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Presentation of Content

In the first article we present *New Mexican school and healthy life: physical activity and sports in Sonora*, by CATALÁN-DIBENE, Ernani Francesco, ESPINOZA-ROMERO, Migdelina Andrea and CRUZ-CASTRUITA, Rosa María and LÓPEZ-GARCÍA, Ricardo, with adscription in the Universidad Contemporánea de las Américas, as the following article we present, *Microplastics in ecosystems and health*, by HERNÁNDEZ-RODRÍGUEZ, María Guadalupe, ORTEGA-CHÁVEZ, Laura Antonia, MARTINEZ-CASTELLANOS, María Elena and GALLEGOS-OROZCO, Carmen Angelina, with adscription in the Instituto Tecnológico de Chihuahua II, as the following article we present, *Perfectionism, anxiety and achievement academic in medical students*, by BARRIENTOS-MARMOLEJO, Swwlet Abigail, BARRERA-HERNANDEZ, Laura Fernanda, QUINTANA-LÓPEZ, Víctor Alexander and BOJÓRQUEZ-DÍAZ, Cecilia Ivonne, with adscription in the Instituto Tecnológico de Sonora, Universidad de Sonora, Universidad Autónoma de Baja California, as the following article we present, *Precise modeling and 3D printing of biocompatible craniofacial prostheses*, by HERNÁNDEZ-MALDONADO, Victor Miguel & RIOS-SOLIS, Leonardo, with adscription in the Centro de Investigación Especializado en el Desarrollo de Tecnologías de la Información y Comunicación (INFOTEC), Dirección Adjunta de Innovación y Conocimiento (DAIC), University College London and University of Edinburgh.

Content

Article **ECORFAN Journal-Republic of Guatemala**
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New Mexican school and healthy life: physical activity and sports in Sonora

Nueva escuela mexicana y vida sana: actividad física y deporte en Sonora

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Abstract

Objective: to describe the methodology that was carried out for the design of the project "Physical Activity and Sport in Educational Extension" and the characteristics of body composition, physical capacity, basic movement patterns and sense of belonging of the students. first, second and third grade schoolchildren attached to a federal elementary school of the Secretary of Public Education of the state of Sonora, in Mexico to participate in the project. The sample consisted of 95 boys and girls from third to sixth grade with an age between 6 and 12 years. Prior to the implementation of the project, an evaluation of body composition, physical capacity, basic movement patterns (BMP) and sense of belonging was carried out. Results: 17.9% (f = 17) are overweight and 14.7% (f = 14) are obese. The data showed that 24.3% (f = 26) sleep the recommended hours. The physical and sports activity that they perform the most is running (31.6%; f = 30). Contribution: The results obtained will help in the planning, redesign, action and control in the contents of the projects of the Physical Education teachers in Educational Extension associated with the project.

Education, Physical activuty, Body composition

Resumen

Objetivo: describir la metodología que se llevó a a cabo para el diseño del proyecto “Actividad Física y Deporte en Extensión Educativa” (AFyDEE) y las características de composición corporal, capacidad física, patrones básicos de movimiento (PBM) y sentido de pertenencia de los escolares de primero, segundo y tercer grado adscritos a una primaria federal de la Secretaría de Educación Pública del estado Sonora, en México a participar en el proyecto AFyDEE. La muestra fue de 95 niños y niñas de tercero a sexto grado con una edad de entre los 6 a los 12 años. Previo a la implementación del proyecto AFyDEE se llevó a cabo una evaluación de la composición corporal, capacidad física, patrones básicos de movimiento (PBM) y sentido de pertenencia. Resultados: un 17.9% (f = 17) presentan sobrepeso y un 14.7% (f = 14) obesidad. Los datos mostraron que el 24.3% (f = 26) duermen las horas recomendadas. La actividad física y deportiva que más realizan es correr (31.6%; f = 30). Contribución: Los resultados obtenidos ayudarán en la planeación, rediseño, acción y control en los contenidos de los proyectos de los profesores Educación Física en Extensión Educativa asociados con el proyecto AFyDEE.

Educación, Actividad física, Composición corporal

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Introduction

This paper presents the methodology used for the curricular design of the project "Physical activity and sport" based on the @ that it has in the formative projects developed and implemented in educational contexts.

The objective of the NEM is the integral human, human development of the learner and from this point, it reorients the National Education System as a whole, impacting the educational culture through co-responsibility and the promotion of social transformations within two contexts: the school and the community, in order to obtain the maximum learning achievement in the children, adolescents and young people of our country.
It is important to mention that the NEM is based on fundamental principles, such as the following It is important to mention that the NEM is based on fundamental principles, such as the promotion of patriotic love, appreciation for their culture, knowledge of their history and commitment to the values embodied in the Constitution. In addition to civic principles, it also supports the fundamental rights of human beings, taking into account the beliefs, traditions and culture that give each human being the ability to reflect on himself (UNESCO, 1982). The values that are promoted from this model are the essential ones, highlighting honesty, respect, justice, solidarity, reciprocity, loyalty, equity, gratitude, among others.

In relation to the articulating axes that make up the New Mexican

In relation to the articulating axes that make up the New Mexican School, the one that primarily underlies the design of this project is the seventh, Healthy Life; under this axis, this project is oriented towards physical activity and sport in student life, as well as in the relationship and the impact they have, not only in the school context, but also in the family and social context, and above all, in the community to which they are part of.

Excellence in education, placing children, adolescents and young people at the center of education, prioritizing the human and integral development of the learner, reorienting the National Education System to influence the educational culture through co-responsibility and the promotion of social transformations within the school and in the community.

In order to obtain the maximum learning achievement in students, the NEM specifies that learning activities are not the main responsible for the formation of the cognitive structures of the subjects, but the appropriation of the cultural baggage product of the human historical processes that are transmitted in the educational relationship. Therefore, the construction that each child and adolescent makes on their representations of reality, through actions, strategies, dialogues, materials and tools that have a historical and social development and meaning, is fundamental (SEC,2019).

The dominant position of learning based on Piaget's genetic theory in 1984, states that the development of the subject takes place according to different stages or evolutionary stages, in which the student has an active role in the development of his or her knowledge structures, from the adaptation to new stages, in which mechanisms of assimilation of new knowledge to the previous structures operate, said by Piaget: "development is, therefore, in a certain way a progressive balancing, a perpetual passing from a state of lower equilibrium to a state of higher equilibrium" (38). In contrast to this evolutionary approach, Vygotsky proposes that it is development that follows learning, since the latter creates an area of potential development, stimulates and activates internal processes within the framework of various interrelationships that become new internal structures. Therefore, it does not matter whether a child has passed from the symbolic stage to a preoperational stage, but what is fundamental is to define how each cultural and historical subject of the child is developing.

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Cultural and historical subject of these. It is reasonable for the school to value the ideas, meanings and intentions that shape the social and material structure of the community where educational processes take place. From this perspective, learning in basic education creates an area of potential development of the subjects in their particular context and condition; it also stimulates and activates internal processes through diverse historical, social, cultural, economic and educational interrelationships, within the framework of the community-territory. Considering the above, the NEM is based on seven articulating axes:

1) Inclusion

2) Critical Thinking

3) Critical interculturality

4) Gender equality

5) Reading and Writing Promotion

6) Aesthetic education

7) Healthy living

The "Healthy life" proposal, as an articulating axis of basic education, plays a relevant role in two ways.

The "Healthy life" proposal, as an articulating axis of basic education, plays a relevant role in two ways: on the one hand, contributing to the learning of healthy ways of taking care of the body, and on the other hand, promoting forms of symbiotic relationship between the community life of human beings and the natural environment in which they live (SEP, 2022). In addition to the above, "Healthy life" cannot be understood only on the margin of good living in community, but also as an education that guides children and young people to take responsibility for others, for others, for their community, that does not seek individual self-realization as its highest aspiration, but in their ability to treat ethically the other members of the community, to show solidarity and take responsibility for their needs and wants, allowing them to seek within themselves the realization as social, political, economic and cultural subjects, is what will allow fostering and deepening practices and thoughts oriented to healthy living in community.

The "Healthy life" axis promotes an education that makes visible from childhood the importance of the processes of health, disease, care and social determinants of health in the community.

Social determinants of health in the school community" (SEP, p. 115, 2022).

Healthy Lifestyles and Physical Education: Physical Activity and Health, Benefits of Physical Exercise

Healthy lifestyles according to Amau et al., 2021 and Urrea-Cuéllar et al., 2021. define a healthy lifestyle as a healthy lifestyle as the result of a series of habits that allow "a state of complete physical, mental and social well-being". This involves issues such as nutrition, physical exercise, disease prevention, work, relationship with the environment, adequate rest, recreation and social activity.

It is important to highlight that a good healthy lifestyle is one in which there is harmony and balance in their diet, physical activity, healthy sexual life, safe driving, stress management, intellectual capacity, recreation, especially outdoors, rest, hygiene, social-emotional skills, good interpersonal relationships, as well as the relationship with the environment, among others.

According to the Ministry of Education

Pública (SEP, 2017) in the key learning for comprehensive education, reference is made to Physical Education as a form of pedagogical intervention that contributes to the integral formation of girls, boys and adolescents by developing their motor skills and integrating their corporeality. To achieve this, it motivates the realization of diverse motor actions, in a dynamic and reflexive process, based on didactic strategies derived from motor play, such as corporal expression, sports initiation and educational sports, among others. It constitutes the curricular space in the school that mobilizes the body (corporeality and motor skills) and allows the promotion of a taste for physical activity.

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As an eminently practical area, it provides learning and experiences to recognize, accept and care for the body; to explore and experience capacities, abilities and skills; to propose and solve motor problems; to use creative potential and strategic thinking; to assume values and to acquire movements.

To acquire movements. Similarly. Pastor, Brunicardi and Arribas et al., (2016), establish three main purposes in physical education as specific curricular aspects in the universal, compulsory and public education system: 1) Physical-motor development.

Physical culture of students; and 3) Global and integral development of students within PA are: 1) Preventive; 2) Effect on the quality of life or well-being; and 3) Functional rehabilitation. In addition to the above, PA has physical and physical-sports practice genres (see Figure 1).

In addition, physical activity should be related to the general framework of education, in which participation, fun, creativity and the objective is the integral development of the person, and not only motor skills, are encouraged. That is why, it seeks to establish other multidisciplinary areas to reinforce knowledge from other curricular areas (Siedentop, Hastie, & Van der Mars, 2019). Around the nineties, 65% of the content of the physical education class was focused on playful sports, treating sport technique and outcome as a priority or (Thorpe, Bunker, & Almond, 1984). That is why sport within the subject of physical education is conceived from a formative approach as comprehensive teaching of sport or teaching games for understandings and even as sport education (Calderón, Hastie, & Martínez, 2011) worldwide.

The definition of physical activity (PA) is a human need for movement. It consists of the body manifesting movement within the environment. From the functional aspect, PA is triggered by any movement that involves muscular contraction and causes energy expenditure. Currently, it has been mentioned that physical practice is related to the biology and organism of the individual, so that PA manifests itself humanly in different areas, including the physical, psychological and social.

By way of example, on the physical level, it involves the use of bone levers that are mobilized by muscular contraction, ligaments and tendons. The social plane stands out because of the contact or interaction with other individuals during physical exercise and finally, in the social dimension, it is the use of the muscles, ligaments and tendons.

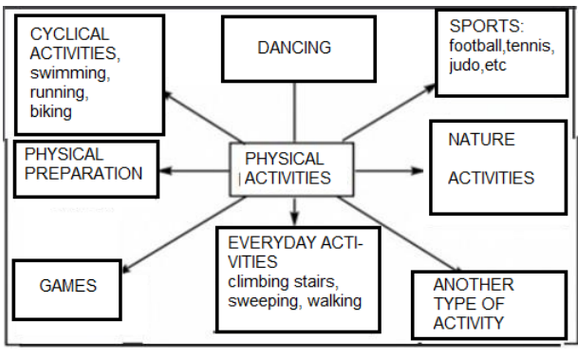

Figure 1 Genres of physical activity
Source: (Gonzales, 2004)

Physical education and sport are variants of PA that stand out for their recognition and in relation to the above, the term exercise is a physical activity that varies in intensity from low to high, that is planned or structured and that includes repetitions. It is performed with the objective of acquiring or maintaining physical fitness (Biddle and Mutrie, 2008).

On the other hand, sport as such covers a range of activities that consider a set of range of activities that consider a set of rules and with a component of competitions (WHO, 2020). Involving physical activity by teams or uncivilized and are supported by an institutional framework, such as a sports agency. Physical activity and exercise increase the overall quality of life (Alvarez-Pitti et al., 2020). They prevent the manifestation of pathologies in healthy children and adolescents (5-17 years), and help in the treatment of prevalent NCDs in the child community. Therefore, if physical physical activity or exercise is medicine and sedentary lifestyle causes diseases. For this reason the Spanish Association of Pediatricians and health committee. In Table 1, we propose actions to improve health through physical activity or exercise. Improving global health:

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Improves physical condition	Improves motor disability
Hormone modulation and control	Hypotonic syndromes decrease
Hypertrophy and oxygen consumption	Decreases prevalence of asthma, cancer and depression
Decrease of adipose tissue: obesity	Decrease of insulin resistance
Improved risk of obesity-associated comorbidity.	Mental health and attitude towards life
Increases bone mass and bone mineral density: decreases osteoporosis	Benefits self-esteem and mood (anxiety and depression).
Cardiorespiratory and metabolic benefits	Increases social integration
Improves lipid-allergenic profile	Improves management of underlying diseases

Table 1 Health benefits of physical exercise
Source: Information compiled from Álvarez-Pitti et al., (2020).

Therefore, the purpose of the present study is to describe the characteristics of body composition, physical capacity, basic movement patterns (BMP) and sense of belonging of first, second and third grade schoolchildren assigned to a federal elementary school of the Secretariat of Public Education of the state of Sonora, in Mexico to participate in the AFyDEE project.

Methodology to be developed

The following is a description of the methodology for the design and implementation of the AFyDEE project, the population to be benefited, the criteria for the pre-selection of the participating schools, general descriptions of the Physical Education teachers previously assigned to these educational institutions, as well as general considerations. 6 to 12 years old. The selection of the elementary school for this first moment was considered only for being an active school and having more than 15 hours of educational outreach, that is, with face-to-face classes after the return to classrooms in the face of the COVID-19 pandemic, and with a Physical Education teacher with previously assigned educational outreach schedule (morning and afternoon hours) and located in the state capital.

Curriculum design for educational outreach

Within the framework of the AFyDEE project, as a product, each Physical Education teacher made a proposal according to the context and specific needs of his/her school community, in order to reinforce areas or skills through a school sport or recreational activities, such as soccer, handball, baseball, athletics and recreational physical activity, among others. Educational extension hours are granted only to teachers who have more than 30 hours or full time (in hours). Teachers with these job characteristics can develop their educational extension project in the following way:

1. Develop the project during non-teaching hours or in front of the group. in front of a group.

2. Use half of their teaching hours for the implementation of the educational extension project.

3. To delimit the age range or by phases (group) to serve the community during the to serve the community during the educational outreach project: lower elementary (1st to 3rd grade) and upper elementary (4th to 6th grade) or combined, depending on the project.

4. Select a physical activity or sport to meet the objective of the project.

5. Distribute the workload (days and hours) of the educational outreach. For example, 3 days a week; 1 hour, 2 days per week; 2 hours, 5 days per week; 1.5 or 2 hours.

6. Diversify hours for implementation of educational outreach. For example, 3:00 Pm to 4:00 Pm, 5:00 Pm to 6:00 Pm or 4:00 Pm to 6 Pm. The topics of each educational outreach project

The topics of each educational outreach project are varied, depending on the context in which the school is located and the

Physics that students not enrolled in the participating schools attend.

9. Approval of the project by the Undersecretary of Basic Education of the State of Sonora.

Basic Education of the State of Sonora.

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10. Meeting with sector heads and supervisors of the 15 pre-selected schools to inform

15 pre-selected schools to present Implementation Route of the AFyDEE project.

11. Extension of information on the Implementation Route of the "Physical Activity and Sports" project to school

Implementation of the "Physical Activity and Sports" project to school principals by supervisors.

12. Meetings with Neighborhood Committees, Social Participation Committees and Parent Associations.

12. Meetings with Neighborhood Committees, Social Participation Committees and Parents' Associations of pre-selected schools to extend the information of the project, request the filling out of non-responsibility letters for physical education teachers and collaboration to open/close schools during extension hours and supervision/accompaniment of the teacher and participants. In assembly, these actors made the decision whether or not to get involved in the AFyDEE project.

13. AFyDEE project banner

Modalities	Training
Physical Education	Development of the body, motor skills, gross and fine motor skills by formative objectives.
Physical Activity	Movement, energetic energy expenditure, prevention of pathologies
Physical Activity and Recreation	Movement, leisure and social recreation
Physical Activity and Nutrition	Movement, nutrition and body composition
Physical Activity and Emotional Health	Movement, sports psychology, decreases anxiety, stress and depression
Physical Activity and Personal Hygiene	Movement and personal health through PA
Sports (baseball, soccer, handball, basketball, athletics or others)	Regulations, technical gesture, values and competition.

Table 2 Curricular contents
Source: own elaboration (2022)

Guidelines for implementation

The following logistical strategies were designed for the implementation of the program:

1. Detection of active schools in the state capital. Only active schools, i.e., with face-to-face classes after the return to school. after the return to the classroom in the face of the COVID-19 pandemic.

2. Screening of physical education teachers assigned with educational extension hours (morning and afternoon) (morning and afternoon schedule).

3. Exploration of educational outreach projects approved by state and federal physical education supervisions.

4. Diagnosis of civic and sports infrastructure

4. Diagnosis of civic and sports infrastructure and physical education teaching materials.

5. Redesign of the educational outreach program in coordination with the education supervisors.

A total of 50 elementary schools at the state and federal level were screened, leaving only one federal school selected by physical education supervisors, and the pre-selection of elementary schools was sent to Infrastructure Evaluation to verify the facilities and sports materials and make a final selection.

Before starting: Pretest

In the first evaluation prior to the implementation of the AFyDEE project, an assessment of body composition, physical capacity, basic movement patterns (BMP) and sense of belonging was carried out. The results obtained in the pretest will help in the planning, redesign, action and control in the contents of the projects of the Physical Education teachers in Educational Extension associated with the AFyDEE project.

The tests and measurements for this project are:

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Basic for 1st and 2nd grade (rolling, crawling, crawling, running and jumping, throwing and catching), application of Evaluation of conditional physical abilities for 3rd and 6th grade (Static Balance: maintaining a posture in various postures on one foot or eyes closed or not; Dynamic Balance Test: Walk on a line drawn with a turn and return without taking the feet off the line; Rhythm: adaptation of the child to the teacher's movements and repeat them instantly; Reaction: catch a ruler as soon as the teacher releases it and take the centimeters where the student took the ruler and Orientation: must make turns or changes of direction to the sides in the marked cones), Evaluation of conditional physical abilities: 20 m round trip test: measure aerobic endurance; Long jump without running; measure the power of the lower body, jumping with both feet without running, from one point to another, taking as an official measure the first point of contact of the body, measuring in cm the distance between each point; basketball throw: measure strength in upper body. It is important that the teacher measures where the ball first touches the ground. If the throw is directed to the sides it cannot be measured. Measurement or Qualification: expressed in whole meters, without measuring centimeters, for example, if a student throws 11.95 cm, it will be scored as follows

11 meters"; flexibility test; measure

Flexibility test; measure the ability to bend the trunk forward, where it is recommended to warm up well and rest 15 to 30 seconds between each attempt.

15 to 30 seconds between each attempt. It will be graded by taking the measurement in centimeters either positive or negative.

positive or negative. For example, + 4 or - 2 centimeters in flexibility; endurance: evaluate aerobic endurance in an area of 28x15 mts, and heart rate can be obtained with a heart rate monitor directly or heart rate can be obtained with a pulsometer directly or by taking the pulse manually in 10 seconds, and then take the heart rate in 10 seconds. seconds, and then take the heart rate with the result of the pulse, is multiplied by 6 to obtain it. by 6 to obtain it. Example: 25 beats times 6 = 180 beats/min".

Finally, the Sense of Belonging Questionnaire, constructed on the basis of a Likert-type response scale Likert type, with α=.779 (see Annex B), to measure the sense of belonging to the school and the 2017) and Physical Activity, Sedentariness and Sleep Questionnaire (WHO,2022).

Considerations

For the design of the project, meetings were arranged with the main educational authorities of the state; during the meetings and work tables with the physical education directorates, the characteristics and intentions of the project to be carried out in educational outreach were presented, with the physical education teachers already hired.

Afterwards, work tables were scheduled with the physical education supervisors to inform them and invite them to collaborate in the development of the AFyDEE project in order to work together and successfully land the project in the context of basic education in Sonora. Subsequently, volunteers were designated to the development of the project topics (design and redesign) and were verified from the pre-selection list of schools that are open to the public, with educational extension and relevant infrastructure for the development and execution of the project. This same list was sent to the infrastructure diagnosis department to corroborate the state of the sports infrastructure (facilities and equipment).

Then they added pedagogical technical advisors to analyze the project structure, wording, congruence, methodology, evaluations and annexes. Subsequently, the information was sent to the basic education supervision for approval and the process of non-responsive letters was started with the legal department, with the parents' councils, training for the application of the evaluation instruments (anthropometric, coordination, conditional and membership questionnaire), quotation of sports materials (budgets) for the 15 pre-selected schools.

Regarding ethical considerations, a letter of non-responsibility was generated in which a no-responsibility letter was generated in which the release or responsibility to the

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Next, the results are shown, according to the research objectives, which are organized in three sections: the first part refers to the context of gender and weight categorization by BMI; the second part presents the results of the questionnaire on physical activity, sleep and sedentary lifestyle, and sense of belonging. Finally, the instrumental proposal "Basic movement patterns" for first and second grade children is presented.

General characterization

The final sample was 95 boys and girls, where females represented 47.7% (f = 45), while males represented 52.6% (f = 50) of the study (Table 3. With an average age of 7 to 9 years (± 7.02).

Sex	*f*	%
Male	50	52.6
Female	45	47.4
Total enrollment	95	100%

Table 3 Sex of 1st and 2nd grade participants
Own elaboration (2022)

Regarding the categorization of weight through BMI, 62.1% (f = 59) of students were identified as having a healthy weight, followed by overweight with 17.9% (f = 17), obesity with 14.7% (f = 14) and in a smaller proportion underweight with 5.3% (f = 5; Table 4).

The most common type of sleep is that of the participants who sleep more than 8 hours (20.3%; f = 19) and the rest sleep less than 6 hours with 7.5% (f = 7; Table 5)

Weight	*f*	%
Low weight	5	5.3
Healthy weight	59	62.1
Overweight	17	17.9
Obesity	14	14.7
Total	95	100

Table 5 Number of hours participants reported sleeping
Source: Own elaboration (2022)

The physical and sporting activities most frequently performed by the students were recreational physical activities; running represented 31.6% (f= 30), running and jumping with 14.7% (f = 14), baseball with 9.5% (f= 9) and soccer 6.3% (f = 6) specifically. On the other hand, students who do not engage in physical activity accounted for 17.9% (f=14).

physical activity represented 17.9% (f = 17) of the population (Table 6).

Sleeping time	*f*	%
Unregistrered	37	38.8
One hour	1	1.1
Three hours	1	1.1
Four hours	2	2.1
Five hours	3	3.2
Six hours	6	6.3
Seven hours	8	8.4
Eight hours	18	18.9
Nine hours	12	12.63
Ten hours	6	6.3
Eleven hours	1	1.1
Total	95	100

Table 4 Categorization of weight through BMI.
Source: Own elaboration (2022)

The results in relation to the time they practice physical activity and sport showed that 24.2% (f = 23) practice 30 minutes, likewise 20% (f = 20) of students show that they practice 2 hours more, followed by the groups of students who practice 1 hour and those who do not practice physical activity and sport.

Table 7 Time spent practicing physical activity and/or sport reported by the participants. Own elaboration (2022)

The results of how much time students spend sitting or lying down during the day showed that 29.5% (f = 28) are 1 hour sitting or lying down. Likewise, 25.3% (f = 24) for more than 2 hours are in this posture. The rest of the students are 1.5 hours 12.6% (f = 12), 30 minutes and 2 hours account for 11.5% (f = 11) each and 9.5% (f = 9) did not record a response (Table 8).

Type of physical activity or sport		
Unregistered	1	17.9
Running	3	31.6
Running and jumping	1	14.7
Football	6	6.3
Baseball	9	9.5
Football and baseball	2	3.2
Football and basketball	1	1.1
Jogging	5	5.3
Tagging	5	5.3
Bycicle	1	1.1
Cycling	1	1.1
Hide and seek	1	1.1

Table 9 Basic Movement Patterns reported by the participants. Own elaboration (2022)

Sense of belonging

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Movement patterns	f	%
Excelent = 0 mistakes	39	41.1
Good = 1 or 2 mistakes	53	55.8
Regular = 3 mistakes	3	2.1
Unefficient = 4 or more	2	1.1
Total	95	100
Crawling		
Excelent = 0 mistakes	58	61.1
Good = 1 or 2 mistakes	36	37.9
Regular = 3 mistakes	0	0
Unefficient = 4 or more	1	1.1
Total	95	100
Crawl		
Excelent = 0 mistakes	86	90.5
Good = 1 or 2 mistakes	8	8.4
Regular = 3 mistakes	0	0
Unefficient = 4 or more	1	1.1
Total	95	100
Running and jumping		
Excelent = 0 mistakes	87	97.6
Good = 1 or 2 mistakes	6	6.3
Regular = 3 mistakes	1	1.1
Unefficient = 4 or more	1	1.1
Total	95	100
Throwing and catching		
Excelent = 0 mistakes	58	91.6
Good = 1 or 2 mistakes	31	6.3
Regular = 3 mistakes	3	3.2
Unefficient = 4 or more	3	3.2
Total	95	100

Table 8 Time spent sitting or lying down (without sleeping) reported by students
Own elaboration (2022)

According to the results of the questionnaire on the sense of belonging in 1st and 2nd grade students, of which 2nd grade students, of which there were 27 items (questions), in the question "What is the meaning of belonging? (questions); in the question "If I could return to If I could choose again, I would choose to study in this school".

If I could choose, I would pick this school again		
Agree	21	22.1
Totally agreee	74	77.9
Total	95	100

Table 10 Sense of belonging reported by students related to school choice. Own elaboration (2022)

According to the results of the question "I like the spaces that make up the school", it was identified that the students strongly agree (60%; f = 57), followed by neither agree nor disagree (22.1%; f = 21), Finally, 17.9% (f = 17) agree (Table 11).

I like the area of the school		
Indifferent		
Agree	17	17.9
Totally agree	57	60
Total	95	100

Table 11 Sense of belonging reported by students related to liking school spaces. Own elaboration (2022)

The results of being an important member in the school reflect strongly agree (62.1%; f = 59), 21.1% (f = 20) say they agree and the rest of 16.8% (f = 16) say they neither agree nor disagree (Table 12).

I´m feeling like a member of this school		
Indifferent		
Agree	20	21.1
Totally agree	59	62.1
Total	95	100

Table 11 Sense of belonging reported by students related to the feeling of being an important member of the school. Own elaboration (2022)

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Conclusions

As it is possible to appreciate, the methodology of this curricular design gave voice to each of the educational figures that intervene directly and indirectly in the development of the project, from educational authorities, such as school secretaries and supervisors, to parents' associations and neighborhood committees, and of course, to teachers and students. The above ensures the success of any educational innovation and change project (Hargreaves, 2013), since it considers the specific needs of the population that will be benefited, really approaching them, making them participants in the process, from its construction and project decision making, to its implementation, a phase where everyone's participation is undoubtedly required.

In relation to the reagents associated with the sense of belonging to the educational community, it is satisfactory that, after returning to classes for almost 2 school cycles of closure, students still perceive recognition, closeness, satisfaction and security in their schools. This is important because the post-pandemic emotional effects point to the need to generate resilience mechanisms in all people, especially in children, adolescents and young people, so it is encouraging that the school has the possibility of strengthening not only the academic, but also socioemotional aspects for a healthy life, especially if they are promoted from training projects such as the one developed in this article.

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In conclusion, the importance of sports and physical importance of sports and physical conditioning as practices for the wellbeing of children and adolescents at different levels of basic education at the State and Federal level. Taking as a preamble the reopening of the school classrooms in the State of Sonora, after the pandemic by COVID-19, it is essential to implement strategies that will help to improve the health of children and adolescents.

In this way, the results of this project may go beyond the objectives set forth in this article. It is worth mentioning

WHO

https://www.paho.org/es/temas/inmuniza cion
It should be emphasized that the willingness of educational institutions, physical education teachers and parents to the willingness of educational institutions, physical education teachers and parents is fundamental for the optimal functioning and development of this project, which is why this project is considered to be the first step to encourage healthy lifestyles in the school environment.

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Microplastics in ecosystems and health

Microplásticos en los ecosistemas y la salud

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Abstract

Microplastics are very small plastic particles, less than 5mm in diameter. These materials may originate from the degradation of larger plastic products, such as bottles and bags, or may be intentionally manufactured for use in cosmetics. Microplastics are a significant environmental problem because they can be ingested by marine animals and other living things, causing them significant damage. Furthermore, these materials can act as toxic contaminants. The objective of this study is to know and understand the negative effects of microplastics on ecosystems, and on human health, and to know the technologies that are being used to reduce this type of contamination through recycling and the development of alternatives to plastic, as well as knowing the policies that are being developed to address this problem. This study seeks to create greater public awareness of the problem, improve understanding of the effects on ecosystems, and identify the sources and routes of entry of microplastics into the environment. In summary, research on microplastics is essential to address the problem of plastic pollution and to find effective solutions to protect our environment and health.

Microplastics, Pollution, Ecosystems, Health

Resumen

Los microplásticos son partículas de plástico muy pequeñas, inferiores a 5mm de diámetro. Estos materiales pueden ser originados por la degradación de productos de plástico más grandes, como botellas y bolsas, o pueden ser fabricados intencionalmente para su uso en cosméticos, Los microplásticos son un problema ambiental importante porque pueden ser ingeridos por animales marinos y otros seres vivos, causándoles un daño significativo. Además, estos materiales pueden actuar como contaminantes tóxicos. El objetivo del presente estudio es conocer y entender los efectos negativos de los microplásticos en los ecosistemas, y en la salud humana, y conocer las tecnológicas que se están utilizando para reducir este tipo de contaminación a través del reciclaje y el desarrollo de alternativas al plástico, así como conocer las políticas que se están desarrollando para abordar esta problemática. Con este estudio se busca crear mayor conciencia pública sobre el problema, mejorar la comprensión de los efectos en los ecosistemas e identificar las fuentes y las rutas de entrada de los microplásticos en el medio ambiente. En resumen, la investigación sobre los microplásticos es esencial para abordar el problema de la contaminación por plásticos y para encontrar soluciones efectivas para proteger nuestro medio ambiente y salud.

Microplásticos, Contaminación, Ecosistemas, Salud

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Introduction

As mentioned above, microplastics are small plastic particles, usually less than 5 millimetres in size, that have become a major environmental concern worldwide. These microplastics are found in a variety of sources, such as personal hygiene products, synthetic clothing, packaging and plastic waste that decomposes over time.

Microplastics can have negative effects on the environment, including pollution of the oceans, disruption of marine and terrestrial ecosystems, and possible ingestion of microplastics by wildlife and humans. In addition, microplastics can also release toxic chemicals that can be harmful to health.

The magnitude of the microplastics problem is increasingly being recognised by governments, businesses and the general public, and measures are being taken to address the problem. Some of these measures include banning microplastics in personal care products, promoting proper waste management, developing alternatives to plastic and research into new technologies to reduce microplastics in the environment.

This topic is important because in addition to the effects already mentioned, microplastics can also disrupt natural biological and ecological processes.

They are also important to study because they are a form of environmental pollution and can persist in the environment for hundreds of years, which can have long-term consequences for the environment. However, microplastics are a global challenge that requires governments, businesses and the general public to work together and collaborate to effectively address the problem.

One way to address the problem of microplastics is through techniques that help reduce the source of these materials. This may include the elimination of certain products containing microplastics, such as personal hygiene products, plastic microbeads, or the promotion of sustainable alternatives to plastic.

One of the techniques used to address this problem is the use of innovative advanced recycling technologies, which are being developed to separate and recover microplastics from plastic waste and, in turn, reduce the amount of microplastics released into the environment.

Such innovative technologies include cleaning with fishing nets and collecting microplastics through flotation and filtration technology. The implementation of monitoring and assessment programs can help to better understand the magnitude of the problem and its impact on the environment. The results of these studies can inform the policies and regulations needed to address this problem.

Last but not least, public education and awareness are critical to addressing this problem. By increasing public awareness of the effects of microplastics on the environment and human health, a change in behavior and consumption of plastic products can be encouraged.

In summary, a variety of techniques are being used to address the microplastics problem, and a comprehensive and collaborative approach will be needed to reduce the amount of microplastics in the environment and protect our health and the planet.

General objective

The main objective of the article is to study the options available and present a proposal for improvement towards the environmental and health problems that have become the disposal of plastics and microplastics, as well as to understand the negative effects of microplastics on ecosystems, from biodiversity to biogeochemical processes, and to understand the effects of microplastics on human health, through the ingestion of contaminated food or the inhalation of particles in the air**.**

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Theoretical framework

Since humans first appeared on Earth, they have used five main materials to make tools and objects: wood, stone, bone, horn and skin. Others were added to these materials during the Neolithic revolution: clay, wool, vegetable fibers and some metals, and it was not until the beginning of the 20th century that these materials of natural origin began to be massively replaced by artificial or synthetic materials, created by human hands; these materials are called polymers, which are a macromolecule composed of long chains in which a smaller unit called monomer is repeated.

Polymers can be classified according to their origin (natural or synthetic), according to their physical properties (elastomers, plastics and duroplastics), and according to their response to temperature (thermoplastics and thermosets).

The raw material of polymers is petroleum, which is subjected to a fractional distillation and cracking process (chemical process by which the original compound is divided into simpler and smaller compounds) for the separation of its components. (Figure 1),

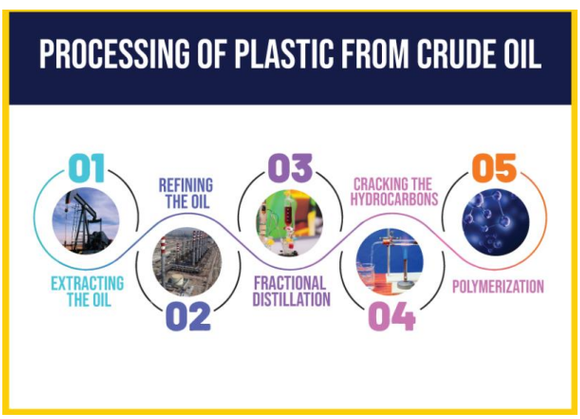

Figure 1 Plastic processing from crude oil
Source: Plastic collectors save the word

History of plastics

The history of plastics dates back to the 19th century, when synthetic materials began to be developed from petroleum chemistry. The first plastics were hard and brittle, but over time new, more flexible and resistant plastic materials were developed.

One of the first synthetic plastics was celluloid, developed in the 1860s from cellulose and initially used in the manufacture of billiard balls, buttons and combs. In 1907, Belgian chemist Leo Hendrik Baekeland invented Bakelite, the first synthetic plastic completely synthesized from phenol and formaldehyde. Bakelite was widely used in the manufacture of electronic products, such as switches and plugs.

In the 1930s, new types of plastics were developed, such as polyethylene and PVC (polyvinyl chloride). During World War II, plastics became an essential material for the production of military products such as parachutes, helmets and airplanes.

In the 1950s, new types of plastics, such as polypropylene and polystyrene, were developed and began to be used in the manufacture of packaging and consumer products. The production of plastics expanded rapidly during the 1950s and 1960s, and they became a ubiquitous material in everyday life. The resulting rapid growth in plastics production is extraordinary, outpacing most other man-made materials. Notable exceptions are materials that are widely used in the construction sector, such as steel and cement.

Plastic production

The manufacture of plastics begins with small molecules, called monomers, which are repeated thousands or millions of times and assembled into long chains, called polymers (Figure 2). Almost all plastics are made from fossil fuels, especially petroleum and natural gas.

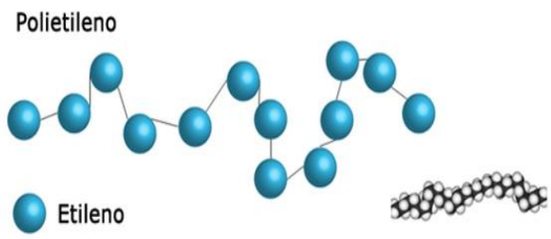

Figure 2 Polymer molecule chain
Source: Ecoplas

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Plastics are produced by adding an initiator with free radicals and modifying substances to the monomer (basic structural unit of the polymer) (Figure 3). Plastics are increasingly used in the industrial and consumer sectors, in packaging, containers, insulating materials, construction and a multitude of other objects.

Figure 3 Plastic manufacturing. Free of hormonal
Source: contaminants.org.

Use of plastic

The global production of plastics has grown relentlessly in recent decades. Plastics help us preserve food through packaging, insulate buildings, use electronics, make vehicles more fuel efficient, manufacture bags, clothing and more. However, the largest market for plastics is packaging, an application whose growth was accelerated by a global shift from reusable to single-use packaging.

The magnitude of plastics consumption in our societies results in a high carbon footprint related to the production of large volumes of waste, persistent pollution, and damage to wildlife and the ecosystem.

As a result, the share of plastics in municipal solid waste (in mass) increased from less than 1 % in 1960 to more than 10 % in 2005 in middle- and high-income countries. In addition, global solid waste generation, which is strongly correlated with gross national income per capita, has grown steadily over the past five decades.

In 2015, about 146 tons of plastic containers and packaging were produced, with an average use of less than 6 months (Figure 4).

Figure 4 Plastic packaging waste
Source: National Geographic

For consumer products, the plastic used in 2015 amounted to more than 42 million tons. These types of products are used on average only 3 years before being discarded. Figure 5.

Figure 5 Consumer products
Source: National Geographic

Plastic is also in our clothes. Around 59 million tons were used in the textile industry in 2015. The average life of textile products is 5 years, after which they usually end up polluting the environment. (Figure 6)

Figure 6 Textile industry
Source: Coats.com

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In the electrical sector, 18 million tons are used annually in all types of cables and electronic devices for their electrical current insulating properties. Most of these components move on to a better life 8 years after their manufacture. (Figure 7)

Figure 7 Electricity sector
Source: Eludesa.com

In 2015 alone, some 3 million tons of plastic were used in different types of industrial machinery. Their average service life will be 20 years in this case. (Figure 8)

Figure 8 Industrial sector
Source: Nacional Geographic

Plastic used in construction is estimated to have an average life span of 35 years, during 2015 alone it amounted to 65 million tons. (Figure 9)

Figure 9 Plastic in construction
Source: Ecoplas.org

47 million tons of plastic were used in 2015 in other types of activities, including healthcare and agriculture. After 5 years, most of these materials will have become waste. (Figure 10)

Figure 10 Plastic in construction
Source: Ecoplas.org

The increasing production of plastics has brought with it pollution, and health problems, which has generated growing awareness of the issue, guiding public opinion and paving the way for stronger policy intervention on this front. The OECD Global Plastics Outlook reports seek to inform and support these efforts.

Fate and toxicity of plastics

By the end of 2015, all plastic waste generated from primary plastics had reached 5800 metric tons (Mt), of which 700 Mt were PP&A fibers. There are essentially three different destinations for plastic waste. First, it can be recycled or reprocessed into a secondary material.

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Recycling delays, rather than avoids final disposal, it would reduce future plastic waste generation only if it displaces primary plastic production; however, due to its counterfactual nature, this displacement is extremely difficult to establish. In addition, contamination and mixing of polymer types generates secondary plastics of limited or low technical and economic value. Second, plastics can be thermally destroyed. While there are emerging technologies, such as pyrolysis, that extract fuel from plastic waste, to date, virtually all thermal destruction has been by incineration, with or without energy recovery.

The environmental and health impacts of waste incinerators depend largely on the emission control technology, as well as the design and operation of the incinerator. Ultimately, plastics can be disposed of and contained in a managed system, such as landfills, or left uncontained in open dumps or in the natural environment.

Between 1950 and 2015, the cumulative generation of primary and secondary (recycled) plastic waste amounted to 6300 MT. Of this, approximately 800 Mt (12 %) of plastics have been incinerated and 600 Mt (9 %) have been recycled, only 10 % of which have been recycled more than once. About 4900 Mt, 60 % of all plastics produced, were discarded and are accumulating in landfills or in the natural environment. Fig. 11

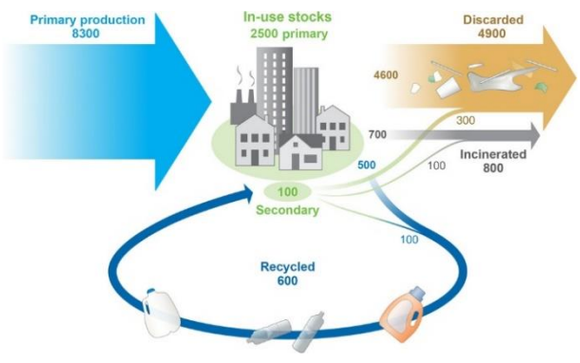

Figure 11 World production, use and destination of polymer resins, synthetic fibers and additives (1950 to 2015; in millions of metric tons)
Source: Science.org

None of the mass-produced plastics biodegrade to any significant extent; however, sunlight weakens the materials, causing fragmentation into particles known to reach millimeter or micrometer size. Research on the environmental impacts of these "microplastics" in marine and freshwater environments has accelerated in recent years, but little is known about the impacts of plastic debris on terrestrial ecosystems.

Although plastic is most visible in its final form as consumer products, packaging or other useful items, all plastics are made of complex mixtures of chemicals.

It is the properties of these chemicals (monomers), and in particular the additives, which are not usually linked to the plastic material itself, that cause serious health problems. These additives are added to make the plastic have different characteristics, such as being softer or softer. A typical example of additives are phthalates. Additives are not part of the polymer structure, so they can be released from the plastic in response to energy from the sun or microwaves and contaminate the air, water or food.

Many of the largest and most dangerous carcinogenic and hormone-disrupting chemical families are directly associated with the production of plastics, compared to other materials such as heavy metals, flame retardants, aphthalates, bisphenols or fluorinated compounds.

The toxic effects produced by microplastics and their associated substances include the production of reactive oxygen species, increased oxidative stress indicators, alterations in gene transcription and expression, DNA damage, endocrine disruption alterations and even effects on population parameters, such as the probability of survival and low fertility rates, which has generated great public health concern.

Classification codes for plastics

Some plastics have numerical codes found on the bottom of most plastics. These codes indicate the type of plastic used, so that each item can be sorted and processed for proper recycling; however, many other types of plastics do not carry a code and are generally not recyclable.

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Table 1 shows the classification of these plastics, examples of common use, their monomers and the hazard of exposure to these monomers.

		POLYMER	COMMON EXAMPLES	MONOMER	MONOMER HAZARD?
1	PET PETE	Polyethylene Terephthalate (Polyester)	Soft drink bottle, yogurt cup, vegetable tray, shampoo bottle, plastic tea bags, polar fleece textile fabric	Terephthalic acid + ethylene glycol	
2	HDPE	High-Density Polyethylene	Drinking water pipes, cutting board, refillable drinking bottle, yogurt drink bottle, trash bag / bin liner, shower gel bottle	Ethylene	
3	PVC	Polyvinyl Chloride	Artificial leather, bath tub squirt toys, inflatable bathing ring, tablecloth, drinking water pipes, flooring, cling wrap, pond liner	Vinyl chloride	Carcinogen
4	LDPE	Low-Density Polyethylene	Cling wrap, trash bag / bin liner, lemon juice bottle, plastic wrap, freezer bag, hair conditioner bottle	Ethylene	
5	PP	Polypropylene	Foldable water container, thermal undergarments, ground water pipes, refillable drinking bottle, yogurt cup, gummy candy packaging	Propylene	
6	PS	Polystyrene	Styrofoam cup, yogurt cup, fruit and vegetable tray	Styrene	Probable carcinogen; suspected reproductive toxicant
7	OTHER	Other			
*	PC	Polycarbonate	Baby bottles, electronics enclosures, compact discs	Bisphenol A Bisphenol S	Endocrine disruptor Endocrine disruptor
*	PUR	Polyurethane	Artificial leather, foam mattress, scouring pad, kids bath sponge, shower slippers	Isocyanate + polyol	Isocycanates: inhalation hazard
*	PTFE	Polytetrafluoroethylene (Teflon) Polyamide (Nylon)	Nonstick baking sheet liner; nonstick cookware; some breathable water-repellent materials like Gore-Tex "Plastic" tea bags clothing	Tetrafluoroethylene (Various)	Probably carcinogen
*	ABS	Acrylonitrile butadiene styrene	Drinking water pipes, electronics enclosures, 3d-printed objects	Acrylonitrile, butadiene, styrene	Acrylonitrile: possible carcincogen; butadiene: known carcinogen; styrene: suspected carcinogen
*	PLA	Polylactide	Yogurt cup, coffee cup lid, shampoo bottle, vegetable tray, 3d-printed objects	Lactic acid	
*	NITRILE	Acrylonitrile butadiene rubber	Non-latex gloves	Acrylonitrile, butadiene	Acrylonitrile: possible carcincogen; butadiene: known carcinogen
*May be numbered "7 OTHER", but often not numbered for recycling					

Table 1 Common plastic polymers and their associated monomers
Source: Heal. Health and enviroment alliance

As previously mentioned, plastics are largely composed of polymers, large chemical molecules consisting of chains of smaller repeating units known as monomers, plus many. Additives that are often found in finished products. During and after use, polymers can break down into smaller components or their constituent monomers, which happens when a plastic bottle of water is exposed to sunlight.

However, despite these inherent concerns about their use, polymers are exempt from registration in both Europe and the United States. This means that companies are not required to provide information on the health and environmental hazards associated with exposure to these polymers.

Table 2 shows the classification of plastics in commonly used products.

PRODUCT	TYPICAL PLASTICS	PRODUCT	TYPICAL PLASTICS
Acoustic foam	PUR	lemon juice bottle	LDPE
Artificial leather	PUR, PVC	nonstick baking sheet liner	PTFE
Baby bottles	PC	oven bag	PET
Bath tub squirt toys	PVC	place mat	PVC
Bib	PE	plastic cup	PS
Cling wrap	PVC, LDPE	plastic tea bags	Nylon, PET
Coffee cup lid	PLA	polar fleece textile fabric	Recycled PET
Compact disc	PC	pond liner	PVC
Crisps packaging	PP+PE layes	pool noodles	PE
Cutting board	HDPE	rain pant	PE
Drinking water pipes	PVC, HDPE, ABS	refillable drinking bottle	PP, HDPE
Flooring	PVC	scouring pad	PUR
Foam mattress	PUR	shampoo bottle	PET
Foldable water container	PE, PP	shower gel bottle	PS
Freezer bag	LDPE	shower slippers	PVC
Fruit tray	PS	soft drink bottle	PP
Furniture foam	PUR	styrofoam cup	LDPE, HDPE
Ground water pipes	PP, PVC	tablecloth	PS, PET, PLA
Gummy candy packaging	PP	thermal undergarments	PET
Hair conditioner bottle	LDPE	trash bag / bin liner	LDPE, HDPE
Handkerchief packaging	PP	vegetable tray	PS, PET, PLA
Inflatable bathing ring	PVC	water bottle (not reusable)	PET
Inflatable pool toys	PVC	yogurt cup	PS, PP, PET, PLA
Kids bath sponge	PUR	yogurt drink bottle	HDPE

Table 2 Typical plastics used in commonly used products
Source: Heal. Health and enviroment alliance

Global problem

In 2022, a study by the Organization for Economic Cooperation and Development (OECD) estimates that 22% of the world's plastic waste will be wasted and only 9% will be successfully recycled. Figure 12

The OECD indicates that, globally, twice as much plastic waste is being produced as two decades ago, and that almost half of all plastic waste is generated in the organization's member countries, according to the OECD Global Plastics Forecast.

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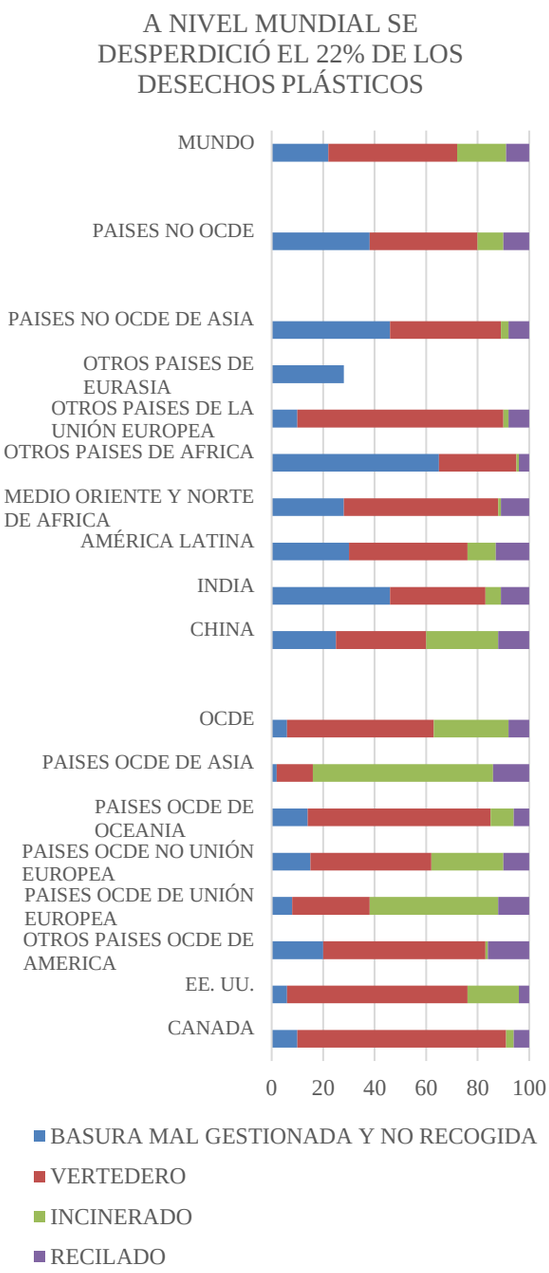

Graphic 1 Disposal of plastic waste
Source: OCDE/Gráfico: LR-LM

According to the study, plastic waste generated annually per person varies from 221 kilograms in the United States and 114 kilograms in the European countries that belong to the OECD, to 69 kg, on average, in countries such as Japan and South Korea.

In addition, most plastic pollution is due to poor collection and disposal of the larger plastic waste known as macroplastics.

However, leakage of microplastics, i.e., synthetic polymers less than 5 millimeters in diameter, from items such as industrial plastic granules, synthetic textiles, road markings and tire wear, is also a serious problem of great concern to the organization.

According to the study, OECD countries are responsible for 14% of total plastic leakage, accounting for 11% of macroplastic leakage and 35% of microplastic leakage.

The COVID-19 crisis led to a 2.2% decline in plastic use in 2020 as economic activity slowed, but led to an increase in litter, such as takeaway food packaging and plastic medical equipment such as face masks. However, as economic activity resumed in 2021, plastic consumption also rebounded and intensified the problem.

Consumption has quadrupled

According to the OECD, consumption of plastic materials is four times higher today than it was 30 years ago, driven by growth in emerging markets. Global production reaches 460 million tons and accounts for 3.4% of global greenhouse gas emissions. Global plastic waste generation more than doubled between 2000 and 2019 to 353 million tons and almost two-thirds of plastic waste has a useful life of less than five years: 40% is packaging; 12% consumer goods and 11% garments.

Sources of exposure to Microplastics

Human exposure to microplastics is manifold, including through the air we breathe, the food we eat or the products we use. Many consumer products now incorporate "microplastics," tiny particles ranging in size from a few millimeters to microscopic "nanoplastics" the size of bacteria.

Microplastics are often deliberately added to certain products such as exfoliants and toothpastes to improve their function, and plastic "microbeads" are used to make sunscreen spread more evenly.

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However, it is surprising to learn that most of the microplastics (35%) come from the clothes we wear, as more and more synthetic textiles (such as nylon) are used to make them cheaper, but each wash releases thousands of fibers that end up in waste water. Another important source of microplastics is car tires (30%) and city dust (25%).

Road signs and paints, as well as cleaning and personal hygiene products represent 5%, respectively. It should be noted that plastic products are made with different chemical compounds and therefore have different densities. For example, plastic bags, made of polyethylene, are less dense than seawater, so they will float; other plastics are heavier and will sink to the bottom of the ocean. This implies an obvious contamination of the marine habitat; but, in addition, microplastics have the capacity to accumulate hundreds of toxic substances, including insecticides, herbicides, fertilizers and persistent organic pollutants that are carcinogenic and endocrine disruptors.

These particles are also colonized by bacteria that can act as accumulators of other pollutants. Thus, the microplastics present in ocean water enter the food chain through plankton and from there pass to fish larvae, mollusks and crustaceans; from there to larger fish, until they reach our plates.

It has been proven that the plastic ingested by the creatures varied from 50 to 100 percent in the Mariana Trench, the deepest trench in the world, and that all the organisms that inhabit it have ingested plastic or semi-synthetic fibers. Figure 12.

Figure 12 Plastics in marine life. Journal of the Mexican Academy of Science

Figure 13 shows the persistent cycle of plastic toxins in the environment and thus in humans.

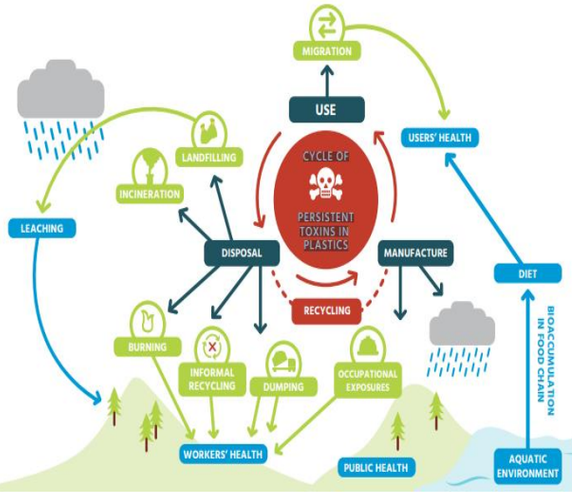

Figure 13 Persistent cycle of plastic toxins
Source: Health and enviroment alliance

Microplastics now constitute "a major potential threat to global aquatic ecosystems" on an almost unimaginable scale. A study by researchers at the University of Newcastle, Australia, suggested that people may be ingesting 5 grams of microplastics each week, roughly the amount of plastic on a credit card.

In 2013, scientists estimated that already more than five trillion plastics and their particles are floating in our oceans, most of them microplastics.

Scientists from the University of Ghent, Belgium, recently discovered that on average the European seafood consumer ingests 6400 grams of microplastics per year.

In addition, the presence of microplastics has also been reported in the stomach contents of freshwater fish globally. This is due to confusion by fish with their natural prey, such as plankton. Therefore, studies have been conducted to evaluate the ingestion of PM fragments according to color (red, green, yellow, white, black and blue), observing that zebrafish in particular preferred to consume the blue fragments, while avoiding green and white fragments. Although it is not yet clear how plastic coloration is related to selectivity and consumption in freshwater fish, the visual abilities of fish may explain why certain colors are attractive to a particular fish species.

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A 2018 investigation of bottled drinking water, analyzing more than 250 samples from nine countries, found that 90% was contaminated by plastics: primarily polypropylene (54%), nylon (16%) and polyethylene or PET (6%). These results prompted the World Health Organization (WHO) to initiate a review of the risks of microplastics in drinking water. Following this first review, WHO highlighted the need for more research on the health effects of microplastics and has called for strong action against plastic pollution.

In January 2019, the European Chemicals Agency (ECHA) proposed a restriction on adding microplastics to certain products, which is expected to prevent the release of 500,000 tons of microplastics over the next 20 years.

An estimated 8 to 12 million tons of plastic are released into the world's oceans each year, and it is expected that by the year 2050 there will be more plastic than fish in the ocean if no action is taken to address the problem. Figure 14.

Figure 14 Impact of plastic
Source: Iberdrola

Recommendations

There are several recommendations and actions that should be taken to address the microplastics problem:

1. Reduce the overall consumption of plastics in our daily lives. This includes avoiding the use of disposable plastic products, opting for sustainable and reusable alternatives, such as cloth bags instead of plastic bags, reusable bottles instead of single-use plastic bottles, and avoiding products with plastic microbeads in their composition.

2. Implement and improve waste management systems to prevent plastics and microplastics from ending up in the environment. This involves encouraging proper recycling of plastics, litter collection and promoting waste reduction in general.

3. Research and track the presence and effects of microplastics in different environments, such as oceans, freshwater bodies, soils and air. This will help to better understand the extent of the problem and to take appropriate measures to address it.

4. Implement effective regulations and policies to address the production and use of microplastics. This may include banning or restricting certain products containing microplastics, promoting sustainable alternatives, and setting quality standards for the proper management of plastics and waste.

5. Create public awareness programs to promote behavioral changes and sustainable habits. Awareness of the environmental and health effects of microplastics should be raised, and clear guidelines should be provided on how to reduce their impact.

Addressing the microplastics problem requires a combination of individual actions, government regulations, ongoing research and public education. A comprehensive and collaborative approach is needed to minimize the release of microplastics into the environment and protect our health and ecosystems.

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Conclusion

Plastic waste is now so ubiquitous, i.e. it is present everywhere in the environment that it has been suggested as a geological indicator of the proposed Anthropocene era, a term that has been created to designate the impact on climate and biodiversity of both the rapid accumulation of greenhouse gases and the irreversible damage caused by excessive consumption of natural resources. Microplastics are considered to constitute one of the main sources of anthropogenic pollution in the world, due to inadequate or non-existent urban and industrial waste collection, recycling and disposal systems (World Bank, 2016). Therefore, the almost permanent contamination of the natural environment with plastic waste is a growing concern. Therefore, it is necessary to create more and better awareness programs, involve governments to create policies that control the manufacture, disposal and recycling of plastics, and create fines for plastic producing companies that use toxic and harmful substances to humans, and do not inform about the dangers of their use.

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Perfectionism, anxiety and achievement academic in medical students

Perfeccionismo, ansiedad y rendimiento académico en estudiantes de medicina

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Abstract

Objective: to analyze the relationship between perfectionism, anxiety and academic performance in medical students. Methodology: non-experimental research with a quantitative and correlational approach. The sample was non-probabilistic of the intentional type and included 363 medical students from universities in Mexico; 29.2% men and 70.8% women, with an age of 20.87 years. Two instruments were applied: the Multifactorial Perfectionism Scale and the Trait and State Anxiety Inventory. To obtain information on the academic performance of the students, they were asked their cumulative general average up to now. Data collection was carried out using a Google form and the collected data was analyzed in the SPSS version 23.0 program. Contribution: A significant difference was found in general anxiety, women presented higher levels of anxiety. compared to men (2.62 vs 2.37 p=0.00). Likewise, a significant negative relationship was found between state anxiety and trait anxiety and academic performance (-.191 -.199 p<0.01) and a significant negative relationship between maladaptive perfectionism and academic performance (-.182 p <0.01).

Medical Students, Anxiety, Perfectionism

Resumen

Objetivo: analizar la relación entre el perfeccionismo, la ansiedad y el rendimiento académico en estudiantes de medicina. Metodología: investigación no experimental con enfoque cuantitativo y de tipo correlacional. La muestra fue no probabilística de tipo intencional e incluyó a 363 estudiantes de medicina de universidades de México; 29.2% hombres y 70.8% mujeres, con una edad de 20,87 años. Se aplicaron 2 instrumentos, la Escala Multifactorial de Perfeccionismo y el Inventario de Ansiedad de Rasgo y Estado. Para obtener la información sobre el rendimiento académico de los estudiantes, se les preguntó su promedio general acumulado hasta el momento. La recolección de datos se llevó a cabo por un formulario de Google y los datos recabados fueron analizados en el programa SPSS versión 23.0. Contribución: Se encontró una diferencia significativa en la ansiedad general, las mujeres presentaron niveles más altos de ansiedad. en comparación con los hombres (2,62 vs 2,37 p=0,00). Así mismo, se encontró una relación negativa significativa entre ansiedad estado y ansiedad rasgo y el rendimiento académico (-,191 -,199 p<0,01) y una relación negativa significativa entre el perfeccionismo desadaptativo y el rendimiento académico (-,182 p<0,01).

Universitarios de medicina, Ansiedad, Perfeccionismo

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Introduction

Several studies have pointed to university students as a population vulnerable to developing mental health problems such as anxiety, stress and others. Anxiety was seen to be on the rise in times of pandemic, so Cortina (2022) conducted a systematic investigation of scientific materials published in different countries on the subject through different databases and found a high prevalence of anxiety in young students.

The possible explanations for the high rates of anxiety found in these students vary from one study to another, among those mentioned were having a chronic illness, using permanent medication, having previous consultation with psychology or psychiatry, being female, being overweight or underweight, living alone, having less than 5 hours of leisure time per week, lack of time to eat, sleeping less than 5 hours per day, not having a restful sleep, feeling discriminated against and the commute to the university being longer than 90 minutes. On the other hand, those significantly associated with less anxiety were attending religious events, going to discos or restaurants, playing sports, being in a union or married, having children, having had sexual activity, being of African descent and coming from rural areas (Monterrosa-Castro et al., 2020; Pinilla et al., 2020). Another factor associated with anxiety has been perfectionism (Pineda-Espejel et al., 2018), which has also been linked to the development of eating disorders (Scappatura et al., 2017). A definition of perfectionism that has been widely disseminated and taken up in various studies on the subject is that of Frost, Marten, Lahart and Rosemblate (1990), who conceive of perfectionism as the inclination to set high performance expectations combined with a critical evaluation of these expectations and an excessive preoccupation with making mistakes. Perfectionism has negative consequences for learning, caused by constant effort, negative self-criticism and also has an impact on health, so it is important that this information reaches educational institutions and teachers (McKay & Stewart 2023).

In recent years, this relationship between anxiety and perfectionism has been found in students at previous educational levels, such as the study by Álvarez et al. (2021) with 1588 students between 12 and 18 years of age in Ecuador, where it was observed that the greater the perfectionism, the greater the school anxiety. Similar results were found by Ceccon and Jorge (2019), who observed a relationship between state anxiety and the discrepancy subscale of perfectionism in 27 middle school student tutors in Córdoba, Argentina. However, further research is needed on the relationship between these variables at the university level, since, although there is research on this topic, such as that carried out by Aragón and Riveros (2021) with 558 university students at UNAM, where a significant relationship between anxiety and maladaptive perfectionism was found, there is very little current literature on the subject in this population.

There is a study on temperament profiles and perfectionism in high-ability university students, which showed that temperament may be another factor that is closely related to perfectionists (Fletcher et al., 2023).

In 2019, the World Health Organization (WHO, 2022) mentioned that 301 million people suffered from an anxiety disorder, including 58 million children and adolescents. However, it later reported that in the first year of the COVID-19 pandemic alone this figure increased by more than 25%. This worsening of the public health problem due to the pandemic was also observed in the Mexican population in a study by Gaitán-Rossi et al. (2021). Given these statistics, it is important to take into account what the WHO Director-General, Dr. Tedros Adhanom Ghebreyesus, added in the previously cited report that "the information we now have on the impact of COVID-19 on the world's mental health is only the tip of the iceberg", as a way of drawing the attention of all countries to give greater importance to mental health and to remember that there were many more factors that were provoking anxiety.

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The journal issued by the Universidad Iberoamericana [IBERO] (2017) mentioned that the teacher responsible for the emotional skills development and prevention programme at the Universidad Iberoamericana, at the fifth RIECA CDMX symposium, pointed out that university students in Mexico City have a higher rate of anxiety compared to the general population because they are continuously subjected to a high load of academic demands, adapting to a new social environment, experiencing economic and family problems and even leaving their place of origin to continue studying. While anxiety is related to various disorders and constructs, one of them is perfectionism (Pineda-Espejel et al., 2018; Álvarez et al., 2021; Ceccon and Jorge, 2019; Aragón and Riberos, 2021). The latter construct has been defined in various ways. One of them is given by Frost, Maretn, Lahart and Rosenblate (1990), who define it as the tendency to set high performance expectations in combination with an overly critical evaluation of them and a growing concern about making mistakes. From Hamachek's theoretical work, two types of perfectionism began to be differentiated: normal and neurotic perfectionism, in order to differentiate the positive and negative characteristics of the construct. Although different ways of calling and conceiving this positive and negative side of perfectionism have emerged, we will use those proposed by Slaney, Rice, Mobley, Trippi and Ashby (2001): Adaptive and maladaptive perfectionism. Referring to the presence of high expectations which, on the one hand, in adaptive perfectionism have low discrepancy, and in maladaptive perfectionism have high discrepancy, i.e. the perception of not meeting one's own expectations.

The university environment, as an area where the high competitiveness and personal demands of its students stand out, in addition to the possibility of a concern for obtaining high levels of performance and not failing in terms of academics, has become a place of interest for various research on perfectionism (Fernán et al., 2010).

Although mental health is essential in all people, we will focus on medical students, since as health professionals they are among the main people who need to set an example of the importance of self-care, not only in the physical but also in the mental sphere. Moreover, it is well known that the level of demand of their profession is very high and a relationship between their performance in their profession and the level of anxiety and the type of perfectionism they display has been reported (Lagos et al., 2017; Trunce et al., 2020).

The importance of studying anxiety lies in the fact that it has been classified by the WHO and the Pan American Health Organization (PAHO), in most countries in the Region of the Americas, as the second most disabling mental disorder (World Health Organization & Pan American Health Organization, 2018). Moreover, this problem affects mental, psychological and social health; it compromises attention, concentration and decision-making skills; and it also leads to unsatisfactory academic performance and school dropout (Bohórquez, 2007; Agudelo et al., 2008; Carrillo, 2008; Moreno et al., 2009; Celis et al., 2001). Several studies have found that early identification of this disorder not only minimises the possibility of academic failure, but also greatly reduces other health risk behaviours, such as smoking, alcohol consumption or maladaptive eating behaviours (Agudelo et al., 2008; Campo et al., 2005). For the above reasons, we consider it essential to know the factors that influence the development of this pathology with current, local and scientifically relevant information. Despite the fact that anxiety has been related to perfectionism, there is not much literature on the subject, and therefore in this study we will seek to find out whether perfectionism influences the development of this mental health problem and these, in turn, in the academic performance of students, complementing the previous information in order to determine what would be the practical utility of developing prevention and/or intervention programmes with more precision in these factors and thus improve the quality of life of future professionals who will later be responsible for taking care of the health of the community in the same way.

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Thus, it is of vital importance to find one of the possible causes of anxiety in these university students and develop prevention and intervention plans to improve the students' quality of life and combat the presence of mental disorders that may worsen over time. Due to previous links between academic performance, perfectionism and anxiety and the presence of the latter two in university students, this paper asks the following question: Is there any relationship between anxiety, academic performance and perfectionism in university medical students?

Objective: to find out if there is a relationship between perfectionism, anxiety and academic performance through measurement instruments in university medical students.

Methodology

The research design is non-experimental with a quantitative, cross-sectional and correlational approach.

Participants

A non-probabilistic purposive sample of 363 undergraduate medical students, 29.2% male and 70.8% female. Their age ranged from 17 to 48 years (M=20.87 years, SD=2.79). The students belonged to different educational institutions, 51% were from the Universidad Autónoma de Nuevo León; 10.7% from the Universidad de Sonora, Hermosillo campus; 9.1% from the Universidad Estatal de Sonora, Benito Juárez unit; 7.7% from the Universidad Autónoma de Durango; 6.1% from the Universidad Autónoma de Baja California, Mexicali campus; and 15.6% from other universities. 30.6% were in their fifth semester, 14.6% in their third semester, 12.9% in their seventh semester, 11.8% in their fourth semester and 7.2% in their eighth semester, 9.1% in their first semester, 5% in their second semester, 3.3% in their sixth semester and 5.6% in more advanced semesters. 53.7% of the participants are studying in universities located in the state of Nuevo León, 29.2% in the state of Sonora, and the remaining 17.2% in other Mexican states.

Instruments

Two instruments were applied, the first one was the Multifactor Perfectionism Scale (Frost, et al., 1990), which contains six subscales corresponding to the dimensions of perfectionism: personal standards, comprising items 4, 6, 12, 16, 19, 24 and 30; concern about mistakes, comprising items 9, 10, 13, 14, 18, 21, 23, 25 and 34; doubts about actions, dimension assessed with items 1, 11, 15, 20 and 26; parental expectations, comprising items 3, 5, 22 and 35; parental criticism, comprising items 17, 28, 32 and 33; and organisation, which is assessed with items 2, 7, 8, 27, 29 and 31. The questionnaire is made up of 35 items with a Likert scale of response between 1 (strongly disagree) and 5 (strongly agree). The second instrument was the Inventory of State and Trait Anxiety (IDARE) (Spielberger et al., 1966) which measures two dimensions of anxiety: state (refers to how the subject feels at the moment) and trait (how the subject generally feels, regardless of specific situations). The trait anxiety section contains 20 items with a response scale ranging from 1 to 4 points (1=not at all, 2=a little, 3=quite a lot and 4=a lot). While the trait anxiety dimension is made up of 20 items with a Likert scale of response between 1 (almost never) and 4 (almost always). According to the manual and instructions created by Spielberger, & Díaz-Guerrero, (1975), the higher the scores, the higher the anxiety. However, there are items that should be scored in reverse, i.e., scores of 1, 2, 3 and 4 will be transformed, respectively, into scores of 4, 3, 2 and 1. The reverse items on the state anxiety scale are the following: 1, 2, 5, 8, 10, 11, 15, 16, 19 and 20. While the reverse items on the trait anxiety scale are the numbers: 1, 6, 7, 10, 13, 16 and 19. To obtain information about the students' academic performance, each participant was asked their cumulative GPA up to the time the research was being conducted.

Procedure and statistical analysis

All questionnaires were uploaded to the Google Forms digital platform. The link for university students to answer the questionnaire was provided by the authors of the research. By accessing the link, interested students could read the informed consent to be aware of the objective of the research, as well as the benefits and risks of participating. Those who accepted, proceeded to answer all the measurement instruments. Descriptive and inferential statistics were used in SPSS software version 23.0.

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Results

The mean for perfectionism was 3.06. In adaptive perfectionism, the mean was 3.54 and in maladaptive perfectionism, 2.82. On the other hand, for general anxiety the mean was 2.55. For state anxiety the mean was 2.56 and for trait anxiety 2.53. Finally, the mean academic performance of the students was 86.87 (see table 1).

	(n=363)
State anxiety	2,56 ± 0,62
Trait anxiety	2,53 ± 0,50
General anxiety	2,55 ± 0,52
Adaptive perfectionism	3,54 ± 0,92
Maladaptive perfectionism	2,82 ± 0,85
General perfectionism	3,06 ± 0,79
Academic performance	85,87 ± 6,67
Mean ± Standard deviation	

Table 1 Descriptive statistics of variables of interest

Comparison tests were conducted to examine whether the variables of interest of perfectionism and anxiety were different between males and females. No statistically significant differences were found between the means for perfectionism in both sexes. Differences were found between males and females in state anxiety (2.38 vs. 2.63 p=0.00), the same in trait anxiety (2.36 vs. 2.60 p=0.00) between males and females respectively. Finally, statistically significant differences were also found between men and women in general anxiety (2.37 vs. 2.62 p=0.00) (see table 2).

	Mens (n=102)	Women (n=249)	p*
Academic performance	85,13 ± 5,61	86,17 ± 7,04	0,18
State anxiety	2,38 ± 0,65	2,63 ± 0,59	0,00
Trait anxiety	2,36 ± 0,51	2,60 ± 0,48	0,00
adaptive perfectionism	3,41 ± 1,01	3,60 ± 0,88	0,07
Maladaptive perfectionism	2,69 ± 0,79	2,87 ± 0,87	0,08
General perfectionism	2,93 ± 0,79	3,11 ± 0,78	0,05
General anxiety	2,37 ± 0,54	2,62 ±0,49	0,00
* t-Student test p≤0.05 is statistically significant Mean and standard deviation			

Table 2 Comparison analysis of perfectionism and anxiety between genders

Regarding the relationship between variables, a significant negative relationship was found between anxiety and academic performance, both general, as well as state and trait dimensions. Other variables with which academic performance had a significant negative relationship were maladaptive perfectionism and general perfectionism. Finally, a significant positive relationship was observed between maladaptive perfectionism and anxiety, both with its state and trait dimensions and with general anxiety. On the other hand, no significant relationship was found between adaptive perfectionism and the academic performance and anxiety variables (see Table 3).

	RA	AR	AE	PD	PA	PG	AG
Academic performance	1						
Trait anxiety	-,199**	1					
State anxiety	-,191**	,730**	1				
Maladaptive perfectionism	-,182**	,391**	,386**	1			
Adaptive perfectionism	0,017	0,015	0,036	,602**	1		
General perfectionism	-,125*	,286**	,291**	,951**	,820**	1	
General anxiety	-,209**	,914**	,945**	,417**	0,028	,310**	1
** Correlation is significant at the 0.01 level (bilateral). * Correlation is significant at the 0.05 level (bilateral).							

Table 3 Correlation matrix between the study variables

Conclusions

According to the information obtained in the study, there is a significant positive relationship between general perfectionism and anxiety, as well as between the latter and maladaptive perfectionism. This is consistent with the findings of Aragón and Riveros (2021) after a study involving 558 university students from UNAM where a significant relationship was observed between anxiety and maladaptive perfectionism. It was also found that those who experienced greater anxiety and perfectionism had lower academic performance.

Díaz and Castro (2020) mention that the anxiety present in various aspects of student life such as exams, overload of academic and practical activities of their career generate a significant impact that translates into alterations at the cognitive, physical and perceptual levels that prevent students from responding correctly to school demands. In relation to this, in the present study the students stated that they did not feel rested at all and were quite worried about any possible setbacks.

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Tamannaeifar & Hadadi (2023) correlated the mediating role of maladaptive cognitive emotion and regulation strategies in the relationship between negative perfectionism and adolescent social anxiety, obtaining a significant relationship, which is a contribution to the field of prevention, diagnosis and treatment of anxiety disorder.

Likewise, in another study, Trunce et al. (2020) found that, compared to other conditions such as stress or depression, anxiety has the most significant relationship in the average student. However, there is also evidence that anxiety is not always related to GPA or academic performance. In this regard, Reyes et al. (2017) surveyed students at a medical school in Mexico prior to their internship process and found that there was no significant relationship between anxiety and academic performance. Díaz and Castro (2020) offer an explanation for this by stating that "there are many factors that actively influence academic performance, these factors can be directly related to the academic context or be external to it". In other important results, it was found that, among the surveyed population, females had a higher prevalence of anxiety. In this regard (González-Jaimes et al., 2020; cited in Cortina, 2022) mentions that there are few exceptions where the prevalence of anxiety is observed in the male population. In another study Monterrosa-Castro et al. (2020) mention that some factors that make women more prone to anxiety are: genetics, sex hormones, the capacity for chemical and endocrine reaction to stress, greater presence of some neurotransmitters and the existence of related neuropsychological determinants. Fekih-Romdhane et al., (2023) report that self-critical perfectionism may mediate between self-esteem and life satisfaction, suggesting the roles of self-esteem and perfectionism as key areas that help improve students' life satisfaction.

In conclusion, this study aimed to find out whether there is a relationship between perfectionism and anxiety in medical students through measurement instruments and whether perfectionism and anxiety influence the academic performance of medical students. The results obtained confirm that there is a negative relationship between academic performance and anxiety, as well as a negative relationship between academic performance and perfectionism. In addition, a positive relationship was found between anxiety and perfectionism.

These findings suggest that both anxiety and perfectionism are important factors to consider when investigating the academic performance of undergraduate medical students.

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Precise modeling and 3D printing of biocompatible craniofacial prostheses

Modelado preciso e impresión 3D de prótesis craneofaciales biocompatibles

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Abstract

Currently, the fabrication of accurate maxillofacial prostheses involves the integration of 3D modeling and printing technologies. This entails using tomographic scans information in (DICOM) images obtained through computed tomography "CT Scan", free-use software, and 3D printers [I, II]. These techniques are widely used by physicians and engineers, however, a generalized methodology for creating prostheses with “absolute accuracy” to patient requirements has not yet been formally established, according to Pöppe, J.P., et al. (2011) [III]. This paper shows the case of a male athlete who required implanting a large volume prosthesis in the right parietal of the Calota. The implanted prosthesis is not absolutely exact, which causes frequent headaches, in addition to being aesthetically sub-optimal. In this work, the objective is to propose a methodology that allows generating maxillofacial prostheses using DICOM images. Python libraries included in free software are used for visualization, '*.stl' stereolithographic modeling and eventual 3D printing [IV, V]. This specific case is deepened, examining each aspect in detail, and the results are compared with those of the prosthesis placed, thus contributing to improving the generation of "absolutely accurate" prostheses.

Prótesis maxilofacial, Subóptima, Tomográfica, Tomografía, Implantes craneales, Estereolitografía, Software ibre, Empleada, Metodología, Establecida, Parietal, Estética

Resumen

Actualmente se generan con éxito prótesis maxilofaciales usando modelado e impresión 3D con alto grado de precisión. Se logra mediante información en imágenes tomográficas (DICOM) obtenidas a través de tomografías computarizadas “CT Scan”, software de uso libre, e impresoras 3D [I, II]. Estas técnicas son ampliamente empleadas por médicos e ingenieros, sin embargo, aún no se ha establecido de manera formal una metodología generalizada para crear prótesis con “absoluta exactitud” a los requerimientos del paciente, según Pöppe, J.P., et al. (2011) [III]. En este trabajo se muestra el caso de un atleta masculino que se requirió implantar una prótesis de gran volumen en el parietal derecho de la Calota. La prótesis implantada no es absolutamente exacta, lo que provoca frecuentes dolores de cabeza, además que estéticamente es sub-óptima. En este trabajo, se plantea como objetivo proponer una metodología que permita generar prótesis maxilofaciales utilizando imágenes DICOM. Se emplean bibliotecas de Python incluidas en software libre para visualización, modelado estereolitográfico ‘*.stl’ y su eventual impresión 3D [IV, V]. Se profundiza en este caso específico, examinando detalladamente cada aspecto, y se comparan los resultados con los de la prótesis colocada, contribuyendo así a mejorar la generación de prótesis de "absoluta exactitud".

Maxillofacial prosthetics, Suboptimal, Tomographic, Tomography, Cranial implants, Stereolithography, Free software, Employed, Methodology, Established, Parietal, Aesthetics

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Introduction

Traumatic brain injury (TBI) represents a widespread reason for emergency department visits worldwide, and it carries significant consequences in terms of both disability and mortality. Brain imaging, specifically using CT scans, plays a crucial role in the management of TBI. Moreover, it greatly aids in the identification of traumatic brain injuries, as illustrated in Figure 1. Consequently, on a global scale, the prevalence of trauma results in approximately 1.2 million fatalities and a range of 20 to 50 million non-fatal cases annually. This, in turn, establishes trauma as the primary contributor to disability. In the specific context of Latin America, the mortality rate stands at 38.8 deaths per 100,000 inhabitants, positioning it as the fourth most common cause of death [V]. These concerns predominantly affect males with an average age of around 34.3 years. Furthermore, approximately one-third of survivors will experience significant sequelae, and only 40% will successfully reintegrate into their occupational roles. In conclusion, a discriminative reflective model has been demonstrated, offering the capacity to prognosticate outcomes pertaining to severe disability, vegetative state, and mortality among individuals afflicted by traumatic brain injury. This predictive model stands as a reliable tool applicable within clinical environments. Consequently, this innovation holds the potential to instill a high degree of confidence in its utilization within medical practice. [VI].

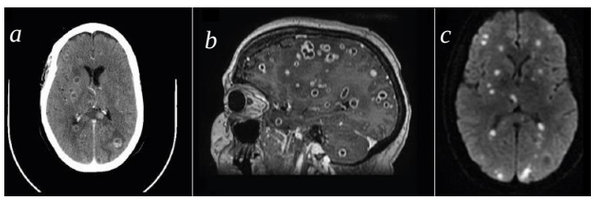

Figure 1 Image example of CTScan (computed tomography) (a) Represents axial section with skull bone, (b) Sagittal section, (c) Axial section without skull bone. *Source: Figure extracted from Multiple brain abscesses due to Streptococcus milleri. Revista de Neurología [VII].*

This subject is of pertinent importance, wielding a substantial influence on Mexican societal dynamics. Primarily, it engenders ramifications for the afflicted individual as the central casualty, along with their familial network, which becomes encumbered with the financial burdens of hospitalization, surgical procedures, provision of prosthetics, and diverse rehabilitation regimens.

Furthermore, not only does it impact governmental bodies and commercial enterprises, but it also has a consequential effect when prolonged disability afflicts an employee, resulting in a 33% probability of encountering notable lingering consequences. Consequently, the multifaceted repercussions of this phenomenon permeate various strata of Mexican society.

In this investigation, our primary emphasis is directed toward formulating a methodology with the specific objective of fabricating a prosthetic apparatus that impeccably aligns with the precise requisites of the patient [III]. The cardinal novelty inherent in this scholarly inquiry resides in the exclusive utilization of publicly accessible, specialized computational tools. These tools empower designers, engineers, or medical practitioners to craft a prosthetic device distinguished by this singular attribute of unequivocal precision. Moreover, the prosthetic construct engendered through the delineated procedure must encompass four designated attributes [VIII]:

a) Comparatively economical.

b) Pleasing in its aesthetic manifestation.

c) Exhibiting commendable functionality.

d) Pertaining to the production of prostheses tailored in accordance with the morphological attributes of the individual. Consequently, the pursuit of these endeavors epitomizes a substantial advancement in the domain of prosthetic development.

Three-dimensional (3D) printing or Additive Manufacturing (AM) is a group of fabrication processes where three-dimensional parts are constructed by adding layers of bondable materials on point, line, or planar surfaces [IX, X]. a swiftly developing technology, has brought about transformative changes across multiple sectors, particularly medicine and surgery. This advancement in medical applications has been facilitated by the convergence of progress in manufacturing technologies, cross-sectional imaging, user-friendly medical 3D computer-aided design (CAD) software and expanding clinical indications.

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The capacity to fabricate accurate, patient-specific anatomical and pathological models has propelled enhancements in surgical preoperative planning, intraoperative decision-making, education, and the design of both customized and commercially available 3D-printed implants. In synergy with novel surgical methodologies, 3D printing has contributed to addressing increasingly intricate spinal deformities, refining outcomes during complex oncological resections, and enabling the production of bespoke implants [XI].

Finally, the fundamental necessity for achieving precise medical prostheses is contingent upon the provisioning of medically customized remedies harmonized with the intricate subtleties of human anatomy. This juxtaposes significantly against conventional medical apparatuses, which lack the capability to accommodate individualized prerequisites and are characterized by their elevated financial implications. Consequently, a pressing need emerges for pioneering fabrication approaches within the domain of tailored precision medicine. This imperative is underscored by the overarching aspirations of curbing financial burdens and enhancing operational efficiency [XII]. Moreover, the emergence of such methodologies bears substantial implications for the landscape of medical intervention.

The DICOM format

The DICOM format (Digital Imaging and Communications in Medicine) is a standard used for the exchange of medical images and related data in clinical settings. DICOM provides a common file format that allows different medical devices, such as magnetic resonance machines, computed tomography scanners, and ultrasound systems, to capture, store, transmit, and display medical images in an interoperable manner The data compilation encompasses additional metadata, encompassing a comprehensive range of attributes including, but not confined to, pixel data particulars as well as pertinent patient demographics like nomenclature, gender, age, mass, and stature. The caliber of medical images stands as an exceedingly pivotal determinant, exhibiting a profound correlation with the precision of diagnostic interpretations and practicability. [XIII].

Consequently, the medical sphere necessitates substantial storage capacity for perpetuating long-term archival pursuits. Moreover, this mandates the implementation of streamlined communication mechanisms adept at expediently transmitting these images. The intricate interplay of these elements forms an integral aspect of the medical landscape. [XIII].

Primarily, DICOM establishes a coherent set of regulations and protocols aimed at guaranteeing harmony and uniformity within the realm of medical image communication. It delineates the stipulations governing the storage of image data and outlines the architecture and structure of accompanying metadata, encapsulating crucial elements like patient specifics, acquisition methodologies, and distinct image attributes. Consequently, this framework ensures the accessibility and accurate interpretation of pertinent clinical data across disparate medical systems and applications. Moreover, it expedites the assimilation of medical images into Health Information Systems (HIS) and Picture Archiving and Communication Systems (PACS). Through the adoption of the DICOM framework, a seamless exchange of images and their associated data becomes feasible across diverse devices and healthcare settings. This, in turn, fosters heightened collaboration and facilitates unimpeded access to clinical insights. This facet assumes paramount importance, especially within contexts demanding the sharing of images among hospitals, clinics, and specialized practitioners for purposes of patient diagnosis, therapeutic interventions, and post-treatment monitoring. Thirdly, DICOM encompasses comprehensive standards encompassing the visualization and manipulation of medical images. It delineates the manner in which images ought to be rendered in terms of grayscale dynamics, annotations, quantifications, and image processing utilities. This meticulous standardization guarantees that medical professionals and healthcare providers can accurately and consistently decipher and assess images, irrespective of the platform or visualization instrument at their disposal [XIII]. This multi-faceted orchestration, rooted in the DICOM framework, orchestrates a symphony of interoperability and precision across the complex landscape of medical imaging.

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In synopsis, the DICOM format stands as an elemental benchmark within the realm of medical imaging, affording a secure and dependable avenue for the seamless transmission of images and correlated data across heterogeneous devices and healthcare infrastructures. This format not only fosters interoperability but also amplifies collaborative capacities, thereby securing the precision of medical image interpretation. Consequently, this pivotal standard engenders an advancement in patient care and therapeutic interventions. Moreover, the multifaceted influence of the DICOM format traverses the intricate expanse of medical practice.

Visualization of DICOM images with free software

DICOM images necessitate rendering through dedicated software entities recognized as DICOM viewers, adept at comprehending and presenting this specialized format. These images, in conjunction with their correlated patient particulars, commonly find their repository within an expansive repository denoted as a Picture Archiving and Communication System (PACS). The reason for being a DICOM application resides in its ability to stockpile comprehensive insights within the PACS pertaining to the imaging exploration, alongside pertinent patient attributes. Subsequently, when requisite, these applications facilitate the visual examination, interpretation, and potentially even manipulation of the medical images procured from the PACS. The distinctive attribute of DICOM images rests in their fusion of patient-specific information and the actual image data. Consequently, the intrinsic character of DICOM images not only encapsulates visual data but also serves as a conduit for conveying indispensable clinical details.

A broad spectrum of software applications, libraries, and open-source platforms is accessible for the purpose of visualizing DICOM images. Moreover, several of the preeminent options encompass:

1. InVersalius [XIV]
2. OsiriX
3. Blue Sky Plan 4 [XV]
4. 3D Slicer [XVI]
5. Ginkgo CADx
6. MedDream DICOM Viewer
7. MicroDicom
8. RadiAnt DICOM Viewer
9. DICOMscope
10. Sante DICOM Viewer Free
11. Mango
12. GDCM (Grassroots DICOM)
13. DicomBrowser

Methodology

Visualization and generation of the stereolithographic model

a) The beginning of this investigation involves the acquisition of tomographic studies conducted within the pertinent medical institution or clinical domain, subsequent to obtaining requisite consent from the patient and/or their familial representatives. Upon the acquisition of this dataset, either Blue Sky Plan 4 (developed by Blue Sky Bio, USA) or 3D Slicer 5.2.2 is employed. Notably, both of these software applications produce analogous visualization outcomes, as evidenced by the illustration in Figure 2. Consequently, the selection of either of these programs offers consistent visualization results for the undertaken analyses.

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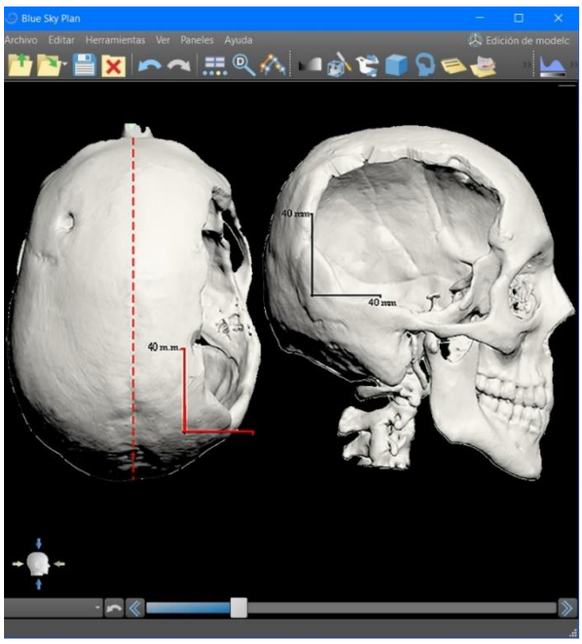

Figure 2 Visualization of tomography in Blue Sky Plan 4 software (Blue Sky Bio, EE. UU.) (Left) superior view, (Right) right lateral view, cavity of the prosthesis. This figure was created in Blue Sky Plan 4 software

b) The selection of software is contingent upon the specific exigencies and predilections of the user. For the purpose of exporting the '.stl' model, our focus converged on both Blue Sky Plan 4 [XV] and Slicer 5.2.2 [XVI]. These two open-source software platforms are notable for their utilization of Python libraries, each equipped with its dedicated Python console. This console interface empowers users to adeptly manipulate commands, thereby streamlining tasks associated with visualization and the formulation of *'.stl'* files. Furthermore, it is noteworthy that a substantial corpus of documentation is at the disposal of users, elaborating on the intricacies of their operational paradigms. The generation of the '*.stl' model is subsequently executed via the "create model" directive integrated within the Blue Sky Plan 4 software, a depiction of which is portrayed in Figure 3. Swiftly and efficiently, this command engenders the model, positioning it within the directory designated by the user. Consequently, the adoption of either of these software platforms facilitates the swift and precise generation of the target model, aligned with user-specific stipulations.

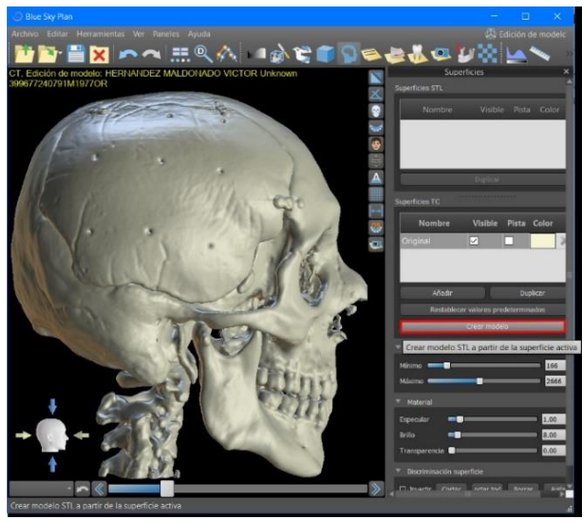

Figure 3 Generation of the '*.stl' model with the Blue Sky Plan 4 software (Blue Sky Bio, EE. UU.) This figure was created in Blue Sky Plan 4

Consequently, this marks the culmination of the visualization and extraction process for the '*.stl' model.

Refining the model and obtaining the final prosthesis

Moreover, the patient manifests a distinctive attribute within their case, necessitating the application of two distinct prosthetic interventions across both hemispheres of their cranial structure. The initial and more imperative prosthesis finds its placement on the right parietal region, which previously underwent a craniotomy procedure. Equally imperative is the requirement for a perforation on the left frontal region to accommodate a drainage valve. Both of these prerequisites are graphically elucidated in Figure 4, demarcated by the dashed red line.

To start, we direct our attention to the scenario entailing the craniotomy-related prosthesis. Evidently, meticulous preoperative strategizing is essential to optimize the design of this prosthesis. The inaugural phase involves the utilization of a computed tomography (CT) scan of the patient's cranium. The purpose here is to conceptualize an implant tailored to the affected area, i.e., the right parietal region of the cranial anatomy, as visually represented in Figure 4.

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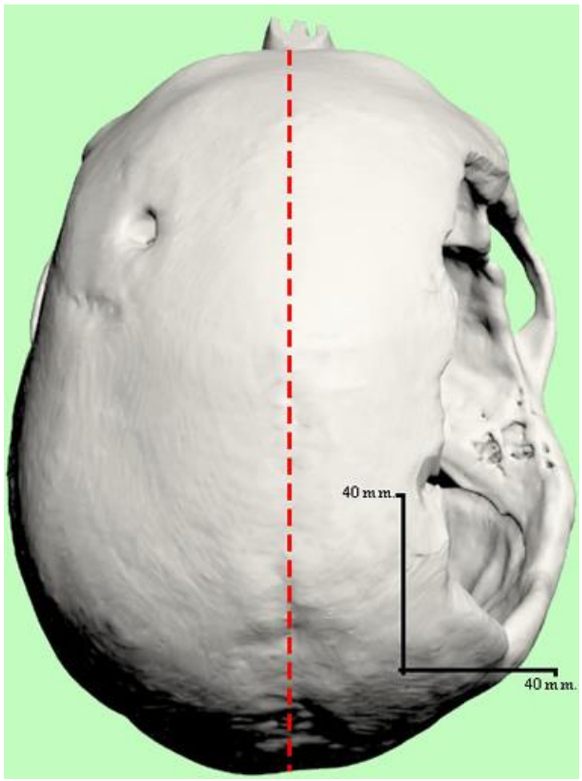

Figure 4 Displays a CtScan of the patient from a superior viewpoint. The left side depicts a healthy skull, while the right side reveals a huge absence or loss. This figure was created in 3DS Max 2023

The procedure for designing entailed the implementation of the mirroring technique, which involved referencing the intact side of the skull (depicted in Figure 4; situated on the left side of the dashed red line). This approach ensured the alignment of the skull while concurrently establishing the precise orientation for the cranial implant. This methodology is visually illustrated in Figure 5. Moreover, this strategy is pivotal in achieving accurate implant alignment and positioning.

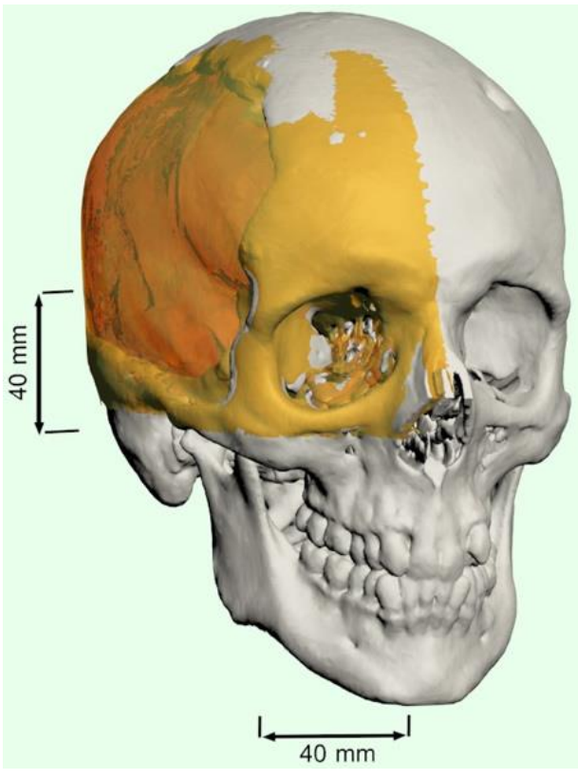

Figure 5 Displays a contrast between both zones, the healthy and the loss of bone. This figure was created in 3DS Max 2023

The mirroring technique appears to yield promising results, and now it is time to exclusively model the area that the prosthesis covers.

It is of utmost importance to carefully adhere to the boundary set by the skull or recipient matrix when designing the prosthesis model. This aspect represents the major contribution of this study. While certain functionalities within Python software, such as Slicer 3D 5.22, are harnessed to execute this task, the resultant prosthesis does not attain the state of "absolute accuracy" as defined by Pöppe, J.P., et al. [III]. Consequently, there remains a potential divergence between the final fabricated prosthesis and the precise contours of the recipient's cranial architecture. This discrepancy underscores the imperative for further refinements in pursuit of enhanced precision.

Therefore, the suggested methodology can be outlined as follows:

1. Meticulously trim the surplus region that intersects between the prosthesis model and the recipient matrix, with careful consideration for precision and alignment.

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2. Subsequently, it becomes imperative to ensure the "closure" of the model, guaranteeing absolute continuity of the surface of the prosthesis model. In essence, the stereolithographic rendition must be devoid of any gaps or disruptions in its mesh structure.

3. This necessity arises due to the mirroring technique employed in modeling from the CT scan (depicted in Figure 5), which does not perceive the cranial osseous system as a cohesive entity with a wholly continuous surface. Instead, it results in the generation of an empty mesh, introducing a void between the internal and external surfaces, or even between both sides of the cranium. The problem of this predicament resides in the inadequacy of this approach for the purposes of fabrication, as a consistent mesh is imperative for comprehensive printing considerations. It is essential that the mesh maintains continuity across all facets of the cranial anatomy, encompassing both surfaces and the structural thickness of the skull. Consequently, the procedural guidelines elucidated, become indispensable in addressing this exigency.

4. During this phase, it becomes apparent that certain regions within the mesh of the prosthetic model persist in overlapping with the patient's cranial structure. These overlapped discrepancies have the potential to engender complications in the event of the prosthesis being "intersected" by the patient's skull during the printing process. Consequently, these regions are pinpointed, and the vertices of the mesh are subject to manual modification or manipulation to rectify these imperfections. This meticulous adjustment is essential to ensure a precise and seamless fit of the fabricated prosthesis onto the recipient's anatomy.

5. In the ultimate stage, the Spline interpolation technique is deployed, leveraging a mathematical function to estimate values with the goal of minimizing the aggregate curvature of the surface. As a corollary, a polished and continuous surface is engendered, meticulously traversing the input points [XIII]. This intricate procedure serves to eradicate irregularities within the prosthesis, the presence of which could potentially instigate persistent cephalgia for the patient. Such irregularities might inadvertently interact with tender regions of the scalp, eliciting sensations of discomfort.

6. The application of the Spline interpolation method thus bears significance in refining the prosthetic structure to ensure patient comfort and satisfaction.

Results

Primarily, it is imperative to comprehend the aftermath of the prosthesis that has been surgically embedded within the patient. This outcome is elucidated through the depiction in Figure 6, which accentuates the regions where the prosthesis does not achieve a seamless integration with the contours of the patient's cranial architecture. This incongruity engenders a lack of continuity, resulting in a persistent and vexing manifestation of headaches that the patient must continually contend with.

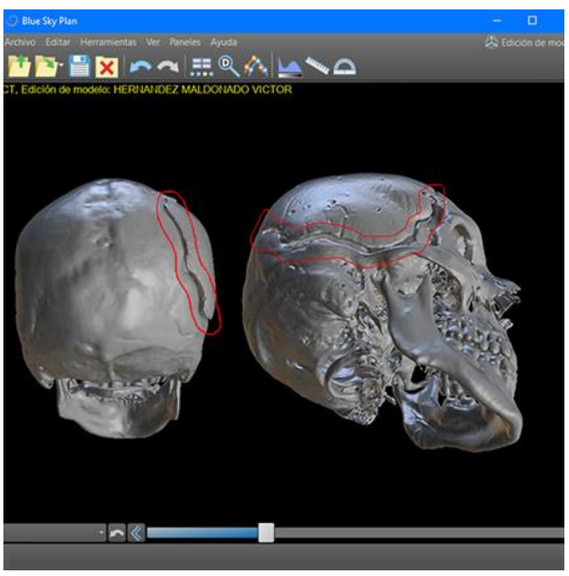

Figure 6 The presented image displays the prosthesis that has been placed on the patient. Additionally, the red highlighting emphasizes the discontinuity between the prosthesis and the skull's boundary. This figure was created in Blue Sky Plan 4

The outcomes of the methodology expounded are visually presented. Figure 5 exemplifies the utilization of the mirroring technique to reinstate the region influenced by the craniotomy. Within this illustration, it becomes discernible that a substantial portion of the "cloned" mesh redundantly intersects with the patient's cranial structure, as conspicuously observed around the right eye socket. Moreover, Figure 7 offers a comprehensive portrayal of the results emanating from the application of steps 1, 2 and 3.

This illustration unveils the efficacious elimination of superfluous material, concurrently affording a proximate representation of the ultimate implanted prosthesis model. This cascade of visual depictions contributes to an enhanced comprehension of the procedural evolution and its resultant impact on the prosthesis fabrication process.

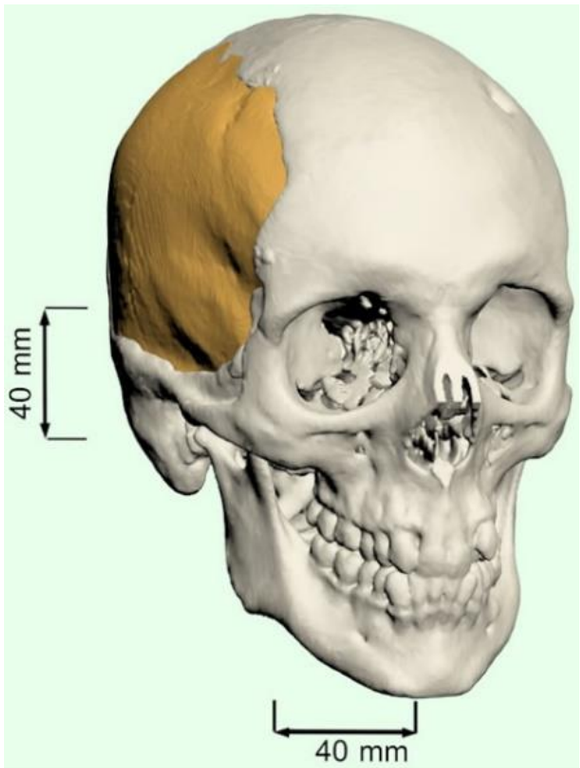

Figure 7 Displays the result of steps 1, 2 and 3; The excess mesh of the prosthesis was trimmed. This figure was created in 3DS Max 2023

In a concluding illustration, Figure 8 serves to exhibit the finalized prosthesis model, having undergone the comprehensive closure and smoothing processes detailed in step 4. Furthermore, the entirety of the cranial structure is depicted, rendered with a pronounced level of transparency.

This strategic visualization technique is employed to accentuate the prosthesis, distinctly demarcating its presence and pinpointing its precise location within the context of the entire skull. This multifaceted visualization aids in elucidating the integration and alignment of the prosthesis within the recipient's cranial anatomy.

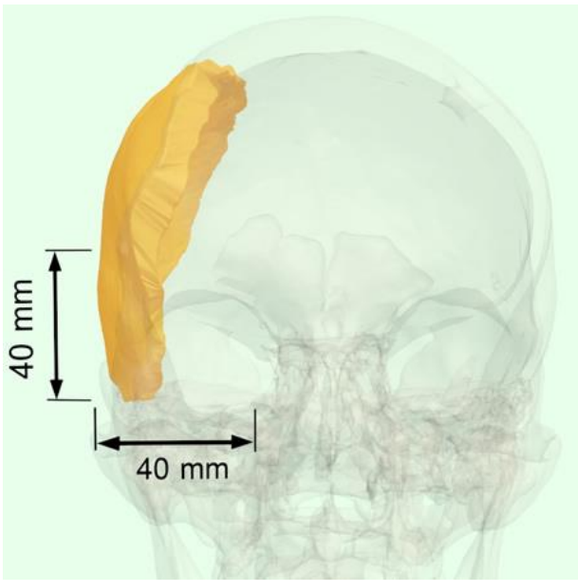

Figure 8 The completed prosthesis is presented, demonstrating the desired softening effect. This figure was created in 3DS Max 2023.

Subsequently, our attention turns to the scenario involving the second prosthesis, whose function is to cover a perforation on the left frontal section. This perforation was necessitated by the insertion of a drainage valve, a depiction of which is evident in Figure 9. This pivotal context underscores the distinct focus of the ensuing analysis and design considerations.

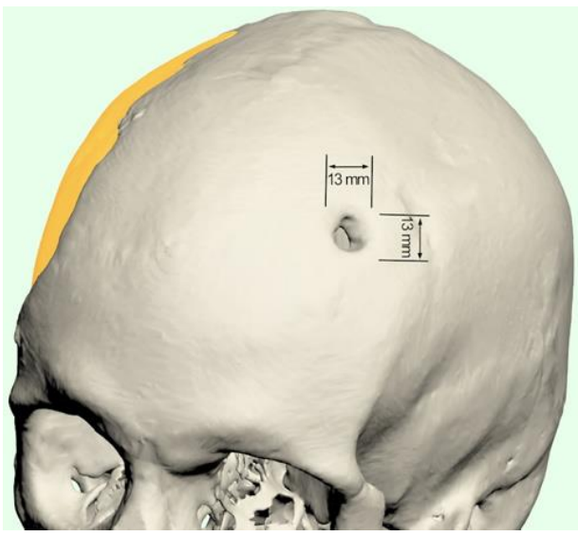

Figure 9 Perforation occurred due to inserting the drain valve in the left frontal bone. This figure was created in 3DS Max 2023

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Figure 10 displays the outcome of applying steps 1, 2, 3, and 4 for the creation of the "plug" prosthesis for the left frontal bone.

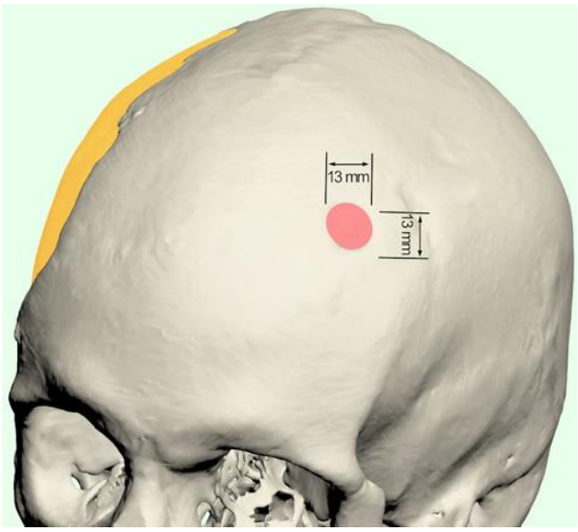

Figure 10 Perforation occurred due to inserting the drain valve in the left frontal bone. This figure was created in 3DS Max 2023

In pursuit of the objective of visually representing both prostheses, Figure 11 serves to present the two finalized prosthesis models, each having undergone the requisite closure and smoothing procedures. Additionally, the entirety of the cranial structure is unveiled, characterized by a notable degree of transparency. This visual depiction strategy is strategically employed to underscore the presence and significance of both prostheses, distinctly highlighting their individual locations within the overall cranial framework. This comprehensive visualization endeavor significantly contributes to enhancing the understanding of the spatial dynamics and alignment of the two prostheses within the anatomical context.

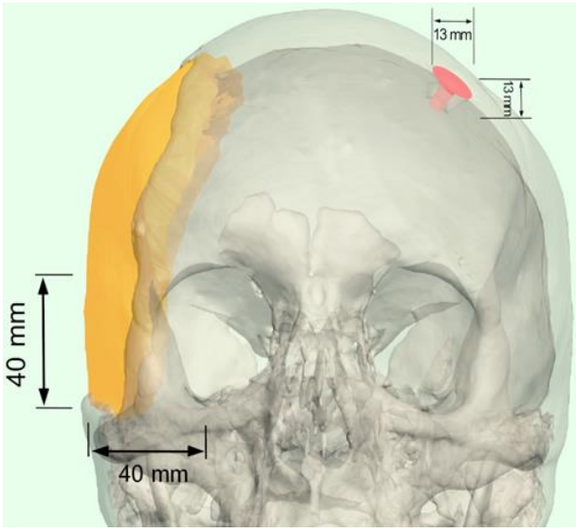

Figure 11 They are shown both prosthesis models. On the left side, it is shown the bigger prosthesis, on the right side the 'plug' prosthesis is shown; the rest of the skull is shown with a transparent effect. This figure was created in 3DS Max 2023

3D printing applications in the near future

The advent of versatile biomaterials possessing intrinsic and specialized functionalities alongside distinct biological impacts satisfactorily fulfills the requisites of diverse biomedical utilization [XVII].

As we know, neoplasms pose a significant peril to human well-being. Concurrent with global demographic aging and shifts in environmental and behavioral patterns, the annual incidence of cancer-related mortalities exhibits a rising trend. Thus, the international community finds itself enmeshed in a critical confrontation with the formidable adversary of cancer [XVIII].

In light of this circumstance, the management of tumor treatment conditions has emerged as a pivotal endeavor for the scientific community. Within the scope of cancer therapeutics, chemotherapy assumes an indispensable function. Regrettably, numerous extant pharmacotherapeutic agents targeting tumors manifest inherent challenges encompassing pronounced hydrophobic characteristics, limited systemic absorption, heightened cytotoxicity, and deleterious secondary outcomes, thereby impeding their alignment with the requisites of efficacious cancer treatment. Consequently, a preeminent imperative in our agenda involves the fabrication of an adept and minimally cytotoxic conduit for dispensing antineoplastic agents.

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Formulations characterized by sustained and/or targeted release mechanisms afford the advantage of protracted and concentrated exposition of neoplastic tissue to therapeutic drug moieties. This strategic modality circumvents the exigency of recurrent dosing, concomitantly attenuating the toxicity profile and untoward repercussions associated with antineoplastic interventions. In contrast with conventional pharmaceutical techniques, three-dimensional (3D) printed pharmaceuticals offer pivotal merits encompassing malleable tailoring and meticulous dose regulation. The capacity for "just-in-time" generation of pharmaceutical constructs utilizing 3D printing modalities obviates the constraints inherent in the conventional paradigm of uniform manufacturing processes, thereby aptly addressing the personalized therapeutic requisites dictated by distinct patient parameters including age, body mass, organ functionality, and disease acuity [XVIII].

Additive manufacturing (AM), commonly known as 3D printing, represents a paradigm-shifting strategy within industrial domains. It constitutes a novel digital process characterized by the successive deposition of materials to form intricate three-dimensional configurations based on digitalized 3D schematics. In the contemporary milieu, the biomedical sphere has become an arena of paramount significance for 3D printing, epitomizing a versatile and environmentally conscientious technique for engendering intricate geometries germane to healthcare domains. The prowess of additive manufacturing materializes in the provision of highly personalized and patient-specific anatomical constructs, presenting an innovative and tailored therapeutic avenue for individual patients. This technology finds exceptional utility within the medical sciences, facilitating the fabrication of surgical and medical apparatuses, prosthetic constructs, and bespoke implants tailored to the anatomical demands of diverse corporeal regions. Its utilization in the medical domain spans disciplines such as orthopedics, dentistry, and the engineering of surgical instrumentation encompassing items like eyeglass frames and lenses.

Beyond its conventional biomedical applications, additive manufacturing has extended its purview to encompass progressive facets like the three-dimensional bioprinting of living cellular and tissue structures. Furthermore, the prevalence of customer-centric requisites within the biomedical milieu, particularly in the realm of prosthetics, has amplified the prominence of additive manufacturing's role [XIX].

This technological advancement thus experiences a burgeoning trajectory in the creation of patient-specific implants and prosthetic solutions, fundamentally redefining the landscape of tailored healthcare solutions.

A diverse array of substances finds application in the additive manufacturing realm, encompassing constituents such as acrylonitrile–butadiene–styrene, nylon, polylactic acid, wood, rubber, and ceramics, among others. This underlines the wide-ranging spectrum of printable materials, ranging from plastic filaments to metallic and carbon powders, as well as hydrogels. This inherent versatility in both the 3D printing materials and the process itself engenders its extensive utilization, surpassing that of conventional methodologies.

The present quandary confronting 3D printing technology within the biomedical domain pertains to the fabrication of materials through this process. Predominantly, the challenges are concentrated in the judicious selection of binding agents and compatible printers. The attainment of desired end products hinges on the choice of an apt binder during the material curation process. In the context of biodegradable 3D printed materials, the binder necessitates attributes of non-toxicity, biodegradability, and operational feasibility; however, a binder possessing the complete suite of these attributes proves to be an elusive proposition. Consequently, the task of identifying a fitting binder suited for the 3D printing of biomedical devices remains a formidable undertaking in this domain [XIX].

Conclusions

This study leveraged two aspects that are readily available for research: Firstly, the current momentum in the field of maxillofacial prosthesis manufacturing using open-source software for modeling and creating stereolithographic files, along with 3D printing.

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Secondly, the significant number of cases in Mexico and worldwide makes traumatic brain injury one of the leading causes of death. Consequently, there is a great need for the population to generate high-quality and cost-effective prostheses.

The second aspect pertains to having the author's own case as a study subject, which provided access to tomographic studies and the input of healthcare professionals, particularly traumatologists and neurosurgeons. As mentioned in the body of this work, the patient suffers from constant headaches primarily caused by the inaccurate positioning of the prosthesis, which is misaligned with the skull bone, as shown in Figure 6.

This imprecision motivated the author to explore options for generating maxillofacial prostheses, as stated by Pöppe, J.P., et al. [III], which must be of "absolute precision."

In addition, the flexibility of 3D printing materials allows the selection of biocompatible options tailored to the individual needs of patients. Integrating 3D printing technology into orthopedic and prosthetic patient care improves the efficiency of the device manufacturing process while ensuring customized solutions that optimize patient outcomes [XVIII].

The next step in this research is the printing or generation of the "plug" prosthesis using biocompatible materials, which will be implanted through a surgical intervention in the patient to observe their reaction and determine the feasibility of the entire process.

Future research involves the utilization of artificial intelligence (AI), as demonstrated by da Rocha et al. (2022) [XX], to implement the method proposed here and generate prostheses of absolute precision.

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Abstract (In English, 150-200 words)

Objectives
Methodology
Contribution

Abstract (In Spanish, 150-200 words)

Objectives
Methodology
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Keywords (In English)

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* Correspondence to Author (example@example.org)
† Researcher contributing as first author.

Introduction

Text in Times New Roman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

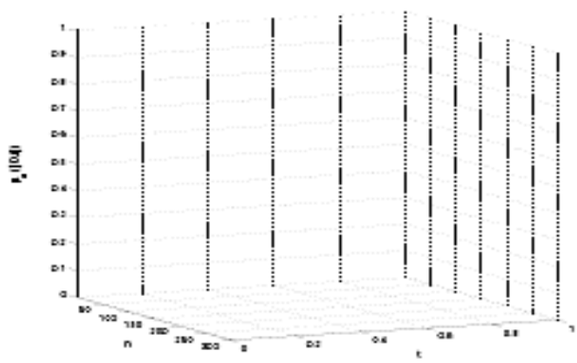
[Title No.12 in Times New Roman, single spaced and bold]

Products in development No.12 Times New Roman, single spaced.

Including graphs, figures and tables-Editable

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the bottom with No.10 and Times New Roman Bold]



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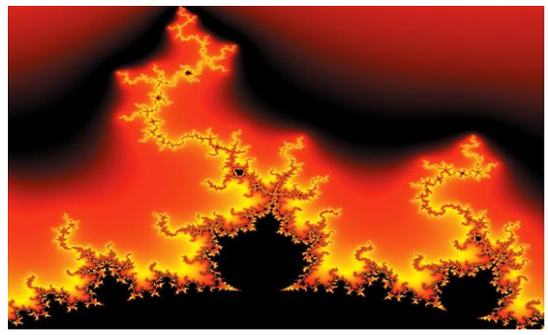

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Each article shall present separately in **3 folders**: a) Figures, b) Charts and c) Tables in .JPG format, indicating the number and sequential Bold Title.

For the use of equations, noted as follows:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij} \qquad (1)$$

Must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the article.

Annexes

Tables and adequate sources thanks to indicate if were funded by any institution, University or company.

Conclusions

Explain clearly the results and possibilities of improvement.

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Use APA system. Should not be numbered, nor with bullets, however if necessary numbering will be because reference or mention is made somewhere in the Article.

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