Interview with Kelly Nunes, Ph. D.

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With great satisfaction, the Conexão Ciência journal team welcomes as a special interviewee Dr. Kelly Nunes, a distinguished researcher at the University of São Paulo, whose academic and scientific trajectory honors and inspires the Brazilian scientific community, especially in the context of the tribute to women in science promoted by the CEPEP research center at the XXI Scientific Initiation Fair of the University Center of Formiga/MG.

With a solid background in Human and Medical Genetics, Dr. Kelly Nunes has built a brilliant academic path, beginning at the Regional University Foundation of Blumenau, followed by a Master's degree at UFPR and a PhD at USP, where she also completed four consecutive postdoctoral fellowships, including collaborations in a research project linked to the University of Washington, for which she received a postdoctoral fellowship funded by the U.S. National Institutes of Health (NIH). Her work stands out in the fields of population genomics, immunogenetics, and the genetic diversity of Brazilian populations, with significant contributions to the understanding of the genetic heritage of Indigenous, African, and admixed peoples of Brazil.

The prestige of her work was widely recognized in 2025, when she shared first authorship of an article published in the prestigious journal Science, entitled "Admixture's impact on Brazilian population evolution and health" (https://www.science.org/doi/10.1126/science.adl3564), a study conducted in Brazil, by Brazilian researchers, and led by Brazilian women. This publication, the result of a robust genomic sequencing of more than 2,700 Brazilians, revealed about 9 million novel genetic variants, in addition to 36,000 variants potentially associated with health risks, a milestone for genomic medicine and for valuing the biological and historical diversity of the Brazilian population. As highlighted by Jornal da USP, the study provides scientific evidence of the biological consequences of traumatic historical events, such as slavery and the extermination of Indigenous peoples, while also shedding light on the underrepresentation of African and Indigenous ancestries in global genomic databases.

It is, therefore, an honor to have Dr. Kelly Nunes present at this event, celebrating not only her academic excellence but also her commitment to a more diverse, inclusive, and socially engaged science. Her trajectory inspires young researchers and reaffirms the importance of women in advancing scientific knowledge in Brazil and worldwide.

1. The 2025 Scientific Initiation Fair of our University Center paid tribute to women in science, recognizing their contributions that have often been rendered invisible throughout history. Your trajectory, marked by excellent training and highly impactful publications, represents an inspiration for young female researchers. What were the main challenges you faced throughout your scientific career as a woman? At what moments did you realize that gender impacted your opportunities or your recognition in the academic sphere?

It took me some time to understand the challenges and the role of being a woman in my academic journey. I come from a family of strong women, was born in Canoinhas, a small town in the countryside of Santa Catarina, and I always studied in public schools. My entry into academia happened through much persistence.

When I took the university entrance exam for the Biology program, I was not admitted to any federal universities. Faced with this, I pursued my undergraduate studies at a municipal institution, the Regional University of Blumenau (FURB). To support myself away from home and pay tuition fees, I obtained a work grant through one of the university's social programs. When the grant ended, I began teaching in the state school system, balancing my studies in the morning with teaching activities in the afternoon and evening.

To continue in academia and science, I decided to pursue a Master's degree and soon realized that the best opportunities were at federal universities. I did not pass my first attempt at UFPR, but even so, I moved to Curitiba. I worked teaching in the municipal school system and took Genetics courses as a special student at UFPR until I was admitted the following year. I obtained a CAPES scholarship, which allowed me to dedicate myself fully to the Master's program. After the Master's, with no doctoral scholarship available at UFPR, I moved to São Paulo. For six months I worked as a laboratory technician fellow and then began my PhD at USP with a FAPESP scholarship.

For a long time, I believed that my biggest barriers were overcoming educational gaps and supporting myself away from home. I always had to prove that I was just as capable as everyone else. Only when I started my postdoctoral work and, for the first time, was on equal footing with my colleagues did I realize that being a woman brought its own challenges. While my male colleagues were listened to, I was questioned, interrupted, or ignored, even when I was the expert on the subject. While they were encouraged to pursue academic positions in Brazil and abroad, I was advised to leave academia, even though my teaching skills were often better than theirs. When I got married, many people said this would limit my professional growth opportunities. At that time, I began to question why this was happening only then, and that was when I realized that these challenges had always existed, I had just not seen them or felt their impact until then.

In the academic environment, there has always been a certain mistrust and underestimation of my work. However, this never paralyzed me; on the contrary, it awakened in me a constant need to overcome, to find ways to learn, to be heard, to show my competence, and to prove that I am equally capable. I know this path has made my journey longer, but it is precisely what strengthens my determination and gives me clarity about where I want to go.

2 - Considering your experience at leading institutions such as the University of São Paulo and the University of Washington in the United States, which areas of genetics currently stand out as the most promising in terms of innovation, social impact, and technological development? What advice would you give to young Brazilian researchers who aspire to pursue a path of scientific excellence in this field?

Currently, several areas of genetics have stood out, but I would like to emphasize the one with which I am most directly involved: population genomics and its application to precision medicine.

Precision medicine, or personalized medicine, seeks to treat each person in a unique way, adapting prevention and treatment according to the characteristics of each individual. This is where genetic factors play an important role, and genomics makes all the difference. By analyzing DNA, we can identify genetic alterations associated with certain diseases or with how someone responds to specific medications. With this information, it becomes possible to better guide prevention strategies and choose more effective treatments for each individual.

Although this reality is still somewhat distant from Brazil's Unified Health System (SUS), there are strategies that can bring these benefits closer to public health. Studies have shown that many DNA variations can differ among people from different countries, continents, or ethnic groups. This is precisely where population genomics becomes essential: it investigates genetic diversity within and between populations, identifying variants that are more common in each population

group. From this knowledge, it is possible to develop public policies aimed at prevention, diagnosis, and more specific and effective treatments that consider the particularities of each population or subgroup. This set of actions is referred to as precision public health, an approach still in its early stages, but with great potential to develop and apply knowledge that makes the benefits of genomics more accessible, thereby promoting greater health equity for all.

For young Brazilian researchers who wish to follow this path, my advice is to invest in a solid background in molecular biology and/or bioinformatics, to remain open to interdisciplinary dialogue, and not to be afraid of seeking partnerships with both the public sector and private initiatives. But above all, it is essential to understand the reality and needs of the Brazilian population, taking into account the particularities of different regions and population groups. Working with cutting-edge science is important, but doing so in a way that has a real social impact is even more relevant.

3 - Brazil is a country of continental dimensions and immense genetic diversity, yet it still faces many obstacles to the advancement of scientific research. In your view, what are the main structural, academic, and political gaps that hinder the development of genetic studies in the country? And how have you managed to overcome them in order to carry out high-level international research?

In Brazil, genetic studies face structural, academic, and political gaps that are interconnected and mutually reinforcing. We know that financial resources are distributed unevenly among universities and across different regions of the country. Since cutting-edge technologies used in genetic studies are expensive, access to these resources ends up being limited to only a few research groups and universities.

From a structural standpoint, this creates an imbalance: while well-funded groups are able to establish state-of-the-art infrastructure with well-equipped laboratories and computational support for data analysis, others, with fewer resources, must rely on

modest or sometimes outdated facilities.

In the academic sphere, this inequality tends to attract faculty members with stronger backgrounds in the field to the universities with better infrastructure. This has a direct impact on student training, both in terms of technical skills and in the complexity of the genetic questions and topics they can explore in their research.

On the political front, obstacles remain. Excessive bureaucracy delays the release of funds, complicates the purchase of supplies, and overburdens researchers. Moreover, there is a lack of strategic and continuous funding, and very few programs connect universities with research centers and public policies. There are also few open science initiatives that provide training in major research hubs while ensuring that such knowledge is disseminated back to institutions in regions with less access to resources.

In my own trajectory, I have experienced many of these challenges firsthand. An important step was seeking opportunities and partnerships with leading institutions. I have always pursued broad, interdisciplinary collaborations, both in Brazil and abroad. This strategy has allowed me to develop and participate in larger projects with multiple branches, capable of addressing different scientific questions and benefiting various students and research groups. By optimizing resources and broadening the reach of results, this approach also helps strengthen cooperation networks and position Brazilian science within the international landscape.

4. We know that you have also shown concern with the popularization of science and the improvement of education, as evidenced by your collaboration with the journal *Genética na Escola*. In your opinion, what strategies can bring cutting-edge research closer to everyday school life, contributing to the development of a more solid and critical scientific culture among Brazilian students?

To bring cutting-edge research closer to everyday school life, it is

essential to introduce scientific culture early on in schools, whether through science fairs, lectures, workshops, or hands-on activities. Over the years, I have participated as a judge at FEBRACE (the Brazilian Science and Engineering Fair), and I am always impressed by the quality and creativity of the projects developed by students in basic and technical education. It is remarkable how they integrate regional elements and make innovative use of local resources. This shows that Brazil has talented and curious young people who truly enjoy science. However, we still need to make science more appealing as a career, valuing and respecting the work of researchers.

This recognition also depends on how we communicate science beyond the walls of the university. The scientific knowledge produced cannot remain confined to academia, it must be translated into simple language and communicated to society. In this sense, science outreach, whether through social media, interviews, or podcasts—plays a fundamental role in this connection, as it broadens the reach of knowledge and ensures it reaches diverse audiences. More than simply transmitting information, it builds bridges between research and education. When teachers bring these recent discoveries into the classroom, they encourage students to discuss and debate the latest scientific advances.

This connection generates a virtuous cycle, in which schools draw from research innovations while also awakening new talents who may contribute to science in the future. Ultimately, building a solid scientific culture is not just about teaching content, but about awakening curiosity, stimulating critical thinking, and showing that science is within everyone's reach.

5 - In 2025, you shared first authorship of an article published in *Science*, one of the most prestigious journals in the world. This is a remarkable and rare achievement among Brazilian researchers. Could you tell us how the process of conception, development, and writing of this study unfolded, from the initial hypotheses to the final publication? What were the greatest challenges and lessons learned along the way?

It was a long process that required a great deal of persistence! The idea for the project emerged in 2017 during conversations among professors and researchers at USP. At that time, we realized that genomic studies, those that sequence entire genomes, were rapidly expanding worldwide, but since they were conducted mainly on populations of European origin, they did not represent the diversity of the Brazilian population. There was, therefore, a need to place Brazil on the global genomics map so that the Brazilian population could also benefit from genetic discoveries and their applications, especially in the field of health. Until then, very few studies had fully sequenced Brazilian genomes, and our goal was to carry out a broad, comprehensive, and representative study of people from all regions of the country.

The first major challenge was obtaining funding. Cutting-edge genomic studies are expensive, and for more than a year we presented the project to several public and private agencies, without success. It was only in 2019 that Professor Lygia da Veiga Pereira managed to present the project to the Ministry of Health. They not only approved the funding but also, from it, launched in 2020 the first Brazilian genomics and precision medicine program, the "Genomas Brasil Program." However, the COVID-19 pandemic caused the project's allocated funds to be frozen for two years, and only in 2022 were we able to actually begin the work.

To ensure regional representativeness of the Brazilian population, we sought partnerships with different research groups across the country. In this first phase, nearly 3,000 Brazilians had their genomes fully sequenced. The next challenge was working with the vast amount of genetic data generated, while simultaneously developing, in real time, the team's capacity for genomic analysis. Since this was a first study, we opted for a more descriptive approach to the results, highlighting general aspects of Brazilian population history and health, leaving more specific analyses for future stages of the project.

Finally, there was the challenge of publication. We completed the manuscript in November 2023, but as is typical in high-impact journals

such as *Science*, it underwent a long peer-review process, taking about a year and a half from submission until publication in May 2025.

In total, it was seven years of planning, negotiations, adjustments, and waiting, but also of constant learning. This work was done by many hands, written by many hands, revised by many hands. Throughout the process, I learned the importance of patience, resilience, and collaborative work. But above all, I learned how Brazilian science, carried out by Brazilian researchers, can be relevant not only to our society but also as a contribution on the international stage.

6 - The article published in *Science* reveals fascinating aspects of the genetic diversity of the Brazilian population, with profound implications for biomedical science, public health, and the country's history. Could you summarize the main findings of the research and explain why understanding the genetic composition of the Brazilian people is so relevant both for the advancement of science and for strengthening our identity as a nation?

One of the main motivations for carrying out this study was the fact that African and Indigenous genetic diversity, which is widely present in the Brazilian population, remains underrepresented in international genomic studies. This has direct implications for public health, since many potentially relevant genetic variants simply do not appear in the studies or in the databases used for diagnosis, treatment, and research worldwide.

By analyzing the complete genome of nearly 3,000 Brazilians, we identified about 9 million previously undescribed genetic variants. Moreover, we know that not all genetic variation causes disease, so we sought to identify those with pathogenic potential, that is, variants that may be associated with disease susceptibility. We found around 65,000 new variants with such potential, many of them related to common metabolic diseases in Brazil, such as obesity and high cholesterol, as well as to neglected infectious diseases like malaria,

hepatitis, tuberculosis, and leishmaniasis. This result highlights how relevant the study of genetically diverse populations is and how it can lead to new and important discoveries for health.

Beyond its biomedical dimension, the study also allowed us to tell part of the history of the Brazilian people. DNA is a true living archive, and although previous studies had already revealed aspects of this history, this is the first time we analyzed the complete genome, that is, letter by letter of our DNA. This provided greater robustness and resolution in our analyses, enabling us to reconstruct part of our history.

For example, we were able to identify three major migratory waves that contributed to the formation of our population: the first, with the arrival of European colonizers starting in the 16th century; the second, with the forced arrival of enslaved Africans between the 17th and 18th centuries; and the third, more recent, with European immigrants in the post-colonial period. These results are corroborated by historical data on the main intercontinental migratory waves that occurred throughout Brazil's history.

We also observed a distinct pattern in ancestral paternal and maternal genetic contributions. Paternal lineages, determined from the Y chromosome, are predominantly of European origin (71%), while maternal lineages, determined from mitochondrial DNA, show a greater contribution from African (42%) and Indigenous (35%) peoples. This pattern reinforces, from a genetic perspective, what history has already shown us: Brazil was largely colonized by European men who, upon arriving here, had children with women of African and Indigenous origin. Popularly, this is reflected in the accounts of many Brazilians who say they had a Portuguese grandfather and an African or Indigenous grandmother.

Therefore, this study is important not only for advancing science and taking the first steps toward precision medicine programs in Brazil, but also for strengthening our identity as a nation. Deeply understanding the genetic composition of the Brazilian population means recognizing our

plurality, our history, and our unique contribution to global science.

7. The publication of the article involved many authors, with different backgrounds, institutions, and areas of expertise. We know that large-scale collaborative science is challenging, especially in multicenter contexts. What was the experience like in coordinating and articulating such a broad and diverse team? Which strategies were fundamental to ensuring scientific cohesion, task distribution, and the integrity of the final work?

Coordinating a scientific project of this magnitude, with a broad, multidisciplinary, and multicenter team, required shared leadership and well-defined strategies of organization and communication. Professor Lygia da Veiga Pereira served as the general coordinator, responsible for managing financial resources as well as bureaucratic and institutional requirements. Professor Tábita Hünemeier led the articulation with collaborators, sample collection, and genetic sequencing. I was responsible for coordinating data analysis and reporting the results.

To deal with the complexity of the project, we adopted a division of tasks based on each researcher's expertise, which allowed us to optimize both time and individual skills. Weekly meetings ensured alignment across work fronts, fostering integration of analyses and the collective construction of result interpretation. Once completed, the findings were presented and discussed with each group of collaborators. This collaborative and structured approach was essential to ensuring scientific cohesion, clarity in reporting, and the integrity of the work as a whole.

This project showed us that leadership is not about centralizing, but about knowing how to distribute responsibilities, recognizing others' skills in order to build together. I learned that shared leadership, based on respect and constant communication, not only strengthens research outcomes but also makes the process more enriching. Working alongside diverse expertise and styles also taught me the importance of

empathy and commitment to the collective. This experience reaffirmed that, despite the challenges of collaborative science, it is precisely in the diversity of knowledge and in collective construction that the strength lies to produce robust, ethical, and socially relevant scientific knowledge.

8 - Your scientific output is impressive, with more than 50 articles published in high-impact journals, which demonstrate not only competence but also resilience. However, the Brazilian scientific landscape is often marked by funding limitations, institutional pressures, and infrastructure challenges. How have you dealt with these adversities and managed to maintain a consistent and relevant scientific output?

I have faced the adversities of Brazilian science with a great deal of resilience, creativity, and scientific partnerships. I recognize that academia imposes constant pressures for productivity, which are not always accompanied by adequate resources and infrastructure. In this context, during times of difficulty, I have adopted different strategies: whether by developing more modest projects that can be carried out with limited resources or by turning to public databases to address questions that are relevant to society.

In addition, I place great value on scientific collaborations, since they not only broaden the scope of studies and strengthen the collective production of knowledge but also often allow for the sharing of resources and infrastructure among research groups. I know that academia is often filled with vanity, but one thing I have learned over the years is that we do not always need to play the role of protagonists in a study; what truly matters is making a qualified contribution to the advancement of science. This perspective has enabled me to maintain a consistent and relevant scientific output, even in challenging contexts.

9 - We live in a paradoxical era: while we witness extraordinary scientific advances, such as the development of vaccines in record

time, we also face a flood of disinformation, denialism, and attacks on science. As a researcher with strong international engagement and an educational sensitivity, how do you perceive this scenario? Which paths do you believe are most effective for combating scientific fake news and promoting a culture of valuing science among the population?

In Brazil, universities are built upon three pillars: teaching, research, and outreach. Unfortunately, outreach, the bridge between academia and society, is still underdeveloped. Today, one of the greatest challenges we face is "translating" academic research for the general public. It is of little use to be at the best university in the country and master all the techniques and scientific language if we cannot explain clearly and accessibly what we do to a family member, a friend, or a neighbor. When science is not communicated in simple terms, it becomes distant from people, losing strength, relevance, and credibility. In this context, disinformation and denialism gain ground, since people tend to better understand simplistic information, even when it is inaccurate.

Facing this challenge requires more than good intentions: it calls for concrete action from institutions. Universities and scientific organizations must invest in training professors, students, and researchers for more effective communication with society, making knowledge both accessible and appealing. More than just disseminating results, it is essential to open the doors of universities, promoting initiatives in which scientific knowledge is applied to people's daily lives and contributes to solving real-world problems. In this way, science ceases to be viewed merely as an academic product and becomes a useful tool for society.

Another important step in this direction is bringing the public closer to the very process of scientific production. It is necessary to seek greater public involvement in research, fostering participatory science. When people contribute data, experiences, or opinions, they not only strengthen research but also become part of the construction of knowledge. In this sense, giving feedback to

participants, sharing results in an understandable way and showing how their contributions were used, is essential. This feedback acknowledges each participant's role, builds trust, and reinforces the understanding that scientific knowledge is relevant, reliable, and useful for everyone's life.

This rapprochement between science and society must begin early. It is crucial that people become familiar with scientific principles from school onward, learning, discussing, and experiencing what scientific methodology is, what evidence means, and why uncertainty exists in science. This foundation helps the population interpret information critically and value science as an essential tool for understanding the world.

Science is not the enemy of the people, nor an activity reserved for the elite: it is at the service of society and its needs. Building this relationship of closeness and trust is, in my view, the most effective way to combat fake news, strengthen scientific culture, and value the role of science in our society.

10 - To conclude, we would like you to leave a message of encouragement to Brazilian students and researchers, especially those facing the difficulties of pursuing a scientific career in challenging contexts. Based on your postdoctoral experience with a fellowship from one of the world's most respected agencies, the NIH, what advice would you give to those who dream of doing high-quality science with social relevance, whether in Brazil or abroad?

The scientific world is not easy: it is full of challenges and can often be a competitive and even toxic environment. That is why it is essential to have a purpose. Mine is to tell life stories, to reconnect with our history and ancestry, and at the same time to understand how this is reflected in our DNA and how such knowledge can benefit the health of our population. For me, nothing is more rewarding than interacting with research participants, sharing results with them, and realizing that our work has made a difference in their lives.

For those who dream of doing high-quality science with social

relevance, whether in Brazil or abroad, my advice is this: there are always ways to make it happen. The path may be long and challenging, but it is along this journey that we grow, learn to deal with obstacles, and develop resilience. Do not give up at the first "no." I myself have received many, and I continue to receive them, but I always seek alternatives to start again and move forward. Persistence, resilience, creativity, and purpose are fundamental for building a dignified and relevant scientific career.