

Discussing health in high school: Coronary artery disease (CAD) and its relationship with gene, sedentary lifestyle and nutrition



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Cisnara Pires Amaral

Professor of the Department of Biological Sciences of the Regional Integrated University of Alto Uruguay and Missions – URI.

Lattes: <http://lattes.cnpq.br/7537983455625777>,

Orcid: <https://orcid.org/0000-0002-5510-5710>,

E-mail: cisnara.amaral@urisantiago.br

Eduarda Pires Amaral

Academic of the VII semester of the Medical Course of the Federal University of Rio Grande.

Lattes: <http://lattes.cnpq.br/7194325145370274>,

Orcid: <https://orcid.org/0000-0003-1853-5460>

Luana Casarotto de Borba

Academic of the VIII semester of the Nursing Course of the Regional Integrated University of Alto Uruguay and the Missions – URI.

Lattes: <http://lattes.cnpq.br/5141322790622646>,

Orcid: <https://orcid.org/0000-0003-2713-4116>

ABSTRACT

The work in question is related to the "XXIII Scientific Exhibition" held at the School of Basic Education linked to the Regional Integrated University – URI where academics guided by the regent of the discipline of Biology encourage high school students to carry out scientific work that provides opportunities for research, scientific

development and protagonism. The relevant points of the work are in the research and understanding carried out between the relationship of genetic and environmental factors and their actions in the development of coronary artery diseases (CAD); in addition to the perception regarding the learning opportunities of this work for high school students. To this end, the bibliographic research was carried out from the search of articles published between 2021 and 2022 found in the "PubMed" database, being discarded articles whose objective and the results/conclusion were not consistent with the central idea of the work. In relation to the research, it was concluded that genes are important factors for the possibility of the development of such diseases, however, a good diet and the practice of physical exercises appear as limiting factors for CAD to manifest themselves, considering their influence on the body, since it is proven that the genes contribute very little to the action of coronary diseases. In relation to the protagonism of the student, it was observed that the research provided scientific knowledge, opportunity to dialogue with academics, incentive to research understanding that it is an essential factor for the development of criticality, autonomy, competence and learning in a significant way.

Keywords: Genes, cardiovascular diseases, middle school, role.

1 INTRODUCTION

The real and significant learning should be related to the daily life of the adolescent, in this way the schools use tools for the students to understand the importance of scientific research, making the relation of the contents developed in different disciplines with those seen in the Universities and with the National High School Examination (ENEM).

These tools are related to "Scientific Initiation Exhibitions", which aim to provide the development of protagonism through research and investigation, experiencing concrete, creative and



innovative experiences, appropriating scientific concepts and values in their own observations, as well as promoting the socialization of the results researched.

This research should contribute to instigate and improve knowledge, starting from the following premise:

When talking about research there is a question that needs to be clarified in principle: the concept "research" is not univocal and it is from it that we begin by defining our understanding and emphasizing that doing research is not an exclusive activity of doctors, professionals of academia, scientists, among others, but constitutes a task of launching new discoveries from something that intrigues us, worries us (NOGARO; CERUTTI, 2016, p.67).

Thus, this research aimed to work with coronary artery disease (CAD), a disease that develops in the arteries that supply the heart, called coronary arteries, which is addressed in high school textbooks, studied in health courses, common in everyday conversations of adults, which occurs due to a process called atherosclerosis, in which atheroma (fat) plaques are deposited in the arteries, obstructing the blood passage and forming atherosclerotic plaques (SWEIS, 2020; JIVAN 2020).

The initial idea was based on the possibility of establishing the relationship between the factors that influence the development of CAD, highlighting the action of multiple genes, obesity, dietary factors, sedentary lifestyle, hypertension, smoking and the high index of low-density lipoprotein (LDL).

To have this perception, we sought research in Genetics that make it clear that genetic inheritance can help the development of diseases, but there are a range of pathogens that are more linked to external factors and not to genetic action, being called multifactorial (MARCHESI, 2020).

This literature review presents the relationship of CAD with genetic and environmental factors; in addition to discussing the importance of scientific research in high school and the different opportunities that this work can bring to the student.

2 THEORETICAL FRAMEWORKS

To understand the relationship that exists between genes, the environment and daily life, we chose a disease that brings many questions, which is expressed in textbooks and manifests itself in family conversation circles, CAD. It becomes essential to demonstrate to the community the importance that genetics or lifestyle have on the health of the population.

Thus, Gottlieb et al (2007), demonstrate that genes play an important role in the formation of CAD, however, it is of primary attention to highlight the action of these other factors, which alone do not represent so much danger, but when joined can cause catastrophic results in the health of the individual. Genetics does not determine the expressiveness or otherwise of CAD, as the genetic contribution in such a disease is relatively low, considering that it is not a syndrome. However, it still plays a risk factor, as it may influence the development of this pathogenesis in a silent way.



One should question how much this relationship is part of everyday life, because in times of processed foods or "*fastfoods*" would be a way to contribute to adolescents understanding the importance of healthy lifestyle habits, making choices that can make a difference in adult life. Diet comes in as one of the main factors to consider when dealing with the onset of CAD. The intake of HDL and LDL are agents that are directly related to CAD, because LDL is the cholesterol that accumulates in the walls of the coronary arteries, thus causing the development of fat plaques called atheroma (HENNING, 2021).

To avoid fat plaques, it is necessary to take care of the diet, which is the main focus to prevent the development of CAD, a fact envisioned by Khera and Kathiresan (2017). In this context, the consumption of unprocessed foods becomes crucial for health, as processed foods have a high content of saturated fats, when compared to unprocessed foods, a fact observed in the studies of Sekhar et al. (2021).

Scientific initiation work can contribute to discussions about the health of adolescents, to the development of habits and attitudes, to the choice in relation to diet or the option of practicing physical exercises, because we live in times when childhood obesity is increasingly fierce. We should still discuss health in its different nuances, because we experience the time of valuing the body by the media, a fact that can have serious consequences for an adolescent. Providing discussion or instigating knowledge regarding CAD may be a stimulus for changing habits.

In this context, Moss collaborates (2015, p.16) "Our culture has turned against cigarette advertising campaigns, but we do nothing while food companies do exactly the same thing. And we could say that the damage to public health caused by a poor diet is comparable to that caused by tobacco."

Another factor to be discussed refers to the lack of regular practice of physical exercises, because the exercises are part of a clinical process that is called "cardiac rehabilitation". This process consists of the practice of exercises, the change of behavior in relation to the disease, psychological support to the sick and education about the risk factors for CAD, as advocated by Yamamoto *et al.* (2010).

Changes in lifestyle, such as inadequate eating patterns associated with sedentary lifestyle, alcohol abuse and smoking, contribute to the occurrence of the development of diseases. In relation to food, the most prominent change is the supply of industrialized foods, with high energy density, at the expense of saturated fats and simple carbohydrates, to the detriment of natural foods, which have lower caloric value and are sources of micronutrients and fiber (DE JESUS; HADDAD, 2017).



3 METHODOLOGIES

The XXIII Scientific Initiation Exhibition, involving interdisciplinarity, the community and the media, took place from October 29 to 31, 2022 and had as its theme: "Transforming our world: the 2030 agenda for Sustainable Development". The high school students chose their advisors and the school supervision provided *the template for article production*, *banner template* for presentation and choice of the board, formed by university professors who evaluated the work. After the choice of the guiding professor, there was an invitation for an academic of the VI semester of the Medical Course of the University of Rio Grande (FURG) and an academic of the VIII semester of the Nursing Course of URI, to act as co-advisors.

The bibliographic review work was performed through queries in the *PubMed* database, through the combination of the keywords "*coronary artery disease*", "*polygenic risk*", "*diet*" and "*exercise*". For the work, a group of *WattsApp* was created where the academics assisted by the regent professor and professor of the University guided the student researchers; in addition to face-to-face meetings. Articles and papers published between 2021 and 2022 were selected. In the first search, 7 papers that corresponded to the descriptors were chosen and, after reading the objectives and abstracts of these, 5 papers were selected to compose this review. In addition, a study from 2017 was used, considering its relevance and correspondence with the objectives of this work. For the discussion, a table was made that describes the selected works and their contributions; in addition to taking into account the testimonials of student researchers at work and their relevance to learning.

4 RESULTS AND DISCUSSIONS

Initially, (table 1) the result of the research related to CAD, the selected articles and their main information will be demonstrated. Afterwards, the testimonies of the students involved in the research will be presented, with the respective analysis.

Table 1 - Presents the article, authors, objective and conclusion.

Article	Authors	Goal	Conclusions
Genetics of Coronary Artery Disease: Discovery, Biology and Clinical Translation	KHERA, A. V.; Kathiresan, S., 2017.	Understand the genetic factors of CAD, the role of human genetics in catalyzing drug discovery efforts for CAD, and the promises and challenges of integrating genetic information into routine clinical practice.	It was noticed that genetic factors such as hypercholesterolemia have a strong action on CAD, and familial hypercholesterolemia is the main monogenic factor of CAD. It is believed that family genetic analysis, focusing on LDL cholesterol levels, promotes an easy mapping of a possible CAD, opening avenues for early treatments.
Obesity and Obesity-induced Inflammatory Disease contribute to	HENNING, R. J., 2021.	Research and relate obesity with the formation of	Visceral adiposity is a severe chronic inflammatory condition that contributes to vascular



<p>Atherosclerosis: A Review of the Pathophysiology and Treatment of Obesity</p>		<p>atherosclerosis, studying the means that this overweight is related to the development of CAD. As well as researching ways to slow down the effects that obesity can cause, and perhaps ways to treat it</p>	<p>atherosclerosis. Obese patients produce the adipokines leptin, resistin, interleukin and chemotactic proteins that attract monocyte and macrophage to the adipose tissue causing inflammation and platelet aggregation responsible for endothelial dysfunction and myocardial fibrosis. Weight loss with diet and exercise, medications and bariatrics will be able to reduce inflammatory adipokines, oxidative stress and abnormal lipid metabolism. A multidisciplinary approach with obese patients that involves lifestyle changes, pharmacological or surgical interventions is essential. Research on inflammatory and anti-inflammatory adipokines should be continued to facilitate the understanding of adipokines with cardiovascular diseases.</p>
<p>Monogenic and Polygenic Models of Coronary Artery Disease</p>	<p>MUSE, E. D. <i>et al.</i>, 2021.</p>	<p>Review and analyze how advances in genomic sequencing have broadened the understanding of monogenic and polygenic contributions to CAD and how these insights can be utilized in order to create polygenic risk estimates, to improve risk stratification for diseases such as CAD.</p>	<p>CAD, being an inherited disease, is being increasingly mapped by the advancement of genomic medicine, which allows to more accurately identify people genetically susceptible to this condition. With this it is possible to act early and in a personalized way in the prevention of CAD.</p>
<p>Food for Thought or Feeding a Dogma? Diet and Coronary Artery Disease: a Clinician's Perspective</p>	<p>SEKHAR, A. <i>et al.</i>, 2021.</p>	<p>Provide an overview of nutritional studies evaluating the association of dietary saturated fat and meat intake with the development of CAD and discuss the implications of recent data.</p>	<p>Trans fats and processed meats are directly related to increased cardiovascular risk. Unsaturated fat is preferred, but there are limitations in studies as to the outcome of saturated fat consumption. It is also noticed that a high intake of refined carbohydrates, which have a high glycemic index, is associated with the worst data on cardiovascular diseases.</p>
<p>Association between Food and Nutrients Intakes and Coronary Plaque Vulnerability in Patients with Coronary Heart Disease: An Optical Coherence Tomography Study</p>	<p>WANG, W. <i>et al.</i>, 2021.</p>	<p>To explore how food intake is linked to the treatment of CAD and its association with coronary plaque vulnerability, the main mechanism for the progression of coronary heart disease, by means of</p>	<p>It has been demonstrated that dietary factors are associated with the vulnerability of atherosclerotic plaque. Salt intake is the main dietary risk factor for plaque vulnerability. On the other hand, the consumption of vegetables, fruits, dietary fiber, folate and vitamin C are dietary protection</p>



		OCT (optical coherence tomography).	factors and are inversely related to plaque vulnerability.
Exercise Training and Interventions for Coronary Artery Disease	FÉRNANDEZ-RUBIO, H. <i>et al.</i> , 2022.	Perform a brief specific analysis of the results that patients with CAD can achieve by performing endurance, strength, or inspiration muscle training.	Physical exercise is an effective therapy for the primary and secondary prevention of CAD, attenuating some pathophysiological processes and promoting improvements in functional capacity and muscle strength. The study shows that the most important parameter to be considered seems to be the total caloric expenditure, and not so much the modality itself.

Source: Prepared by the authors.

It should be considered that 2 selected articles bring the discussion of the relationship of CAD with genetics. Khera *and* Kathiresan (2017) demonstrate the importance of understanding genetic factors as a challenge to integrate this content into clinical practice, noting that hypercholesterolemia has a strong action on CAD and Muse *et al.*, (2022) observe that CAD is a hereditary disease, hence the importance of understanding nutrigenomics.

We understand that discussing the action of the gene in the organism is a very intriguing factor, because genes have as characteristic penetrance and expressiveness, factors that can undergo oscillations, contributing to the understanding of epigenetics, which according to Moalem (2016) is characterized as the study of how genetic traits 'can change and be changed in a single generation, and even be passed on to the next generation. Following this reasoning we understand that the environment will be able to act on the expressiveness of the gene:

Some genes are activated by external triggers or random factors. In this process, proteins act as master sensors, turning genes on or off, or even combinations of genes. Like the score of a symphony, the genome contains the information for the development of these proteins, which often causes this score to be described differently, suffering the influence of the environment (KEAN, 2013, p.56).

Another fact demonstrated by Moalem (2016, p.69) consists in understanding that "your thoughts are always impacting your genes, which need to change over time to align your cellular machinery within the expectations you have set and the experiences you have experienced."

Along these lines, Muse *et al.* (2021) observe that CAD is increasingly related to genomic medicine, which according to Romboli and Viola (2017) consists of the science that studies the influence of nutrients on the expression of genes and their products on the alteration of the phenotype, that is, on the information of gene expression, which allows the understanding of the influence of food components on metabolic routes.



And they also contribute by stating that about 80% of cases of cardiac coronary disease, 90% of cases of type 2 diabetes and 1/3 of cancers can be prevented by changes in eating habits and maintenance of an ideal body weight, associated with physical activity (ROMBOLI; VIOLA, 2017). As for environmental factors, the selected authors report that visceral adiposity is a determining condition for inflammation of the arteries (HENNING, 2021). Each one-point increase in the Body Mass Index (BMI) of an overweight individual causes a 10% increase in the risk of atherosclerosis and CAD (WANG *et al.*, 2021).

They report that trans-fat and processed meats are directly related to increased cardiovascular risk (SEKHAR *et al.*, 2021), that dietary factors are associated with the vulnerability of atherosclerotic plaque, especially salt intake (WANG *et al.*, 2021), that consumption of vegetables, fruits, dietary fiber, folate and vitamin C are dietary protective factors and are inversely related to plaque vulnerability (WANG *et al.*, 2021).

It is observed that nutrition is directly related to CAD, but this is not the only factor. Fernández-Rubio *et al.* (2022) emphasize that physical exercise is an effective therapy for the primary and secondary prevention of CAD, attenuating some pathophysiological processes and promoting improvements in functional capacity and muscle strength. It is noted that all selected authors make it clear that nutrition and lifestyle habits are directly related to CAD. Risk factors are obesity, high cholesterol (LDL), high blood pressure, smoking and alcohol. Therefore, a change in life habits, and not only in food, can promote better quality of life; in addition to having an impact on the factors that contribute to chronic diseases (SARTI; TORRES, 2017).

A healthy diet generates enormous impacts on the control and prevention of various diseases, but it needs to be complete and varied, in order to provide not only the essential nutrients as the bioactive substances that will improve the functioning of the body (SALVADOR, 2017). It should still be considered that it is we who invented our lifestyle, and it is within our power to change it. We do not need to wait for the invention of a magic pill or a low-calorie potato chip, it is already clear that the changes that will minimize the risks to CAD, depends on each one. These changes include: not smoking, exercising regularly, limiting total calorie intake, alcohol, salt, saturated and trans fats, sugar, soft drinks, processed foods, among others (DIAMOND, 2014).

As with most complex diseases, an individual's risk of developing CAD is modulated by the interaction between genetic factors and lifestyle (KHERA *et al.*, 2017), and some of the most eminent risk factors for this disease are chronic elevation of blood pressure, hypercholesterolemia, diabetes, age, obesity, smoking and sedentary lifestyle (FÉRNANDEZ-RUBIO *et al.*, 2022).

Regarding the perception of the students, the transcript of the testimony of those involved in the research follows:



"Our scientific initiation show stood out among the other works, because we were able to conclude our main objective with excellence - to demonstrate that CAD does not have a great influence due to genes, having a higher probability of development from external factors, such as sedentary lifestyle. This experience provided us with a greater knowledge in the area of Biology, as well as corroborated to understand how scientific research occurs. I am very grateful to Professor Cislara Amaral and the academics Eduarda and Luana, who helped and collaborated with the accomplishment of our work with quality and in a pedagogical way. Finally, I would like to say that I was pleased to receive the outstanding work award, which certainly rewarded all the effort that my group put into this work."

A.M.A

"I am passionate about work and studies on medicine and the human body, I love learning and being able to pass on what I know to people and, in some way, help them. Producing the Scientific Exhibition was fantastic! I had the opportunity to venture into clinical cases and other literature reviews, which made me understand the dimension that is human life. I realized that the more we study, the more we have to learn and when done in a group, we have the possibility to discuss our findings and thus learn from each other. Even though I was a teenager, I found myself at times having discussions above my age group and with extremely important topics. The work done made me realize not only how laborious and rewarding scientific work is, but it made me sure of the profession I want to pursue!" E.F.M

"The scientific initiation show that we held, with the supervision and assistance of Professor Cislara Amaral and the academics, was extremely impactful in terms of presenting a new reality. The methods proposed for the research carried out differed greatly from the classic school models, being a more scientific and reliable approach to the reality of scientific research. To realize, then, that our effort and hard work in carrying out this work was rewarded, with the award of outstanding in the activity, was extremely rewarding, encouraging me even more to carry out external research, in the areas of my personal interest, as well as increasing my taste for reading and researching things hitherto unknown to my person." J.P.S.S.

It is noted that the research provided scientific knowledge, since the reference and the discussion took place in partnership with the academics of health courses and the guiding professor. It provided the opportunity for interdisciplinarity, as it demonstrated the importance of English for academic knowledge, orality for the presentation of the work and the perception in relation to the rules of a scientific study. In "liquid times", we need new ways of thinking about education, since the challenges of teaching grow with the changes in the world pointing to the creation of a teaching culture



that has research as an educational principle to overcome the reproductionism and accumulation of contents transmitted in a little significant way (NOGARO; CERUTTI, 2016).

Nogaro and Cerutti (2016, p.68) also contribute "stripping ourselves of the "academic" sense, clothed in the pomp of research, becomes necessary for it to be incorporated into the practice of the teacher of basic education and in the life of the student".

It should be emphasized the change in habits that may cause in relation to diet and physical exercises, determining factors to avoid CAD; the mastery of concepts studied in Genetics that do not make much sense, and that related to a disease can establish parameters that stimulate learning. Learning with comprehension is more likely to promote transfer than simply memorizing information from a text or lecture (WIGGINS; McTIGHE, 2019).

In relation to the orality and presentation of the work, it is observed that it gained as "featured work" (figure 1) a fact that will serve as a stimulus to students to understand the importance of research, using knowledge in their daily lives, making analogies, reflective thinking, autonomy to make decisions and criticality in relation to life habits. In addition to the recognition that genetics or environmental factors are related, that everything in our body is related, including our perceptions and thoughts. That we experience times of choices, which can affect positively or negatively on our health and that of our families.

Figure 1 – Certification and outstanding award medal.



Source: Personal archive of the authors.

5 FINAL CONSIDERATIONS

In relation to research on CAD and environmental factors, it is perceived that a complexity of factors related to each other can lead to the expression of the disease. Among the environmental factors,



the lifestyle gains prominence, especially in relation to the consumption of fats, unbalanced diet, sedentary lifestyle and obesity. The high consumption of fats, especially trans and saturated fats, and refined carbohydrates with a high glycemic index, favor the creation of atherosclerotic plaques, which are responsible for causing CAD. Similarly, salt intake is the main dietary risk factor for plaque vulnerability, unlike the intake of fruits and vegetables that have an inverse action.

It is noted that sedentary lifestyle and obesity lead to the accumulation of fatty plaques in the arteries, causing CAD. People with obesity produce adipokines and some proteins that attract monocytes and macrophages to adipose tissue, causing inflammation and aggregation of atheromatous plaques. Another problem associated with obesity is a sedentary lifestyle. With the practice of physical exercises, the atheroma plaques can undergo a regression, increasing the blood passage in the arteries and decreasing the risks of the disease.

Still, it is noticeable the genetic influence on the development of CAD, but it is proven that genes have little action in the development of these diseases, because they have variable expressiveness and act by binding and disconnecting proteins, and suffer demonstrably the environmental action.

In relation to the contribution to high school students, it was observed that the practice of scientific initiation can corroborate to sharpen the taste for research, interdisciplinarity, academic experience, significant learning, protagonism in relation to habits and attitudes, scientific literacy, mastery of contents that make little sense, choices regarding diet and physical exercise as a prerequisite for health.



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