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Examining the Relationship between Attitudes Towards Genomic Technology and Genetic Entrepreneurial Intention among Egyptian Healthcare Professionals

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Abstract

In the contemporary landscape, nurturing genomic entrepreneurial attitudes and intentions poses a substantial challenge for healthcare organizations. The present paper examines the factors affecting attitudes towards genomic technology and entrepreneurial intentions among Egyptian healthcare professionals. The study applied a quantitative approach and collected cross-sectional data from 276 health professionals using convenience sampling. Using structural equation modeling (SEM) through SmartPLS 4, the findings suggest a positive significant effect of innovation and genomic knowledge on attitudes towards genetic technology. On the other hand, risk perception negatively predicts attitudes towards genetic technology. Finally, the path analysis also confirmed a positive significant effect of attitudes towards genetic technology on entrepreneurial intention. The study's findings would help develop policies regarding genomic innovation among healthcare professionals. Unraveling the dynamics at the genomics-entrepreneurship intersection empowers healthcare professionals to seize genomic technology opportunities, advancing the healthcare sector.

Keywords
Attitudes towards genomic technology; innovation; genomic knowledge; risk perception; genomic entrepreneurial intention; health professionals

1. Introduction

The convergence of genomics and entrepreneurship presents a promising frontier in healthcare innovation [1]. In recent years, genomic technology has emerged as a transformative force, offering unparalleled opportunities for personalized medicine, disease prevention, and healthcare optimization [2, 3]. At the heart of this emerging landscape are healthcare professionals—individuals uniquely positioned to harness the potential of genomics for entrepreneurial endeavors that can revolutionize healthcare delivery. However, this intersection of genomics and entrepreneurship does not face challenges [4]. Attitudes, beliefs, and perceptions held by healthcare professionals play a pivotal role in shaping their intentions to venture into the entrepreneurial domain of genomics [5].

In Egypt, a nation experiencing significant advancements in healthcare and genomics, understanding the intricate relationship between healthcare professionals' attitudes towards genomic technology and their entrepreneurial intentions becomes paramount. This research explores this dynamic relationship, shedding light on the factors that drive or hinder genomic entrepreneurial purpose among Egyptian healthcare professionals. By delving into the attitudes, knowledge, and contextual influences, this study offers valuable insights into the prospects and challenges of genomic entrepreneurship in Egypt's evolving healthcare landscape. The transformational potential of genomics within healthcare is poised to reshape how diseases are diagnosed, treated, and prevented [6, 7]. Unlocking the genomic code allows precision medicine tailored to an individual's unique genetic makeup, opening doors to more effective therapies and improved patient outcomes [8, 9]. Simultaneously, the burgeoning field of genomics presents entrepreneurial opportunities that can drive innovation and economic growth within the healthcare sector. Genomic entrepreneurs are poised to develop novel diagnostic tools, therapeutic interventions, and healthcare solutions that address previously unmet needs [10]. However, the success of genomic entrepreneurship hinges on the attitudes and intentions of healthcare professionals—those who bridge the gap between genomic science and patient care [11]. Thus, this research explores how Egyptian healthcare professionals perceive genomic technology and the extent to which these perceptions influence their attitudes towards genetic technology and ultimately their genetic entrepreneurial intentions.

This study underscores the importance of context-specific insights, recognizing that cultural, educational, and regulatory factors unique to Egypt can significantly shape attitudes and intentions in genomic entrepreneurship. Furthermore, it acknowledges the multifaceted nature of this relationship, encompassing psychological, educational, ethical, and regulatory dimensions. By investigating these dimensions and considering longitudinal perspectives, this research provides a holistic understanding of the intricate interplay between attitudes toward genomic technology and entrepreneurial intentions within Egypt's evolving healthcare landscape.

This research seeks to contribute valuable knowledge that can inform policies, educational

initiatives, and entrepreneurial endeavors to foster genomic innovation and entrepreneurship among Egyptian healthcare professionals. By unraveling the dynamics at the intersection of genomics and entrepreneurship, this study aims to empower healthcare professionals to embrace the opportunities presented by genomic technology, ultimately advancing healthcare delivery and outcomes in Egypt and beyond.

2. Literature Review and Hypotheses Development

A complex interplay of factors with significant findings from pertinent studies develops healthcare professionals' attitudes toward innovative genetic technology. In the perception of [12], public beliefs and attitudes about healthcare technologies influence healthcare professionals' perspectives, highlighting the dynamic link between societal views on genetic technology and its integration into healthcare through innovation [13]. A seminal work by [14] posits a positive correlation between attitudes toward responsible research and biotechnology innovation, emphasizing the impact of stakeholder perspectives. The role of community participation in shaping gene technology healthcare professionals shapes their attitudes, with potentially positive implications for public health [15]. As exemplified by [16] in forensic genetics. Ethical considerations influence healthcare professionals' attitudes toward genetic technology, highlighting the importance of ethical frameworks in guiding innovation and practice. Recent research by [17] underscored the critical role of technological innovation in modern healthcare, even beyond genetics, and how it shapes healthcare professionals' attitudes.

[18] reveals a crucial insight: individuals with advanced genomic knowledge tend to favor genetics and genomics. This finding is foundational to our hypothesis, logically extending its influence on healthcare professionals. When equipped with comprehensive genomic insights, healthcare professionals are more inclined to embrace genetic technology, as evidenced by the transformative impact of information provision on genomic science, as highlighted by [19]. This implies that augmenting genomic knowledge can cultivate more promising attitudes among healthcare professionals. Moreover, [20] emphasizes the pivotal role of scientists in effective science communication, stressing how heightened genomic knowledge empowers healthcare professionals to better understand the merits and limitations of genetic technology. Consequently, it becomes evident that more excellent genomic understanding among healthcare professionals correlates with a robust disposition towards genetic technology.

In attitudes towards genetic technology, a tapestry of insights has emerged, woven from a nuanced understanding of risk perception. In the perception of [21], media reporting has a significant impact, revealing that it significantly shapes individuals' risk perceptions, influencing their attitudes toward genetic technology. Complementing this, [22] identifies perceived risks as a potent driver of public resistance to biotechnology, firmly establishing the pivotal role of risk perception in shaping attitudes within the genetic technology landscape. Delving deeper, [23] contributes a unique perspective, uncovering the influence of academic disciplines on risk perceptions and, subsequently, on attitudes. Their study highlights that diverse professional backgrounds can lead to varying attitudes based on the perceived risks inherent in genetic technology. Building on this foundation, [24] emphasizes the dynamic facet, underlining the role of emotions in sculpting risk perceptions and, by extension, overall attitudes toward genetic technology. Besides, [25] adds another layer to the narrative by accentuating the significance of

health literacy. Their findings suggest that a deeper comprehension of genetic technology can foster positive attitudes by facilitating nuanced risk assessments. These collective insights coalesce to underscore the intricate interplay between risk perception and perspectives in the context of genetic technology, painting a comprehensive picture of the multifaceted factors at play.

Consequently, exploring the connection between attitudes toward genomic technology and genomic entrepreneurial intention among Egyptian healthcare professionals is a compelling research endeavor. Understanding how healthcare professionals perceive and engage with genomic technology in the context of entrepreneurship is crucial, given the transformative potential of genomics in healthcare. This research aims to bridge existing gaps in the literature by providing context-specific insights into the attitudes and factors influencing entrepreneurial intentions in Egypt's healthcare sector. Based on these needs and existing holes in the literature, the researcher developed a conceptual model (Figure 1) for testing among Egyptian health professionals. Ultimately, this research holds the potential to inform policies and initiatives that foster genomic entrepreneurship and innovation in Egyptian healthcare.

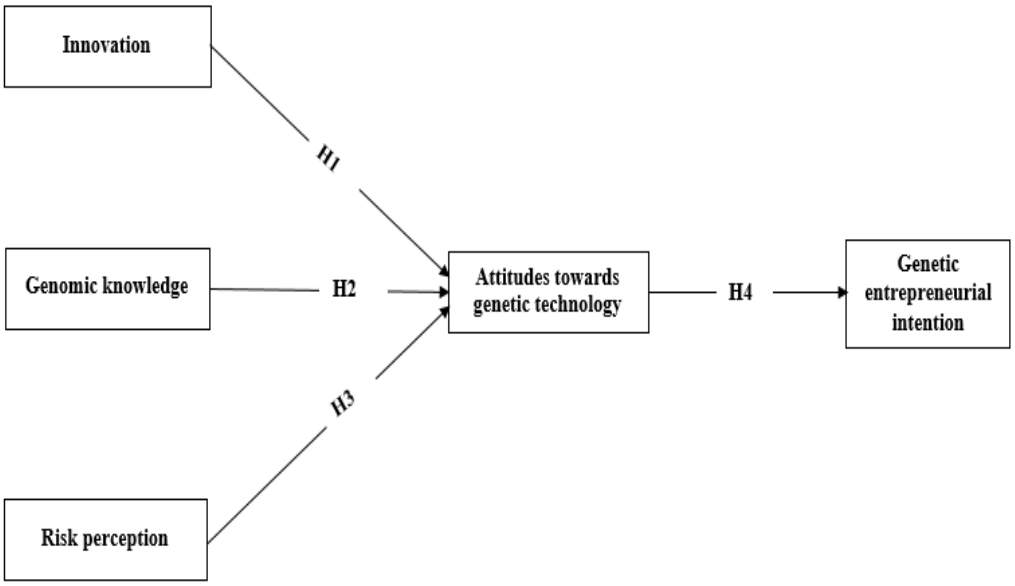

Figure 1 Model of the study. Source: Developed by the researcher.

2.1 Innovation, Genomic Knowledge, Risk Perception, and Attitudes Towards Genetic Technology

The attitudes of healthcare professionals towards innovative genetic technology are shaped by a multifaceted interplay of factors, as underscored by pertinent studies. [12] public beliefs and attitudes regarding innovative healthcare technologies influence healthcare professionals' perspectives. This insight suggests a dynamic interconnection between the broader societal views on genetic technology and its potential to permeate the healthcare sector through innovation, as illuminated by [13]. Furthermore, [14] reveals a positive correlation between attitudes toward responsible research and biotechnology innovation, emphasizing the impact of stakeholder perspectives. [15] highlight the pivotal role of community participation in shaping public policy related to gene technology, implying that involving healthcare professionals in policy discussions can significantly affect their attitudes. Ethical considerations also weigh heavily on healthcare

professionals' attitudes toward genetic technology, as [16] exemplified in the context of technological innovations in forensic genetics. Recent research by [17] underscores the ever-evolving landscape of advanced technologies in healthcare, even if not directly related to genetics. This exploration emphasizes the pivotal role of technological innovation in modern healthcare and its potential to impact the attitudes of healthcare professionals. Consequently, healthcare professionals' attitudes towards innovative genetic technology are influenced by intricate interactions between public perceptions, societal dynamics, stakeholder affiliations, community involvement, and ethical considerations, all within a continually evolving healthcare landscape.

A compelling hypothesis emerges, positing a direct, positive correlation between the depths of genomic knowledge held by healthcare professionals and their predisposition towards embracing genetic technology, with heightened genomic acumen aligning with increasingly positive attitudes. Substantiated by findings from the referenced studies, [18] the revelation that individuals possessing advanced genomic knowledge exhibit a penchant for positive views towards genetics and genomics serves as a foundational pillar. This phenomenon, logically extrapolated, extends its influence to healthcare professionals, who are more likely to embrace genetic technology when equipped with comprehensive genomic insights. Besides, [19] illuminates the transformative impact of information provision on genomic science, leading to enhanced public attitudes. This implies that augmenting genomic knowledge could engender more significant attitudes among healthcare professionals. Moreover, [20] underscores the responsibility of scientists in championing science communication, emphasizing how heightened genomic learning empowers healthcare professionals to grasp the merits and limitations of genetic technology, further fortifying the hypothesis. Consequently, it becomes evident that more excellent genomic knowledge among healthcare professionals correlates with a more positive disposition towards genetic technology, urging thorough exploration and analysis within the healthcare context.

The individuals' attitudes towards genetic technology are intricately linked to their perceptions of the associated risks, with a higher perception of risk being negatively correlated with attitudes. The study of [21] unearthed the influence of media reporting on risk perceptions, shedding light on how media portrayals of risks can negatively shape public attitudes. [22] insights into the reasons underpinning public resistance to biotechnology due to perceived risks corroborate the notion that risk perception is pivotal in shaping attitudes towards genetic technology. Similarly, [23] empirical research unveils how one's academic discipline can significantly influence risk perceptions. This implies that individuals who discern higher risks within their respective fields may harbor less substantial attitudes toward genetic technology. [24] Investigating affective influences on risk perceptions accentuates the impact of emotions in shaping these perceptions, potentially influencing one's overall attitude toward genetic technology. Furthermore, [25] posit that health literacy plays a pivotal role in shaping risk perceptions, hinting that a more profound comprehension of genetic technology could lead to more favorable attitudes through nuanced risk assessments. These collective findings substantiate the hypothesis that risk perception is intricately linked to attitudes toward genetic technology, warranting further exploration of this intricate relationship.

Consequently, the attitudes of Egyptian health professionals towards genetic technology are associated with societal factors, stakeholder perspectives, community involvement, ethical considerations, and their depth of genomic knowledge. Moreover, these attitudes are intricately connected to their perceptions of risk. To foster greater acceptance of genetic technology in the

Egyptian healthcare context, there is a dire need for efforts to enhance genomic knowledge among healthcare professionals while also considering the cultural and ethical dimensions that shape their attitudes. Likewise, the balanced assessments of genetic technology's risks and benefits ultimately influence their attitudes positively and negatively. Hence:

H1. Adopting innovative genetic technology in healthcare settings positively influences the attitudes of Egyptian healthcare professionals.

H2. The genomic knowledge in healthcare settings positively influences the attitudes of Egyptian healthcare professionals.

H3. The risk perception in healthcare settings negatively influences the attitudes of Egyptian healthcare professionals.

2.2 Attitudes Towards Genetic Technology and Genetic Entrepreneurial Intention

The relationship between attitudes and entrepreneurial intention is a multifaceted and dynamic process influenced by various factors, as the literature reveals. As consumer attitudes significantly impact purchase intentions [26], individuals' attitudes toward emerging fields like genetic technology can shape their entrepreneurial intentions. Education, as demonstrated by [27] and [28], plays a pivotal role, as exposure to genetic technology-related education can cultivate positive attitudes and promote entrepreneurial intentions among health professionals in Egypt. As emphasized by [29], personality traits further contribute to this relationship, as individuals with personality traits aligned with entrepreneurship may develop positive attitudes towards genetic technology, ultimately fueling their intentions to venture into genetic entrepreneurship. Moreover, entrepreneurial knowledge and personal attitudes [30] are critical drivers; health professionals with entrepreneurial expertise and a positive attitude toward genetic technology are more inclined to express intentions to engage in entrepreneurial activities within this domain. Moreover, [31] explored the genetic component, suggesting a possible genetic predisposition towards entrepreneurship, which can interact with individual attitudes to influence entrepreneurial intentions.

Furthermore, family background, knowledge, and attitudes positively predict entrepreneurial intention [32-34]. Educational initiatives, such as those studied by [35] and [36] that focus on entrepreneurial attitudes and expertise can help shape students' positive attitudes and entrepreneurial intentions. Finally, societal factors, such as gender attitudes [37], can influence perceived desirability and feasibility, which, in turn, interact with individual perspectives to impact social entrepreneurial intentions.

As a result, addressing confirmation bias among health professionals in Egypt is crucial for improving patient care and healthcare outcomes. Strategies such as continuing education focused on critical thinking, promoting a culture of open communication and constructive feedback, and encouraging evidence-based practice can help mitigate the impact of confirmation bias. Also, fostering a healthcare environment that values diversity of thought and encourages professionals to challenge their beliefs can contribute to more effective and unbiased decision-making, ultimately benefiting healthcare providers and their patients. Hence:

H4. Attitudes towards genetic technology in healthcare settings positively influence the genetic entrepreneurial intention of Egyptian healthcare professionals.

3. Methods

3.1 Survey Strategy and Respondents

The researcher applied the quantitative approach and collected the cross-sectional data. This method has excellent significance and is prominent in research and data collection [38]. Quantitative research, driven by numerical data, offers objectivity and reproducibility, making it a cornerstone of rigorous scientific inquiry. Its reliance on statistical analysis enables researchers to uncover patterns, relationships, and trends within data, thereby shedding light on complex phenomena. With large sample sizes, quantitative research allows for generalizability, facilitating broader applicability of findings, while its ability to measure cause-and-effect relationships is instrumental in understanding various phenomena precisely [39]. In the field of entrepreneurship and genomic studies in a health context, scholars like [13, 14, 17, 18, 20, 21, 25, 29] and [30] applied quantitative methods. The researcher targeted health professionals, including physicians, genetic counselors, nurses, and other healthcare professionals who interact with patients and provide genetic services and can offer insights into their attitudes and intentions regarding genomic technology adoption in Egypt [40, 41]. These respondents' understanding of healthcare providers' perspectives is crucial because they often guide patients' decisions [42].

3.2 Survey Tool, Reliability, and Validity

The survey questionnaire served as this research's primary data collection tool, underscoring the critical importance of ensuring reliability and validity for maintaining data integrity. A thorough method was used to handle these crucial concerns. An essential first step in ensuring the validity of the questionnaire was to perform a pilot study using fifteen samples. Applying Cronbach's alpha, which measures the internal consistency among the questionnaire items, significantly reinforced this approach. It was crucial to pursue dependability since it assures accurate measurements over time and among responders. The results were positive, with each item exhibiting acceptable levels of consistency (>0.7) and total dependability reaching the desired threshold (>0.7) [43]. The survey instrument was also distributed to university professors and subject-matter specialists who provided valuable input on the content, design, and format to strengthen the validity. Their feedback resulted in a few minor modifications, which were then promptly incorporated, and the researcher launched a robust, reliable, and valid instrument for large-scale data collection.

3.3 Data Collection Modes

The data are collected from Egyptian healthcare professionals using an online methodology. This strategy improves accessibility by making the study more accessible to a more extensive and varied group of participants. Since internet connection is widely available in Egypt, this strategy offers a practical way for medical professionals to participate in the study regardless of location or time limitations. In addition, the online method saves money by preventing costs related to more conventional data-collecting techniques, such as printing and travel. Further, the seclusion and anonymity of the Internet environment may encourage openness and honesty in replies to delicate topics [44].

Regarding the respondents' ethics, the researcher received informed permission from each participant by thoroughly clarifying the study's goals, participation criteria, potential advantages and disadvantages, and the voluntary nature of their participation. The researcher ensured the respondents' anonymity, privacy, confidentiality, and security. Moreover, the researcher respected the cultural and ethical norms of the Egyptian health professionals and provided them with explicit feedback on the study's results if participants expressed interest. By adhering to these ethical guidelines, the researcher ensured that their online data collection respected the rights and well-being of the respondents and maintained the integrity of the research. The researcher collected 276 samples and provided the data was cleaned, examining missing values and outliers. As a result, neither any case existed with missing more than 5% nor any outlier. Hence, the researcher utilized 276 valid points for the final analysis.

3.4 Measures

The researcher adopted all the items from the literature, and some things were slightly modified to fulfill the present aim and objective of the study. The innovation factor is measured with four items adopted from [45]. The sample content of the scale is “Innovation improves health services.” Likewise, the researcher borrowed three items from the study of [46] to measure genomic knowledge, with the sample item as “I am well-versed in the genomic challenges that health practitioners confront.” The risk perception construct is assessed on four items adopted from the study of [47]. The sample item of the risk perception is “Risky situations stress me out (reverse scaled)”. Similarly, three items by [48] are applied to evaluate attitudes towards genetic technology, with a sample item as “Using genetic technology in the health sector is a good idea”. Finally, the researcher adopted three items from [49] to gauge genetic entrepreneurial intention. The taster content of the scale is “I am determined to create genetic technology in the future.” The researcher applied a five-point Likert scale where strongly agree = 1; agree = 2; neither agree nor disagree = 3; disagree = 4; and strongly disagree = 5.

4. Analysis

4.1 Measurement Model

The researcher ensured the measurement model due to its great significance in establishing the validity and reliability of the constructs [43]. Initially, the researcher confirmed the Variance Inflation Factor (VIF) to detect and quantify the multicollinearity of the model, which appeared with accepted values (<5.0) for each item [50]. The loading scores ranged greater than 0.707 [43] from 0.809 (RP2) to 0.956 (GEI2), which indicates a good convergent validity, signifying that the observed variables effectively measure the latent factors. The values of average variance extracted (AVE) are noticed from 0.702 (innovation) to 0.905 (attitudes towards genetic technology). This ensured the values greater than 0.5, which observed variables effectively measure the intended latent constructs. Besides, the researcher observed composite reliability (CR) to assess the internal consistency or reliability of the constructs. The range of the CR falls between 0.904 (Risk perception) to 0.966 (genetic entrepreneurial intention), which is greater than 0.70 and acceptable [43]. Lastly, the researcher conducted Cronbach's alpha (α) to gauge internal consistency among the items. As a result, the range of alpha has appeared between 0.859

(risk perception) to 0.948 (genetic entrepreneurial intention). This range is above 0.70 and excellent [43] (Table 1 and Figure 2).

Table 1 Measurement model.

Item	Loading	VIF	AVE	CR	Alpha (α)
ATGT1	0.942	4.14			
ATGT2	0.937	3.775	0.883	0.958	0.933
ATGT3	0.939	3.86			
GEI1	0.954	4.077			
GEI2	0.956	4.290	0.905	0.966	0.948
GEI3	0.945	4.323			
GK1	0.947	4.322			
GK2	0.922	3.299	0.882	0.957	0.933
GK3	0.947	4.583			
INO1	0.843	2.32			
INO2	0.912	3.13	0.806	0.943	0.919
INO3	0.904	3.439			
INO4	0.929	4.168			
RP1	0.838	4.303			
RP2	0.809	4.799	0.702	0.904	0.859
RP3	0.833	4.755			
RP4	0.870	4.961			

Note(s): All the items of scale are loaded above 0.708

Source: Author's own estimation

AVE = average variance extracted values; CR = composite reliability; α = Cronbach's alpha

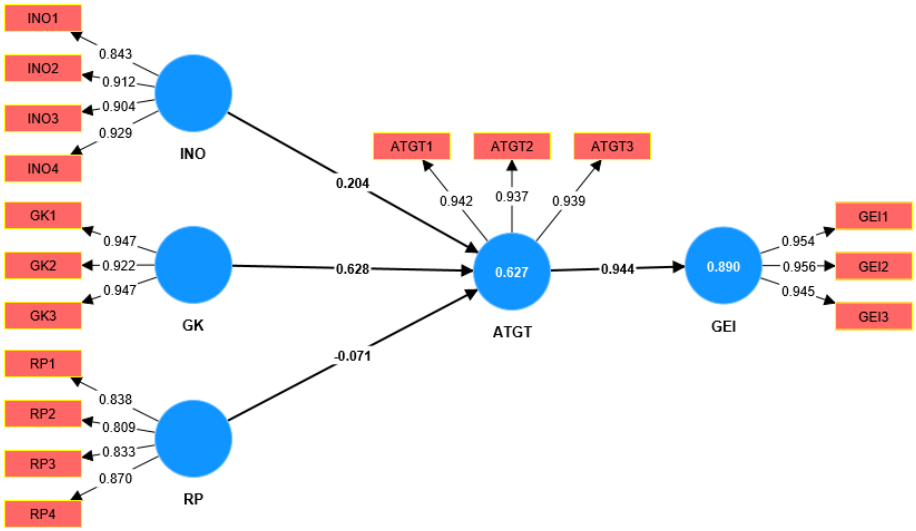

Figure 2 Measurement model. Note: INO = innovation; GK = genomic knowledge; RP = Risk perception; ATGI = attitudes towards genetic technology; GEI = genetic entrepreneurial intention. Source: Developed by the researchers.

Furthermore, the researcher employed the Heterotrait-Monotrait (HTMT) ratio, a valuable tool in structural equation modeling (SEM) for evaluating discriminant validity. This metric assists researchers in gauging the distinctiveness of their latent constructs by examining the relationships between construct correlations and the average variances extracted by these constructs, as highlighted by [51]. The analysis confirms that the HTMT values fall within acceptable ranges, affirming the discriminant validity of the constructs (Table 2).

Table 2 HTMT ratio.

Construct	ATGT	GEI	GK	INO	RP
ATGT					
GEI	0.802				
GK	0.827	0.783			
INO	0.685	0.635	0.732		
RP	0.165	0.169	0.096	0.125	

Note: Diagonals represent the square root of the AVE while the other entries represent the correlations

Source: Researcher own estimation

INO = innovation; GK = genomic knowledge; RP = Risk perception; ATGI = attitudes towards genetic technology; GEI = genetic entrepreneurial intention

4.2 Structural Model

The researcher used structural equation modeling (SEM) through SamrtPLS 4 [52] due to a comprehensive approach that combines elements of regression analysis, factor analysis, and path analysis to provide a holistic understanding of the relationships among variables in a research context [53]. The path analysis found a positive significant effect of innovation and genomic knowledge on attitudes towards genetic technology (H1 = $\beta = 0.204$; $p < 0.01$; H2 = $\beta = 0.628$; $p < 0.01$). Hence, H1 and H2 are accepted. On the other hand, the analysis found a negative effect of risk perception on attitudes towards genetic technology (H3 = $\beta = -0.071$; $p > 0.01$), which also supported the H3. Lastly, the impact of attitudes towards genetic technology on genetic entrepreneurial intention is positive and significant (H4 = $\beta = 0.944$; $p < 0.01$). As a result, H4 is also accepted (Table 3 and Figure 3).

Table 3 SEM estimations.

H.No.	Relationships	Std. (β)	Mean	Std. Dev	t-value	p-value	Decision
H1	INO → ATGT	0.204	0.205	0.066	3.091	0.002	Accepted
H2	GK → ATGT	0.628	0.625	0.065	9.647	0.000	Accepted
H3	RP → ATGT	-0.071	-0.077	0.038	1.871	0.061	Accepted
H4	ATGT → GEI	0.944	0.944	0.016	58.759	0.000	Accepted

Source: Researcher own estimation

INO = innovation; GK = genomic knowledge; RP = Risk perception; ATGI = attitudes towards genetic technology; GEI = genetic entrepreneurial intention

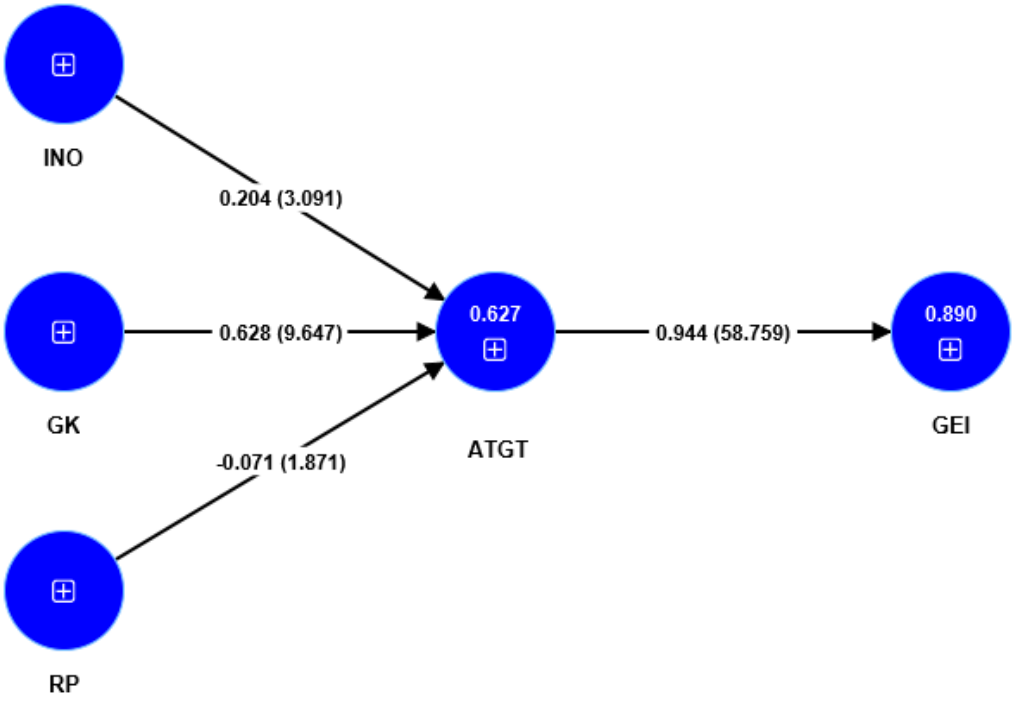

Figure 3 Structural equation model. Source: Researcher own estimation. INO = innovation; GK = genomic knowledge; RP = Risk perception; ATGI = attitudes towards genetic technology; GEI = genetic entrepreneurial intention.

5. Discussion and Conclusion

The study proposed the examination of the relationship between attitudes toward genomic technology and genetic entrepreneurial intention among Egyptian healthcare professionals. The study found a significant positive effect of innovation and genomic knowledge on attitudes towards genetic technology. These results are accorded with researchers like [13-19] and [20], who found the positive effect of innovation and genomic knowledge on attitudes towards genetic technology. The findings vividly underscore the unwavering commitment of Egyptian health professionals toward elevating the caliber of their work through relentless innovation. Their enthusiasm for pioneering genomic advancements burns with an intensity that knows no bounds as they ardently seek more efficient avenues to revolutionize this realm. Pursuing cost reduction in innovation is not merely a preference but an ardent quest, reflecting their unwavering dedication to making cutting-edge healthcare accessible. Their desire to catalyze groundbreaking innovations on a massive scale to enhance health services resonates with an unquenchable thirst for progress. The survey respondents demonstrated enthusiasm for innovation and a profound understanding of genomic activities. It became abundantly clear that they are well-versed in the intricate landscape of genomic challenges confronting healthcare practitioners. Their knowledge extends beyond the scientific domain and encompasses a comprehensive understanding of genomic laws, regulations, rules, and administrative protocols. This holistic awareness equips them with the necessary tools to navigate the complex terrain of genomics, ensuring compliance with regulatory frameworks while simultaneously pushing the boundaries of innovation. Their expertise extends far beyond the theoretical realm and is pivotal in their capacity to drive transformative genomic advancements in the healthcare sector.

Regarding the connection between risk perception and attitudes towards genetic technology, it was found to be negative among Egyptian health professionals. These findings were accorded with several previous studies [21-25]. The discovery of a negative correlation between risk perception and attitudes towards genetic technology among Egyptian health professionals can be attributed to several factors. Firstly, it may stem from a need for more familiarity with genetic technology and its intricacies, leading to overestimating associated risks. Ethical concerns surrounding genetic discrimination or privacy breaches could also contribute to these negative attitudes. Cultural and religious beliefs and concerns about the adequacy of genetic counseling and education may play a significant role. Historical precedents, past controversies, and a lack of clear regulatory guidelines might amplify perceived risks.

Finally, the study confirmed a positive significant effect of attitudes towards genetic technology on genetic entrepreneurial intention among Egyptian health professionals. These results align with scholars like [26, 28-30, 34, 35] and [37], who confirmed a positive significant effect of attitudes towards genetic technology and entrepreneurial intention. These positive attitudes are often associated with an intrinsic belief in the potential opportunities that genetic technology holds within the healthcare landscape. Health professionals who promise sentiments may keenly recognize unmet needs or gaps in the field, thus fostering their motivation to embark on entrepreneurial endeavors to address these deficiencies. Moreover, these positive attitudes frequently dovetail with an innate penchant for innovation and creativity, propelling professionals to explore novel genetic technology applications. Confidence in the reliability and safety of genetic tools can also be a contributing factor, as those with positive attitudes may be more inclined to invest their time, expertise, and resources into entrepreneurial ventures that leverage these technologies. The underpinning passion for advancing healthcare and improving patient outcomes, often synonymous with positive attitudes, can be a compelling impetus behind entrepreneurial intentions.

Overall, the study's findings reveal a sophisticated interplay of factors among Egyptian health professionals. A strong understanding of genomics and a penchant for innovation positively influence attitudes toward genetic technology. Conversely, heightened risk perception negatively impacts these attitudes. Most significantly, positive attitudes drive entrepreneurial intent in this field, highlighting the importance of nurturing a visionary outlook to foster innovation and entrepreneurial spirit among healthcare professionals.

6. Implications of the Study

Practically, healthcare institutions and educational bodies can implement targeted educational programs to bolster genomic knowledge among health professionals, emphasizing real-world applications and benefits of genetic technology. Furthermore, promoting healthcare innovation through incentives and research support can foster positive attitudes toward genetic technology. Addressing perceived risks by transparently communicating safety measures, ethical guidelines, and robust regulatory frameworks can alleviate concerns and pave the way for smoother technology adoption. Encouraging health professionals with positive attitudes to pursue entrepreneurial ventures in genetic technology holds promise for developing innovative healthcare solutions. Collaboration between those with genomic expertise and innovators can expedite progress in this field.

From a theoretical standpoint, these findings contribute to the evolution of theories exploring the interplay between knowledge, attitudes, and entrepreneurial intent in healthcare innovation, specifically within the genetic technology domain. They shed light on the intricate relationship between risk perception and attitudes, illuminating the pivotal role of perceived risks in shaping individuals' views on emerging technologies. This insight can inform the development of more nuanced risk communication models. Moreover, the study underscores the significance of personal beliefs and attitudes as drivers of entrepreneurial intent within the healthcare sector, offering valuable insights into entrepreneurship theories. Lastly, these findings prompt a reconsideration of innovation adoption models, highlighting the need to incorporate factors such as genomic knowledge and risk perception as predictors of attitudes, which, in turn, influence the adoption of genetic technology in healthcare settings. These implications provide a comprehensive roadmap for policymakers, educators, healthcare organizations, and researchers seeking to facilitate a more positive reception of genetic technology, reduce perceived risks, and stimulate entrepreneurial pursuits, ultimately advancing patient care and healthcare innovation.

7. Limitations and Future Research

The study has several limitations that warrant consideration. Firstly, it is constrained by its exclusive focus on a specific theoretical framework, potentially overlooking other influential factors that could impact the relationships under investigation. Secondly, the reliance on data collected solely from Egyptian health professionals constitutes a single-source data approach, which might introduce biases and limitations by excluding the perspectives of other relevant stakeholders. Moreover, while efficient, the study's reliance on an online data collection method may inadvertently exclude individuals who need internet access or prefer alternative modes of participation, possibly leading to selection bias. Lastly, the study's relatively small sample size, comprising only 276 participants, raises concerns about the generalizability of the findings to a broader population of health professionals in Egypt.

The limitations of this study offer valuable insights for future research endeavors in the domain of attitudes toward genetic technology and entrepreneurial intent among healthcare professionals. To mitigate the single-source data limitation, researchers can adopt a multi-stakeholder perspective, incorporating the views of patients, policymakers, and genetic technology experts, ensuring a comprehensive evaluation of the subject matter. Combining online data collection with diverse research methods, such as interviews or focus groups, can enhance inclusivity and rigor. Cross-cultural studies can expand the scope beyond Egypt, permitting cross-regional comparisons and a broader perspective. Enlarging sample sizes, with representation from various healthcare specialties and regions, can boost statistical power and generalizability. Longitudinal research can track evolving attitudes and entrepreneurial intentions over time. Intervention studies assessing the impact of educational programs can offer practical insights, while comparative research on healthcare systems in different countries can elucidate policy influences. These future research directions aim to address the identified limitations, enriching our understanding of the intricate interplay between attitudes, genomic technology, and entrepreneurial behavior in healthcare.

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Author Contributions

Abdelwahed AAA developed all the sections.

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Competing Interests

The author declares no competing interests exist.

References

1. Laibach N, Bröring S. The emergence of genome editing—Innovation network dynamics of academic publications, patents, and business activities. Front Bioeng Biotechnol. 2022; 10: 868736.
2. Onyema EM, Lilhore UK, Saurabh P, Dalal S, Nwaeze AS, Chijindu AT, et al. Evaluation of IoT-enabled hybrid model for genome sequence analysis of patients in healthcare 4.0. Meas Sensors. 2023; 26: 100679.
3. Parker G, Hunter S, Hogarth S, Miller FA. Industry involvement in evidence production for genomic medicine: A bibliometric and funding analysis of decision impact studies. PloS One. 2023; 18: e0285122.
4. Van der Loos MJ, Koellinger PD, Groenen PJ, Thurik AR. Genome-wide association studies and the genetics of entrepreneurship. Eur J Epidemiol. 2010; 25: 1-3.
5. Verheul I, Block J, Burmeister-Lamp K, Thurik R, Tiemeier H, Turturea R. ADHD-like behavior and entrepreneurial intentions. Small Bus Econ. 2015; 45: 85-101.
6. Selkirk CG, Weissman SM, Anderson A, Hulick PJ. Physicians' preparedness for integration of genomic and pharmacogenetic testing into practice within a major healthcare system. Genet Test Mol Biomarkers. 2013; 17: 219-225.
7. Calzone KA, Kirk M, Tonkin E, Badzek L, Benjamin C, Middleton A. Increasing nursing capacity in genomics: Overview of existing global genomics resources. Nurse Educ Today. 2018; 69: 53-59.
8. Frizzo-Barker J, Chow-White PA, Charters A, Ha D. Genomic big data and privacy: Challenges and opportunities for precision medicine. Comput Support Coop Work. 2016; 25: 115-136.
9. Román RJF, León Palacio A, García Simón A, Beyrouti RC, Pastor O. Integration of clinical and genomic data to enhance precision medicine: A case of study applied to the retina-macula. Softw Syst Model. 2023; 22:159-174.

10. Heller B, Erlich Y, Kariv D, Maaravi Y. On the opportunities and risks of examining the genetics of entrepreneurship. Genes. 2022; 13: 2208.
11. Elia G, Gatti L, Margherita A. The genome of digital entrepreneurship: A descriptive framework. In: Innovative entrepreneurship in action: From high-tech to digital entrepreneurship. Cham: Springer; 2020. pp. 7-26.
12. Calnan M, Montaner D, Horne R. How acceptable are innovative health-care technologies? A survey of public beliefs and attitudes in England and Wales. Soc Sci Med. 2005; 60: 1937-1948.
13. Weisberg SM, Badgio D, Chatterjee A. A CRISPR new world: Attitudes in the public toward innovations in human genetic modification. Front Public Health. 2017; 5: 117.
14. Kuzma J, Cummings CL. Cultural beliefs and stakeholder affiliation influence attitudes towards responsible research and innovation among United States stakeholders involved in biotechnology and gene editing. Front Political Sci. 2021; 3: 677003.
15. Dietrich H, Schibeci R. Beyond public perceptions of gene technology: Community participation in public policy in Australia. Public Underst Sci. 2003; 12: 381-401.
16. Wienroth M, Morling N, Williams R. Technological innovations in forensic genetics: Social, legal and ethical aspects. Recent Adv DNA Gene Seq. 2014; 8: 98-103.
17. Li X, Budzin A, Wang Y. Application and innovation of multiomics technologies in clinical oncology. Front Oncol. 2023; 13: 1179829.
18. Carver RB, Castéra J, Gericke N, Evangelista NA, El-Hani CN. Young adults' belief in genetic determinism, and knowledge and attitudes towards modern genetics and genomics: The PUGGS questionnaire. PloS One. 2017; 12: e0169808.
19. Sturgis P, Brunton-Smith I, Fife-Schaw C. Public attitudes to genomic science: An experiment in information provision. Public Underst Sci. 2010; 19: 166-180.
20. Reydon TA, Kampourakis K, Patrinos GP. Genetics, genomics and society: The responsibilities of scientists for science communication and education. Pers Med. 2012; 9: 633-643.
21. Vilella-Vila M, Costa-Font J. Press media reporting effects on risk perceptions and attitudes towards genetically modified (GM) food. J Socio-Econ. 2008; 37: 2095-2106.
22. Sjöberg L. Principles of risk perception applied to gene technology: To overcome the resistance to applications of biotechnology, research on risk perception must take a closer look at the public's reasons for rejecting this technology. EMBO Rep. 2011; 5: S47-S51.
23. Weisenfeld U, Ott I. Academic discipline and risk perception of technologies: An empirical study. Res Policy. 2011; 40: 487-499.
24. Townsend E. Affective influences on risk perceptions of, and attitudes toward, genetically modified food. J Risk Res. 2006; 9: 125-139.
25. Brewer NT, Tzeng JP, Lillie SE, Edwards AS, Peppercorn JM, Rimer BK. Health literacy and cancer risk perception: Implications for genomic risk communication. Med Decis Making. 2009; 29: 157-166.
26. Bredahl L. Determinants of consumer attitudes and purchase intentions with regard to genetically modified food–Results of a cross-national survey. J Consum Policy. 2001; 24: 23-61.
27. Shah N, Ali B. Investigating attitudes and intentions among potential entrepreneurs of a developing country: A conceptual approach. Proceedings of the 2nd International Conference on Humanities, Economics and Geography (ICHEG'2013); 2013 June 17-18; London, UK.
28. Do Paço A, Ferreira JM, Raposo M, Rodrigues RG, Dinis A. Entrepreneurial intentions: Is

education enough? Int Entrep Manag J. 2015; 11: 57-75.
29. Murugesan R, Jayavelu R. The influence of big five personality traits and self-efficacy on entrepreneurial intention: The role of gender. J Entrep Innov Emerg Econ. 2017; 3: 41-61.
30. Hussain T, Zia-Ur-Rehman M, Abbas S. Role of entrepreneurial knowledge and personal attitude in developing entrepreneurial intentions in business graduates: A case of Pakistan. J Glob Entrep Res. 2021; 11: 439-449.
31. Nicolaou N, Shane S, Cherkas L, Hunkin J, Spector TD. Is the tendency to engage in entrepreneurship genetic? Manage Sci. 2008; 54: 167-179.
32. Soomro BA, Shah N. Developing attitudes and intentions among potential entrepreneurs. J Enterp Inf Manag. 2015; 28: 304-322.
33. Shah N, Kalwar MS, Soomro BA. Early COVID-19 outbreak, individuals' mask attitudes and purchase intentions: A cohesive care. J Sci Technol Policy Manag. 2021; 12: 571-586.
34. Palmer C, Fasbender U, Kraus S, Birkner S, Kailer N. A chip off the old block? The role of dominance and parental entrepreneurship for entrepreneurial intention. Rev Manag Sci. 2021; 15: 287-307.
35. Demirova S, Amedova S. Studying entrepreneurial attitudes of students-case study of TU-Varna. Proceedings of the 2019 II International Conference on High Technology for Sustainable Development (HiTech); 2019 October 10; Sofia, Bulgaria. Piscataway Township: IEEE.
36. Soomro BA, Lakhan GR, Shah N. Knowledge, attitudes and practices towards the spread of COVID-19: A health counseling initiative among potential entrepreneurs of FUUAST. Health Educ. 2021; 121: 670-682.
37. Lopes JM, Gomes S, Dias C. How do gender attitudes influence the relationships between perceived desirability, perceived feasibility and social entrepreneurial intentions? Int J Gend Entrep. 2023. doi: 10.1108/IJGE-03-2023-0074.
38. Xu X, Pasricha PJ, Sallam HS, Ma L, Chen JD. Clinical significance of quantitative assessment of rectoanal inhibitory reflex (RAIR) in patients with constipation. J Clin Gastroenterol. 2008; 42: 692-698.
39. Ginevičius R, Trishch H, Petraškevičius V. Quantitative assessment of quality management systems' processes. Econ Res Ekon Istraz. 2015; 28: 1096-1110.
40. El-Attar EA, Helmy Elkaffas RM, Aglan SA, Naga IS, Nabil A, Abdallah HY. Genomics in Egypt: Current status and future aspects. Front Genet. 2022; 13: 797465.
41. Hassan RM, Elanany MG, Mostafa MM, Yousef RH, Salem ST. Whole genome characterization of methicillin resistant Staphylococcus aureus in an Egyptian Tertiary Care Hospital. J Microbiol Immunol Infect. 2023; 56: 802-814.
42. Talwar D, Tseng TS, Foster M, Xu L, Chen LS. Genetics/genomics education for nongenetic health professionals: A systematic literature review. Genet Med. 2017; 19: 725-732.
43. Hair Jr JF, Howard MC, Nitzl C. Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. J Bus Res. 2020; 109: 101-110.
44. Stratton SJ. Population research: Convenience sampling strategies. Prehosp Disaster Med. 2021; 36: 373-374.
45. Ji-fan Ren S, Fosso Wamba S, Akter S, Dubey R, Childe SJ. Modelling quality dynamics, business value and firm performance in a big data analytics environment. Int J Prod Res. 2017; 55: 5011-5026.

46. Franke N, Luthje C. Entrepreneurial intentions of business students - A benchmarking study". Int J Innov Technol Manag. 2004; 3: 269-288.
47. McCrimmon KR, Wehrung DA. A portfolio of risk measures. Theory Decis. 1985; 19: 1-29.
48. Lee MC. Predicting and explaining the adoption of online trading: An empirical study in Taiwan. Decis Support Syst. 2009; 47: 133-142.
49. Liñán F, Chen YW. Development and cross-cultural application of a specific instrument to measure entrepreneurial intentions. Entrep Theory Pract. 2009; 33: 593-617.
50. Alauddin M, Nghiem HS. Do instructional attributes pose multicollinearity problems? An empirical exploration. Econ Anal Policy. 2010; 40: 351-361.
51. Afthanorhan A, Ghazali PL, Rashid N. Discriminant validity: A comparison of CBSEM and consistent PLS using Fornell & Larcker and HTMT approaches. J Phys Conf Ser. 2021; 1874: 012085.
52. Ringle CM, Wende S, Becker JM. SmartPLS 4 [Internet]. Oststeinbek: SmartPLS GmbH; 2022. Available from: http://www.smartpls.com.
53. Stein CM, Morris NJ, Nock NL. Structural equation modeling. In: Statistical human genetics: Methods and protocols. Totowa, NJ: Humana Press; 2012. pp. 495-512.