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Green Innovation in the MENA Healthcare Industry:
A Knowledge-Based View

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ABSTRACT

Drawing on the knowledge-based perspective, this research developed and tested a model consisting of five technological innovation characteristics (relative advantage, complexity, compatibility, observability, and triability) as antecedents, green innovation as a mediator, sustainable competitive advantage as an outcome, and government environmental support as a moderator. A survey was administered to 305 participants from the Middle Eastern healthcare sector and 305 participants from the North African healthcare sector. The findings were antagonistic to what was hypothesized by revealing heterogeneity rather than homogeneity in technological and green innovation perceptions. This research calls for the implementation of newly developed rather than adopted green innovation strategies across the Middle East and North Africa.

KEYWORDS

Green Innovation, Knowledge-Based Perspective, Sustainable Competitive Advantage

INTRODUCTION

The radical decline of the environment is mainly due to the vast dependency and depletion of natural resources. Although many factors are held accountable for damaging the environment, technology has shown to be one of the main contributors to the rising of various ecological problems (e.g., high energy consumption and e-waste), but also, recognized to be part of the resolution (Muslim, Sim, & Hee, 2019). From a broad perspective, the term "technology" is widely defined as the collection of skills, knowledge, systems, processes, and techniques that combine resources to achieve organizational objectives. When technology addresses environmental concerns, it is known as green or sustainable technology. Green technology, which is the main interest of this research, is defined as the efficient and ecological practice or use of technology resources to increase organizational performance and productivity (Murugesan, 2010); thus, maintaining a sustainable competitive advantage over other rivals in the industry.

In a recent report by BusinessWire (2019), the green technology market is projected to reach US$ 28.9 billion by 2024, but yet, there are no empirical studies that explicitly examine the concept

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of green innovation in developing nations. In green technology literature, such countries have been overlooked when compared to developed countries; thus, business reports without empirical support may be considered inaccurate and misleading for future investors and businesses. Furthermore, there have been urgent research calls for examining the role of technological innovations in developing countries, where there is a lack of green technology implementations (Li, Pan, Kim, Linn, & Chiang, 2015). As such, this research examines the concept of green innovation in the Middle Eastern and North African (MENA) regions.

On one hand, the global and rapid spread of innovative technologies has modernized the medical sectors by providing fast, effective, and sustainable healthcare services (Sodhro, Pirphulal, Sangaiah, Sekhari, & Ouzrout, 2018). On the other hand, the healthcare sector is identified as the main contributor to environmental pollution and health risk hazards (e.g., radioactive, toxic chemicals, and water wastes) (World Health Organization, 2017). Yet, the healthcare industry has been infrequently examined in green technology literature when compared to other major business sectors (e.g., tourism, automotive, hospitality). Thus, limited findings may hinder breakthrough discoveries in green medical devices and ecological solutions. For such motives, this research focuses on MENA healthcare industries. Therefore, the research question is the following:

RQ: Are technological innovation characteristics perceived as causes of green innovation for sustainable competitive advantage in the MENA healthcare sector?

Drawing on the knowledge-based theoretical perspective, this research develops and tests a model consisting of five different technological innovation characteristics (relative advantage (RA), complexity (COM), compatibility (COP), observability (OB), and triability (TR)) as antecedents, green innovation (GI) as a mediator, and sustainable competitive advantage (SCA) as an outcome with government environmental support (GES) as a moderator. For the testing of the seven proposed hypotheses, a survey was administered to 305 clinical/non-clinical hospital staff members from six hospitals in the Middle East and 305 clinical/non-clinical hospital staff members from nine hospitals in North Africa.

Two complementary contributions are offered by this research. First, empirical studies in GI mainly focused on developed (e.g., Europe, America, China, etc.) rather than on developing countries (e.g., Middle Eastern or African regions) (Muslim et al., 2019). Second, empirical examination of the concept of GI in the healthcare industry has been relatively ignored (Muslim et al., 2019). Thus, to date, no cross-national initiative has been carried out to examine GI in the context of the MENA healthcare sector. This research attempts to address such a knowledge gap (see Table 1 for a comparative analysis that supports the contributions of this research).

The rest of the research is structured as follows: the following section focuses on introducing MENA healthcare and the concepts of green ergonomics and SCA. Then, the authors present arguments for the proposed research model and the hypotheses development preceded by the knowledge-based theoretical perspective. The research design, participants, and results of each survey are discussed and analyzed independently. The authors then elaborate on the findings and conclude with a shared discussion for both studies.

LITERATURE REVIEW

MENA Healthcare

The economic conditions and environments are diverse in the MENA region. The area includes some of the highest and lowest income countries (Yorulmaz, 2016). Nevertheless, there are several positive and negative shared factors in the MENA healthcare systems (e.g., insufficient financing of

Table 1. Comparative analysis

Author	Research area / Sector	Location
Gluch, Gustafsson, & Thuvander (2009)	Construction	Sweden
Chiou, Chan, Lettice, & Chung (2011)	Transportation	Taiwan
Bergquist & Soderholm (2011)	Manufacturing	Sweden
Zhang & Liang (2012)	Telecommunications	China
Leenders & Chandra (2013)	Food (wine)	USA, Canada, South Africa, Australia, & New Zealand
Fiott (2014)	Defense	Europe
Zailani, Iranmanesh, Nikbin, & Jumadi (2014)	Transportation	Malaysia
Li (2014)	IT	China
Abdullah, Zailani, Iranmanesh, & Jayaraman (2016)	Manufacturing	Malaysia
Roy & Khastagir (2016)	Petro-chemical	India
Kushwaha & Sharma (2016)	Automotive	General - unspecified
Leal-Millan, Roldan, Leal-Rodriguez, Ortega-Gutierrez (2016)	Automotive	Spain
Saez-Martínez, Avellaneda-Rivera, & González-Moreno (2016)	Hospitality	Spain
Aid, Eklund, Anderberg, & Baas (2017)	Waste management	Sweden
Halila, Tell, Hoveskog, & Lu (2017)	Construction	Europe-China
Tantayanubutr & Panjakajornsak (2017)	Food	Thailand
Toppinen, Patari, Tuppura, & Jantunen (2017)	Paper industry	Europe
Muscio, Nardone, & Stasi (2017)	Food (wine)	Europe (Italy)
Chen, Liu, Li, & Wang (2017)	Education	China
Iranmanesh, Zailani, Moeinzadeh, & Nikbin (2017)	Electronics	Malaysia
Handayani, Wahyudi, & Suharnomo (2017)	Manufacturing	Indonesia
Suasana & Ekawati (2018)	Creative industry	Bali
Aldieri, Carlucci, Cira, Ioppolo, & Vinci (2019)	Manufacturing	USA, Japan, Europe
Chu, Wang, & Lai (2019)	Third party logistics	China
Bai, Song, Jiao, & Yang (2019)	Energy	China
This research	***Healthcare***	***MENA***

*Empirical & literature review papers strictly related to environmental management or policies were excluded

In a recent systematic review by Taklo, Tooranloo, & Shahabaldini (2020), multiple industrial sectors (e.g. manufacturing, automotive, electronics and power, energy, food, IT, construction, hospitality, transportation, military, tourism, agriculture, paper, forestry, communications, petrochemicals, metals, supply chain) and regions (e.g., China, US, Europe, Australia, Japan) have been identified within the GI literature. **Yet, the "healthcare sector" and the "MENA region" remain missing. Table 1 lists the authors, sectors, and settings of earlier and recent studies related to GI

health coverages, fragmented healthcare provisions, budget constraints, and the recent adoption of innovative technologies).

Similarly, in a recent study by Yazbeck, Rabie, & Pande (2017), six main themes have emerged that impact the healthcare sector in MENA (e.g., health benchmarking, health financing, social justice, payment policy lever, organizational reforms, and IT).

This research focuses on the adoption of innovative technologies (characteristics) in the MENA healthcare sector (i.e., the IT theme). In a recent report by Frost & Sullivan (2019), medical technological advancements are emerging in these regions through the adoption of Information technology (IT) and Artificial intelligence (AI) infrastructures. Such innovative technologies are used for enhancing medical diagnostics, improving technical systems, and enriching patient experience.

Green Ergonomics and SCA

Sustainable development is defined as a complex balancing of economic, human/social, and natural capitals (Dyllick & Hockerts, 2002). In early literature, any development that meets the present needs without threatening the ability of future generations to meet their own needs is referred to as "sustainable development and human factors" (Brundlandt, 1987). In recent literature, the term has been developed as "green ergonomics" (Hanson, 2010).

The ergonomics discipline explains the interactions among humans and other elements of a system; thus, optimizing the human well-being with the overall system performance (International Ergonomics Association, 2009). On the other hand, green ergonomics focuses on how to contribute to diminishing the environmental impact. Thus, it promotes an understanding of the role of the human-nature connection.

Green ergonomics is directly linked to designing new innovative products/services with pro-nature benefits, such as solar-powered vehicles, smart-meter interfaces, traffic circles, or any energy-saving innovation that reduces emissions and pollution (Mandavilli, Rys, & Russell, 2008; Sanquist, 2008; Hilliard & Jamieson, 2008). This research adopts the concept of green ergonomics in the context of green innovation (GI) (i.e., green healthcare).

GI is the development of the products/services that aim at reducing the environmental impacts of organizations and achieving eco-benefits (Bernroider, 2002; Damanpour, 1992). GI can be categorized into three types (i.e., green product, green process, and green management innovations) (Chen, Shih, Shyur, & Wu, 2012; Chen & Hsu, 2009). The first type is related to reforms in existing goods/services in response to ecological concerns. The second type is related to updates in methods, processes, and systems to produce eco-friendly products/services that meet environmental targets. The third type is related to new management methods (internally and externally) in commercial practices (Antonioli, Mancinelli, & Mazzanti, 2013).

GI literature has mainly focused on either green product innovation or environmental management systems. This research follows the second type (i.e., green process), which is infrequently examined in the literature, that deals with the development of technological systems, programs, and devices that are newly adopted by organizations.

Specifically, the adoption of innovative technologies in the healthcare sector may take the form of green healthcare, which deals with integrating environmentally friendly practices. Healthcare organizations that follow the green approach have the potential to protect the environment, educate students, save money, and establish leadership in the market among the competitors (Institute of Medicine (IOM), 2006). This research focuses on measuring the latter. Leadership in the market is achieved by gaining SCA. SCA enables organizations to gain long-term economic and eco-benefits, and avoid being surpassed by other competitors in the same market, region, or industry (Lu, Kuo, Lin, Tzeng, & Huang, 2016; Lei & Ngai, 2014).

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

The Knowledge-based view (KBV), a modern management concept of organizational learning, suggests knowledge as a significant cause, resource, and antecedent for strategically achieving SCA (Kogut & Zander, 1992), firm innovativeness, and performance (Darroch, 2005). Technology is identified as the most significant and strategic contributor for advancing knowledge capabilities in organizations for gaining a competitive advantage in the market (Alavi & Leidner, 2001). As such, this research focuses on measuring technological innovation characteristics as causes of SCA.

KBV extends on the classic theory of the resource-based view (RBV), which has been widely used in the green technology literature (e.g., Rahim, Eladwiah, & Rahman, 2013). Nevertheless, only recently the KBV has been used in multiple research streams (e.g., stakeholder theory (Hoskisson, Gambeta, Green, & Li, 2018), open innovation (Santoro, Vrontis, Thrassou, & Dezi, 2018), big data management (Xu, Frankwick, & Ramirez, 2016), and outsourcing and offshoring (Pereira, Munjal, & Ishizaka, 2019)), but remains missing in the green technology literature and the context of the developing markets (Popli, Ladkani, & Gaur, 2017). For those reasons, KBV's theoretical approach is used in this research.

Technology Innovation Characteristics and GI

It is suggested by Sneideriene & Rugine (2019) that to implement green innovations, organizations should focus on technological advances and innovations. Despite their scarcity, previous studies in the green technology literature have identified and examined multiple technological and innovation characteristics (i.e., RA, COM, COP, OB, & TR) that may affect (positively and negatively) an organization's adoption or use of GI (e.g., Kousar, Sabri, Zafar, & Akhtar, 2017; Weng & Lin, 2011; Lin & Ho, 2011).

RA reflects an organization's perception of the benefits of innovation (in terms of price, quality, ease of use, life span, satisfaction) over its cost (Rogers, 2003). If an organization perceives RA of innovation greater and better than the cost and current technology, the organization will be more willing to adopt innovation for higher economic gains (Lin & Ho, 2011; Rogers, 2003). Moreover, earlier and more recent studies have found that RA is positively related to innovation and green innovation adoption (e.g., Kousar et al., 2017; Grandon & Pearson, 2004). Therefore, this research proposes that:

Hypothesis 1a: The perception of relative advantage is perceived to be positively related to green innovation.

COM of innovation reflects the degree to which an organization perceives technology as difficult to understand and use (Rogers, 2003). As the COM of innovation increases, the adoption of innovation decreases (Kousar et al., 2017). Difficulties in the diffusion of innovation or knowledge-sharing lead to increased levels of COM; thus, organizations are more willing to adopt an innovation if knowledge is shared effectively or innovation is diffused efficiently (Etzion, 2007; Rogers, 2003; Tornatzky & Klein, 1982). If innovation requires high levels of skills to operate (high levels of physical and mental efforts), the degree of COM increases, and the level of innovation adoption decreases (Deng & Ji, 2015; Bradford & Florin, 2003). Moreover, complexities in technology replacement have shown to negatively affect the adoption of GI (Bollinger, 2015). In other words, COM can be viewed as the opposite to ease of use. Therefore, this research proposes that:

Hypothesis 1b: The perception of complexity is perceived to be negatively related to green innovation.

COP reflects the organization's perception of the consistency of technology with the organization's existing values, norms, experiences, and demands (Rogers, 2003). If an organization perceives new technology is compatible with the existing knowledge, the organization will be willing to adopt GI (Kousar et al., 2017; Chau & Tam, 1997). Furthermore, innovations that are compatible with an organization's capabilities have larger positive effects on the environment (Etzion, 2007). Therefore, this research proposes that:

Hypothesis 1c: The perception of compatibility is perceived to be positively related to green innovation.

OB reflects the benefits or results of using an innovation visible to potential adopters (before and after scenarios) (Rogers, 2003). In technology literature, innovation is adopted when the impacts of innovations are observed (Shahrul & Normah, 2015; Tan & Eze, 2008). Besides, OB has shown to be the most significant characteristic in the effectiveness of technologies since it enables businesses to identify the benefits of innovation (Hatimtai & Hassan, 2018; Rogers, 2003). Thus, there is a higher probability that innovation will be accepted and adopted by organizations. Therefore, this research proposes that:

Hypothesis 1d: The perception of observability is perceived to be positively related to green innovation.

TR reflects the organizational adoption of any type of innovation with a trial or a testing phase before the actual use or implementation because of the high degree of uncertainty (Rogers, 2003). Organizations are more willing to adopt new technologies or innovations that can be put to the test before use, especially in the case of innovations with high levels of uncertainty. Environmental uncertainty is shown to significantly affect green technology innovation (Zailani, Iranmanesh, Nikbin, & Jumadi, 2014). Thus, TR is one of the significant determinants of the adoption of innovation (Le, Hollenhorst, Harris, McLaughlin, & Shook, 2006). Therefore, this research proposes that:

Hypothesis 1e: The perception of triability is perceived to be positively related to green innovation.

GI and SCA

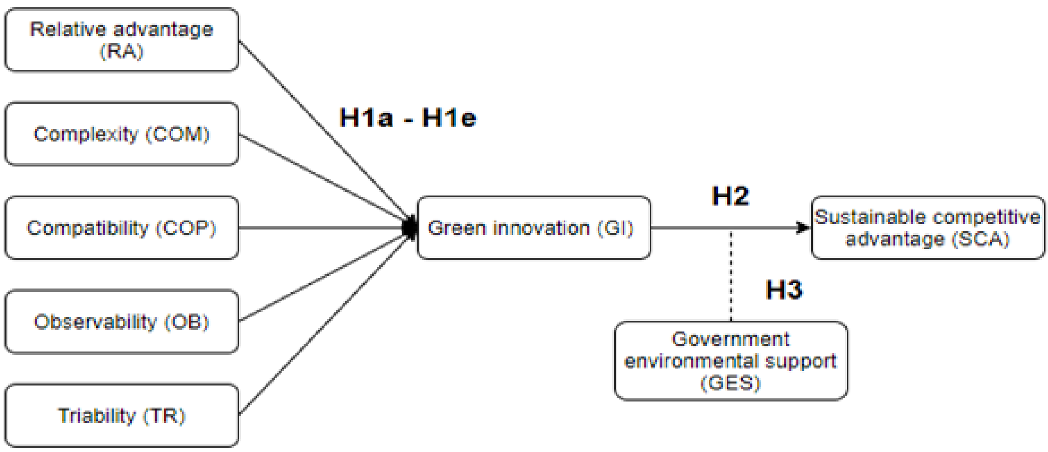
Given the significance of GI in environmental sustainability (Seebode, Jeanrenaud, & Bessant, 2012), several researchers have recently investigated its positive performance implications, and thus, leading to SCA (e.g., Zhang, Sun, Yang, & Li, 2018; Huang & Li, 2017; Ge et al., 2018; Chiou, Chan, Lettice, & Chung, 2011; Chang, 2011). Furthermore, implementing advanced GIs has been found to restore the competitiveness of economies, provide new jobs, and create SCA (Demirel, Li, Rentocchini, & Tamvada, 2019; Ghiseti & Quatraro, 2013; Constantini & Mazzanti, 2012). Thus, to remain competitive in the market, organizations are pressured by governments and stakeholders to reduce their environmental impact by adopting green technologies (Brooks, Hedman, Henningsson, Sarker, & Wang, 2018). Given the evidence in the literature, this research proposes the following:

Hypothesis 2: Green innovation positively relates to sustainable competitive advantage.

GES as a Moderator

Government environmental support (GES) takes the form of environmental regulations, policies, standards, and/or interventions. This research does not differentiate between the types. GES refers to a series of government environmental support systems to reduce the organization's environmental effect and encourage enterprises to engage in environmental innovation (Eiadat, Kelly, Roche, & Eyadat, 2008). In developing countries, GES has shown to play a significant role in motivating enterprises to adopt environmental methods of production (Gadenne, Kennedy, & McKeiver, 2009). Thus, GES has been identified to be crucial to increase the adoption of green innovation (Lin & Ho, 2010). In past and recent green technology literature, GES has shown to significantly moderate innovation and organizational environmental performance (e.g., Xing, Jianhua, & Tou, 2019; Porter & van der Linde, 1995). Based on the literature, this research proposes the following:

Figure 1. Research model and proposed hypotheses



Hypothesis 3: Green environmental support positively moderates green innovation and sustainable competitive advantage relationship. That is, when GES is at a higher level, innovation is more willingly adapted to the improvement of sustainable competitive advantage.

RESEARCH METHODOLOGY

A web-based survey (using SurveyMonkey tool) was implemented for both studies to examine the seven proposed hypotheses. The survey consisted of 28 constructs' items (see Table 2) and four demographics (i.e., gender, age, education, and type of position). All the items followed a seven-point Likert scale (1= Strongly Disagree, 2= Disagree, 3= Somewhat Disagree, 4= Neither Agree nor Disagree, 5= Somewhat Agree, 6= Agree, 7= Strongly Agree).

The final sample sizes for both studies (n=305) are acceptable. According to Sekaran (2003), i) sample sizes between 30 and 500 are appropriate for most research, and ii) sample size should be several times (10 times or more) as large as the number of variables. In this research, both conditions are met.

Study 1

Study 1 focused on the Middle Eastern healthcare sector. The targeted sample consisted of medical staff members and employees working in hospitals, clinics, laboratories, surgical centers, medical offices, and healthcare facilities in Qatar, Saudi Arabia, UAE, and Bahrain. These four countries have shown to have the most efficient healthcare systems and effective technology harnessing in the Middle East (Geiger, 2015). The organizations were randomly selected based on their green technology commitment and ecological activities (e.g., green buildings, green lights, green tech systems, carbon footprint reduction, wastes diversion, pollution prevention, air quality, etc.). Healthcare organizations that were not committed to green innovations and tech systems were excluded from the study. Electronic invitation letters were delivered to the HR departments of twenty-one green healthcare establishments. Only eight accepted to participate in the survey. Participation was voluntary with guaranteed anonymity for all responses. A final number of 354 responses were received after four months; however, 305 complete responses were attained after eliminating incompletes, missing data, and outliers (see Table 3a).

Table 2. Questionnaire items

***Relative advantage* (*Lin & Ho, 2011*)**	
RA 1	Green technology increases environmental performance.
RA 2	Green technology increases economic benefits.
RA 3	Green technology improves the organization's reputation.
Complexity *(Lin & Ho, 2011)*	
COM 1	It is difficult to learn green technology.
COM 2	It is difficult to understand green technology.
COM 3	It is difficult to share the knowledge of green technology.
COM 4	Green technology needs much experience.
Compatibility *(Lin & Ho, 2011)*	
COP 1	Green technology is compatible.
COP 2	Integrating green technology in our systems is feasible.
COP 3	Green technology is consistent with the organization's values.
Observability *(Moore & Benbasat, 1991)*	
OB 1	I have seen what others do with their green technology.
OB 2	In the organization, green technology is visible throughout every division.
OB 3	I have witnessed green technology in use outside the organization I work for.
Triability *(Moore & Benbasat, 1991)*	
TR 1	I have the opportunity to try the green technology.
TR 2	I am able to properly try the green technology.
TR 3	Permission to use a green technology on a trial basis long enough to see its benefits causes to increase adoptability.
TR 4	I am able to try the green technology multiple times before the actual adoption.
Green innovation *(Baines, Brown, Benedettini, & Ball, 2012)*	
GI 1	Adoption of green innovation reduces the negative impacts of the organization's tech systems processing.
GI 2	Adoption of green innovation reduces the negative impacts of the organization's medical processing.
GI 3	Adoption of green innovation reduces the negative impacts of the organization's internal/administrative processing.
Sustainable competitive advantage *(adopted from Thatte, 2007))*	
SCA 1	Because of green innovation adoption, the organization offers competitive prices.
SCA 2	Because of green innovation adoption, the organization offers green products/services.
SCA 3	Because of green innovation adoption, the organization offers highly reliable and ecological products/services.
SCA 4	Because of green innovation adoption, all transportations deliver on time and are environmentally friendly
SCA 5	Because of green innovation adoption, the organization is the first to introduce innovative products/services.
Government environmental support (*Lin & Ho, 2008)*	
GES 1	The government provides financial support for adoption of green technology.
GES 2	The government encourages the organization to use green technology with technical assistance.
GES 3	The government arranges training sessions and workshops to promote green technology skills.

*Green technology also refers to green innovation; organization also refers to healthcare institution of any type; and product/service refers to medical product/service

Table 3a. Demographics

Measures	Descriptions	Frequency	%
Age	18 - 24 25 - 31 32 - 37 38 - 43 44 - 49 > 50	28 55 85 79 50 08	9.20 18.00 27.90 25.90 16.40 2.60
Gender	Male Female	157 148	51.50 48.50
Education	Medical degrees Specialized degrees BA – Masters degrees Advanced doctoral degrees	126 110 65 04	41.30 36.10 21.30 1.30
Type of position	Clinical 1 Clinical 2 Nonclinical 1 Nonclinical 2	90 124 48 43	29.50 40.70 15.70 14.10
Total		**305**	**100**

**Nonclinical 1= Medical admissions clerks, social workers, and records clerks; Nonclinical 2=CEOs, HRMs, IT specialists, Coding specialists; Administrative workers; Clinical 1= Medical technologists and technicians; Clinical 2= Dieticians, Doctors, Therapists, Nurses, Pharmacists*

Study 2

Study 2 followed the exact approach as Study 1 but focused on the North African healthcare sector (i.e., Egypt, Morocco, and Tunisia). Electronic invitation letters were delivered to fifteen green healthcare establishments. Only six accepted to participate in the survey. 289 responses were received after five months; however, 257 complete responses were attained after eliminating incompletes, missing data, and outliers. Nevertheless, to reach the same number of participants as in Study 1, Algeria was added to the sample. Seven green healthcare establishments were contacted, but only two accepted to participate in the survey. After two months, 67 responses were received. The 67 responses were randomly reduced to 48 (including the cancellation of missing data and incompletes) to reach a final number of 305 full responses (see Table 3b).

RESULTS

Study 1

Data were analyzed using two statistical tools (SPSS 23.0 and AMOS 23.0). Before the regression analysis, common method bias was not found to be a major issue (see Table 4a). Second, factor loadings showed significant correlations (see Table 5a). Third, convergent and discriminant validity showed satisfactory estimates (see Table 6a). Finally, the appropriateness of the model was assessed providing an adequate overall measurement model fit (see Table 7a).

Study 2

For Study 2, common method bias was not found to be a major issue (see Table 4b). Second, factor loadings showed significant correlations (see Table 5b). Third, convergent and discriminant validity showed satisfactory estimates (see Table 6b). Finally, the appropriateness of the model was assessed providing an adequate overall measurement model fit (see Table 7b).

Table 3b. Demographics

Measures	Descriptions	Frequency	%
Age	18 - 24 25 - 31 32 - 37 38 - 43 44 - 49 > 50	18 45 59 77 76 30	5.90 14.80 19.30 25.20 24.90 9.80
Gender	Male Female	194 111	63.60 36.40
Education	Medical degrees Specialized degrees BA – Masters degrees Advanced doctoral degrees	76 136 85 08	24.90 44.60 27.90 2.60
Type of position	Clinical 1 Clinical 2 Nonclinical 1 Nonclinical 2	76 136 85 08	24.90 44.60 27.90 2.60
Total		**305**	**100**

Table 4a. Harman's One Factor Test

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.136	18.344	18.344	4.025	14.375	14.375
2	4.420	15.786	34.131	3.347	11.953	26.329
3	2.823	10.082	44.213	2.835	10.124	36.453
4	2.454	8.764	52.978	2.426	8.663	45.115
5	1.983	7.082	60.060	2.186	7.806	52.922
6	1.759	6.282	66.341	2.120	7.572	60.493
7	1.316	4.700	71.041	2.066	7.379	67.872
8*	***1.053***	***3.759***	***74.800***	***1.940***	***6.928***	***74.800***
9	.876	3.127	77.927			

* Eigenvalues > 1.0; cumulative 74.800%; No single or general factor emerged for most of the variance

HYPOTHESES TESTING

Study 1

The empirical analysis presented several interesting insights. H1a (RA-GI) was supported ($t= 2.125$; $\beta= .109$; $p< .05$); H1b (COM-GI) was not supported ($t= -1.209$; $\beta= -.063$; $p> .05$); H1c (COP-GI) was supported ($t= 5.346$; $\beta= .272$; $p< .01$); H1d (OB-GI) was not supported ($t = -4.144$; $\beta = -.204$; $p< .01$); H1e (TR-GI) was supported ($t= 7.618$; $\beta= .379$; $p< .01$); H2 (GI-SCA) was not supported

Table 4b. Harman's One Factor Test

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.809	17.175	17.175	3.572	12.758	12.758
2	3.731	13.324	30.499	3.072	10.973	23.731
3	2.742	9.793	40.292	2.600	9.285	33.016
4	2.271	8.112	48.404	2.271	8.111	41.127
5	1.895	6.767	55.171	2.158	7.708	48.835
6	1.612	5.756	60.927	2.051	7.324	56.159
7	1.310	4.678	65.605	1.978	7.064	63.223
8*	***1.180***	***4.214***	***69.819***	***1.847***	***6.596***	***69.819***
9	.892	3.184	73.003			

* Eigenvalues > 1.0; cumulative 69.819%; No single or general factor emerged for most of the variance

(t= .424; β= .060; p> .05); and H3 (GIxGES-SCA) was not supported (t= -.655; β= -.132; p> .05) (see Table 7a and Figures 2a and 2b).

Study 2

The findings of Study 2 were completely different from Study 1. H1a (RA-GI) was not supported (t= 1.293; β= .069; p> .05); H1b (COM-GI) was supported (t= 6.234; β= .337; p< .01); H1c (COP-GI) was not supported (t= -.054; β= -.003; p> .05); H1d (OB-GI) was supported (t = 3.064; β = .165; p< .01); H1e (TR-GI) was not supported (t= 1.113; β= .061; p> .05); H2 (GI-SCA) was supported (t= 3.228; β= .363; p< .01); and H3 (GIxGES-SCA) was not supported (t= -1.017; β= -.516; p> .05) (see Table 7b and Figures 3a and 3b).

MEDIATION ANALYSIS

Study 1

Submodels 1, 2, 3, & 4 showed partial mediation effects. Thus, there is a significant relationship between GI and SCA; and there are also some direct relationships between the innovation characteristics and SCA. Thus, RA, COM, COP, & OB have both direct and indirect relationships with SCA. On the other hand, submodel 5 showed full mediation effects. GI tends to decrease the significance of the relationship between TR and SCA. Thus, TR might no longer affect SCA after GI is controlled. In other words, TR characteristic only has indirect effects on SCA (see Table 8a).

Study 2

Submodels 1, 3 & 5 showed partial mediation effects. Thus, there are significant relationships between GI and SCA; and there are also some direct relationships between the innovation characteristics and SCA. Thus, RA, COP, & TR have both direct and indirect relationships with SCA. On the other hand, submodels 2 and 4 showed full mediation effects. GI tends to decrease the significance of the relationships between COM-SCA and OB-SCA. Thus, both innovation characteristics might no longer affect SCA after GI is controlled. In other words, COM & OB characteristics only have indirect effects on SCA (see Table 8b).

Table 5a. Factor loadings for Study 1

	1	2	3	4	5	6	7	8
RA1	.062	-.055	.131	-.009	.071	-.091	**.852**	.041
RA2	.207	-.001	.310	.076	-.082	.132	**.725**	-.051
RA3	.083	.015	.018	.070	.135	-.052	**.792**	.086
COM1	.160	-.200	**.749**	.021	.050	-.011	.240	.034
COM2	-.035	.060	**.783**	.021	-.042	-.104	.023	-.043
COM3	.108	-.008	**.844**	.079	.019	-.066	.181	-.053
COM4	.004	.053	**.863**	.025	.204	-.070	-.001	-.069
COP1	-.158	.082	-.117	-.022	.186	**.743**	-.086	.180
COP2	-.014	.212	-.109	-.009	-.061	**.749**	-.046	.054
COP3	-.140	.063	-.034	-.046	.004	**.810**	.059	.176
OB1	.157	.108	.120	-.046	**.615**	.300	.156	-.067
OB2	.047	-.066	.081	-.043	**.902**	.021	-.035	-.023
OB3	.052	.012	.010	-.001	**.876**	-.096	.083	-.121
TR1	.202	**.817**	.059	-.059	.000	.031	-.036	.265
TR2	.106	**.886**	-.008	-.002	.033	.167	-.006	.128
TR3	.214	**.897**	-.047	.054	-.027	.133	-.008	.102
TR4	.126	**.849**	-.048	.000	.017	.088	-.004	.225
GI1	-.011	.229	-.036	.041	.041	.066	.028	**.756**
GI2	-.011	.244	-.050	.025	-.062	.128	.054	**.771**
GI3	-.044	.157	-.058	.014	-.277	.257	.020	**.704**
SCA1	**.913**	.066	.023	.028	.093	-.068	.082	.027
SCA2	**.877**	.115	.048	-.026	.092	.018	.061	.012
SCA3	**.885**	.090	.067	.040	.088	-.139	.030	.053
SCA4	**.854**	.131	.115	-.030	-.016	.013	.122	-.110
SCA5	**.792**	.250	-.016	-.050	-.002	-.169	.090	-.050
GES1	.002	.028	.041	**.877**	-.041	-.057	.028	.050
GES2	-.031	.033	.043	**.916**	-.003	-.058	.097	.028
GES3	-.001	-.062	.047	**.881**	-.031	.040	-.002	-.005

* Factor loadings > 0.30 (Yusoff, Esa, Mat Pa, Mey, & Aziz, 2011); Satisfactory estimates

**GES= Government environmental support; RA= Relative advantage; COM= Complexity; COP= Compatibility; OB= Observability; TR= Triability; GI= Green innovation; SCA= Sustainable competitive advantage

DISCUSSION

Study 1 delivered different findings from Study 2. First, the antecedents, which were perceived to be positive (or negative) in Study 1, were perceived to be negative (and positive) in Study 2. The findings support the idea that different developments of technological trends (digitalization and innovation) and other aspects (e.g., economic situation, job market, infrastructures, levels of access to resources.) are existent between Middle Eastern and North African nations (Goll & Zwiers, 2018).

Table 5b. Factor loadings for Study 2

	1	2	3	4	5	6	7	8
GI1	.093	.007	.132	-.022	**.826**	.090	-.074	.088
GI2	.188	.010	.296	.038	**.742**	-.045	.086	.053
GI3	.077	.034	.024	.095	**.784**	.166	-.010	.074
COM1	.143	-.126	**.684**	.024	.346	-.017	-.055	.001
COM2	.043	.038	**.754**	-.008	-.048	-.054	-.053	.113
COM3	.054	.005	**.802**	.112	.252	.015	-.033	-.052
COM4	-.031	.026	**.844**	.024	.035	.226	-.057	-.045
COP1	-.069	.057	-.083	-.066	-.060	.117	**.715**	.259
COP2	-.046	.265	-.102	.026	-.020	-.059	**.724**	-.038
COP3	-.195	.058	-.016	-.024	.039	-.021	**.819**	.120
OB1	.171	.136	.139	-.056	.191	**.576**	.339	-.051
OB2	.020	-.035	.048	-.039	.001	**.890**	-.017	.035
OB3	.112	.095	-.004	.030	.115	**.843**	-.088	-.134
TR1	.108	**.811**	.059	-.024	.000	-.020	.102	.237
TR2	.051	**.851**	.011	-.004	-.044	.070	.164	.069
TR3	.182	**.849**	-.069	.043	.032	.060	.125	.041
TR4	.114	**.815**	-.017	.007	.060	.042	.014	.230
GES1	.086	.208	.095	.028	.080	.009	.081	**.711**
GES2	-.050	.203	.009	.040	.104	.048	.041	**.701**
GES3	-.085	.068	-.068	-.017	.016	-.213	.172	**.738**
RA1	.052	.032	.021	**.859**	.038	-.038	-.031	.010
RA2	-.029	.054	.010	**.874**	.049	.007	-.054	.009
RA3	.044	-.067	.089	**.845**	.014	-.010	.023	.030
SCA1	**.874**	.045	.046	.043	.078	.117	-.058	.016
SCA2	**.832**	.091	-.002	-.038	.084	.100	-.001	.066
SCA3	**.853**	.029	.079	.084	.020	.139	-.119	.104
SCA4	**.790**	.077	.147	.034	.130	-.031	-.050	-.163
SCA5	**.720**	.256	-.054	-.033	.099	-.056	-.104	-.094

Second, both studies showed that GES is nonexistent. This is mainly because of the a) inadequate or lack of governance for innovation for the whole MENA region (Goll & Zwiers, 2018); and b) corruption, unsteady socio-economic conditions, and non-transparent regulations that are integrated into these regions' political regimes (Goll & Zwiers, 2018). Governments are supposed to support green technology dissemination, influence the flow of technology, implement sound policies, support the deployment of clean technologies, adopt favorable investments, and remove restrictions. Unfortunately, in the MENA region, governments seem to disregard such initiatives.

Third, in Study 1, H2 was not supported. Such a finding opposes previous studies in the green technology literature but is consistent with others that suggested no significant relationship is found between GI and SCA, improved profitability, or enhanced performance (e.g., Ghisetti & Rennings,

Table 6a. Descriptive statistics, Convergent and Discriminant validity

	Mean	St.Dv	CR*	AVE*	MSV**	GES	RA	COM	COP	OB	TR	GI	SCA
GES	2.869	1.310	0.878	0.708	0.018	**0.841**							
RA	5.114	1.004	0.761	0.517	0.158	0.136	**0.719**						
COM	5.591	1.096	0.851	0.592	0.158	0.120	0.397	**0.770**					
COP	2.748	1.279	0.751	0.504	0.228	-0.080	-0.105	-0.229	**0.710**				
OB	4.231	1.031	0.795	0.575	0.061	-0.058	0.122	0.166	0.081	**0.758**			
TR	2.453	1.363	0.927	0.761	0.261	0.020	-0.012	-0.047	0.290	-0.026	**0.872**		
GI	3.044	1.316	0.727	0.500	0.261	0.065	0.049	-0.159	0.477	-0.247	0.511	**0.687**	
SCA	4.545	1.275	0.931	0.730	0.095	-0.007	0.264	0.165	-0.221	0.146	0.309	-0.030	**0.854**

*CR > 0.70 & AVE > 0.50 (Fornell & Larcker, 1981); Convergent validity is satisfactory
**MSV < AVE (Fornell & Larcker, 1981; Discriminant validity is satisfactory)
***GES= Government environmental support; RA= Relative advantage; COM= Complexity; COP= Compatibility; OB= Observability; TR= Triability; GI= Green innovation; SCA= Sustainable competitive advantage

Table 6b. Descriptive statistics, Convergent and Discriminant validity

	Mean	St.Dv	CR*	AVE*	MSV**	RA	GI	COM	COP	OB	TR	GES	SCA
RA	3.017	1.739	0.830	0.620	0.018	**0.787**							
GI	2.580	1.660	0.764	0.521	0.219	0.110	**0.722**						
COM	5.035	.689	0.810	0.523	0.219	0.136	0.468	**0.723**					
COP	3.089	.989	0.715	0.502	0.179	-0.078	-0.037	-0.166	**0.676**				
OB	4.213	.738	0.755	0.519	0.053	-0.006	0.229	0.150	-0.014	**0.721**			
TR	2.587	1.282	0.885	0.659	0.214	0.028	0.081	-0.019	0.315	0.122	**0.812**		
GES	4.794	.643	0.702	0.501	0.214	0.051	0.207	-0.001	0.423	-0.168	0.463	**0.607**	
SCA	5.146	1.867	0.890	0.621	0.090	0.070	0.300	0.159	-0.246	0.231	0.242	-0.016	**0.788**

*CR > 0.70 & AVE > 0.50 (Fornell & Larcker, 1981); Convergent validity is satisfactory
**MSV < AVE (Fornell & Larcker, 1981; Discriminant validity is satisfactory)

2014; Caracuel & Mandojana, 2013). Nevertheless, few have also suggested the possibility of a nonlinear (inverted U-shaped) relationship between GI and competitive advantage (Chen & Chang, 2013). In other words, competitive advantage may be reversely (negatively) affected as GI increases to higher levels.

Because the finding showed a linearly insignificant relationship, this research further attempted to investigate the possibility of a nonlinear relationship. A “curve estimation” test was conducted without any regression analysis. The graph showed the possibility of a cubic s-shaped relationship between GI and SCA (see Figure 4. That is, SCA slightly increases and decreases as GI increases to moderate levels. However, a drastic drop in the level of SCA is observed as GI increases to higher levels.

Practical Implications

Two main practical implications are found. First, in developed nations, the healthcare sector is outperforming the rest of the economy, whereas, in developing nations, the healthcare sector is lagging despite the vast amounts of capital investments. This research highlighted that the problem is not related to financial or medical concerns, but rather improper identification of the technological innovation characteristics that are supposed to be contributors to the effective use of GI. Thus, MENA healthcare establishments are now able to identify the innovation characteristics that are either

Table 7a. Regression analysis

Variables	Green innovation			Hypotheses
	t	Stnd ß	Unst. ß	
Relative advantage	2.125**	.109**	.143**	H1a Supported
Complexity	-1.209	-.063	-.076	***H1b Not supported***
Compatibility	5.346*	.272*	.279*	H1c Supported
Observability	-4.144*	-.204*	-.260*	***H1d Not supported***
Triability	7.618*	.379*	.366*	H1e Supported
R		.558		
R^2		.311		
Adjusted R^2		.299		
VIF***		1.43		
	Sustainable competitive advantage			
Green innovation	.424	.060	.058	***H2 Not supported***
Government environmental support	.520	.077	.075	
GI x GES	-.655	-.132	-.028	***H3 Not supported***
R		.047		
R^2		.002		
Adjusted R^2		-.008		
VIF***		1.00		
		Model fit		
CMIN/DF		2.577	(< 3)	(Hair et al., 2010)
CFI		.900	(> .900)	(Hair et al., 2010)
RMSEA		.072	(< .080)	(Hooper et al., 2008)

* <.01; ** <.05; *** VIF estimates < 5 (Gruber, Heinemann, Brettel, & Hungeling., 2010); thus, multicollinearity is not a concern in Study 1

supporting or hindering their growth. Second, in Study 1, the relationship between GI and SCA was found to follow a nonlinear rather than a linear pattern. This implies that green innovation strategies and approaches that are adopted from developed countries are ineffective for the Middle Easterns. The research urges public and private Middle Eastern healthcare establishments to develop their green and sustainable practices/measures rather than adopting international green technology strategies from advanced nations. Thus, strategies should be approached with greater sensitivity, especially since cultural differences were found to impact innovation processes in general (Westwood & Low, 2003).

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Several limitations are noteworthy, which also suggest avenues for future research. First, this research did not explicitly measure a specific type of GI (i.e., technological system or e-health program) used or newly adopted by the sampled healthcare establishments. Such an attribute is hard to control since both studies surveyed participants from different regions (i.e., different work norms and values) who are employed at diverse medical establishments (i.e., hospitals, laboratories, medical offices, etc.) and use various types/brands/features of green technologies. Future studies are suggested to build-on

Table 7b. Regression analysis

Variables	Green innovation			Hypotheses
	t	Stnd ß	Unst. ß	
Relative advantage	1.293	.069	.027	***H1a Not supported***
Complexity	6.234*	.337*	.314*	H1b Supported
Compatibility	-.054	-.003	-.002	***H1c Not supported***
Observability	3.064*	.165*	.144*	H1d Supported
Triability	1.113	.061	.031	***H1e Not supported***
R		.413		
R^2		.170		
Adjusted R^2		.157		
VIF**		1.20		
	Sustainable competitive advantage			
Green innovation	3.228*	.363*	1.054*	H2 Supported
Government environmental support	.904	.438	.470	
GI x GES	-1.017	-.516	-.106	***H3 Not supported***
R		.268		
R^2		.072		
Adjusted R^2		.062		
VIF**		1.08		
		Model fit		
CMIN/DF		2.396	(< 3)	(Hair et al., 2010)
CFI		.915	(> .900)	(Hair et al., 2010)
RMSEA		.068	(< .080)	(Hooper et al., 2008)

* <.01; ** VIF estimates < 5 (Gruber et al., 2010); thus, multicollinearity is not a concern in Study 2

Figure 2a. Insignificant moderating effects of GES for Study 1

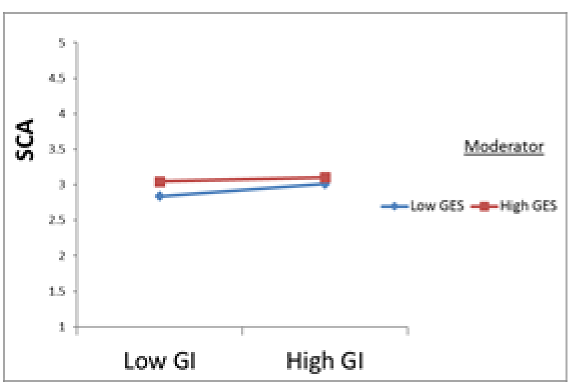


Figure 2b. Insignificant moderating effects of GES for Study 2 (GES dampens the positive relationship between GI & SCA)

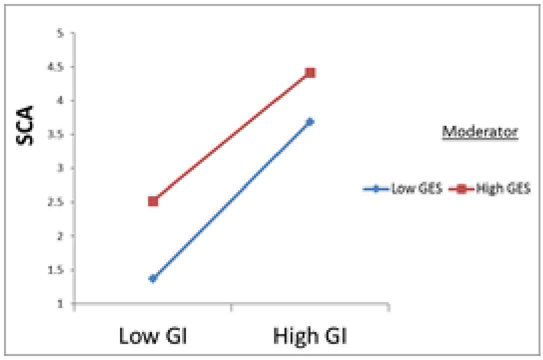


Figure 3a. Empirically tested research model for Study 1 (t values; Beta values)

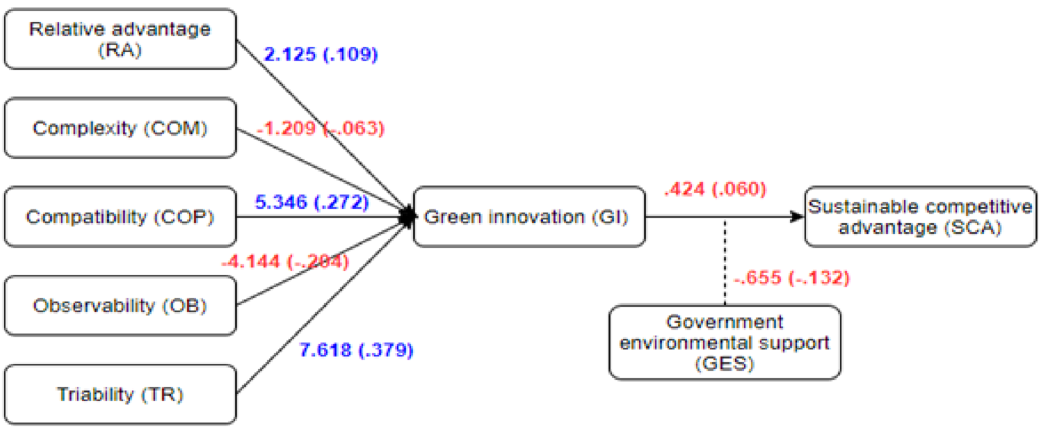


Figure 3b. Empirically tested research model for Study 2 (t values; Beta values)

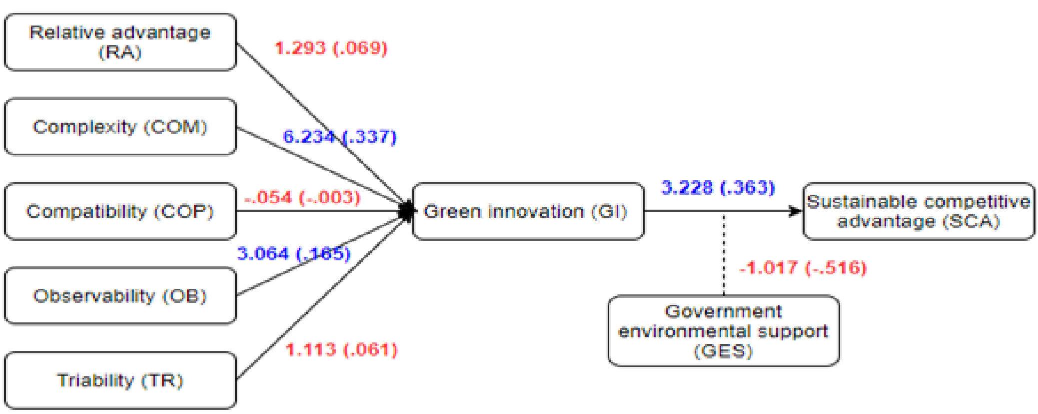


Table 8a. Mediation analysis

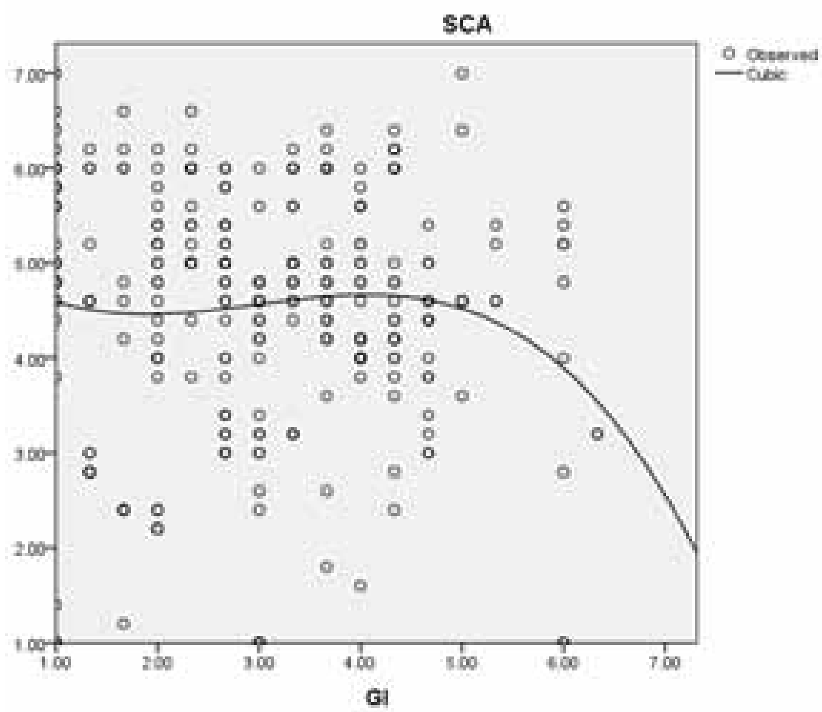
Submodel	Lower CI	Upper CI	Point	P value	Result
(1) RA-GI-SCA	-.0272	.0060	-.0020	>.05	Partial mediation
(2) COM-GI-SCA	-.0178	.0233	.0013	>.05	Partial mediation
(3) COP-GI-SCA	-.0310	.0614	.0150	>.05	Partial mediation
(4) OB-GI-SCA	-.0384	.0247	-.0001	>.05	Partial mediation
(5) TR-GI-SCA	-.1438	-.0246	-.0826	<.05	Full mediation

* Medcurve macro analysis (SPSS); If zero is not found within the interval, then there is a significant mediating effect (i.e., full mediation) (Preacher & Hayes, 2004; 2008)

Table 8b. Mediation analysis

Submodel	Lower CI	Upper CI	Point	P value	Result
(1) RA-GI-SCA	-.0009	.0707	.0279	>.05	Partial mediation
(2) COM-GI-SCA	.0944	.4281	.2345	<.05	Full mediation
(3) COP-GI-SCA	-.0808	.0324	-.0127	>.05	Partial mediation
(4) OB-GI-SCA	.0262	.2516	.1231	<.05	Full mediation
(5) TR-GI-SCA	-.0057	.0665	.0276	>.05	Partial mediation

Figure 4. Cubic S-shaped relationship between GI and SCA



these limitations for better insights and higher practical awareness for the healthcare sector. Second, the findings of both studies relate to North African and Middle Eastern contexts. The differences between these regions (along with western and eastern cultures) should be carefully considered. Thus, it would be interesting for future studies to investigate how the current findings can be generalized to other contexts and newly introduced industries (e.g., FinTech). Third, while the cross-regional research is appropriate for a theoretical model with significant implications, longitudinal studies are still desirable. With similar settings, longitudinal studies are more effective since GI is rapidly evolving in the MENA region. Moreover, this research did not empirically measure the plausible s-shaped relationship between GI and SCA. Examining non-linear (curvilinear) relationships may provide new avenues and perhaps discover inconsistencies that may have been overlooked by this research.

CONCLUSION

Careful market research has been suggested to identify which markets (Middle Eastern or North African) offer higher future opportunities for healthcare (HealthcareMarkets, 2020), especially since the medical-technology market in the MENA region is projected to grow exponentially with large amounts of investments in GI (ArabHealth, 2020). Yet, to date, there is no cross-national research that has empirically examined if the MENA region has the same perceptions of technological innovation characteristics as causes of GI for SCA within the healthcare sector. This research is the first to do so.

In Study 1, TR showed to have the highest impact on GI (with OB as the lowest) and GI was revealed to be negatively related to SCA. Whereas in Study 2, COM showed to have the highest impact on GI (with RA as the lowest) and GI was revealed to be positively and significantly related to SCA. GES showed no correlation in either region.

The findings were antagonistic to what was expected and revealed that Middle Eastern and North African healthcare establishments are heterogeneous rather than homogeneous in their perceptions of GI. Thus, this research supports the concept that the health-technology assessment is still nascent with some heterogeneity in the MENA (Fasseeh et al., 2020). Consequently, it is evident by now that previous assumptions and reports, which consider Middle Eastern and North African healthcare markets as the same, have been empirically proven to be inaccurate and misleading.

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