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A Comparative Analysis of Walt's Balance of Threat Theory and the Logic of Biopower

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ABSTRACT

This study critically evaluates the framework of Walt's balance of threat theory in relation to the emergence of advanced biotechnological systems, such as synthetic biology and genome editing. The central argument is that the structural characteristics of biological technologies, particularly their small scale, inherent concealability, and dual-use capacities, have shifted the balance of power in international security from an objective dimension based on material resources to a subjective and perceptual dimension. Technological developments have reinforced the structural gap between objective and perceived power and have significantly increased the analytical weight of the qualitative components of threat, namely "offensive capability" and "offensive intention." Redefining Walt's components within the biological context shows that "aggregate power" is now equivalent to the capacity for biological innovation, "proximity" has shifted from geographical proximity to technological proximity, and offensive capabilities and hostile intentions have become almost inseparable and difficult to identify. Consequently, biological threat is more of a processual construct based on uncertainty than a reaction to an observable material capability. This situation changes the equations of coalition formation and drives actors toward strategies of preemptive balancing. The comparative analysis shows that countries with infrastructural weaknesses in the field of biological monitoring and control, such as Iran, are more vulnerable to the intensification of perceived threat. Accordingly, the study proposes necessary strategies for reducing this perception, including strengthening biodefense, increasing controlled transparency, and enhancing scientific and biological literacy at the national level. Ultimately, biotechnology is presented as a new structural variable that can activate the balance of threat without necessarily requiring a change in material capability.

Keywords: *advanced biotechnology, balance of threat, perceived threat, biosecurity*

Introduction

At the beginning of the twenty-first century, the structure of international security has faced a profound and paradigmatic transformation; a transformation that has not only redefined the nature of power and the patterns of competition among states, but has also confronted the foundations of many classical theories of international

relations with conceptual and functional challenges. While traditional approaches were primarily based on the accumulation of military power, hardware-based deterrence, and balancing grounded in material capabilities, the emergence of a new generation of advanced biotechnologies—from synthetic biology and genome editing to systems for designing, modeling, and simulating emerging diseases—indicates that the source of power and the origin of threat in the new global order are rooted more than ever in the capacity to produce knowledge, bio-technological architecture, and the acceleration of scientific transformation. This fundamental development has brought the international security environment into a condition that may be called a “crisis of strategic ambiguity”; a condition in which the boundary between defensive and offensive applications becomes highly fluid, capabilities acquire structural concealability, and the real intentions of actors remain unobservable behind the complex layers of dual-use technologies. The COVID-19 pandemic, as a historical turning point, revealed how biological vulnerability, technological gaps, and the inefficiency of scientific surveillance systems can— even in the absence of any hostile action—dramatically increase perceived threat, disrupt power equations, and expose the national security of states to turbulence within a short period. The experience of COVID-19 showed that in the age of biotechnology, “threat” is less the outcome of actual power than the product of perception, ambiguity, and the speed of dissemination of biological information; this has unprecedentedly increased the weight of the “threat perception” variable in the strategic calculations of states.

Necessity of the Study

At the beginning of the twenty-first century, the structure of international security has undergone a profound and paradigmatic transformation. The emergence of a new generation of advanced biotechnologies—from synthetic biology and genome editing to systems for designing, modeling, and simulating emerging diseases—shows that the source of power and the origin of threat in the new global order are rooted more than ever in the capacity to produce knowledge, bio-technological architecture, and the acceleration of scientific transformation. This fundamental development has brought the international security environment into a condition that may be called a “crisis of strategic ambiguity”; a condition in which the boundary between defensive and offensive applications becomes highly fluid, capabilities acquire structural concealability, and the real intentions of actors remain unobservable behind the complex layers of dual-use technologies (1). The COVID-19 pandemic, as a historical turning point, revealed how biological vulnerability, technological gaps, and the inefficiency of scientific surveillance systems can—even in the absence of any hostile action—dramatically increase perceived threat, disrupt power equations, and expose the national security of states to turbulence within a short period. This experience showed that in the age of biotechnology, “threat” is less the outcome of actual power than the product of perception, ambiguity, and the speed of dissemination of biological information; this has unprecedentedly increased the weight of the “threat perception” variable in the strategic calculations of states (2).

Walt’s balance of threat theory, as a fundamental revision of the classical balance of power approach, is based on the core principle that states in an anarchic environment react not to the mere increase of power, but to “perceived threat.” This theory identifies four main components as involved in the formation of perceived threat: aggregate power, geographic proximity, offensive capabilities, and offensive intentions. However, the significance of this theoretical link becomes even greater when it is examined in the context of biological technologies and biotechnology; a domain in which the boundary between defensive capability and offensive capacity is highly ambiguous, and this very ambiguity substantially increases the weight of the components of “offensive capability”

and “offensive intention” in the formation of perceived threat (3). Characteristics such as the dual-use nature of technology, the inherent concealment of biological experiments, political deniability, the low cost of development, the speed of scientific breakthroughs, and the possibility of conducting sensitive activities on a small scale have led states to consider even ordinary research activities as potentially threatening. In this context, with the entry of advanced biotechnology, the logic of threat assessment has shifted from the “measurement of material power” to the “measurement of perceived threat.” Even the smallest advance in molecular biology, vaccine design, genome engineering, or the development of modeling platforms can produce multiple units of increase in perceived threat. This transformation structurally changes the weight of Walt’s four components: aggregate power no longer means the number of weapons or the size of the economy, but the ability to produce knowledge and the speed of innovation; proximity has shifted from geographic distance to technological and networked distance; offensive capabilities have moved from the battlefield to the laboratory, where the smallest experiment can create targeted and difficult-to-trace capacities; and offensive intention has also become fundamentally difficult to identify, because the dual nature of technology complicates any distinction between therapeutic and weapons-related applications. These transformations cause biological threat—even in the absence of hostile action—to take shape as a constructed, processual, and mind-centered phenomenon, and states respond not to actual power, but to potential and imagined threat (4). In recent decades, deep scientific, technological, and security ties between the United States and Israel have become, from the perspective of many regional actors, an important factor in the formation of biological threat perception. A considerable part of this perception stems from the assumption that the United States, as one of the most advanced biological powers in the world, provides parts of its scientific capabilities, research infrastructures, and emerging technologies to Israel within the framework of security, research, and defense cooperation. Even if the actual nature of these collaborations is merely defensive or scientific, in the strategic environment of the Middle East—which is marked by historical mistrust, recurrent conflicts, and chronic information gaps—such collaborations are often interpreted as reinforcing Israel’s potential capabilities in sensitive biological domains (5). Under such conditions, any sign of American biological progress, such as the development of genomic prediction models, systems for detecting unknown agents, or advanced biocomputational platforms, becomes linked in the minds of many regional actors to the assumption that “such capabilities may, directly or indirectly, become available to Israel.” This perceptual assumption—which does not necessarily mean full factual accuracy, but plays a decisive role in international politics—multiplies the perceived threat arising from Israel’s biological capability and makes the balance of threat formed around it more complex. This dynamic intensifies when the characteristics of biotechnology make the assessment of real intention and capability almost impossible. In such a framework, technological cooperation between the United States and Israel, whether at the military level or the research level, is automatically interpreted as an ambiguous strategic signal that can make Israel’s real capabilities appear more enhanced than they actually are. The result is that even without definitive evidence of offensive programs, perceived threat toward Israel increases, and other states are compelled to adopt new balancing, precautionary, or coalition-oriented behaviors (6). This situation shows why the present study is necessary, important, and theoretically innovative. In the literature of Walt’s balance of threat theory, “aggregate power,” “offensive capability,” “proximity,” and “intention” are the four main components of threat. However, in the field of biotechnology, these components have not only changed form, but have also acquired much greater perceptual weight because of technological cooperation between great powers and their regional allies. In other words, in the biological domain, “technology transfer” or “research cooperation” can have a security effect equal to an “increase

in material power," because threat perception is strongly intensified. On this basis, the present study seeks to show why American technological cooperation with Israel is interpreted by some regional actors as an "increase in potential offensive capability"; how this perception intensifies perceived threat without any actual change in material power; and why, under such conditions, redefining Walt's balance of threat theory within the framework of "biotechnology" is necessary. The importance of the study lies precisely at this point: in a world where biotechnology has a dual-use and concealable nature, perceived threat is more important than actual capability, and scientific cooperation between the United States and Israel can itself become an independent driver of the formation or intensification of the balance of threat. This gap between "actual power" and "perceived power" is the very theoretical gap that the present study seeks to fill (4, 7).

Theoretical Framework:

In the post-coronavirus world, biotechnology has transformed not only public health, but also the nature of power and threat in international politics. The experience of COVID-19 showed that biological technologies, from molecular diagnostics and genomic sequencing to synthetic biology and disease modeling, are not merely scientific tools, but operate within structures of power, governance, and national security (2). States realized that control over biological infrastructures means control over population dynamics, social behavior, and even economic flows; therefore, biotechnology has become a source for shaping global order and disorder. This transformation has confronted classical security theories, including Walt's balance of threat theory, with serious limitations, because these theories were based on observable military power and geographic proximity, whereas biological threats are invisible, rapidly evolving, deniable, and unpredictable (2). With the expansion of advanced biotechnology, threat assessment has shifted from the measurement of material power to the measurement of perceived threat, in such a way that even limited advances in genome engineering, vaccines, or biological modeling can generate a significant increase in perceived threat. In this framework, Walt's four components have been transformed: aggregate power has become dependent on the capacity to produce knowledge and the speed of innovation; proximity has shifted to technological and networked distance; offensive capability has moved to the laboratory; and offensive intention has become fundamentally ambiguous because of the dual nature of the technology (8). At the same time, the historical transformation of biotechnology—from synthetic biology and the declining cost of DNA sequencing to its linkage with artificial intelligence—has turned scientific infrastructures into sources of power (9). As a result, countries such as the United States, China, and the United Kingdom are not merely holders of biological power, but producers of the "structure of biological power," determining standards and research pathways; a condition that creates a gap in "response capability" for smaller states (9). This technological gap intensifies uncertainty about the real intentions and capabilities of great powers, because a significant part of biological power is invisible, and competitors are forced to make exaggerated estimates based on limited signals. Consequently, every actual advance is reflected several times over in perceived threat, and the gap between actual power and perceived power widens (10). The competition between the United States and China in biotechnology, along with sanctions and control over supply chains, shows that this field has become an arena of geopolitical competition and has redefined the logic of the balance of threat (6, 11). In this environment, the role of institutions such as IARPA becomes prominent; an institution whose bio-computational projects and efforts to predict emerging threats, even when presented as defensive, structurally produce signals of perceived offensive capability and increase the weight of threat in the minds of competitors (12). The consequence of this situation is a transition from purely military balancing to

biological-networked balancing, which is based on early warning, bio-information alliances, and deterrence grounded in scientific power (13). In such an order, countries such as Iran face greater perceived threat, because the technological gap and the structural vulnerability of the health system cause even non-hostile phenomena to be perceived as threatening. The experience of the coronavirus pandemic showed that the absence of genomic surveillance and institutional incoherence intensifies this perceived threat; therefore, Iran must prioritize defensive-technological balancing by strengthening biological capacities, biological diplomacy, and rapid response architecture, because in the new order, biological power is equivalent to national security (10).

Biotechnology as a Source of Perceived Threat

Biotechnology was traditionally regarded as a tool for treating diseases and improving health, but in the past decade, with the emergence of technologies such as CRISPR/Cas9, synthetic biology, gene synthesis, and artificial intelligence-based platforms, it has become a domain with potential offensive capacities. Alongside their peaceful functions, these technologies are considered from the perspective of international security as a new source of threat perception, because they enable targeted, low-cost, and concealable intervention in biological systems (14). First, biotechnology increases the level of “asymmetry” in conflicts; unlike conventional weapons, which require extensive industrial and logistical infrastructures, biological capabilities are primarily knowledge-based, small-scale, and difficult to observe. This causes even small states or non-state actors to be perceived as potential holders of asymmetric strike capacity and reduces the perceptual distance between large and small actors (15). Second, the concealable and “dual-function” nature of biological research intensifies “strategic ambiguity,” because many biological activities—from medical research to vaccine development—are outwardly similar, and identifying their real intention is difficult. For precisely this reason, even legitimate and peaceful activities may be interpreted as signs of potential offensive capacity, thereby increasing the weight of the “offensive intention” component in the balance of threat (16, 17). Third, biotechnology strengthens “perceived offensive capacity,” because characteristics such as high targetability, rapid effect, and the possibility of bypassing classical defense mechanisms mean that even theoretical capacities can provoke security reactions, and state decision-making becomes based less on actual capability than on imaginable potential capability; this increases the level of strategic uncertainty (18). Fourth, these developments transform the mechanism of state balancing, such that states are compelled, in addition to traditional deterrence instruments, to develop scientific monitoring, biosafety standards, information exchange, early warning, and international cooperation; balancing therefore acquires a multidimensional, networked, and preemptive nature (11, 19). Fifth, biotechnology expands the gap between “actual power” and “perceived power,” because the invisibility of biological activities leads competitors to assess capabilities based on limited signals, scientific reports, or scattered indications. As a result, even a small scientific advance may be interpreted as a sign of a major increase in biological power, leading to threat overestimation and excessive balancing (20, 21). Overall, biotechnology is not merely a new technological domain, but a structural source for producing perceived threat that redefines the dynamics of international security by increasing asymmetry, ambiguity, and perceptual gaps, and pushes states toward more sensitive and preemptive strategies (8).

Analysis of the Components of the Balance of Threat in the Field of Biotechnology

In Walt’s balance of threat theory, “aggregate power” in the age of biotechnology has acquired a multilayered and structural nature and has become fundamentally different from the classical definition of power in realism. If, in the past, aggregate power was mainly inferred from indicators such as population, economy, industry, and hard

military capability, in the biotechnological environment its main axis is the “capacity to produce knowledge” and the “capacity to guide pathways of scientific transformation.” Therefore, countries such as the United States, China, and the United Kingdom, which stand at the top of the global chain of biological innovation, are regarded not merely as holders of power, but as producers of the “structure of power,” and this feature turns their power, in the eyes of others, into a potential source of threat (22). Aggregate biological power rests on three main components: first, infrastructural depth, including leading universities, multilevel laboratories, specialized supply chains, computational capacity, and industrial networks; second, the speed of scientific accumulation, which depends on innovation cycles, the quality of human capital, and the capacity to translate knowledge into technology; and third, the ability to shape the rules of the game through the formation of standards, governance regimes, and research pathways, such that power includes not only “possessing,” but also “defining” (21). From the perspective of smaller states and developing countries, this concentration of power leads to a technological gap that is not merely scientific, but turns into inequality in the capacity for monitoring, understanding, and security response; in this way, the speed of biological progress among great powers is perceived as a security variable, not merely as a technological advantage. This perception intensifies when a considerable part of biological power is “invisible” and embedded in data networks, genome analysis platforms, and research centers; this invisibility, even without hostile intention, structurally produces threat signals and pushes competitors toward assuming worst-case scenarios (23). Moreover, aggregate biological power has a “domain effect,” meaning that progress in one scientific field is generalized in the minds of competitors to other fields and creates exaggerated perceptions of biological capability; therefore, an actor that is advanced in one biological sector is assumed to potentially possess capability in other sectors as well (24). As a result, aggregate biological power is not a reflection of what states actually possess, but an expression of what competitors imagine they may possess; a dynamic that shifts the logic of international security from “power against power” to “future capability against future capability” and turns aggregate power into one of the main drivers of the balance of threat.

Geographic Proximity

In Walt’s classical balance of threat theory, “geographic proximity” was one of the main sources of increased threat perception; that is, the closer a state was to the physical borders of another state, the more likely it was to be perceived as a threat. However, in the field of biotechnology, the traditional function of this component has been transformed, and its impact has been substantially reduced. The architecture of modern biological technologies—from synthetic biology and disease modeling to networks for exchanging genomic data, biobanks, and transnational research chains—is such that perceived threat is no longer a function of physical distance, but of technological distance and the capacity for indirect dissemination. In such an environment, a state may be located thousands of kilometers away, yet be perceived by other actors as far more threatening than nearby neighbors, simply because it possesses advanced biological infrastructures, large-scale data analysis capacity, and the ability to guide scientific trends (25). An important characteristic of biotechnology is that the “range of perceived threat” is linked not to borders, but to the “mobility of the biological phenomenon.” Unlike conventional weapons, which require physical presence or geographic proximity to produce effect, biological activities may become influential through indirect, networked, and dispersed pathways. Global supply chains, intercontinental laboratories, the free flow of genomic data, multinational scientific collaborations, the circulation of scientists, and even international therapeutic and commercial infrastructures all make it possible for the potentially threatening effects of a biological activity not to

remain confined to the geography of origin. As a result, geographic distance is no longer assumed to be a reliable criterion for estimating threat intensity; what matters is the “capacity for indirect dissemination” and the “dynamics of biological networks” (26). This transformation gives threat perception a trans-spatial and network-centered nature. In assessing biotechnology, states no longer ask, “How close is it to us?” but rather, “How much can it affect us?” The second question is often answered independently of physical borders. Under such conditions, a state such as the United States or China, despite its great geographic distance from the Middle East, Africa, or Latin America, is perceived in the minds of actors in these regions as far more threatening than their neighbors, because its capability to shape research flows, regulate technology, control biological data, and produce international standards is much greater (27). In other words, in the field of biotechnology, “geographic proximity” gives way to “technological proximity” and “networked proximity.” States located within the orbit of biological innovation, even if geographically distant, have greater potential influence because of their active presence in global science and technology networks, and therefore the perceived threat from them is greater. This condition fundamentally rearranges Walt’s classical logic: threat does not emerge from a nearby neighbor, but from a distant power that has higher laboratory capability, computational capacity, complex research chains, or speed of knowledge production. Ultimately, the declining importance of geographic distance causes the balance of threat in the biological sphere to become more global, more fluid, and more anticipatory. To assess threat, states are compelled to look not at borders, but at the architecture of scientific and technological networks; this shift is one of the most important reasons for the multidimensionalization of biosecurity in international politics (28).

Offensive Capabilities

Synthetic biology, by rearranging biological foundations and enabling the design of emerging biological systems, has created a capacity that, from the perspective of states, goes beyond a mere scientific advance and becomes an important source of increased “threat perception” in Walt’s logic. Capabilities such as creating advanced mechanisms of resilience, designing targeted characteristics, and the possibility of creating difficult-to-trace biological phenomena even at the purely theoretical and laboratory level substantially strengthen states’ perception of “potential offensive capacity.” Such technologies, without necessarily presenting any sign of offensive intention, produce a form of structural uncertainty, because competitors cannot determine whether the purpose of a state is merely basic research or the preparation of a platform that could be used in offensive pathways in the future. This inability to distinguish purposes, as Walt emphasizes, causes “perceived offensive capability” to grow faster than “actual intention,” and threat to take shape much earlier. Therefore, synthetic biology, even in the absence of any suspicious behavioral sign, creates such a level of technological ambiguity and theoretical possibility that it leads other actors to believe that a change in the balance of power may be sudden, unpredictable, and asymmetric; this perception alone is sufficient to activate the logic of the balance of threat, without any state displaying hostile behavior (29).

Offensive Intentions

In the logic of Walt’s balance of threat theory, “offensive intentions” constitute the most important variable in determining the intensity of perceived threat, because states always face a perceptual gap between observing the capabilities of the other side and understanding its real purposes; a gap that becomes far deeper and more structural in the field of biotechnology. The dual nature of biological activities—from biosafety level 3 and 4 laboratories and

officially defensive programs to public health projects and biological surveillance—is such that distinguishing real intention from outward activities becomes almost impossible. This causes a laboratory officially established to identify emerging agents or study infectious diseases to be perceived by some states as part of a potential offensive capacity; not because of hostile evidence, but because of the possibility that knowledge, technical infrastructure, and generated data may be transferred to high-risk applications (16). This ambiguity in biological intentions is not accidental, but structurally rooted, because modern biological technologies—from synthetic biology to genome editing and biological modeling—possess application flexibility, and their outputs can simultaneously be used in therapeutic, protective, or potentially harmful pathways. This feature causes even entirely health-oriented projects to acquire a "security layer of meaning" in the assessment of competitors and to be interpreted as signs of potential capacity to change the balance of power; a situation consistent with Walt's emphasis on the role of perception and intention in the formation of threat (4). This condition intensifies when a significant part of the biological innovation cycle—from experimental data and scientific methods to domestic infrastructures—has limited public observability, and this "invisibility" of key activities causes competitors, in the absence of transparent information, to base their analysis on the most pessimistic scenarios and to estimate possible intention as more dangerous than the available evidence suggests; a phenomenon that Walt describes as the subjective nature of threat (30). Consequently, even non-offensive bioprotection programs, health security projects, and ordinary research centers may be exposed to security interpretation, and this ambiguity not only helps increase suspicion, but also leads at the macro level to the intensification of technological competition and a tendency toward preemptive balancing. In this way, biotechnology, by reinforcing ambiguity in intentions, contributes to the intensification of the balance of threat and the increasing complexity of global biosecurity, even without hostile intent (30).

Biotechnology and Changing Patterns of Coalition Formation

According to the logic of Walt's balance of threat theory, when a state perceives another actor as threatening, three main behavioral patterns—balancing, bandwagoning with the threat, and distancing or active neutrality—emerge as possible responses. In the field of biotechnology, because of the networked, dual-use, and asymmetric nature of biological technologies, these patterns appear in more complex and intensified forms. In the biological competition between the United States and China, balancing has mainly emerged through the expansion of biosecurity cooperation, joint research partnerships, alignment in standard-setting, and the creation of networks for data exchange and monitoring emerging threats among American allies in the Indo-Pacific and Europe; in such a way that countries such as Japan, Australia, South Korea, and the United Kingdom are effectively creating an institutional-technological bloc to balance China's rapid biotechnological growth. This trend is consistent with Walt's logic, because the increase in perceived threat, before the emergence of overt offensive action, leads to convergence and the strengthening of institutional ties among actors (4). By contrast, some developing countries that are more dependent on China's biological infrastructures, pharmaceutical supply chains, and research projects have moved toward a form of "technological bandwagoning"; an alignment that is not necessarily security-oriented or political, but results from the combination of technological need, economic access, and the attractiveness of China's biological development model. This may be considered an example of bandwagoning, where balancing is perceived as costly or difficult. Meanwhile, some states choose the strategy of "active neutrality" and seek to benefit from the scientific advantages of both sides by diversifying scientific cooperation, using multilateral mechanisms, and maintaining relative balance between the two poles, without directly entering geobiological competition.

However, the non-geographic and perceptual nature of biological threats causes even technical and research decisions to be interpreted as strategic signals, making active neutrality more difficult than before. Overall, the biological competition between the United States and China shows that biotechnology, as a new structural variable, has redefined patterns of coalition formation and reproduced the balance of threat theory in a technological and contemporary form (4).

Security Implications for Regional Countries Such as Iran

For countries such as Iran, which face a combination of classical and emerging threats in a complex and competitive geopolitical environment, the security implications of biotechnological developments appear above all in the form of increased “perceived threat”; a threat that does not necessarily arise from the offensive intentions of great powers, but from the widening gap in technological capability and the structural vulnerability of health and biosecurity infrastructures (31). The increasing technological distance from leading powers causes countries such as Iran to face the concern that the speed of biological knowledge accumulation in the United States, China, and the United Kingdom may gradually weaken their capacity for monitoring, prediction, and response, and, in the logic of Walt’s balance of threat theory, lead to increased perceived threat. At the same time, structural limitations in laboratory networks, biological surveillance, and medical logistics cause even non-hostile biological phenomena to be perceived as potential sources of threat and intensify perceptual asymmetry. Under such conditions, policymakers rationally move toward two complementary paths: on the one hand, strengthening biodefense, upgrading research capacity, and developing health surveillance systems in order to reduce internal vulnerability; and, on the other hand, expanding scientific cooperation, increasing transparency, and pursuing regional biological diplomacy in order to manage misperceptions and control hostile perceptions. In accordance with Walt’s framework, this approach is an attempt to manage uncertainty and reduce the intensity of the balance of threat in the surrounding security environment (32).

Conclusion

The unprecedented emergence of advanced biotechnologies in the twenty-first century has not only fundamentally transformed the global threat system, but has also confronted the theoretical paradigms of international security, especially Walt’s balance of threat theory, with deep conceptual challenges. Accordingly, classical approaches focused on measuring material military capability and geopolitical proximity have now lost their former effectiveness when faced with a constellation of knowledge-based power, accelerating capacities for biological innovation, technological asymmetries, and strategic ambiguity. The nature of biological threat is no longer necessarily defined as a material reality that can be directly perceived; rather, it essentially acquires identity in the realm of “perception” and “social construction.” The COVID-19 pandemic, as an objective and tangible experience, reminded the world, and especially the Islamic Republic of Iran, that the absence of integrated genomic surveillance infrastructures, institutional incoherence, and deficiencies in the management of scientific information can increasingly push perceived threat beyond its actual dimensions and place the country in a highly vulnerable position against emerging crises. The redefinition of the four components of Walt’s balance of threat theory is one of the central and definite achievements of this study. “Aggregate power” is no longer confined to the accumulation of military weapons or the economic size of countries; it is now embodied in the capacity to produce biological knowledge, the relentless speed of innovation, and the ability to shape global scientific and technological norms.

The concept of “proximity” has also moved beyond purely geographic dimensions and has become technological and networked proximity. “Offensive capabilities” have moved from the classical battlefield to the laboratory space, where the smallest advance in molecular biology can cause a sudden increase in perceived threat. The crucial component of “offensive intention,” in light of the structural ambiguity and dual nature of biological technologies, has also become fundamentally difficult to identify, turning “strategic ambiguity” into the main driver of perceived threat formation. Taken together, these developments demonstrate that biological threat—even in the absence of any direct hostile action—takes shape as a processual and mind-centered construct and compels states to react to potential and imagined threats (8). A deeper examination of the theoretical literature and documented evidence clearly confirms this claim. The World Health Organization and the illuminating works of Koblentz clearly explain the dual nature of biological technologies and the difficulty of distinguishing between purely defensive purposes and potentially offensive intentions. Reports such as “biotechnology in the age of terror” and Danzig’s analyses also warn firmly about the dangers of sensitive dual-use research and the networked expansion of genomic capabilities. In the field of international law, the Biological Weapons Convention, despite its undeniable importance, has intensified strategic ambiguity surrounding the intentions and biological capabilities of states because of the absence of strong verification mechanisms. Regarding actors such as the Israeli regime, Turkey, Saudi Arabia, and the United Arab Emirates, policies for developing biological technology, together with insufficient transparency in some domains and the significant history of technology transfer from great powers, have turned these countries into actors with considerable dual-use capacities and potentially threatening capabilities, making their analysis within the framework of the regional balance of threat unavoidable. The high scientific capacity and long-standing policy of strategic ambiguity of the Israeli regime, the massive investments of Turkey and the Arab countries of the Persian Gulf in biological infrastructures and emerging technologies, all are interpreted as signals in the literature of the balance of threat that can affect threat perception in the region. All of these documents emphasize a bitter but undeniable reality: threat perception, especially in the biological domain, has now become a determining variable in the behavior of states in the international system. The results of this study clearly indicate that countries such as Iran—which simultaneously face a technological gap in relation to leading biological powers and structural challenges in health infrastructures—are more exposed than other actors to the increase of perceived threat. The experience of the coronavirus pandemic revealed this vulnerability in an objective and tangible way. Therefore, this study strongly argues that establishing an integrated genomic surveillance network, comprehensively strengthening biodefense infrastructures, unconditionally enhancing responsible transparency in scientific-research activities, decisively modernizing crisis-management architecture with the aim of response capability in less than 48 hours, and broadly developing public biological literacy are not merely recommendations, but vital and necessary preconditions for effectively reducing perceived threat and establishing powerful defensive deterrence. This study concludes that biotechnology has emerged as a new structural variable in international politics, one that is capable of activating the balance of threat even without a direct increase in material power. Therefore, Walt’s theory, with a precise and intelligent redefinition of its concepts and components, becomes the most effective analytical framework for explaining biosecurity and understanding state behavior in the new global order. The optimal and unavoidable path for countries such as Iran is not merely costly competition in the accumulation of hard power, but a strategic movement toward intelligent balancing, continuous indigenous scientific capacity-building, active diplomacy, and responsible transparency. This approach can move Iran from a state of “perceptual vulnerability” to a stable and robust condition of “biological stability” and fully provide the capacity to manage emerging crises and preserve

national and regional cohesion. Future research should immediately examine more precisely the ethical and legal implications of dual-use applications of biotechnology and develop international protocols for reducing strategic ambiguity in this vital field.

Proposed Strategies:

To address the complex challenges of biosecurity in the present era and effectively reduce perceived threat, several key policy strategies are proposed: creating and strengthening a national genomic surveillance network through investment in comprehensive infrastructure capable of rapidly monitoring and identifying pathogens, genetic mutations, and emerging threats, including reference laboratories, advanced sequencing centers, and big-data analysis systems with the capacity for rapid and secure information exchange at national and international levels; strengthening and updating biodefense infrastructures through a comprehensive review of capacities for responding to biological attacks or events, developing indigenous vaccines and treatments, strategically stockpiling protective equipment, and training specialized personnel; enhancing responsible transparency in biological scientific and research activities through the formulation of national protocols and standards for dual-use projects, while preserving security considerations, in order to reduce strategic ambiguity and increase mutual international trust; modernizing crisis-management architecture with rapid response capability and coordination among military, health, intelligence, and scientific institutions in such a way that the system can respond in less than 48 hours; developing public biological literacy through educational and awareness-raising programs for the public and specialists, in order to increase public understanding of biological technologies, risks, and opportunities and to counter misinformation during crises; and pursuing active biological diplomacy and international participation with global organizations and other countries in the fields of scientific information exchange, cooperation in research and development, and the formulation of norms and regimes for biological arms control in order to reduce uncertainty and strengthen confidence-building frameworks.

This study shows that biotechnology functions as a new structural variable in international politics that, even without a direct increase in material power, has the capability to activate the balance of threat. Therefore, Walt's theory, by precisely redefining the components of aggregate power, offensive capability, and offensive intention, provides the best framework for analyzing biosecurity and state behavior in the new global order. The optimal path for countries such as Iran is not merely costly competition in the accumulation of hard power, but a strategic movement toward intelligent balancing, indigenous scientific capacity-building, active diplomacy, and responsible transparency. This approach moves Iran from a condition of "perceptual vulnerability" to stable "biological stability" and provides the capacity to manage emerging crises and preserve national and regional cohesion. Future research should address the ethical and legal implications of dual-use applications of biotechnology and the development of international protocols for reducing strategic ambiguity in this vital domain.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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