurological system and mood states such as stress, so the desire to continue to address these problems as quickly as possible has led to more studies using research as the primary method. *Excessive methods of measuring stress exist, but not a non-invasive one with the potential to be as effective.* By designing and practicing a questionnaire containing chronic stress symptoms and saliva samples, the efficacy and feasibility of this approach will be determined. The hypothesis was accepted; it is possible to infer a relationship between all biomarkers of the stress response and the symptoms experienced by the patient. Finally, a questionnaire was created, where ten were chronic stress and the other seven were any other symptoms. To ignore what such a disturbance is causing in our society would be entirely unwise, and therefore, going beyond observation will provide us with the moral knowledge to further pursue our goal.

Future Works

- ✓ Do an informed consent , administer the questionnaire to collect data and draw conclusions
- ✓ Investigate if the use of tryptophan helps balancing the levels of cortisol found in the blood.
- ✓ Integrating an engineering goal, that will develop in a non-invasive treatment that contributes to my main objective, treating chronic stress with therapeutic targets.

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Layla López Morales

Lack of Sleep and Its Effects on Students Academic Performance, Learning Ability, And Memory

Layla E. López-Morales[1], Secondary School Specialized in Science, Mathematics and Technology (CIMATEC), #19 C. Baldoriety #9, Caguas, Puerto Rico, 00725.
Fabiola D. Pagán-Torres[2] University of Puerto Rico, Bayamon PR 00959

Abstract

Sleep is an integral part of any student's routine, but what happens when the brain lacks this necessary activity? This research project aims to identify and analyze what negative effects insufficient and inconsistent sleeping habits, as well as patterns, can produce on students' academic and cognitive performance. As a student, dealing with copious amounts of work, as well as absorbing knowledge provided by their classes, requires an extensive amount of energy. According to a research paper realized in 2020, sustained evidence shows that sleep plays a fundamental role in cognitive functioning (Gomez & Genzel, 2020). However, what damaging consequences could poor sleep quality have on a student's academic performance, learning ability, and memory? The researcher performed an extensive process of data collection and information retrieval regarding the topic of sleep and its counterparts. After concluding the data collection stage, they found that the students whose sleeping schedules were irregular or had insufficient sleep had poor memory retention, and presented various negative effects such as, a possimistic or depressive mood, lack of energy, inability to focus, fatigue, forgetfulness, irritability, among others. (Bandyopadhyay & Ninotchka, 2019) To conclude, the researcher's hypothesis was partially supported since poor amounts of sleep do have set negative effects on a student's learning ability and memory, however, there is an insufficient amount of data that suggests it also has a direct impact on their academic career.

Introduction

- Sleep is a fundamental part of a student's school-life; therefore, it is necessary for students to educate themselves on the importance of sleep, in addition to the consequences a lack of it can bring.
- This research project aims to analyze the possible negative effects students' sleeping habits may have on their academic and cognitive performance.
- According to an article posted in 2018 by the US Centers for Disease Control and Prevention (CDC), 72.7% of high school students reported insufficient sleep. In addition, a 20% who reported sleeping fewer than six hours per night.

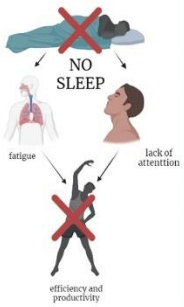

Figure 1. Effects of no sleep. The American Thoracic Society states that sleep loss can cause chronic fatigue and lack of attention, potentially affecting a person's efficiency and productivity. (The American Thoracic Society, 2019) **Created with BioRender.com**

Methodology

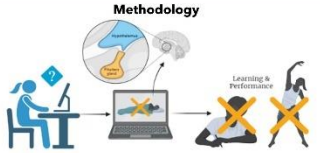

Figure 2. Research process. A. Selecting relevant scientific articles from the Google Scholar with a restriction to articles in English with a time limit of 2017 until present day. B. Combinations of different terms such as *Sleep, Academic performance, Cognitive performance, Survey, Sleep patterns, Fatigue, Sleep Deprivation, Memory, Lack of sleep, Sleep loss*. In total, 12 publications were included in this research project. C. Conclusions were drawn and, finally, the results were informed. **Created with BioRender.com**

Results

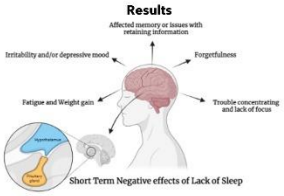

Figure 3. Short Term Negative effects of Lack of Sleep. The short-term effects that lack of sleep may have on a person, includes having an affected memory or issues with retaining information, irritability and/or depressive mood, forgetfulness, trouble concentrating and lack of focus, fatigue, and unexpected weight gain. **Created with BioRender.com**

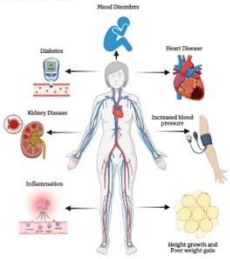

Figure 4. Long Term Negative effects of Lack of Sleep. For instance, people who get poor amounts of sleep are less able to produce sugar, increasing their chance of developing type 2 diabetes, in addition to increased blood pressure and inflammation, meaning a 48% greater chance of developing a heart attack disease and 15% greater chance of experiencing a stroke, affected and decreased height growth and poor weight gain. (Bandyopadhyay & Ninotchka, 2019). **Created with BioRender.com**

Discussion

- Sleep loss does indeed affect a student in certain aspects of daily life. Lack of sleep has both long-term and short-term consequences on a student, or individual in general. It is evident that a lack of sleep does negatively affect a person's learning abilities and memory, however, there is insufficient information that suggests that a lack of sleep directly affects a student's academic career. (Keanu Paul B. Sygaco, 2021). Though we can infer that factor such as fatigue, inability to focus, and retain information can, in some way affect the way a student processes information and applies it in academic environments. A study realized by Keanu Paul B. Sygaco in 2021, suggests that students often sacrifice a portion of their time asleep to obtain their desired grades. To conclude, the hypothesis was partially supported since poor amounts of sleep do have set negative effects on a student's learning ability and memory, however there is an insufficient amount of data that suggests it also has a direct impact on academic career.

Future Works

- ✓ Conduct an anonymous PSQI survey to 10th grade students ranging in the ages of 14-16 and both male and female.
- ✓ Investigate alternatives which may positively impact sleep issues for students and, in turn, improve their academic career.

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I am extremely grateful for the various people who aided in the completion of this research project including Dr. Arratia, and Fabiola D. Pagán Torres for their feedback, patience, and time spent proofreading and correcting the mistakes I made while in the development stages. Due to their guidance, encouragement and support, this project was completed to the best of my abilities and handled with upmost care. In addition, I would like to extend my gratitude to the Citizen Diplomacy Action Fund for providing me with this wonderful opportunity to challenge myself as a researcher and develop a final product I would be satisfied with.

Normarie Martinez Flores

The relationship between household detergents and plant growth

Normarie Martinez-Flores[1], CIMATEC #19 C. Baldorioty #9, Caguas, 00725 PR
Fabiola D. Pagán-Torres [2] University of Puerto Rico, Bayamon PR 00959

Abstract

In Puerto Rico, the AAA discharges an average of 243 million gallons of sanitary wastewater into rivers, reservoirs, estuaries, and the sea, treated at primary, secondary, or tertiary levels. It's often seen that the daily products that we use that go down the drain end up in local water bodies. For example, laundry detergents, a mixture of different compounds, are used as washing agents in houses and cleaning agents in institutions and industries. As a result, industrial and domestic wastewater usually contains detergent contamination in variable amounts, and that water is consumed by plants which can affect its growth. This research aims to determine how much impact the chemicals, such as detergents, have on plant growth since it relies on healthy soil with the proper chemistry of salinity and pH. The researcher expects the water only and eco-friendly sampling to grow while the detergent not so much. For this investigation, research of information was done beforehand and cautiously revised. To conduct this investigation, the researcher will plant seeds on pots and water them weekly with detergent dissolved in water and a control group of only water. In addition, the researcher will measure the plants on a daily basis to analyze the results in order to determine the effects of the detergents. The results consist of the plants watered with detergent didn't grow, the plant watered with eco-friendly detergent passed away and the plant in the control group watered with fresh water grew healthy. Meaning that is necessary for a plant to have healthy soil with the proper chemistry of salinity and pH. In conclusion, we must pay attention to the ingredients in our laundry's detergents because it causes a chemical imbalance in the soil and makes it impossible for plants to grow and affect their well-being.

Introduction

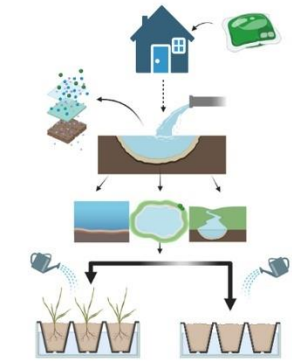

Figure 1. Relationship of how laundry detergents affects plants growth.
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Methodology

Research
This research was based on scientific articles searched in the Google Scholar database, with a time limit of 2018-2021.

A combination of different terms was used for a more specific search on the databases.

For example: chemicals/plants/ growth.

Experimental
Plant *Coriandrum sativum* seeds on 3 different pots.
→ **Control group:** treated with normal water
→ **Experimental group:** treated with dissolved detergent in water
The plants were watered with 10 ml daily and were measured weekly for a period of 4 weeks.
The gathered data were analyzed using statistical analysis.

Figure 2. Materials: Ace laundry detergent, Eco's laundry detergent, measuring cups, *Coriandrum sativum* seeds, pots, soil and ruler.

Results

Figure 5. Plant growth in the process of 4 weeks

Figure 5. From the results obtained in **Table 1.** , we see a clear difference in plant growth between the control group and the variable group. During the first 2 weeks, both the water-only pot and the eco-friendly pot were able to germinate. In week 3, we can see that the water-only pot grew 2 more centimeters more than the eco-friendly detergent pot. On week 4, the water-only pot continued showing growth while the eco-friendly pot was diseased. On the other hand, during the 4-week period, the detergent-only pot didn't show any signs of growth.

Different pots	Week 1	Week 2	Week 3	Week 4
Water Only	0 cm	Germination Process	3 cm	4 cm
Eco Friendly-Detergent dissolved in wa	0 cm	Germination Process	1 cm	No Survival
Detergent Dissolved in water	0 cm	o cm	0 cm	0 cm

Table 1. Plant height in centimeters (cm) in the duration of 4-week plant growth.

Discussion

- Based on the present investigation, it can be concluded that household detergents do in fact affect plant growth.
- The researcher's hypothesis was correct by the Coriandrum Sativum watered with detergent dissolved in water was the most affected of the 3 samples.
- This should spread awareness on detergent usage, and even if it improves the chances of a plant to live, switch to an eco-friendly detergent.

Future Works

- ✓ Continue testing with different plants and chemicals commonly found in households.
- ✓ Compare pH levels on different types of plants expose to other detergents.
- ✓ Study chemicals concentrations of different type of waters.

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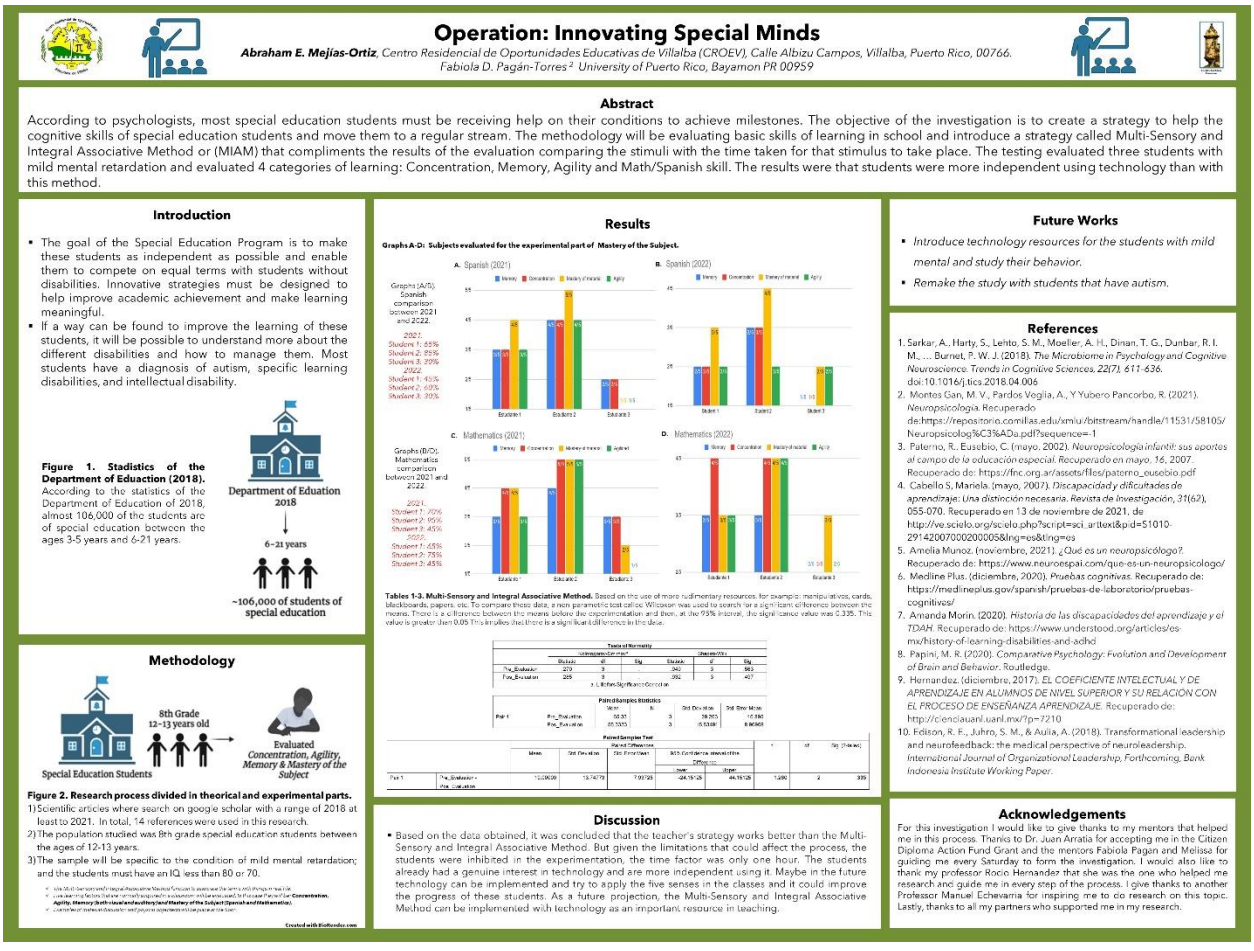
Abraham Mejías Ortiz



Operation: Innovating Special Minds

Abraham E. Mejías-Ortiz, *Centro Residencial de Oportunidades Educativas de Villalba (CROEV), Calle Albizu Campos, Villalba, Puerto Rico, 00766.*
Fabiola D. Pagán-Torres [2] University of Puerto Rico, Bayamon PR 00959

Abstract

According to psychologists, most special education students must be receiving help on their conditions to achieve milestones. The objective of the investigation is to create a strategy to help the cognitive skills of special education students and move them to a regular stream. The methodology will be evaluating basic skills of learning in school and introduce a strategy called Multi-Sensory and Integral Associative Method or (MIAM) that compliments the results of the evaluation comparing the stimuli with the time taken for that stimulus to take place. The testing evaluated three students with mild mental retardation and evaluated 4 categories of learning: Concentration, Memory, Agility and Math/Spanish skill. The results were that students were more independent using technology than with this method.

Introduction

- The goal of the Special Education Program is to make these students as independent as possible and enable them to compete on equal terms with students without disabilities. Innovative strategies must be designed to help improve academic achievement and make learning meaningful.
- If a way can be found to improve the learning of these students, it will be possible to understand more about the different disabilities and how to manage them. Most students have a diagnosis of autism, specific learning disabilities, and intellectual disability.

Figure 1. Stadistics of the Department of Eduaction (2018). According to the statistics of the Department of Education of 2018, almost 106,000 of the students are of special education between the ages 3-5 years and 6-21 years.

Methodology

Figure 2. Research process divided in theorical and experimental parts.

1) Scientific articles where search on google scholar with a range of 2018 at least to 2021. In total, 14 references were used in this research.
2) The population studied was 8th grade special education students between the ages of 12-13 years.
3) The sample will be specific to the condition of mild mental retardation; and the students must have an IQ less than 80 or 70.

- Use Multi-Sensory and Integral Associative Method Concept to assess the terms and things in real life.
- Learning factors that are normally assessed in a classroom will be assessed, in Passive Flow of Bar: **Concentration, Agility, Memory (both visual and auditory) and Mastery of the Subject (Spanish and Mathematics).**
- Learn level of mastery in Education and pass to superiors in the pursue of the Goal.

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Results

Graphs A-D: Subjects evaluated for the experimental part of Mastery of the Subject.

Tables 1-3. Multi-Sensory and Integral Associative Method. Based on the use of more rudimentary resources for example: manipulatives, cards, blackboards, papers, etc. To compare these data, a non parametric test call as Wilcoxon was used to search for a significant difference between the means. There is a difference between the means before the experimentation and then, at the 95% interval, the significance value was 0.035. This value is greater than 0.05 This implies that there is a significant difference in the data.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre_Evaluation	.279	3	.	.942	3	.563
Pos_Evaluation	.385	3	.	.892	3	.407

a. Lilliefors Significance Correction

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_Evaluation	50.35	3	38.265	10.180
	Pos_Evaluation	85.3333	3	15.53381	8.96969

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre_Evaluation - Pos_Evaluation	-12.03639	13.74779	7.93725	-46.19128	46.19128	-1.286	2	.319

Discussion

- Based on the data obtained, it was concluded that the teacher's strategy works better than the Multi-Sensory and Integral Associative Method. But given the limitations that could affect the process, the students were inhibited in the experimentation, the time factor was only one hour. The students already had a genuine interest in technology and are more independent using it. Maybe in the future technology can be implemented and try to apply the five senses in the classes and it could improve the progress of these students. As a future projection, the Multi-Sensory and Integral Associative Method can be implemented with technology as an important resource in teaching.

Future Works

- *Introduce technology resources for the students with mild mental and study their behavior.*
- *Remake the study with students that have autism.*

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Exiel Rodríguez Colón

Identification and Insolation of Fungal Endophytes in Medicinal Plants

Exiel Y. Rodriguez-Colón[1], Secondary School Specialized in Science, Mathematics and Technology (CIMATEC), #19 C. Baldorioty #9, Caguas, Puerto Rico, 00725.
Fabiola D. Pagán-Torres[2], University of Puerto Rico, Bayamon PR 00959

Abstract

This research is about the isolation and identification of fungal endophytes in medicinal plants. The researcher's goal is to identify and know the types of fungi found in medicinal plants. By knowing the types of fungi found on these plants, the researcher can learn the types of chemicals they produce, and about they're influence on the plant. The hypothesis is that fungal endophytes will be found on the plants. The experimental part of the research will begin by using aloe vera and peppermint. Samples of the leaves of each of the four plants were taken. The samples were then disinfected using 70% ethyl alcohol. Afterwards, they were placed on an agar plate to create bacteria and fungi cultivation at ambient temperature. A solution of iodine, distilled water and glycerin was used to dye the samples. After about seven days, using a microscope, microscope slide and a solution of iodine, distilled water and glycerin, the samples will be used to identify any fungal endophytes that are present within. The data collected will be stored and analyzed using charts and graphs made by using Microsoft Word and Excel. The materials needed for the research are pencils, notebooks, a microscope, agar plates, aloe vera, peppermint, scissors, ethyl alcohol, parafilm tape and blue lactophenol. Fungal endophytes were identified in two of the four leaf samples. These two samples were the aloe vera samples. There were no identified fungal endophytes on the peppermint plant.

Introduction

- The endophytic fungus *P. Africana* from *A. vera* has wide therapeutic applications against severe disease conditions.
- The fungal endophytes that inhabit Egyptian medicinal plants could be an effective source for bioactive compounds useful for developing better antioxidant, antibacterial or anticancer drugs with good therapeutic index value.

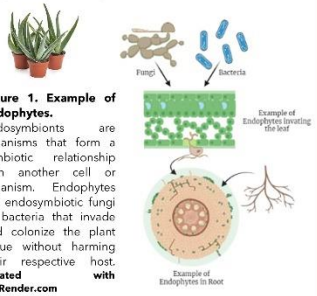

Figure 1. Example of Endophytes. Endosymbionts are organisms that form a symbiotic relationship with another cell or organism. Endophytes are endosymbiotic fungi or bacteria that invade and colonize the plant tissue without harming their respective host. **Created with BioRender.com**

Methodology

RESEARCH

- Gather information from original scientific papers and articles searched in Google Scholar database; has a time limit of 2018-2022.
- It was used different combinations of terms: *Ephedra Features, Endophytic Fungi, Plant growth promotion, Endosymbiotic fungi, Plant tissue, Bioactive metabolites, endophytic bacteria, Medicinal plants, Bioactive compounds, Endophytic plant interactions, Antifungal compounds.*
- A total of 10 references were chosen for this research.

EXPERIMENT

Plants: *Aloe vera and Peppermint. (Samples were disinfected using 70% ethyl alcohol)*
Materials: *pencil, notebooks, a microscope, agar plates, aloe vera, peppermint, scissors, ethyl alcohol, parafilm tape and blue lactophenol.*
Samples: *Placed in an agar plate to create bacteria and fungi cultivation at ambient temperature.*
Dye solution: *Iodine, distilled water, and glycerin.*
Duration: *seven days after, the samples were analyzed to identify any fungal endophytes and report findings.*

Figure 2. Samples slides. Mixture of iodium, distilled water and glycerin solution for dyeing samples.

Results

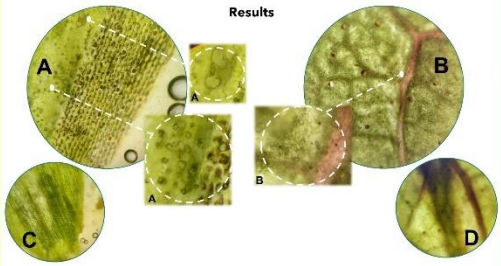

Figure 3. A. Fungal Endophytes presented in *A. vera (S1)* **B.** Fungal Endophytes presented in *Peppermint (S1)* **C.** *A. vera (S2)* & **D.** *Peppermint (S2)* No fungal endophytes identified. All the images were done using a 10x microscope objective with the dyeing solution of iodine, distilled water, and glycerin.

Plant Samples (S)	Samples with Fungal Endophytes
A. vera S1	**1**
A. vera S2	0
Peppermint S1	**1**
Peppermint S2	0

Table 1. The four samples were classified into S1 and S2 for each plant, respectively. The results show that only *A. vera* S1 and *Peppermint* S1 presented fungal endophytes. Meanwhile, both *A. vera S2* and *Peppermint S2* did not present any fungal endophytes within the seven-day period. The results are presented in the above images.

Discussion

- Only two of the four samples presented fungal endophytes. In this case, considering that the samples with fungal endophytes were from both *Aloe Vera* and *Peppermint* suggest that plant species is a factor that does not depend on the growth of fungal endophytes. This confirms that the researcher's hypothesis is only partially correct, since fungal endophytes were not found on all the four samples. The possible reason for why only two of the four samples presented fungal endophytes can be that the growth process of fungi in the samples was different. The differences in growth are caused by the process of disinfection of the leaves using ethyl alcohol, or even by the status of the leaves, since nutrients from the leaves help create a microorganism cultivation. Isolation and identification of fungal endophytes is a very interesting topic, mainly because researchers can test this subject with other types of plants to see if they vary by species. Identifying fungi can expand the knowledge that human beings have and could further revolutionize the medical aspect of science.

Future Works

- ✓ Identify the fungal endophytes with a microscope in a better way.
- ✓ Identify other types of fungi in a plant.
- ✓ Compare the efficiency of slow-release granular fertilizers with water-soluble fertilizers when it comes to plant growth and development.

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I want to thank my family for always supporting me through this process, to the Department of Science of CIMATEC, especially Professor Milagros Carire Pérez for electing me as a candidate to participate in this research and to Dr. Arratia for handing out this amazing opportunity. I would also like to thank Fabiola Pagán for mentoring me throughout the research and the Citizen Diplomacy Action Fund for the grant. Last, but not least, to my cousin Nicole Colón for helping me and giving me ideas during the research process.

Carolina Ferrer Angulo

Regenerating the Liver with Stem Cells

Carolina I. Ferrer-Angulo, Academia Maria Reina, San Juan, PR 00921 USA
Fabiola D. Pagán-Torres[2] University of Puerto Rico, Bayamon PR 00959

Abstract

The purpose of this study is to develop a lab procedure that will focus on the regeneration of the human liver using biotechnology and stem cells. The project is composed of three phases. The first phase constitutes extracting the human liver stem cells, isolating them, and harvesting them with an 80% chance of recovery. The cells will be cultured with a growth medium that mirrors the environment of the liver to create hepatocytes. In 63 days, the number of cells needed should be obtained. In phase two, the liver will be printed through extrusion bioprinting. The bio-ink will be made out of hydrogel, hepatocytes, and the growth medium from the culture. Once the liver is developed, phase three begins. This part of the experiment is based on the study of the organ: its functionality and longevity. It will be put under dialysis to test run it; the bioprinted organ will be put under the daily challenges a liver encounters daily. After, simulations of bioprinted rat livers will be made and implanted on the organism. Liver function tests will be taken from the rat's blood to see how well it is detoxifying the body. Finally, human trials could be run. There are other alternatives we would like to study while conducting this procedure, like a group of cells called "small hepatocytes" found in the ductular reaction. These cells are responsible for the regeneration of a liver after injury. These studies purpose a way to print an organ and study its potential use in medicine..

Introduction

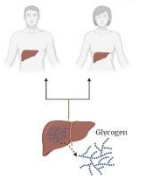
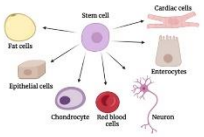


Figure 1. Liver stores glycogen. The liver converts nutrients into substances the cell can use. It is responsible for metabolic processes because it stores glycogen. The liver is a sito of detoxification in the body; therefore, it is primal for it to regenerate from healthy liver tissue after surgery or chemical injury. Created with BioRender.com

Figure 2. Stem cell differentiation. Stem cells are unspecialized cells that substitute the place of dead cells, becoming specialized when exposed to a specific environment. Created with BioRender.com



Methodology

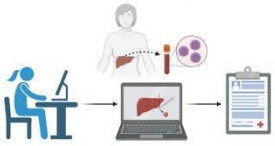


Figure 2. Research process.

1. Read investigation where human liver stem cells (HLCs) were extracted from a hepatectomy, isolated, harvested and cultured.
2. Read investigation about 3D printing tissue.
3. Propose a procedure to study the potential regeneration of the liver and its functionalities

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Results

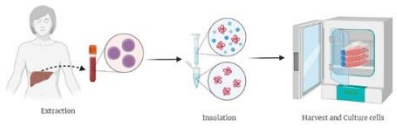

Figure 3. Phase 1: Extraction, Isolation, Harvest and Cell Culture

- A 2004 study that successes the first extraction of human liver stem cells carries out the following procedure to successfully create hepatocytes.
  - Remove part of the liver (5-20g), specifically part of the lobules. These parts contain the Canals of Hering, a site rich in stem cells.
  - A collagen digester is stirred out to isolate the hepatocytes. The tissue will be perfused with 250 mL of warm (37 degrees C) calcium free buffer. Specifically, the Gibco Liver Perfusion Medium (5439L). The tissue will end up blanching as softening as the hepatic tissue dissociates. This take 10 12 minutes.
  - Using a large bore pipette, these cells are released. Then the cells are filtered through a sterile 100 µm nylon mesh into a beaker placed on ice. The cells will be centrifuged for 5 minutes. The cell is now suspended and washed two to three times with cold Gibco Hepatocyte Wash Medium.
  - A scientist, Sanoka's Stedim Biotech has developed a continuous single-use centrifugation process that promises to harness up to 80 L of a specimen with high recovery rates especially for cells.
  - Cell cultures are difficult to make because many mistakes are made along the way. The study used the following ingredients to feed the cells and create a hepatic environment.
    - williams E medium (from Cocos/Cambrex), supplemented with L-glutamine (5mM), Heparin (12mM, pH 7.4), penicillin (50 U/mL), streptomycin (50µg/mL) (from Sigma). Fetal calf serum (10%) and hormones and (10%) (from bovine origin).
  - Individual attached cells were harvested in the dish with the growth medium after three weeks. After colonies developed, starting dings were placed in a shaker flask for 24 hrs.
  - There should be primarily HLSC cell on, 25 cell to be exact.
  - The study showed that the cells can grow exponentially, have immunology cell functions that coincide with the liver, processes insulin, etc.

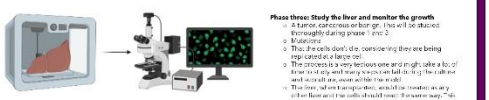

Figure 4. Phase 2: 3D print the liver

- The liver will be sliced and.
- The bioink consists of hepatocytes created in the culture along with the growth medium, and hydrogels.
- The technique is extrusion bioprinting. A computerized image of the liver will guide the placement of the cell stacks.

Phase three: Study the liver and monitor the growth

- A tumor, cancerous or benign. This will be studied thoroughly during phase Three 3.
- Mutations
- That the cells don't die, considering they are being replicated on a large cell.
- The process is a very tedious one and might take a loop of time to study and many setbacks can fall during the culture and actual use, even within the model.
- The liver, when transplanted, would be treated in any other liver and the cells should react the same way. This means that the patient is not at risk of rejection of the organ from the immune system.
- The liver functions, over the long run, is good or acute, theoretically, the liver is now one has never been used. However, since it is man made, mistakes could have been done through the development but may affect longevity.

It is important to note that the study intends to solve all these issues and learn more about the liver's functions.

Created in BioRender.com

Discussion

- **Phase 1** consist of taking a sample of the cells, purifying it, and replicating it. During this process, a medium is needed to feed the cells for them to receive the necessary nutrients to functions and model the environment that will make the stem cells specialize as hepatocytes. Here, the growth of the cells is closely observed, although it is estimated that the culture will grow by a factor of 3 exponentially every 3 weeks.
- **Phase 2** involves printing the liver with the culture made in phase 1. The culture will take approximately 63 days to achieve the number of cells we need to build a liver with an area of 525 cm^2. This is the most efficient way to build the liver as the growth and shaping can be closely monitored through a computer image that guides the bioprinter.
- **Phase 3** is based on the study of the liver's growth and functionality. It is important to see if the cells can stay alive and function for a lifetime. For this, after the liver is printed, the liver is place on dialysis to expose it to it role in the body. If complication happen, we will study why they do and how to fix them. Miniature livers would be tested on rats to see if the liver co function well internally.
- *Much experimentation must be carried out before animal and human trials to make sure this engineered organ can function as efficiently and a regular one. The liver has the potential to be regenerated in the lab. However, the functionality and longevity of the organ in an organism is questionable and need further study to be nulled or confirmed.*

Future Works

Studies have shown that "small hepatocytes" in rats are responsible for the regeneration of the liver after a hepatectomy. They are phenotypically different from hepatocytes and have not been in the human body. However, they have been sited in the ductular reaction. The study of these cells can be another alternative to regenerating the liver.

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To Dr. Juan Arratia for giving me the opportunity to work on an investigation and helping me develop a project idea and scientific character, and to Fabiola D. Pagán for mentoring me throughout the whole process. I would also like to thank Martin Fuentes for the endless support and pushing me to do better on each research project.

María Jove Valero
Carolina López Caraballo

Brain-gut microbiota interaction: the role of *E. coli* in Alzheimer's Disease

María A. Jové-Valerio[1], Carolina D. López-Carballo[1], Colegio Puertorriqueño de Niñas, Guaynabo PR 00969
Fabiola D. Pagán-Torres[2] University of Puerto Rico, Bayamon PR 00959

Abstract

The gastrointestinal tract has its own network of neurons because its function is governed by the enteric nervous system responsible for secretory and sensory signals sent through the brain. Negative gram bacteria *Escherichia coli* produces bacterial amyloid; one of the leading causes of neurodegeneration in Alzheimer's Disease being β-amyloid protein accumulation. If the gut is exposed to bacterial amyloid proteins, these may cause priming of the immune system, as a result enhancing immune response to endogenous production of neuronal amyloid in the brain. This research aims to address the effect E. coli and its production of amyloid protein can have on the development of Alzheimer's disease. This information was based on the research of original scientific articles in Google Scholar database via Google, restricted to articles in English during the period between 2017 and 2021. *E. coli* is associated with the development of Alzheimer's disease causing an accumulation of β-amyloid protein. *E. coli* can play an essential role in the development of the neurological disease preventing effective communication between neurons.

Introduction

1. The brain-gut axis refers to communication between the gastrointestinal tract's enteric nervous system and the brain's central nervous system, with the vagus nerve, passive diffusion, and oxyhemoglobin serving as a carrier.
2. Alzheimer's Disease is a progressive neurodegenerative disorder that accounts for 80% of dementia worldwide, particularly in adults over the age of 60.
3. It is characterized by a severe deficit in memory, cognitive, and motor functions, causing a decline in mental, behavioral, and functional activities. *Escherichia coli* is one of the many bacterial strains that express and secrete amyloid proteins, which contribute to Alzheimer's disease pathogenesis.

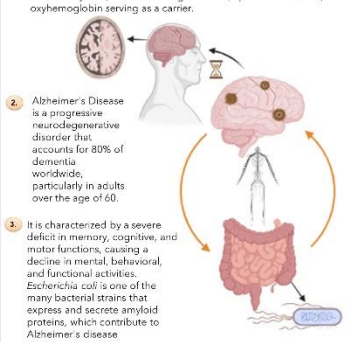

Figure 1. Relationship of brain-gut axis.

Methodology

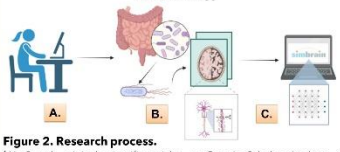

Figure 2. Research process.
(A). Search original scientific articles on Google Scholar database via Google, with a restriction made to articles in English with a time limit of 2017-2021. (B). The research was performed using different combinations of terms: microbiota, *E. Coli*, brain-gut, Alzheimer's. Priority was given to the most recent and complete review articles. In 6 publications were included in this study. (C). To analyze the neural network of the brain the software Simbrain is suggested for further understanding of the relationship between the brain-gut axis.

Results

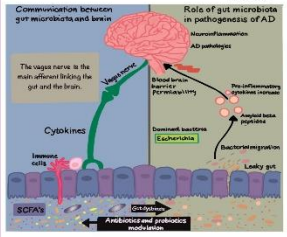

Figure 3. Antibiotics and probiotics influence the microbiota-gut-brain axis. Neuronal, immune-mediator, and metabolite-mediated routes are all used to communicate between the gut microbiota and the brain. Dysbiosis in the gut activates the immune system and changes the production of neurotransmitters and bacterial metabolites. These could play a role in aberrant signaling via the vagus nerve. Bacterial migration and inflammation are caused by a reduction in the integrity of the gastrointestinal barrier. The permeability of the blood-brain barrier is disrupted by pro-inflammatory cytokines. Antibiotics have the ability to normalize the microbiota-gut-brain pathways, while probiotics have the potential to inhibit the growth of specific bacteria.

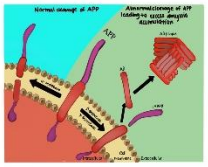

Figure 4. AB formation. E. coli is associated with the development of Alzheimer's disease causing an accumulation of β-amyloid protein. Negative gram bacteria Escherichia coli produces bacterial amyloid; one of the leading causes of neurodegeneration in Alzheimer's Disease being β-amyloid protein accumulation which is formed by sequential cleavage of the amyloid precursor protein (APP) in the cell membrane. If the gut is exposed to bacterial amyloid proteins, these may cause priming of the immune system, as a result enhancing immune response to endogenous production of neuronal amyloid in the brain. The amyloid precursor protein (APP) is a transmembrane protein of the neuronal cell. In the case when it is cleaved by α-secretase, the formed soluble aggregates can be digested by microglial cells. When APP is cleaved by β-secrase and γ-secrase, it leads to formation of Aβ insoluble aggregates. Such protein aggregation results in amyloid plaques, one of the hallmarks of Alzheimer's Disease.

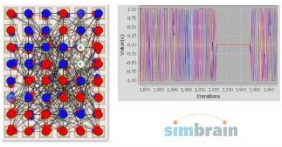

Figure 4. Simbrain projection. Example of a neural network using the Sparce Connection, an algorithm to determine what percentage of target and source neurons will be interconnected. For this simulation, the density of the connection's variable. Each group of neurons can be connected to a time series plot, which records the neural activity over time. For significant results, simulations should be left running for 2 hours or more. Studies show that there is a prominent volumen loss in brains of Alzheimer's Disease. This means that neurons die, and the connections are lost. So, this type of connection would be a viable option to simulate a brain representation of the gut-brain axis relationship.

Discussion

- The use of antibiotic and probiotics could be used to control and maintain a healthy gastrointestinal barrier. This way the bacterial infection of *E. coli* could be reduce; having a positive effect of less AB formation.
- By reducing the AB formation, Alzheimer's Disease could be less progressive, meaning the longevity of the patient could be extended.
- Further running's on the Simbrain software must be made to study more in depth the Sparce Connections and how the simulation could represent a more realistic way to understand the brain-gut axis relationship.
- The scientific community should be conscious of this relationship and additional studies should be made for a better comprehension of the disease.

Future Works

- *How E.coli* can be prevented from exposure to the brain.
- How the amyloid precursor protein (APP) can be prevented from leading to excess amyloid. accumulation contributing to Alzheimer's Disease.
- Which other negative gram bacteria could produce amyloid protein.

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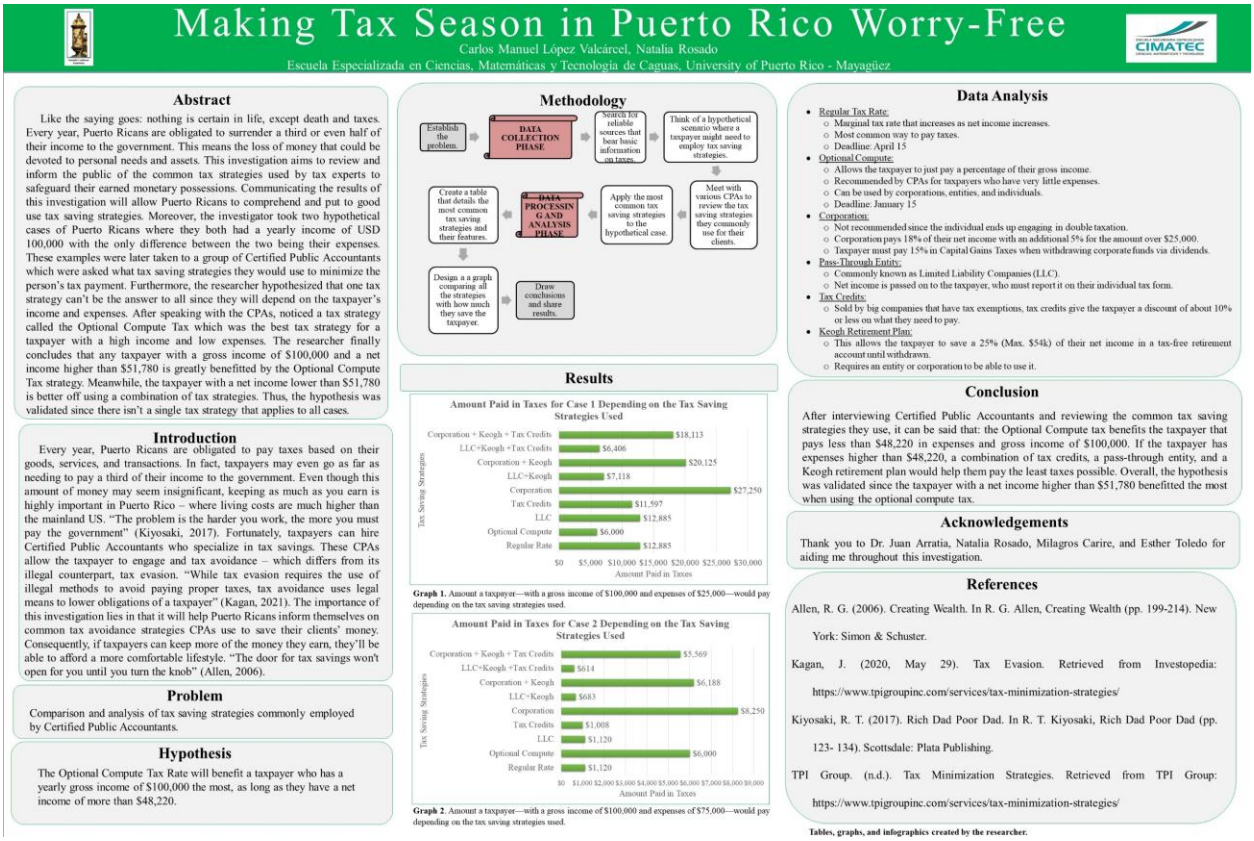
Carlos López Valcárcel



Making Tax Season in Puerto Rico Worry-Free

Carlos Manuel López Valcárcel, Natalia Rosado
Escuela Especializada en Ciencias, Matemáticas y Tecnología de Caguas, University of Puerto Rico - Mayagüez

Abstract

Like the saying goes: nothing is certain in life, except death and taxes. Every year, Puerto Ricans are obligated to surrender a third or even half of their income to the government. This means the loss of money that could be devoted to personal needs and assets. This investigation aims to review and inform the public of the common tax strategies used by tax experts to safeguard their earned monetary possessions. Communicating the results of this investigation will allow Puerto Ricans to comprehend and put to good use tax saving strategies. Moreover, the investigator took two hypothetical cases of Puerto Ricans where they both had a yearly income of USD 100,000 with the only difference between the two being their expenses. These examples were later taken to a group of Certified Public Accountants which were asked what tax saving strategies they would use to minimize the person's tax payment. Furthermore, the researcher hypothesized that one tax strategy can't be the answer to all since they will depend on the taxpayer's income and expenses. After speaking with the CPAs, noticed a tax strategy called the Optional Compute Tax which was the best tax strategy for a taxpayer with a high income and low expenses. The researcher finally concludes that any taxpayer with a gross income of $100,000 and a net income higher than $51,780 is greatly benefitted by the Optional Compute Tax strategy. Meanwhile, the taxpayer with a net income lower than $51,780 is better off using a combination of tax strategies. Thus, the hypothesis was validated since there isn't a single tax strategy that applies to all cases.

Introduction

Every year, Puerto Ricans are obligated to pay taxes based on their goods, services, and transactions. In fact, taxpayers may even go as far as needing to pay a third of their income to the government. Even though this amount of money may seem insignificant, keeping as much as you earn is highly important in Puerto Rico – where living costs are much higher than the mainland US. "The problem is the harder you work, the more you must pay the government" (Kiyosaki, 2017). Fortunately, taxpayers can hire Certified Public Accountants who specialize in tax savings. These CPAs allow the taxpayer to engage and tax avoidance – which differs from its illegal counterpart, tax evasion. "While tax evasion requires the use of illegal methods to avoid paying proper taxes, tax avoidance uses legal means to lower obligations of a taxpayer" (Kagan, 2021). The importance of this investigation lies in that it will help Puerto Ricans inform themselves on common tax avoidance strategies CPAs use to save their clients' money. Consequently, if taxpayers can keep more of the money they earn, they'll be able to afford a more comfortable lifestyle. "The door for tax savings won't open for you until you turn the knob" (Allen, 2006).

Problem

Comparison and analysis of tax saving strategies commonly employed by Certified Public Accountants.

Hypothesis

The Optional Compute Tax Rate will benefit a taxpayer who has a yearly gross income of $100,000 the most, as long as they have a net income of more than $48,220.

Methodology

Results

Graph 1. Amount a taxpayer—with a gross income of $100,000 and expenses of $25,000—would pay depending on the tax saving strategies used.

Graph 2. Amount a taxpayer—with a gross income of $100,000 and expenses of $75,000—would pay depending on the tax saving strategies used.

Data Analysis

- Regular Tax Rate:
  - Marginal tax rate that increases as net income increases.
  - Most common way to pay taxes.
  - Deadline: April 15
- Optional Compute:
  - Allows the taxpayer to just pay a percentage of their gross income.
  - Recommended by CPAs for taxpayers who have very little expenses.
  - Can be used by corporations, entities, and individuals.
  - Deadline: January 15
- Corporation:
  - Not recommended since the individual ends up engaging in double taxation.
  - Corporation pays 18% of their net income with an additional 5% for the amount over $25,000.
  - Taxpayer must pay 15% in Capital Gains Taxes when withdrawing corporate funds via dividends.
- Pass-Through Entity:
  - Commonly known as Limited Liability Companies (LLC).
  - Net income is passed on to the taxpayer, who must report it on their individual tax form.
- Tax Credits:
  - Sold by big companies that have tax exemptions, tax credits give the taxpayer a discount of about 10% or less on what they need to pay.
- Keogh Retirement Plan:
  - This allows the taxpayer to save a 25% (Max. $54k) of their net income in a tax-free retirement account until withdrawn.
  - Requires an entity or corporation to be able to use it.

Conclusion

After interviewing Certified Public Accountants and reviewing the common tax saving strategies they use, it can be said that: the Optional Compute tax benefits the taxpayer that pays less than $48,220 in expenses and gross income of $100,000. If the taxpayer has expenses higher than $48,220, a combination of tax credits, a pass-through entity, and a Keogh retirement plan would help them pay the least taxes possible. Overall, the hypothesis was validated since the taxpayer with a net income higher than $51,780 benefitted the most when using the optional compute tax.

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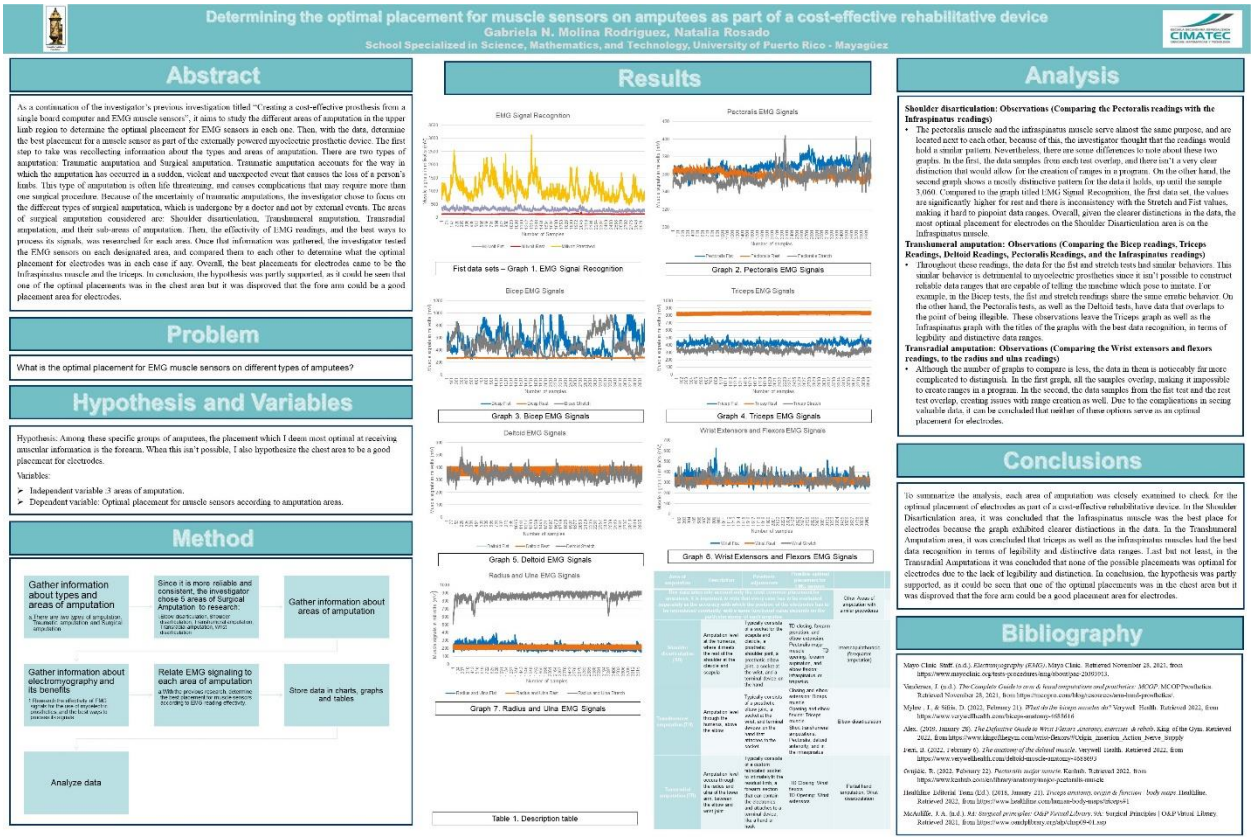
Tables, graphs, and infographics created by the researcher.

Gabriela Molina Rodríguez



Determining the optimal placement for muscle sensors on amputees as part of a cost-effective rehabilitative device

Gabriela N. Molina Rodríguez, Natalia Rosado

School Specialized in Science, Mathematics, and Technology, University of Puerto Rico - Mayagüez

Abstract

As a continuation of the investigator's previous investigation titled "Creating a cost-effective prosthesis from a single board computer and EMG muscle sensors", it aims to study the different areas of amputation in the upper limb region to determine the optimal placement for EMG sensors in each one. Then, with the data, determine the best placement for a muscle sensor as part of the externally powered myoelectric prosthetic device. The first step to take was recollecting information about the types and areas of amputation. There are two types of amputation: Traumatic amputation and Surgical amputation. Traumatic amputation accounts for the way in which the amputation has occurred in a sudden, violent and unexpected event that causes the loss of a person's limbs. This type of amputation is often life threatening, and causes complications that may require more than one surgical procedure. Because of the uncertainty of traumatic amputations, the investigator chose to focus on the different types of surgical amputation, which is undergone by a doctor and not by external events. The areas of surgical amputation considered are: Shoulder disarticulation, Transhumeral amputation, Transradial amputation, and their sub-areas of amputation. Then, the effectivity of EMG readings, and the best ways to process its signals, was researched for each area. Once that information was gathered, the investigator tested the EMG sensors on each designated area, and compared them to each other to determine what the optimal placement for electrodes was in each case if any. Overall, the best placements for electrodes came to be the Infraspinatus muscle and the triceps. In conclusion, the hypothesis was partly supported, as it could be seen that one of the optimal placements was in the chest area but it was disproved that the fore arm could be a good placement area for electrodes.

Problem

What is the optimal placement for EMG muscle sensors on different types of amputees?

Hypothesis and Variables

Hypothesis: Among these specific groups of amputees, the placement which I deem most optimal at receiving muscular information is the forearm. When this isn't possible, I also hypothesize the chest area to be a good placement for electrodes.

Variables:

- Independent variable :3 areas of amputation.
- Dependent variable: Optimal placement for muscle sensors according to amputation areas.

Method

Gather information about types and areas of amputation

Since it is more reliable and consistent, the investigator chose 5 areas of Surgical Amputation to research:

Gather information about areas of amputation

Gather information about electromyography and its benefits

Relate EMG signaling to each area of amputation

Store data in charts, graphs and tables

Analyze data

Results

Fist data sets – Graph 1. EMG Signal Recognition

Graph 2. Pectorals EMG Signals

Graph 3. Bicep EMG Signals

Graph 4. Triceps EMG Signals

Graph 5. Deltoid EMG Signals

Graph 6. Wrist Extensors and Flexors EMG Signals

Graph 7. Radius and Ulna EMG Signals

Table 1. Description table

Analysis

Shoulder disarticulation: Observations (Comparing the Pectoralis readings with the Infraspinatus readings)

- The pectoralis muscle and the infraspinatus muscle serve almost the same purpose, and are located next to each other, because of this, the investigator thought that the readings would hold a similar pattern. Nevertheless, there are some differences to note about these two graphs. In the first, the data samples from each test overlap, and there isn't a very clear distinction that would allow for the creation of ranges in a program. On the other hand, the second graph shows a mostly distinctive pattern for the data it holds, up until the sample 3,060. Compared to the graph titled UMG Signal Recognition, the first data set, the values are significantly higher for rest and there is inconsistency with the Stretch and Fist values, making it hard to pinpoint data ranges. Overall, given the clearer distinctions in the data, the most optimal placement for electrodes on the Shoulder Disarticulation area is on the Infraspinatus muscle.

Transhumeral amputation: Observations (Comparing the Bicep readings, Triceps Readings, Deltoid Readings, Pectoralis Readings, and the Infraspinatus readings)

- Throughout these readings, the data for the fist and stretch tests had similar behaviors. This similar behavior is detrimental to myoelectric prosthetics since it isn't possible to construct reliable data ranges that are capable of telling the machine which pose to imitate. For example, in the Bicep tests, the fist and stretch readings share the same erratic behavior. On the other hand, the Pectorals tests, as well as the Deltoid tests, have data that overlaps to the point of being illegible. These observations leave the Triceps graph as well as the Infraspinatus graph with the titles of the graphs with the best data recognition, in terms of legibility and distinctive data ranges.

Transradial amputation: Observations (Comparing the Wrist extensors and flexors readings, to the radius and ulna readings)

- Although the number of graphs to compare is less, the data as them is noticeably far more complicated to distinguish. In the first graph, all the samples overlap, making it impossible to create ranges in a program. In the second, the data samples from the fist test and the rest test overlap, creating issues with range creation as well. Due to the complications in seeing valuable data, it can be concluded that neither of these options serve as an optimal placement for electrodes.

Conclusions

To summarize the analysis, each area of amputation was closely examined to check for the optimal placement of electrodes as part of a cost-effective rehabilitative device. In the Shoulder Disarticulation area, it was concluded that the Infraspinatus muscle was the best place for electrodes because the graph exhibited clearer distinctions in the data. In the Transhumeral Amputation area, it was concluded that triceps as well as the infraspinatus muscles had the best data recognition in terms of legibility and distinctive data ranges. Last but not least, in the Transradial Amputation it was concluded that none of the possible placements was optimal for electrodes due to the lack of legibility and distinction. In conclusion, the hypothesis was partly supported, as it could be seen that one of the optimal placements was in the chest area but it was disproved that the fore arm could be a good placement area for electrodes.

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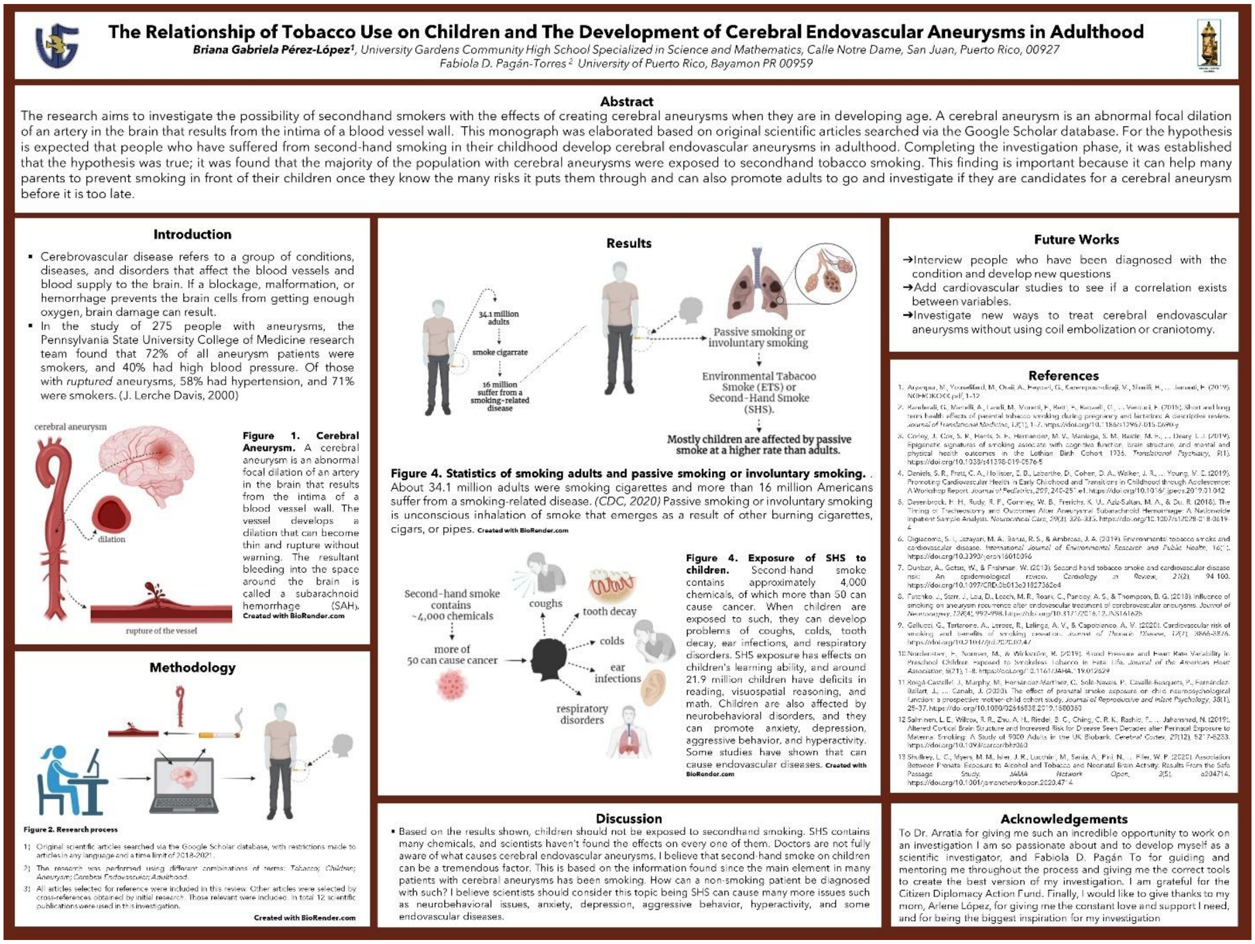
Briana G. Pérez López



The Relationship of Tobacco Use on Children and The Development of Cerebral Endovascular Aneurysms in Adulthood

***Briana Gabriela Pérez-López*[1]**, *University Gardens Community High School Specialized in Science and Mathematics, Calle Notre Dame, San Juan, Puerto Rico, 00927*
Fabiola D. Pagán-Torres [2] University of Puerto Rico, Bayamon PR 00959

Abstract

The research aims to investigate the possibility of secondhand smokers with the effects of creating cerebral aneurysms when they are in developing age. A cerebral aneurysm is an abnormal focal dilation of an artery in the brain that results from the intima of a blood vessel wall. This monograph was elaborated based on original scientific articles searched via the Google Scholar database. For the hypothesis is expected that people who have suffered from second-hand smoking in their childhood develop cerebral endovascular aneurysms in adulthood. Completing the investigation phase, it was established that the hypothesis was true; it was found that the majority of the population with cerebral aneurysms were exposed to secondhand tobacco smoking. This finding is important because it can help many parents to prevent smoking in front of their children once they know the many risks it puts them through and can also promote adults to go and investigate if they are candidates for a cerebral aneurysm before it is too late.

Introduction

- Cerebrovascular disease refers to a group of conditions, diseases, and disorders that affect the blood vessels and blood supply to the brain. If a blockage, malformation, or hemorrhage prevents the brain cells from getting enough oxygen, brain damage can result.
- In the study of 275 people with aneurysms, the Pennsylvania State University College of Medicine research team found that 72% of all aneurysm patients were smokers, and 40% had high blood pressure. Of those with *ruptured* aneurysms, 58% had hypertension, and 71% were smokers. (J. Lerche Davis, 2000)

Figure 1. Cerebral Aneurysm. A cerebral aneurysm is an abnormal focal dilation of an artery in the brain that results from the intima of a blood vessel wall. The vessel develops a dilation that can become thin and rupture without warning. The resultant bleeding into the space around the brain is called a subarachnoid hemorrhage (SAH). **Created with BioRender.com**

Methodology

Figure 2. Research process

1) Original scientific articles searched via the Google Scholar database, with restrictions made to articles in any language and a time limit of 2018-2021.
2) The research was performed using different combinations of terms: *Tabacco; Children; Aneurysm; Cerebral Endovascular; Adulthood.*
3) All articles selected for reference were included in this review. Other articles were selected by cross-references obtained by initial research. Those relevant were included. In total 12 scientific publications were used in this investigation.

Created with BioRender.com

Results

Figure 4. Statistics of smoking adults and passive smoking or involuntary smoking. . About 34.1 million adults were smoking cigarettes and more than 16 million Americans suffer from a smoking-related disease. *(CDC, 2020)* Passive smoking or involuntary smoking is unconscious inhalation of smoke that emerges as a result of other burning cigarettes, cigars, or pipes. **Created with BioRender.com**

Figure 4. Exposure of SHS to children. Second-hand smoke contains approximately 4,000 chemicals, of which more than 50 can cause cancer. When children are exposed to such, they can develop problems of coughs, colds, tooth decay, ear infections, and respiratory disorders. SHS exposure has effects on children's learning ability, and around 21.9 million children have deficits in reading, visuospatial reasoning, and math. Children are also affected by neurobehavioral disorders, and they can promote anxiety, depression, aggressive behavior, and hyperactivity. Some studies have shown that can cause endovascular diseases. **Created with BioRender.com**

Discussion

- Based on the results shown, children should not be exposed to secondhand smoking. SHS contains many chemicals, and scientists haven't found the effects on every one of them. Doctors are not fully aware of what causes cerebral endovascular aneurysms. I believe that second-hand smoke on children can be a tremendous factor. This is based on the information found since the main element in many patients with cerebral aneurysms has been smoking. How can a non-smoking patient be diagnosed with such? I believe scientists should consider this topic being SHS can cause many more issues such as neurobehavioral issues, anxiety, depression, aggressive behavior, hyperactivity, and some endovascular diseases.

Future Works

→Interview people who have been diagnosed with the condition and develop new questions
→Add cardiovascular studies to see if a correlation exists between variables.
→Investigate new ways to treat cerebral endovascular aneurysms without using coil embolization or craniotomy.

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Eva Méndez Astwood

Scientific Caribbean Foundation

Chromosomes: How they affect phenotypic sexual characteristics in people?

Eva Mendez Astwood, Colegio Cardenal Sancha, Santo Domingo, Dominican Republic[1]
Angel M. Marquez Otero[2]; Scientific Caribbean Foundation San Juan, PR 00921, USA[2]

CITIZEN DIPLOMACY ACTION FUND for U.S. Alumni

Abstract

The myth of intersexuality and androgyny, are they abnormal? Is it contagious? are they capable of procreation? This poster breaks down this taboo from its origin, through in-depth research, analysis, interpretation and deduction of the effects of DNA. Expressing the effects of chromosome variation within the genome, dealing with causes and consequences. Observing and analyzing susceptibility statistics within the area of the Dominican Republic, with the hypothesis that this is due to one of two causes, thanks to some hereditary factor or simply chance.

Introduction

To give an introduction, we can affirm that chromosomes are basically structures located inside the cell that contain all the genetic information of the individual they compose. From this, we will be able to observe in detail the effects produced by their different variations within the human genome, specializing in physical sexual characteristics. All this entering mainly the Dominican population, verifying statistics, testimonies, research, articles... analyzing the climate, the regions and the hereditary pathology factor of people who have this condition. We seek a way to make people aware of that group of people who are excluded, marginalized and ignored by society, for the simple fact of being physically different.

Methodology

- Use of articles and essays on the study of DNA and its genetic variations.
- Use of news, reports and investigations classified within the Dominican macro-regions: North, Southeast and Southwest.
- Use of demographic reports and censuses, taking into account the genetic heritage of people.
- Data analysis to determine areas and types of person most prone to different conditions.

Results

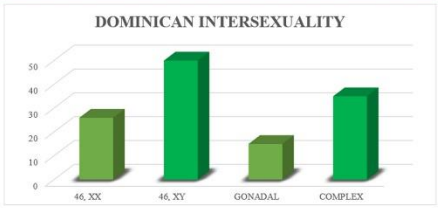


Table 1.This variety shows the complexity and diversity of the intersex reality within everything that corresponds to it.

Intersex implies a variety in the characteristics of typical sexual physical development that occurs in 1 in 1,500 births. There are an estimated 65,000 annual intersex births in the world. Intersex, formerly known as hermaphrodism, is a medical term that was captured by the intersex population to refer to their "condition."

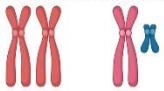
Intersex people can present: Ambiguous genitalia, Incomplete or unusual development of the reproductive organs, Inconsistency between the external genital organs and the internal reproductive organs, variation in the sex chromosomes, and inability of the body to respond normally to sex hormones responsable to physical sexual characteristics after puberty.

Intersex can be divided into 4 categories:

- ***Intersex 46, XX.*** Formerly called female pseudohermaphroditism, the person has a female's chromosomes, a female's ovaries, but male-appearing external genitalia. Which is often the result of a female fetus being exposed to excess male hormones before birth.
- ***Intersex 46, XY.*** It used to be called male pseudohermaphroditism. It is when the person has the chromosomes of a man, but the external genitalia have not fully formed, are ambiguous or clearly female. Similarly, internally, the testicles may be normal, malformed, or absent. It has many possible causes, such as: problems with the testicles, problems with the formation of testosterone, problems with the use of testosterone, or the most common of all, SIA or testicular feminization.
- ***True gonadal intersex.*** The person must have both ovarian and testicular tissue. This could be in the same gonad (an ovotestis) or the person could have 1 ovary and 1 testis. You can have XX chromosomes, XY chromosomes, or both. The external genitalia may be ambiguous or may appear male or female. This condition used to be called true hermaphroditism. In most people with true gonadal intersex, the underlying cause is unknown.
- ***Complex or undetermined intersexuality.*** Many chromosome configurations other than the simple 46,XX or 46,XY combinations can cause disorders of sex development. These include, but are not limited to, 45, XO (only one X chromosome) and 47, XXY, 47, XXX - both have an extra sex chromosome, either an X or a Y. These disorders do not cause a condition in which there is a discrepancy between organs external and internal genitalia. However, there may be problems with sex hormone levels, sexual development in general, and altered numbers of sex chromosomes.

Discussion & Conclusion

Based in our findings, we can conclude that people with intersex features can live a completely healthy life but there can be a psychological side effect. This might be caused by how they feel about their appearance.



Future Work

- Among my next works are scheduled to tour the entire United States, so that I go together with a specialized work team for each institution, whether private or public, with or without profit, investigating and obtaining statistics about the effects that chromosomes can have on the physical appearance of people.
- While we inform about them, fighting against the taboo of intersex people, previously called hermaphrodites, and the unknown and little prioritized androgyny.

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Jade Peralta
Scientific Caribbean Foundation

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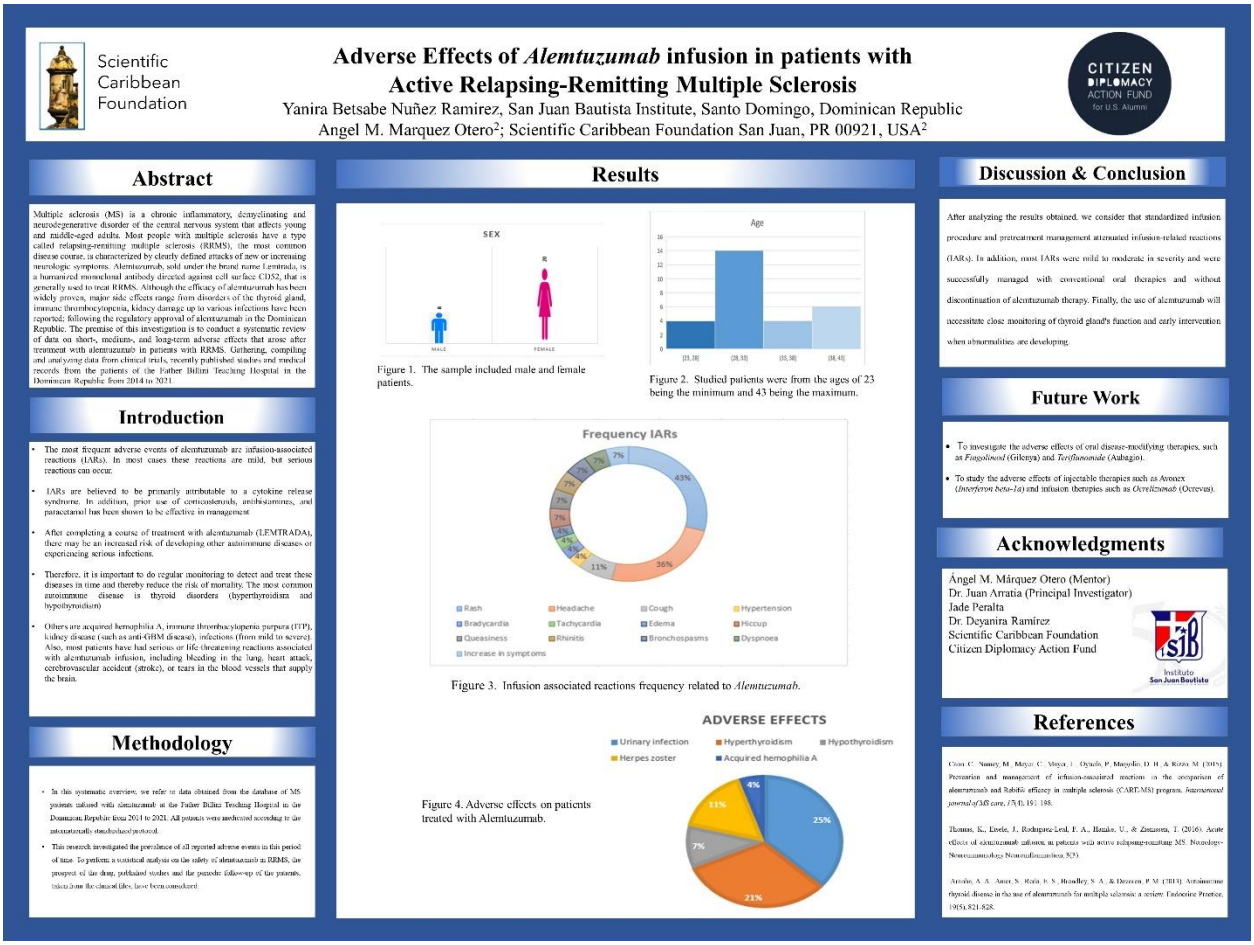
Yanira Núñez Ramírez



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Adverse Effects of *Alemtuzumab* infusion in patients with Active Relapsing-Remitting Multiple Sclerosis

Yanira Betsabe Nuñez Ramirez, San Juan Bautista Institute, Santo Domingo, Dominican Republic
Angel M. Marquez Otero[2]; Scientific Caribbean Foundation San Juan, PR 00921, USA[2]

CITIZEN DIPLOMACY ACTION FUND for U.S. Alumni

Abstract

Multiple sclerosis (MS) is a chronic inflammatory, demyelinating and neurodegenerative disorder of the central nervous system that affects young and middle-aged adults. Most people with multiple sclerosis have a type called relapsing-remitting multiple sclerosis (RRMS), the most common disease course, is characterized by clearly defined attacks of new or increasing neurologic symptoms. Alemtuzumab, sold under the brand name Lemtrada, is a humanized monoclonal antibody directed against cell surface CD52, that is generally used to treat RRMS. Although the efficacy of *alemtuzumab* has been widely proven, major side effects range from disorders of the thyroid gland, immune thrombocytopenia, kidney damage up to various infections have been reported; following the regulatory approval of alemtuzumab in the Dominican Republic. The premise of this investigation is to conduct a systematic review of data on short-, medium-, and long-term adverse effects that arose after treatment with alemtuzumab in patients with RRMS. Gathering, compiling and analyzing data from clinical trials, recently published studies and medical records from the patients of the Father Billini Teaching Hospital in the Dominican Republic from 2014 to 2021.

Introduction

- The most frequent adverse events of alemtuzumab are infusion-associated reactions (IARs). In most cases these reactions are mild, but serious reactions can occur.
- IARs are believed to be primarily attributable to a cytokine release syndrome. In addition, prior use of corticosteroids, antihistamines, and paracetamol has been shown to be effective in management
- After completing a course of treatment with alemtuzumab (LEMTRADA), there may be an increased risk of developing other autoimmune diseases or experiencing serious infections.
- Therefore, it is important to do regular monitoring to detect and treat these diseases in time and thereby reduce the risk of mortality. The most common autoimmune disease is thyroid disorders (hyperthyroidism and hypothyroidism)
- Others are acquired hemophilia A, immune thrombocytopenia purpura (ITP), kidney disease (such as anti-GBM disease), infections (from mild to severe). Also, most patients have had serious or life threatening reactions associated with alemtuzumab infusion, including bleeding in the lung, heart attack, cerebrovascular accident (stroke), or tears in the blood vessels that supply the brain.

Methodology

- In this systematic overview, we refer to data obtained from the database of MS patients infused with Alemtuzumab at the Father Billini Teaching Hospital in the Dominican Republic from 2014 to 2021. All patients were medicated according to the alemtuzumab standardized protocol.
- This research investigated the prevalence of all reported adverse events in this period of time. To perform a statistical analysis on the safety of alemtuzumab in RRMS, the prospect of the drug, published studies and the periodic follow-up of the patients, taken from the clinical files, have been considered.

Results

Figure 1. The sample included male and female patients.

Figure 2. Studied patients were from the ages of 23 being the minimum and 43 being the maximum.

Figure 3. Infusion associated reactions frequency related to *Alemtuzumab*.

Figure 4. Adverse effects on patients treated with Alemtuzumab.

Discussion & Conclusion

After analyzing the results obtained, we consider that standardized infusion procedure and pretreatment management attenuated infusion-related reactions (IARs). In addition, most IARs were mild to moderate in severity and were successfully managed with conventional oral therapies and without discontinuation of alemtuzumab therapy. Finally, the use of alemtuzumab will necessitate close monitoring of thyroid gland's function and early intervention when abnormalities are developing.

Future Work

- To investigate the adverse effects of oral disease-modifying therapies, such as *Fingolimod* (Gilenya) and *Teriflunomide* (Aubagio).
- To study the adverse effects of injectable therapies such as Avonex *(Interferon beta-1a)* and infusion therapies such as *Ocrelizumab* (Ocrevus).

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Jorge Vázquez Cruz

Scientific Caribbean Foundation

How has Paleoclimate affected Human's Evolutionary Process?

Jorge Vazquez, Colegio La Altagracia, San Francisco de Macoris, Duarte, Dominican Republic
Angel M. Marquez Otero[2]; Scientific Caribbean Foundation San Juan, PR 00921, USA[2]

CITIZEN DIPLOMACY ACTION FUND for U.S. Alumni

Abstract

In the present investigation, the causes that the climate has greatly benefited the evolutionary process of the human being in its evolutionary history will be exposed. It is of the utmost importance that we know the correlation that the paleoclimate and its changes had in the human being , this is because the climate is what defines the fauna or vegetation of a place. However due to these findings we are clear that climate can also affect man, leading him to evolve, to adapt to new climatic conditions, a colder climate or drier could lead ancient living beings to find ways to survive. In order to determine how paleoclimate has affected the human species, we had to evaluate important paleoclimatic events that lead to our actual status as a species. Due to the few resources of the time, the climate affected their evolutionary process and also created different relevant periods in human's natural history.

Introduction

- An evolutionary chain that began approximately 7 million years ago in Africa with the appearance of hominid species such as *Sahelanthropus* and *Orrorin tugenens*. The proliferation of different species such as *Australopithecus africanus* and *Australopithecus afarensis* began around 4 million years ago.
- When the *Australopithecus* gave way to the first representatives of the homo genus such as *Homo habilis* and *Homo rudolfensis* they continued to evolve and were characterized by improving their social organization, improving the design of tools and expand their food chain with more variety of foods.
- However, 1 million years ago another abrupt global climate change took place and a glaciation took place, resulting in large glaciers and ice sheets throughout the hemisphere and it should be noted that interglacial changes also took place during those periods causing the climate to become warmer and drier. This happened in America and Europe.
- The changes occurred that gave the human species favorable weather conditions, which allowed them to develop agriculture, something key that gave way to urban exploration and later to different societies such as the Mesopotamian and Egyptian.
- Despite this, many changes occurred that were no longer as big as the heat or the glacier, but after that in the 19th century, for the first time in history, the climate would be affected by the human species due to industrialization and harmful gases that led to the atmosphere being damaged.

Methodology

- Based on observed data, it is provided that the climate change and its consequences affected our ancestors to evolve and adapt to different forms of life. In order to move forward such of these climate changes were 54 million years ago which gave rise to periods such as the Paleolithic, Neolithic and Metal Ages and produced changes such as bipedalism and encephalization.
- To develop this research, several past investigations and published data that have a correlation with the climate and its changes will be analyzed. Also, research related to the evolutionary processes and the different climatic factors that caused them to pass from one period to another. This research aims to identify how the paleoclimate has benefited human beings in their evolutionary process to the form we know today.

Results

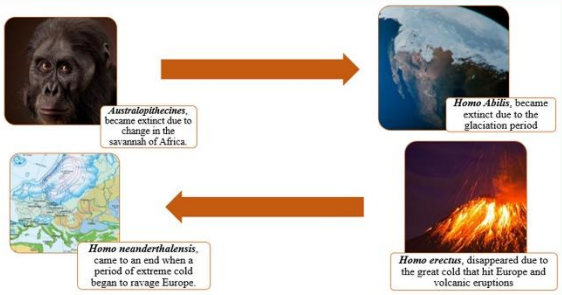

Figure 1. Timeline of important climatologic / natural events that lead to our existence.

Related events regarding human evolutionary process:

- ***Australopithecines*** were one of our first ancestors to appear in the world. They inhabited Africa from 3.9 million years ago to about 2 million years ago, from the Zanclean age (earliest age in the Pliocene epoch) to the Gelasian age (pleistocene epoch). They were very primitive, featuring wider molars and thicker enamel. Later they would become extinct due to a **climatic crisis** that occurred 2.5 million years ago, which led to the extinction of the Australopithecines.

- ***Homo habilis*** is a primitive human genus that lived on the African continent about 2.3 million years ago. They were among the first to -develop tools for their subsistence. They would then become extinct due to **glaciation.**

- ***Homo erectus*** is often called "the primitive human" that lived about 1.8 million years ago in East Asia. When moving towards colder territories, *H. erectus* learned to use fire to warm up and cook their food. *H. erectus* disappeared about 500,000 years ago from the Asian continent, except on the island of Java, in Indonesia. It lived there until about 100,000 years ago and it is presumed that the conditions of geographic isolation favored its survival.

- ***Homo neanderthalensis*** lived in Asia and Europe about 230,000 years ago. *H. neanderthalensis* were stronger than modern humans, but their limbs were shorter. Their extinction was largely caused by a demographic crisis in Western Europe that seems to coincide with a period of extreme cold in Western Europe. Also, a series of volcanic eruptions were closing his legacy.

Discussion & Conclusion

Based in our findings, the data collected from diverse studies makes it clear that one of the main factors that human beings have evolved and have developed new methods of survival is due to the harsh climatic conditions. Since in order to survive they had to work in community and create every possible method to get on with their lives. This eventually led to the development of early societies such as Mesopotamia and Egypt empire.

Future Work

- For a future I would like to investigate further about climatology, to know the impact it has on human life and how it benefits us and how poor care of it would affect us, on the other hand I would like to investigate more about the specific origin of the human being and see the other factors that led him to evolve to the way we are today

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Deborah Wu Ramirez

Scientific Caribbean Foundation

Impact of Alzheimer's Disease on its Non-Professional Caregivers

Deborah Wu Ramirez, San Juan Bautista Institute, Santo Domingo, Dominican Republic[1]
Angel M. Marquez Otero[2]; Scientific Caribbean Foundation, San Juan, PR 00921[2]

CITIZEN DIPLOMACY ACTION FUND for U.S. Alumni

Abstract

Alzheimer's is a progressive neurological disorder characterized by memory loss, impaired thinking and behavior, making it difficult for them to perform basic activities, and therefore many of their caregivers bear some consequences. A descriptive, retrospective study was conducted to determine the impact of Alzheimer's disease on non-professional caregivers. Families of Alzheimer's patients are more likely to develop anxiety, depression, anger management problems, and other behavioral disorders.

Introduction

- Alzheimer's disease is the most common form of dementia, estimated to account for 60% to 70% of cases. There is a greater tendency of presentation in the female sex. After the age of 60, 1 in 6 women will develop Alzheimer's disease, while only 1 in 11 men will.
- However, it is important to take into consideration the family members or non-professional caregivers of patients with Alzheimer's disease. Caring for a patient with senile dementia requires a lot of patience and maturity from a caregiver. These patients need to remain calm and oriented; they need to be helped to maintain control and many even need help with basic daily tasks such as grooming, dressing or eating.
- Lately, it has been questioned what effects Alzheimer's disease can have on the non-professional caregivers of the patient, what physical or psychological burden this responsibility entails. It has been suggested that caregivers have become more anxious and intolerant. The findings of the present study would raise awareness of the importance of these caregivers also receiving help.

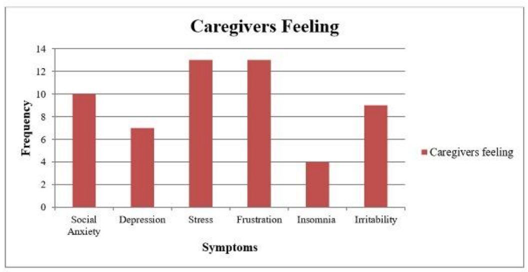
Methodology

This 6-month retrospective study involved 15 patients and their caregivers. Face-to-face interviews were conducted by the care team for 3 months after the diagnosis of dementia was made. The primary outcome was as expected. Generalized estimating equations were used for data collection. The interviews evaluated the patient's cognitive function, life status, behavioral and psychological symptoms, and the caregiver's caregiving burden and mood, also includes bibliographic reviews retrieved from google academic. The search is conducted during the months of november to february 2022. The interview consisted of questions resulting in the caregiver's changes since their patient was diagnosed with Alzheimer's diseases.

Results

Frequency of Symptoms in non-professional caregivers of Alzheimer's disease patients		
Social Anxiety	**10/15**	**66%**
Depression	**7/15**	**46%**
Stress	**13/15**	**86%**
Frustration	**13/15**	**86%**
Insomnia	**4/15**	**26%**
Irritability	**9/15**	**60%**
Exhaustion	**14/15**	**93%**

Table 1. Frequency of symptoms among caregivers being exhaustion the highest one and then stress, and frustration at 86%.



Graphic 1. Symptoms frequency among caregivers being stress and frustration the highest ones.

Discussion & Conclusion

Alzheimer's patients during the early stages of development are generally cared for by family members who, like the caregiver, suffer the consequences of an illness, therefore it is important that family members or caregivers are trained and also provided with assistance for their well-being and that of the patient.

Future Work

An intensive research in the field of a psychiatric hospital that allows me to investigate if there is any kind of neuro-anatomical modification in non-professional caregivers of Alzheimer's patients.

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Alexander Zambrano Tapia

Acidic Rain Impact and its Prevalence Over the Years in USA Territory

Alexander Zambrano Tapia[1], Diego Garcia[2]
1 Secondary School Specialized in Science, Mathematics and Technology (CIMATEC), Caguas, Puerto Rico, Puerto Rico,
2 Universidad Ana G. Mendez, Gurabo, Puerto Rico

Abstract

Since world's industrialization begin, an increase in pollution along with sulfur dioxide (SO2) and nitrogen oxide (NOx) release from different companies has caused an environmental problem that has been increasing year after year. Although different methods have been used to decrease the pollution and the SO2 and NOx concentration on the atmosphere, acidic rain is still a problem that affects crops and soils in different parts of the world. Acidic rain occurs when (SO2) and (NOx) get mixed into the atmosphere by air pollution which causes them to get mixed during condensation via the water cycle and when it starts to precipitate, the SO2 and NOx falls alongside with the water from the clouds causing soils to turn acidic and damaging crops in the process. When acidic rain happens, it has a variety of effects on the ecosystem along as pH alterations such as increasing the solubility of aluminum. During acidic rain, the pH decrease causes aluminum to become more soluble in the soil which leads to the absorption of aluminum in the roots of the plant directly from the soil causing aluminum toxicity and eventual death. Remedies and techniques have been developed to avoid soils acidification and consequently aluminum solubility such as liming. Liming is the process of spreading limestone across the field to increase the pH of the soil. This is because limestone has many basic properties. The purpose of this investigation is to observe how acidic rain has affected more crops overtime and how the problem has developed. Research was done to conclude that acidic rain has diminished in the last couple of years due a diminishing rate of Sulfur dioxide and Nitrogen oxide emissions. This was done thanks to the improvement for the environment.

Introduction

- Acidic rain occurs when sulfur dioxide (SO2) and nitrogen oxides (NOx) get mixed into the atmosphere by air pollution (United States Environmental Protection Agency, 2021). This then causes them to get mixed in with clouds via the water cycle. When it starts to rain, the SO2 and (NOx) fall alongside the water in the clouds.
- Liming is the process of spreading crushed limestone across an agriculture field to increase the pH of the soil. It is also used to control the number of toxic metals that exist in the soil.
- This proves to be an excellent countermeasure to acidic rain (E.J. Kamprath, 2005).
- Aluminum soil toxicity is when there is too much aluminum in the terrain. This phenomenon is often caused by acidic rain and may inflict harm to the environment through its side effects. This includes Low pH on the ground which is mostly caused by acidic rain (Trace Dominguez, 2018).
- Avocados are a type of fruit that is grown in tropical areas such as both in the island of Puerto Rico and in Florida. These plants thrive in tropical like environments and tend to grow the most in the summer season. (T.L. Davenport, 1982)

Methodology

Research was made about how acidic rain affects most habitats and how it can endanger the plant life.

The paper titled "World, U.S. and Florida Avocado situation and Outlook" by Edward Evans was used to measure the growth rate of Avocados.

The researcher observed the temperature, humidity, geography, agricultural techniques (such as liming), and the amount of Sulfur Dioxide and Nitrogen Oxide emissions that were released in the area.

All the data was then analyzed in order to bring about one conclusion.

Results

Photos from EPA website

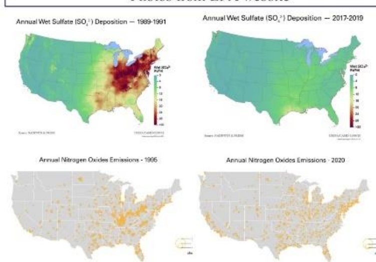

Photo from paper titled "World, U.S. and Florida Avocado situation and Outlook" by Edward Evans

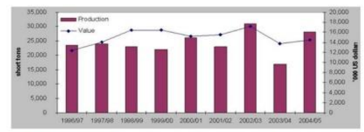

Figure 5. Florida avocado production (volume & value), 1996/97 to 2004/05

Conclusions

In conclusion, the results directly go against the hypothesis of this investigation and thus disprove it. This is because acidic rain has been diminishing over the years thanks to an overall reduction in Sulfur Dioxide and Nitrogen Oxide emissions. This happened thanks to many pro environmentalist movements that forced the industries near the area to lower their emissions and thus having less of an impact on the atmosphere. Another factor that has helped is liming and how it helps soils get more basic when affected with acidic rain whenever it hit. This is done by adding limestone in the soil to counteract the acidity in the soil that can later cause aluminum poisoning. Overall, acidic rain seems to have been responsibly taken care of, which Is a major step forward to solving global crisis worldwide.

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Dr. Michael Caraballo, US Army Medical Research Institute, Maryland, USA
Keishla Sanchez, Scripps Research Institute in La Jolla, California, USA

RESEARCH MENTORS AND ASSISTANTS:

Fabiola D. Pagán, University of Puerto Rico, Bayamón, Puerto Rico
Natalia Rosado, University of Puerto Rico, Mayaguez, Puerto Rico
Angel Marquez, Inter American University of Puerto Rico, Bayamon, Puerto Rico
Andrey Rimashevskii, High School # 734 in Moscow, Russia
Olesia Machukova, Institute of Natural and Technical Systems (Sochi, Russia).
Dr, Denis Gusev, Associate Professor in Graduate School of Business / Department of Operations Management and Logistics HSE University, Moscow, Russia

SYMPOSIUM COORDINATORS:

Dr. Juan F. Arratia, Research Professor and Mentor, Scientific Caribbean Foundation, Inc., Puerto Rico
Dr. Leonid Zotov, Research Professor and Mentor, Moscow State University, Russia
Dr. Elba M. Sepúlveda, Project Evaluator, Johns Hopkins University, MD,USA
Jade Peralta, Dominican Republic's Site Coordinator, Santo Domingo, DR

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