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NUTRIGENOMICS AND PERSONALIZED NUTRITION: BRIDGING GENETIC INSIGHTS WITH PUBLIC HEALTH INTERVENTIONS

Fitri Dian Nila Sari
Universitas Nahdlatul Ulama Sumatera Utara, Indonesia
Email: firawadi16@gmail.com

Abstract

This study aims to explore the role of nutrigenomics and personalized nutrition in the context of public health interventions through a literature review approach. Nutrigenomics is a branch of science that studies the interaction between genes and nutrients, and how individual genetic variations influence responses to certain food intakes. In recent decades, the development of genomic technologies has enabled a deeper understanding of how nutrition can be tailored to an individual's genetic profile to prevent disease and promote optimal health. Through a systematic review of various scientific publications, articles, and recent research reports, this study identifies the potential for integrating nutrigenomics into community nutrition strategies, while analyzing the ethical, social, and practical challenges in its implementation. The results of the study indicate that personalized nutrition based on genetic data has great prospects in improving the effectiveness of public health programs, especially in efforts to prevent non-communicable diseases such as diabetes, obesity, and cardiovascular disease. However, the widespread implementation of this approach still requires a strong regulatory framework, public education, and multidisciplinary collaboration between nutritionists, geneticists, and policy makers. This study is expected to be the basis for the development of scientific evidence-based nutrition policies and more precise approaches in the future.

Keywords: nutrigenomics, personalized nutrition, genetics, public health, nutrition interventions

INTRODUCTION

Advances in genetics and biotechnology have provided a new paradigm in understanding the relationship between genes and the environment, especially in the context of health and nutrition. One branch of science that has developed rapidly in the last decade is nutrigenomics, which is the study of how interactions between genes and nutrients can influence genetic expression and the risk of various chronic diseases (Fischer, 2024a). The basic concept of nutrigenomics rests on the understanding that physiological responses to food are not uniform, but are strongly influenced by individual genetic variation. Therefore, the effectiveness of generalistic nutritional approaches has begun to be questioned, especially in the context of lifestyle-based disease prevention. As an alternative, personalized nutritional approaches have emerged, which integrate individual genetic information with diet and lifestyle, to produce more targeted and effective nutritional recommendations (Clemente-Suárez et al., 2024). In the context of public health, the application of nutrigenomics and personalized nutrition opens up strategic opportunities to address the increasing burden of non-communicable diseases, such as diabetes, hypertension, obesity, and heart disease. These diseases are not only triggered by unhealthy diets, but also by genetic predispositions that individuals may not be aware of. Knowledge of an individual's genetic profile allows for earlier, more specific, and potentially more effective interventions, compared to general nutritional approaches based on population recommendations. Through this strategy, individuals with certain genetic risks can be provided with tailored nutritional interventions to reduce or avoid the clinical manifestations of the disease, while improving their quality of life (Agrawal et al., 2024). However, despite the promising potential benefits of nutrigenomics and personalized nutrition, the implementation of this concept on a population scale still faces complex challenges. One of the main obstacles is the gap between scientific research and practical implementation in the field. Knowledge about the relationship between genes and nutrition is still developing, and not all genetic variants that affect nutrient metabolism have been comprehensively mapped (Hosseiniara & Hosseini Zijoud, 2024). On the other hand, the general public generally does not have access to affordable and accurate genetic testing technology, and there is a lack of understanding of the interpretation of complex genetic test results. This complicates the transition from science to practice, and raises the potential for disinformation if the personalized nutrition approach is carried out without a strong scientific basis. In addition, there are also ethical, social, and regulatory challenges in the adoption of nutrigenomics in the context of public health. Genetic information is highly sensitive and private data. Therefore, its use must be accompanied by guarantees of security and protection of personal data, as well as a clear legal framework so that it is not misused by irresponsible parties. The issue of discrimination based on genetics, unequal access to personalized nutrition services, and the potential for excessive commercialization by the health industry are also important highlights in the development of public policies based on nutrigenomics. In a multicultural society like Indonesia, a genetic-based approach also needs to consider ethnic diversity and unique local diets, so that the resulting interventions remain culturally and socially relevant (Lagoumintzis & Patrinos, 2023).

However, the potential of integrating nutrigenomics into public health systems cannot be ignored. With a careful and collaborative approach between researchers, health workers, policy makers, and the community, the concept of personalized nutrition can be gradually adopted into large-scale nutrition intervention programs. For example, in programs to prevent stunting and malnutrition, genetic information can help identify individuals or groups who are sensitive to certain micronutrient deficiencies. This allows for more efficient and focused distribution of supplements and nutritional improvements. Likewise, in the treatment of obesity and metabolic disorders, a genetic-based approach can improve patient compliance with nutritional interventions, because the recommendations given are more personalized and based on objective data about their own bodies (Wuni & Vimaleswaran, 2024). Within the framework of national health development, the integration of nutrigenomic insights with public health strategies has the potential to increase the effectiveness of interventions as well as the efficiency of resource allocation. Although in the early stages this approach is still limited to certain groups, the development of information and communication technology, especially in the fields of bioinformatics and artificial intelligence, opens up opportunities to expand the reach of personalized nutrition more evenly. Digital-based systems can be used to collect, analyze, and deliver tailored nutritional information to individuals through easily accessible platforms, such as smartphone applications (Fischer, 2024b). Thus, the transformation towards a more precise and preventive health system can be carried out with an adaptive and sustainable approach.

From an academic perspective, the study of the role of nutrigenomics in supporting personalized nutrition is important as a scientific basis for policy development and health service innovation. Previous studies have shown that genetic-based interventions can provide more significant results than conventional interventions in managing weight, cholesterol levels, and blood glucose control. However, more in-depth studies are needed on how these results can be translated into inclusive and equitable community nutrition service models. In addition, multidisciplinary involvement in nutrigenomic research, including nutrition science, genetics, epidemiology, ethics, and public policy, is crucial for this approach to develop in a balanced and integrated manner (Kapellou et al., 2025).

In the context of Indonesia, which has high genetic and dietary diversity, nutrigenomic and personalized nutrition approaches need to be further studied to tailor health interventions to the characteristics of the local population. This is especially relevant considering the high prevalence of non-communicable diseases, such as diabetes and hypertension, which also burden the national health system. Therefore, this study aims to examine the strategic role of nutrigenomics in building a bridge between genetic insights and public nutrition policies, as well as exploring the potential for implementing personalized nutrition approaches in the public health system. By building a comprehensive understanding of the relationship between genes and nutrition, it is hoped that the results of this study can provide scientific contributions as well as become an initial step in designing health interventions that are more adaptive to the needs of individuals and populations.

RESEARCH METHOD

The research method used in this study is a literature review method, which aims to examine in depth the relationship between nutrigenomics and personalized nutrition in the context of public health interventions. This study was conducted by tracing, identifying, and analyzing various scientific sources such as international and national journal articles, academic books, research reports, and policy documents related to the field of nutrigenomics, personalized nutrition, and its implementation in public health. The selection of literature focused on relevant publications in the last ten years in order to obtain a current and contextual understanding of the dynamics of the development of science and practice in the topic.

The data collection process was carried out through searches in various scientific databases such as PubMed, Scopus, ScienceDirect, and Google Scholar using keywords such as "nutrigenomics," "personalized nutrition," "public health intervention," and "genetic-based dietary recommendation." Each source found was then selected based on inclusion criteria, namely having direct relevance to the research theme, containing a strong theoretical and empirical basis, and published by a reputable institution or publisher. Articles that met these criteria were analyzed qualitatively to identify key themes, important findings, and knowledge gaps in them.

Data analysis was conducted using a thematic approach, where various literature findings were grouped based on key issues such as the impact of genetic variation on nutritional responses, the effectiveness of personalized nutritional interventions, challenges of implementation at the population level, and the potential for integrating nutrigenomics into public health policies. Through this approach, the study is expected to be able to produce a comprehensive and critical synthesis of knowledge on how genetic insights can be bridged with effective nutritional strategies to improve the health status of the community at large.

RESULT AND DISCUSSION

Basic Concepts of Nutrigenomics

Nutrigenomics is a rapidly growing multidisciplinary field that combines nutritional science, genomics, biotechnology, and bioinformatics to understand how specific dietary components affect gene expression and biological function at the molecular level. The term “nutrigenomics” is derived from the words “nutrition” and “genomics,” which literally means the study of how nutrients affect gene activity in the human body. The main goal of nutrigenomics is to identify how specific nutrients and dietary patterns can regulate or modify gene expression, and ultimately, how these changes impact health or disease risk. With this approach, nutrigenomics provides a new perspective in understanding the relationship between food and health in a personalized way, paving the way for nutritional interventions tailored to an individual’s genetic profile, also known as personalized nutrition (Bahinipati et al., 2021). The scope of nutrigenomics is very broad and covers a wide range of aspects, from molecular analysis of interactions between nutrients and genes, to the development of diets specifically designed based on an individual’s genetic profile. In practice, nutrigenomics focuses not only on identifying genes involved in nutrient metabolism, but also on understanding how bioactive compounds in food can regulate gene function epigenetically. For example, consumption of foods rich in folate or omega-3 fatty acids has been shown to influence the expression of genes involved in inflammation or lipid metabolism. In addition, nutrigenomics also includes the analysis of metabolic networks and cellular signaling pathways involved in the body's response to various nutrients, including vitamins, minerals, polyphenols, and other bioactive components. This approach allows the identification of biomarkers that can be used for early detection of disease, monitoring health conditions, or even for the development of more targeted dietary therapies (Mishra et al., 2022). The relationship between genes, gene expression, and the body's response to nutrients is at the heart of the nutrigenomic approach. Genes are the basic units of heredity that contain instructions for forming proteins and enzymes that regulate various biological processes in the body (Vyas, 2022a). Gene expression, the process by which information in DNA is translated into functional products such as proteins, can be influenced by various environmental factors, including nutrition. When the body receives certain food intake, the chemical compounds contained in the food can interact with the genetic regulatory system and trigger changes in the level of expression of certain genes. For example, consumption of foods high in sugar can trigger the expression of genes related to glucose metabolism pathways and energy storage, while consumption of foods high in antioxidants can activate genes related to cell protection against oxidative stress. Therefore, the body's response to food is not only determined by the nutrient content of the food, but also by how individual genes respond to the nutrients through genetic expression mechanisms.

By understanding the complex interactions between genes and nutrients, nutrigenomics can explain why individuals consuming the same diet can respond very differently. Some people may experience weight gain or diabetes risk despite following a diet considered healthy, while others can maintain optimal health on the same diet. This underscores the importance of a nutrition approach that is not generic, but rather considers an individual's genetic factors as an integral part of diet planning. In this context, nutrigenomics can be used to design more accurate, effective, and personalized dietary recommendations, with the hope of improving quality of life and preventing chronic disease more optimally. It is important to distinguish between nutrigenomics and nutrigenetics, two fields that often overlap but have different focuses. Nutrigenomics studies how food components affect gene expression and biological function, while nutrigenetics focuses on how an individual's genetic variation affects the body's response to a particular food. In other words, nutrigenetics answers the question "how do genes affect responses to nutrients," while nutrigenomics answers the question "how do nutrients affect genes and their expression." For example, in nutrigenetics, research might explore how variation in the FTO gene contributes to obesity risk in a given individual, while in nutrigenomics, studies might look at how a high-fiber diet may regulate the expression of genes that control fat metabolism. Both are important in understanding the interactions between food and genes, but they are different and complementary approaches (Mozsik & Díaz-Soto, 2021).

Overall, both nutrigenomics and nutrigenetics provide the scientific foundation for the development of personalized nutrition, which aims to optimize health based on each individual's unique genetic profile. With advances in omics technologies such as DNA sequencing, microarrays, and metabolomics, it is now increasingly possible to integrate genetic information with diet and lifestyle data to generate more targeted nutritional interventions. However, significant challenges remain, including the complexity of gene-nutrient interactions, the need for robust scientific validation, and ethical and privacy considerations for genetic data. Nonetheless, nutrigenomics has tremendous potential to revolutionize public health approaches and pave the way for major transformations in dietetics, preventive medicine, and nutrition policy in the future.

Personalized Nutrition in the Context of Public Health

Personalized nutrition refers to a nutritional approach designed to meet the unique needs of each individual based on their biological characteristics, lifestyle, environment, and genetic factors. Unlike the general approach in conventional nutrition science that suggests population-based dietary guidelines, personalized nutrition attempts to understand how a person's body responds to food individually (Agostoni et al., 2021a). This approach combines various disciplines such as nutrition, genetics, microbiomics, and metabolomics to create more effective and accurate nutritional strategies in supporting health and preventing disease. The basic principle of personalized nutrition is that there is no one-size-fits-all diet, because each individual has a different metabolism, energy needs, and biological responses to the type and amount of food consumed. The principle of personalized nutrition involves several important aspects.

First, the collection of individual biometric and genetic data is the main basis for designing nutritional interventions. Through DNA testing, a person's genetic profile can be identified to determine their tendency towards certain responses to carbohydrates, fats, proteins, and micronutrients. Second, monitoring biomarkers such as blood glucose levels, lipid profiles, blood pressure, and inflammation indicators can help evaluate the effectiveness of the interventions given. Third, lifestyle factors such as sleep patterns, physical activity, stress levels, and food preferences are also taken into account because they indirectly affect an individual's metabolism and eating habits. This holistic approach makes personalized nutrition not only oriented towards disease prevention, but also towards improving quality of life and optimal body performance (Agostoni et al., 2021b).

The implementation of personalized nutrition tailored to an individual's genetic profile is a key element in nutrigenomics practice (Adams et al., 2020). Genetic analysis technology allows the identification of genetic variations (polymorphisms) related to nutrient metabolism, such as the FTO gene associated with obesity risk, or the TCF7L2 gene associated with glucose tolerance and type 2 diabetes. By knowing these variations, dietary interventions can be tailored to avoid unwanted metabolic reactions. For example, someone who has a genetic predisposition to insulin resistance can be directed to limit simple carbohydrate intake and increase fiber and unsaturated fat consumption. Individuals with gene variants that inhibit caffeine metabolism can be advised to reduce coffee consumption to avoid increased blood pressure. The implementation of nutrition based on genetic profiles does not only focus on disease, but also on optimizing overall body performance, including increasing energy, emotional stability, and endurance. In the context of chronic disease prevention, personalized nutrition has enormous potential.

Chronic diseases such as type 2 diabetes mellitus, obesity, and cardiovascular disease are highly influenced by nutritional and lifestyle factors. Although genetic factors cannot be changed, understanding genetic risk allows for earlier and more targeted prevention. In the case of diabetes, for example, someone with a high genetic predisposition can be directed to undertake intensive lifestyle interventions earlier than those who do not have such risks. These interventions include a low glycemic index diet, portion control, and increased physical activity. In the case of obesity, a personalized approach can help identify dietary patterns and hormonal responses that cause weight gain, allowing for more effective and sustainable weight loss strategies.

Cardiovascular disease is also an important area for the application of personalized nutrition. Responses to saturated fat, sodium, and cholesterol vary widely between individuals. Some people may show a sharp increase in LDL cholesterol after consuming a high-saturated fat diet, while others do not experience similar effects due to genetic differences in lipid metabolism (Paving the Way to Better Population Health through Personalized Nutrition - Mathers - 2019 - EFSA Journal - Wiley Online Library, n.d.). By understanding this variation, nutritional strategies can be tailored to reduce the risk of atherosclerosis and high blood pressure. In addition, the consumption of antioxidants and other nutrients can also be optimized based on individual metabolic needs and efficacy. The use of this approach is expected to reduce disparities in response to standard dietary interventions that often do not work for some groups of individuals. In today's era of technological and biomedical advances, the potential for personalized nutrition is expanding, especially with the integration of digital data from wearable devices, electronic medical records, and gut microbiome analysis. All of this opens up new opportunities to make nutritional predictions and interventions more dynamic, precise, and adaptive to changes in a person's body condition. This approach also allows real-time monitoring of the impact of diet on the body, so that strategies can be updated periodically according to evolving needs. Therefore, personalized nutrition is not only an important tool in the prevention of chronic diseases, but also an important foundation towards a more preventive, efficient and person-oriented health system (Verma et al., 2018).

However, the implementation of personalized nutrition still faces various challenges. Limited access to genetic testing, relatively high costs, and low nutritional and genetic literacy in the community are obstacles to mass adoption of this approach. In addition, clear regulations and ethical standards are needed to protect genetic data and individual privacy. However, the rapid development of technology and increasing awareness of the importance of disease prevention can be the main drivers towards the integration of personalized nutrition into the health care system. With a strong scientific foundation and the use of modern technology, personalized nutrition has the potential to revolutionize the way people understand their bodies and care for their health in an individual, sustainable, and evidence-based manner.

Integration of Nutrigenomics in Public Health

The integration of nutrigenomics in public health is an innovative approach that aims to connect individual genetic insights with more personalized and targeted nutritional strategies on a population scale. Nutrigenomics as a branch of science that studies the relationship between genes and the body's response to food has grown rapidly along with technological advances in genomics and bioinformatics. In the context of public health, the integration of nutrigenomics not only focuses on disease prevention through diet, but also has the potential to reduce the economic and social burden of increasing non-communicable diseases, such as obesity, diabetes, cancer, and cardiovascular disease (Reddy et al., 2018).

The development of chronic diseases that are multifactorial in nature encourages the need for a more complex approach than just general dietary interventions. Traditional public health generally provides nutritional guidelines based on general population recommendations, which do not take into account genetic diversity between individuals. In many cases, responses to diet vary, even when similar nutrient intakes are applied, because each individual has a unique genetic expression. Nutrigenomics is here to bridge this gap by enabling the development of more appropriate nutritional strategies according to a person's genetic profile. Therefore, the implementation of nutrigenomics on a large scale requires a transformation in the public health system, from a curative approach to a preventive one and from uniform treatment to personalized nutrition.

The implementation of nutrigenomics in public health policies opens up great opportunities for early detection of disease risk through genetic screening and population nutrigenetic mapping. By knowing specific genetic variants related to fat metabolism, carbohydrate sensitivity, or predisposition to certain diseases, health authorities can design more effective and efficient intervention programs. For example, individuals with FTO gene variants associated with an increased risk of obesity can be given low-fat dietary guidance and specific behavioral approaches to manage weight. This strategy is much more targeted compared to the one-size-fits-all nutritional approach that tends to produce limited effectiveness in efforts to control chronic disease epidemics (Vyas, 2022b).

However, the integration of nutrigenomics into public health requires careful consideration of ethics, data privacy, and equity of access. Not all groups in society have equal access to genetic testing or health services based on genomic data. This inequality risks widening the health gap between socio-economic groups if not managed with fair and inclusive policies. Therefore, it is crucial for governments and health institutions to design regulations that guarantee the security of genetic data, ensure the confidentiality of information, and build an equitable service distribution system. Public education also plays a vital role in ensuring that the public understands the benefits and limitations of nutrigenomics, so that they can make informed decisions about their own health. In addition, the integration of nutrigenomics into public health requires synergy between various disciplines and sectors. Collaboration between nutritionists, geneticists, epidemiologists, information technology, and policymakers is crucial in creating a holistic and sustainable health service ecosystem.

National population genomic databases, for example, can be a strategic resource that enables planning of nutrition interventions based on regions and risk groups. Digital platforms integrated with nutritional and genetic information can also facilitate the implementation of data-driven public health programs, such as personalized diet campaigns for the prevention of diabetes or hypertension in areas with high prevalence. In the long term, the successful integration of nutrigenomics in public health can change the paradigm of health services from a system that is reactive to disease to a system that is proactive in maintaining body balance from an early age. In other words, health is no longer understood only as the absence of disease, but as the result of a harmonious interaction between genetic factors, lifestyle, and the environment that are continuously managed dynamically. Nutrigenomics provides a great opportunity for people to not only live longer, but also be healthier and more productive through nutritional interventions designed based on a deep understanding of their own bodies.

Although still in its infancy, the implementation of nutrigenomics in public health programs shows revolutionary potential comparable to the discovery of vaccines or the control of infectious diseases in the past. To achieve this, consistent investment in scientific research, development of supporting technologies, training of health workers, and the formulation of adaptive and evidence-based policies is needed. When all these components are successfully consolidated, nutrigenomics will not only be a diagnostic tool, but also a key pillar in shaping a smarter, fairer, and more sustainable future for public health (Lucini et al., 2020).

Applications of Genetic Technology and Data Analysis

The application of genetic technology and data analysis has become a revolutionary milestone in the fields of molecular biology, medicine, agriculture, and various other disciplines. Technological advances such as high-speed genome sequencing (next-generation sequencing/NGS), CRISPR-Cas9, and artificial intelligence-based computing have opened up new insights into the structure, function, and genetic interactions of humans and other organisms. In the past, gene mapping required years and large resources, but now the entire genome can be analyzed in just a matter of days, even hours. This capability not only accelerates scientific research but also enables practical applications in disease diagnosis, treatment personalization, and more precise genetic engineering (Lasky-Su, 2017).

In the field of health, the application of genetic technology plays a central role in the development of personalized medicine. Analysis of genetic data allows the identification of individual genetic variations associated with risk for certain diseases, response to drugs, and tendencies towards side effects of therapy. Through this approach, doctors can design more specific and effective therapeutic interventions, thereby improving treatment outcomes and reducing long-term health costs. For example, in cancer patients, genetic data is used to determine the molecular profile of the tumor, which then becomes the basis for selecting targeted therapy. This represents a paradigm shift from "one-size-fits-all" to a more individualistic and predictive approach in modern medical practice. Not only limited to humans, genetic data technology and analysis also have a major contribution in the fields of agriculture and animal husbandry. Using genotyping and gene editing techniques, scientists can develop superior crop varieties that are more resistant to pests, diseases, and climate change. Similarly, in livestock, data-driven genetic selection allows for increased productivity, feed efficiency, and disease resistance. This is crucial in the context of global food security facing the challenges of a growing population and environmental degradation. Technologies such as CRISPR are also used to create genetically modified organisms (GMOs) that can provide higher crop yields and better nutritional quality.

The development of bioinformatics and artificial intelligence has also strengthened the capacity for analyzing very large and complex genetic data. Data from genetic sequencing results are usually very large and cannot be processed conventionally. Therefore, a computational approach is needed to identify hidden patterns, analyze gene expression, and predict the biological function of certain genes. The use of machine learning algorithms, artificial neural networks, and big data analytics allows scientists and clinicians to gain sharper and faster insights from genetic data. In addition, the development of cloud computing allows collaboration and data integration between research centers in various parts of the world, thus accelerating the process of innovation and scientific discovery (Khoury, 2010). However, behind all the promising potential, the application of technology and genetic data analysis also presents ethical, social, and legal challenges that cannot be ignored. The issue of privacy and data security is very crucial considering that genetic data is unique and very personal. Misuse of genetic information by irresponsible parties, such as insurance companies or employers, can lead to genetic discrimination. Therefore, strict regulations and a strong data protection system are needed so that the use of this technology does not violate individual rights. In addition, ethical dilemmas regarding genetic engineering, especially in humans, such as embryonic gene editing, continue to fuel global debates about moral boundaries and their potential impacts on the future of humanity.

Amidst the advancement of this technology, it is also important to ensure that its benefits can be felt equally by all levels of society. The disparity in access to genetic services between developed and developing countries, or between high and low socioeconomic groups, can increase health and social disparities. Therefore, the integration of genetic technology into health and education systems needs to be accompanied by an inclusive approach that considers aspects of justice, community genetic literacy, and infrastructure availability. A transdisciplinary approach involving geneticists, information technology, bioethics, public policy, and civil society is needed to create a sustainable and responsible ecosystem in the use of genetic technology (Mills et al., 2020).

Overall, the application of genetic technology and data analysis has brought about major transformations in various aspects of human life and the environment. In the future, the potential of this technology will continue to grow along with advances in computing and a deeper scientific understanding of genomics. With proper governance and cross-sector collaboration, genetic technologies will not only be a tool to solve health and food problems, but also an important pillar in building a healthier, smarter and more sustainable future.

CONCLUSION

Research on nutrigenomics and personalized nutrition shows that understanding the interaction between genes and nutrition can open up new opportunities to improve the effectiveness of public health interventions. By analyzing individual genetic variation, this approach allows for the development of dietary strategies tailored to each person's specific biological needs. As a result, the body's response to nutritional interventions is more optimal, while also encouraging the realization of a healthy lifestyle based on scientific evidence.

The integration of genomic technologies with public nutrition policies has the potential to reduce the risk of chronic diseases such as obesity, type 2 diabetes, and cardiovascular disorders. However, the implementation of this approach still faces challenges, especially in terms of ethics, the availability of representative genetic data, and equitable access to genome-based health technologies and services. Therefore, it is important to ensure that the application of nutrigenomics in public health does not widen disparities, but rather promotes equity in access to health services.

Overall, nutrigenomics and personalized nutrition are important innovations in the world of preventive health. By bridging genetic insights and nutritional interventions, this approach not only enriches public health strategies but also strengthens the paradigm of proactive, person-based health. Moving forward, cross-sector collaboration between researchers, health practitioners, and policy makers is essential to optimize the application of nutrigenomics on a broader and more sustainable scale.

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