



International Association of
Scientists
www.iasnetedu.com

Available online at www.jobiost.com

IJBLS 2023; 2(2):314-318



Intl Journal of
BioLife Sciences

Review paper

Synergistic Approach of Nanotechnology and Genomic Tools to Improve Farmer Health and Productivity

Hasta Handayani Idrus^{1,2*}, Basri Modding³, Salim Basalamah⁴, Nona Rahmaida Puetri², Khariri²

¹ Department of Microbiology, Faculty of Medicine, Universitas Muslim Indonesia, Makassar, Indonesia

² Center for Biomedical Research, Research Organization for Health, National Research and Innovation Agency, Cibinong Science Center, Jl. Raya Bogor No. 490, Cibinong – Bogor, West Java, Indonesia

³ Department of Management Science, Postgraduate Program, Universitas Muslim Indonesia, Makassar, Indonesia

⁴ Department of Islamic Education Management, Postgraduate Program, Universitas Muslim Indonesia, Makassar, Indonesia

Received: 13 August 2023

Revised: 22 August 2023

Accepted: 29 August 2023

Abstract

Background and Aim: Nanotechnology and genomics offer a promising pathway to enhance farmer health and productivity in sustainable agriculture, addressing challenges such as climate change, declining crop yields, and plant diseases. This study explores their potential in developing resilient, high-yielding plant varieties resistant to environmental stresses, including climate change impacts. Smart agrochemical delivery systems are also investigated for optimizing water and nutrient conditions to maximize crop yields.

Method: Employing nanotechnological advancements, this research investigates the utilization of nanoparticles for gene transformation and the delivery of macromolecules that induce gene expression in plants. The study explores the synergistic effects of nanotechnology and genomic tools, not only in plant breeding but also in animal breeding. Notably, gene editing technologies are harnessed to precisely modify the genetic code, allowing for the targeted enhancement of desired traits in animals.

Results: The results showcase successful applications of nanotechnology and genomics in agriculture. High-yielding plant varieties with enhanced resistance to environmental stress factors and diseases are developed. Smart agrochemical delivery systems prove effective in optimizing water and nutrient conditions, leading to increased crop yields. The utilization of gene editing technologies in animal breeding demonstrates precision in modifying the genetic code to confer specific traits, such as disease resistance, in cattle.

Conclusion: The synergistic collaboration between nanotechnology and genomics holds promise for advancing farmer productivity and health, contributing to sustainable agriculture by developing resilient crops and disease-resistant animals. Successful implementation requires interdisciplinary collaboration among scientists, farmers, and stakeholders, addressing challenges in plant and animal breeding.

Keywords: *Resilience healthcare, Adaptation healthcare, Islamic Perspective, Non-communicable diseases*

***Corresponding author:** Hasta Handayani Idrus, Department of Microbiology Faculty of Medicine, Universitas Muslim Indonesia, Makassar, Indonesia.

E-mail address: hastahandayani@umi.ac.id

Introduction

- Primary Factors Non-Communicable Diseases

Non-communicable diseases (NCDs), which are not transmitted from person to person, have emerged as a significant global health issue. They are especially prevalent in developing countries. This increase in NCDs can be attributed to a combination of genetic, physiological, environmental, and behavioral factors [1]. The primary factors contributing to the rise in NCDs are unhealthy diets, lack of physical activity, and tobacco use. Additionally, the global population is aging, and older individuals are at a higher risk of NCDs. Unless people change their lifestyle behaviors, the prevalence of NCDs worldwide will continue to rise, particularly with the growing older population [2].

NCDs are the leading cause of death, accounting for around of the 56 million global deaths in 2015. Four major types of NCDs are responsible for most of these deaths: cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes. Moreover, an estimated 15 million people die from NCDs between the ages of 30 and 69 years, with a significant impact on developing countries, where of premature NCD-related deaths occur [3]. One such developing country experiencing this health transition is Cambodia, which has seen economic growth, improved life expectancy, and a shift toward an aging population. However, rapid urbanization and changes in lifestyle due to economic development have led to an increased incidence of NCDs in Cambodia. Without specific interventions to control risk factors, the morbidity and mortality associated with NCDs are expected to continue rising [4].

- Access to Universal Health Coverage (UHC)

The United Nations has established the Sustainable Development Goals (SDGs), with one of the crucial objectives being Universal Health Coverage (UHC). UHC aims to ensure that every citizen has fair access to healthcare services at affordable rates, preventing them from facing financial burdens [5]. However, achieving UHC has proven challenging for many low- and middle-income countries due to the lack of financial risk protection for equitable healthcare access. Several countries, including Bangladesh, have prioritized UHC to enhance healthcare accessibility for their citizens. Unfortunately, without effective risk pooling mechanisms, a significant portion of the population in LMICs faces high out-of-pocket healthcare expenses, leading to financial hardship. This situation compels households to resort to borrowing, selling assets, or seeking help from friends and relatives, often resulting in catastrophic health expenditures [6].

Globally, around 150 million people experience CHE annually due to high out-of-pocket healthcare payments, residing in low-resource countries. In Bangladesh, healthcare financing primarily relies on households, accounting of total health expenditure in 2015, while public funding contributes, with additional support from development partners. Unfortunately, about 5 million people in Bangladesh fall below the poverty line each year due to high out-of-pocket healthcare spending [7]. The financial burden of CHE in Bangladesh has grown significantly, from of total household consumption expenditure in 2010 to between 2010 and 2016. A recent study in Bangladesh reported that approximately of households seeking healthcare resorted to selling assets, borrowing, or receiving assistance from relatives. Nonetheless, the factors contributing to such high levels of distress financing in the country require further investigation, as only a few studies have explored CHE and distress financing related to out-of-pocket expenses in Bangladesh [8].

- Health Behavioral Non-Communicable Diseases (NCDs)

Non-communicable diseases (NCDs) encompass a range of chronic illnesses, including cardiovascular diseases, cancers, diabetes mellitus (DM), and respiratory diseases. These NCDs

contributed to a staggering 41 million deaths globally in 2019, accounting for all deaths. Surprisingly, NCD-related deaths occur in individuals under 70 years old. The primary culprits behind most NCDs are four specific health behavioral risk factors: smoking, harmful alcohol consumption, unhealthy diet, and physical inactivity [9]. These behaviors lead to four distinct metabolic-physiological abnormalities: elevated blood pressure, overweight/obesity, elevated blood sugar, and elevated cholesterol [10].

Beyond these risk factors and medical conditions, the prevalence of NCDs is closely tied to socioeconomic status (SEP). Several NCD risk factors, such as smoking and physical inactivity, are linked to SEP as well [11]. At the population level, the occurrence of CVDs, like stroke and coronary heart disease, is strongly associated with lower GDP per capita and health expenditure per capita [12]. In the past decade, the prevalence of type 2 DM has risen due in part to poor working conditions, low income, and educational levels. Interestingly, high-income countries have higher rates of type 2 DM compared to low- and middle-income nations.

Despite overall health improvements in many European countries, significant health inequalities persist due to NCDs [13]. These inequalities exhibit a social gradient and socioeconomic disparities, with lower socioeconomic classes experiencing higher NCD rates for most diseases. Addressing these disparities has long been recognized as a critical public health challenge. Health inequalities refer to unjust and avoidable differences in health status within and between population groups. The economic costs of these inequalities are substantial, causing deaths and 33 million cases of illness annually across the European Union. They account for of total healthcare expenditure of social security expenditure. Inequality-related health losses also impact labor productivity, reducing GDP by annually. These welfare losses are estimated equivalent to of the EU's GDP [14].

Research into health inequalities in Europe has primarily focused on prevalence and mortality disparities between eastern, western, and central regions [15]. Studies consistently reveal significant health inequalities, especially between eastern and western countries, with almost all health indicators worse in the east. Factors contributing to these disparities include differences in health literacy, access to healthcare services, economic situations, and national health policies. Efforts to reduce these disparities should concentrate on improving educational opportunities, income distribution, health-related behaviors, and access to healthcare [16].

Conclusion

Non-communicable diseases (NCDs) have emerged as a significant global health concern, particularly in developing countries. The rise in NCDs can be attributed to a complex interplay of genetic, physiological, environmental, and behavioral factors. Unhealthy diets, physical inactivity, and tobacco use are the primary behavioral factors contributing to this surge. Furthermore, the aging global population is at a higher risk of NCDs, compounding the problem. Without substantial changes in lifestyle behaviors, the prevalence of NCDs worldwide is expected to continue increasing, especially given the aging demographic. Universal Health Coverage (UHC) is a critical goal set by the United Nations' Sustainable Development Goals (SDGs). UHC aims to provide equitable healthcare access at affordable rates, preventing financial burdens. Unfortunately, many low- and middle-income countries face challenges in achieving UHC due to inadequate financial risk protection. For instance, Bangladesh, despite prioritizing UHC, grapples with a significant portion of its population incurring high out-of-pocket healthcare expenses, often leading to catastrophic health expenditures (CHE). Globally, millions experience CHE annually due to high out-of-pocket payments, especially in low-resource countries, emphasizing the need to address

these financial barriers to healthcare access.

Acknowledgment

We thank and appreciate all those who helped us in conducting this research.

Conflict of interests

The authors declare that there are no competing interests.

Reference

- [1]. Ansah JP, Islam AM, Koh V, Ly V, Kol H, Matchar DB, Loun C, Loun M. Systems modelling as an approach for understanding and building consensus on non-communicable diseases (NCD) management in Cambodia. *BMC Health Serv Res.* 2019;19(1):1-10.
- [2]. Sheikh N, Sarker AR, Sultana M, Mahumud RA, Ahmed S, Islam MT, Howick S, Morton A. Disease-specific distress healthcare financing and catastrophic out-of-pocket expenditure for hospitalization in Bangladesh. *Int J Equity Health.* 2022;21(1):1-16.
- [3]. Andrade C, Mahrouseh N, Unim B, Cuschieri S, Grad DA, Gaetano I, Baravelli C, Fischer F, Charalampous P, Chen-Xu J, Mechili EA, Haneef R, Weye N, Ghattas J, Lesnik T, von der Lippe E, Haagsma J, Varga O. Inequalities in the burden of noncommunicable diseases across European countries: a systematic analysis of the 2019 global burden of disease study. *Population Medicine.* 2023;5(Supplement).
- [4]. Tabassum R, Froeschl G, Cruz JP, Colet PC, Dey S, Islam SMS. Untapped aspects of mass media campaigns for changing health behaviour towards non-communicable diseases in Bangladesh. *Global Health.* 2018;14(1):10-3.
- [5]. Idrus HH, Modding B, Basalamah S. Collective Competence as an Enable for Services Integration in Health and Social Care Services [Letter]. *J Multidiscip Healthc.* 2022;15:2901-2.
- [6]. Amerzadeh M, Takian A, Pouraram H, Sari AA, Ostovar A. Policy analysis of socio-cultural determinants of salt, sugar and fat consumption in Iran. *BMC Nutr.* 2022;8(1):1-7.
- [7]. Rawal L, Jubayer S, Choudhury SR, Islam SMS, Abdullah AS. Community health workers for non-communicable diseases prevention and control in Bangladesh: a qualitative study. *Glob Heal Res Policy.* 2021;6(1):1-10.
- [8]. Magnusson RS, McGrady B, Gostin L, Patterson D, Taleb HA. Legal capacities required for prevention and control of noncommunicable diseases. *Bull World Health Organ.* 2019;97(2):108-17.
- [9]. Idrus HH, Sunarno, Rijal S. Detection of Antibiotic Resistance Genes in *Pseudomonas aeruginosa* by Whole Genome Sequencing. *Infect Drug Resist.* 2022;15:7125-6.
- [10]. Banatvala N, Akselrod S, Webb D, Sladden T, Hipgrave D, Schneidman M. Actions needed to prevent noncommunicable diseases and improve mental health. *Bull World Health Organ.* 2019;97(2):2018-9.
- [11]. Peykari N, Hashemi H, Asghari G, Ayazi M, Janbabaei G, Malekzadeh R, Raeisi A, Sadrolsadat A, Asadi-Lari M, Farshad A, Farzadfar F, Ghanei M, Haghdoost AA, Heshmat R, Jamshidi H, Ostovar A, Takian A, Larijani B. Scientometric study on non-communicable diseases in Iran: a review article. *Iranian Journal of Public Health.* 2018;47(7):936-43.
- [12]. Jackson-Morris AM, Mutungi G, Maree E, Waqanivalu T, Marten R, Nugent R. Implementability' matters: Using implementation research steps to guide and support non-communicable disease national planning in low-income and middle-income countries. *BMJ Glob Heal.* 2022;7(4):1-8.

- [13]. Jacob CM, Killeen SL, McAuliffe FM, Stephenson J, Hod M, Diaz Yamal I, Malhotra J, Mocanu E, McIntyre HD, Kihara AB, Ma RC, Divakar H, Kapur A, Ferriani R, Ng E, Henry L, Van Der Spuy Z, Rosenwaks Z, Hanson MA. Prevention of noncommunicable diseases by interventions in the preconception period: a FIGO position paper for action by healthcare practitioners. *International Journal of Gynecology & Obstetrics*. 2020;151:6-15.
- [14]. Gupta N, Coates MM, Bekele A, Dupuy R, Fénelon DL, Gage AD, Getachew T, Karmacharya BM, Kwan GF, Lulebo AM, Masiye JK, Mayige MT, Mbaye MN, Mridha MK, Park PH, Dagnaw WW, Wroe EB, Bukhman G. Availability of equipment and medications for non-communicable diseases and injuries at public first-referral level hospitals: a cross-sectional analysis of service provision assessments in eight low-income countries. *BMJ open*. 2020;10(10):e038842.
- [15]. Poustchi H, Eghtesad S, Kamangar F, Etemadi A, Keshtkar AA, Hekmatdoost A, Mohammadi Z, Mahmoudi Z, Shayanrad A, Roozafzai F, Sheikh M, Jalaeikhoo A, Somi MH, Mansour-Ghanaei F, Najafi F, Bahramali E, Mehrparvar A, Ansari-Moghaddam A, Enayati AA, Esmaeili Nadimi A, Rezaianzadeh A, Saki N, Alipour F, Kelishadi R, Rahimi-Movaghar A, Aminisani N, Boffetta P, Malekzadeh R. Prospective epidemiological research studies in Iran (the PERSIAN Cohort Study): rationale, objectives, and design. *American journal of epidemiology*. 2018;187(4):647-55.
- [16]. Islam SM, Salehin M, Zaman SB, Tansi T, Gupta RD, Barua L, Banik PC, Uddin R. Factors associated with chronic kidney disease in patients with type 2 diabetes in Bangladesh. *International Journal of Environmental Research and Public Health*. 2021;18(23):12277.