RESEARCH ARTICLE

Is it an opportunity? COVID-19's effect on the green supply chains, and perceived service's quality (SERVQUAL): the moderate effect of big data analytics in the healthcare sector

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Abstract

This study examines the relationship between uncertainty-fear toward COVID-19, green supply chain management (GSCM), and perceived service quality based on the five dimensions service quality model (SERVQUAL). It also tests the moderating effect of big data analytics (BDA) capabilities. Based on a sample of 300 healthcare managers and customers, we used partial least squares structural equation modeling to analyze the data and test our hypotheses. The empirical results show that the uncertainty-fear toward COVID-19 positively affects GSCM. Also, BDA moderates the relationship between uncertainty-fear toward COVID-19 and GSCM. GSCM positively impacts service quality (empathy, responsiveness, and assurance) but not reliability or tangible items. In addition, GSCM significantly mediates the relationship between uncertainty-fear toward COVID-19 and services' empathy, responsiveness, and assurance. However, it has an insignificant mediation effect regarding reliability and tangible-item dimensions.

Keywords Uncertainty-fear · COVID-19 · Green supply chain management · Big data analytics · Service quality model (SERVQUAL)

Introduction

COVID-19 is considered one of the most dramatic events that disrupted the supply chains (SCs) (Figliozzi and Unnikrishnan 2021; Lin et al. 2021). SC disruptions rose rapidly due to the state-imposed curfew and tight travel restrictions (Song et al. 2021). According to Kholaif et al. (2022b), the COVID-19 outbreak caused dread and apprehension; this led to challenges such as a lack of materials, delayed supplies, unsteady transit systems, and others. Moreover, according to Balsalobre-Lorente et al. (2022), the ability to achieve sustainable economic growth has continued to be impeded by the pandemic's environmental degradation. This situation prompted many researchers and industry experts to point out COVID-19's extraordinary impact on the shape and structure of the services' SCs (Ferrara 2020; Govindan et al. 2020). Moreover, the pandemic has created a challenging environment of uncertainty and fear in which companies must respond quickly to unknown SC issues (Schleper et al. 2021; Chowdhury et al. 2021). According to Wang et al. (2020) and Elsaid et al. (2021), COVID-19 increases the desire to promote green and sustainable development and comply with environmental rules, thus endorsing green SC practices (Usman et al. 2022). Further, COVID-19 is compelling businesses, including those in the healthcare industry, to use big data analytics (BDA) capabilities to be more proactive in seeking out novel knowledge that can aid in the growth of their green operations and enhancement of the quality of their green services (Govindan et al. 2020). As a result, businesses, including healthcare, are rapidly appreciating and attempting to maximize the benefits of BDA capability usage to implement green supply chain management (GSCM) successfully (Özkan et al. 2014; Wang et al. 2020) and to enhance the service's quality, as perceived by customers (Gualandris and Kalchschmidt 2014; Pitkänen and Linnosmaa 2021).

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Based on the social cognitive theory, uncertainty-fear against COVID-19 was defined by Jian et al. (2020) as an unfavorable emotional situation that results in stress and despair since COVID-19's possible effects are not fully understood. The strong contagious capacity and enormous mortality rates of COVID-19 raised many people's worries and unease. (Schimmenti et al. 2020). Moreover, Chan (2017) noted that norms and/or conventions might change or evolve due to the anxiety and uncertainty engendered by ecological disasters or other natural hazards.. Consequently, Wang and Zhang (2021) argued that during the current crisis, organizations' uncertainty and fear of the pandemic led to a re-think of the green and ecological practices toward healthcare SCs and to capture the opportunities in the current situation to enhance the GSCM practices. And to make use of the current situation's chances to improve the GSCM processes.

Previous studies utilize the resource-based view theory to describe how resources, including data and natural resources, can help elevate environmental concerns during crises (Usman et al. 2021, 2022; Chien and Shah 2022). Based on the "resource-based view" theory, Akter et al. (2016) defined the BDA as the company's ability to capture, integrate, and use data analytics-based assets alongside promotional resources and skills. Thus, using novel technological innovative techniques, including BDA capabilities, provides a platform with adequate capacity to obtain, incorporate, and use data analysis–related resources (Akter et al. 2016; Usman and Radulescu 2022). As well as to attain detailed information (Gunasekaran et al. 2017), allowing the companies to shift from spontaneous to more information-based decision-making (Özkan et al. 2014; Gunasekaran et al. 2017) and dramatically boost their rational decision-making ability (Araz et al. 2020; Power 2016).

Furthermore, based on the "theory of needs" and the (SERVQUAL) model (Parasuraman et al. 1985), Pitkänen and Linnosmaa (2021) argued that during the pandemic, GSCM has a significant impact on the client's perception of the services' quality. This research will use the service quality "SERVQUAL" model proposed by Parasuraman et al. (1985) to measure healthcare service quality, as it proved to be a fruitful background in the healthcare sector (Saleh and Ryan 1991; Al-damen 2017).

Research gap and questions

Prior research has investigated COVID-19's effect on the SCs and different stakeholders in the business (Wang and Zhang 2021; Kholaif and Ming 2022b). However, there is a gap, as limited studies showed how the fear-uncertainty of COVID-19 affects the GSC's activities in the healthcare sector, and shows the pressure on the businesses, including the healthcare providers, to think more about the SCs'

ecological issues and integrate environmental and green practices directed into their business and SC schemes to overcome performance issues and achieve service quality passed on the SERVQUAL model (reliability, tangible-items, empathy, responsiveness, and assurance). Prior studies like Rew and Cha (2020), Channa et al. (2021), and Kholaif and Ming (2022a) pointed out that recently businesses faced pressure toward green practices. They tend to implement more holistic ecological and innovative management systems, such as GSCM, and BDA, to overcome performance issues. However, there is an existing research gap as the research investigating how the pandemic affects the mechanisms through which such relationships are established is lacking and limited in emerging market economies like Egypt (Kholaif et al. 2022a).

Also, a plethora of research has studied COVID-19's adverse effect on the economy and environment (Grida et al. 2020; Chowdhury et al. 2021; Figliozzi and Unnikrishnan 2021), though limited highlighted the positive side of the pandemic, which has reintroduced the concepts of green practices and sustainability (Kholaif et al. 2022a; Wang and Zhang 2021). Furthermore, although scholars have studied how BDA affects SCs' use of green practices, there has not been much study about how BDA's moderate impact on the GSCM in the healthcare industry and the mediating role the GSCM plays between uncertainty-fear and the service quality based on SERVQUAL model during COVID-19. Additionally, some scholars have identified the pandemic's effect on the service's quality (Özkan et al. 2014), though there is a gap in the study on applying GSCM to assess the efficacy of healthcare providers' efforts in balancing the service's quality during the pandemic and how the pandemic influenced people around the world to adopt greener techniques (Hoang et al. 2021). Thus, our study addresses the following questions:

RQ1: How does COVID-19 indoctrinate the healthcare providers to consider GSCM practices extensively?

RQ2: What are the associations—both direct and indirect—between uncertainty-fear toward COVID-19 and the five SERVQUAL model dimensions (reliability, tangible items, empathy, responsiveness, and assurance) in the Egyptian healthcare sector?

RQ3: How does GSCM help enhance the customers' perception of healthcare services' quality during the pandemic, and how does it mediate the association between uncertainty-fear toward the pandemic and the healthcare service's quality, as perceived by customers based on the (SERVQUAL) model?

RQ4: Does the BDA moderate the relationship between uncertainty-fear toward the pandemic and GSCM?

Research aim and scope

The goal of the current study is to thoroughly analyze the connection between fear and uncertainty regarding COVID-19, the GSCM, and the service's quality, as perceived by customers, based on the SERVQUAL model, to investigate the role that BDA plays in moderating the link between the different variables. Our study scope focuses on both the firms, expressed by managers and customers expressed by patients, uncertainty, and fear toward the pandemic. First, the stakeholders' fear and uncertainty of COVID-19 placed pressure on firms to adopt more safe and environmentally friendly procedures to provide safe and eco-friendly service throughout the pandemic while assuring good service quality (Kholaif and Ming 2022a). Second, healthcare firms' uncertainty-fear directs them to prioritize workplace safety and green practices for their employees and customers. This promotes businesses to re-think their GSCM practices and adopt more environmentally friendly and safe procedures (Millroth and Frey 2021), which will affect the quality of healthcare service (Govindan et al. 2020).

Furthermore, our study scope extends to show how the healthcare firms utilize the GSCM to enhance healthcare services' quality, and additionally, how the pandemic urges administrators of healthcare organizations to provide careful thought to GSCM and BDA. Hence, the positioning of this research, among other studies, is to further the research that connected COVID-19 with healthcare service quality and did not consider the GSCM (Özkan et al. 2014; Govindan et al. 2020), and also, to make an effort to bridge the gap revealed by Jian et al. (2020) and Kholaif and Ming (2022a) of ignoring the COVID-19 opportunities toward the green practices in the SCs, by adding BDA as a moderator and study the mediating effect of the GSCM for that relationship in Egypt's healthcare firms.

Research motivation and significance

Four main reasons drive the motivation and significance of this research. First, according to Govindan et al. (2020), the nationwide lockdowns during the pandemic, and immobility of commodity transfers from one location to another, harmed the shape and structure of healthcare SC. Close engagement between patients and service providers increases COVID-19 cases and exacerbates the problem (Sriyanto et al. 2021). Moreover, in emerging economy countries like Egypt, the path to reducing the COVID-19 cases is made more difficult by a lack of healthcare expenditures and a lack of healthcare protective medical equipment supplies, which also affect the healthcare firms' ability to provide high-quality services.

Second, research about healthcare quality is more challenging than other services since the patients themselves and their quality of life are the subject of measurement (Naidu

2009; Russell et al. 2015; Vasiliki and Maditinos 2017). In the same vein, Baker et al. (2007) and Reivich and Shatte (2003) argued that a mutual feature of research on services, especially the healthcare service quality is that the clients' quality assessment becomes highly complicated and hard to define.

Third, the earlier studies are narrow to certain aspects, as they only revealed the negative impact of the pandemic on the global SCs. For instance, Grida et al. (2020) assess the effect of COVID-19 prevention policies on SC features under uncertainty. Researchers have also highlighted the harmful influences of COVID-19 on psychological and physical health (Tzur et al. 2020). However, no research highlighted the positive impact COVID-19 has on the SCs' green practices. Besides, since the outbreak is so recent, few studies examine how people's feelings and perceptions of the pandemic influence their practices of the SC's environmentally friendly techniques (Jian et al. 2020).

Fourth, the previous studies disregarded the effect of the healthcare SCs' green practices and their effect on the healthcare service quality, which is critical for understanding the increase and decrease of coronavirus infections due to growing unmanageable logistical activities in some African nations like Egypt. Egypt is one of the biggest states in Africa affected by COVID-19 (Kholaif and Ming 2022b; Elgendy et al. 2022). According to the Egyptian Medical Syndicate, more than 395 life losses in doctors have been recorded in the first months of the epidemic in Egypt, which caused a severe effect on the Egyptian healthcare SCs, causing an evolving need for green practices in the healthcare SCs to protect both the healthcare providers and the patients (Tawfik et al. 2021).

Research contribution and novelty

The novelty of this research is derived from its theoretical contribution and practical implications.

First, theoretical novelty

This research will contribute to the literature in three critical theoretical areas. First, this study adds to the "social cognitive theory" by spotlighting how people can change their lifestyle to confront the pandemic's fear-uncertainty issues and how these issues will affect the healthcare-GSCM process. Second, this paper adds to the "stakeholder theory" to show how COVID-19 and business firms' operations, including healthcare firms, during that period generate externalities, which may drive stakeholders to exert pressure in favor of green practices to protect both the clients and the healthcare service providers during the COVID-19 pandemic (Kholaif and Ming 2022a). Third, this study utilizes the "resource-based view theory" (Sun et al. 2022;

Usman and Balsalobre-lorente 2022) as a solid theoretical foundation for presenting the notion of BDA capabilities as a moderator (Wang et al. 2020; Galetsi et al. 2020) for the correlation among the GSCM and COVID-19's uncertainty-fear. Third, we expand on the "theory of needs" by showing the impact of healthcare GSCM on the customers' perception of the provided services' quality (Solomon et al. 1985), using the five SERVQUAL model dimensions.

Additionally, to broaden the research that connected the pandemic and the healthcare GSCM activities and make an effort to fill in the gaps noted by Çankaya and Sezen (2019), Nasrollahi (2018), Hao et al. (2020), and Noar and Austin (2020), this study will expand on the BDA capability aspect and present actual data from hospitals and healthcare facilities in Egypt, on the effect of the pandemic on the healthcare GSCM, and perceived service quality.

Second, practical novelty

The practical importance of this research derived from the crucial role GSCM plays in affecting the healthcare firms' service quality during COVID-19. According to Sriyanto et al. (2021), the healthcare GSCM played a critical role during COVID-19, as it allows for the free and safe flow of medical supplies such as hand sanitizers, face masks, surgical gloves, diagnostic swabs, lab tools, ventilators, medicines, and much other life-saving equipment (Bag et al. 2021). Generally speaking, the significance of the GSCM in healthcare activity is evident as it provides green and safe logistical services to assist the healthcare providers and help the firms render their services on a broader scale. Moreover, applying GSCM in the Egyptian healthcare sector can help the healthcare providers address global environmental challenges during COVID-19, thus meeting stakeholders' needs and improving their perceived service quality (Hoang et al. 2021). Thus, the study's results persuade healthcare managers to carefully consider GSCM activities, which settles the problems with service quality during COVID-19 and produces a superior position in the ambiguous context of the pandemic.

Background and hypotheses development

Uncertainty-fear effect on GSCM in healthcare sector

GSCM in the healthcare sector refers to a process that includes green procurement for medical supplies, green manufacturing/material management, green distribution, marketing, green healthcare service rendering for patients and clients, and reverse logistics (Özkan et al. 2014). Thus, according to Zaini et al. (2014), Awan et al. (2017),

Govindan et al. (2020), and Bag et al. (2021), GSCM in the healthcare sector can be divided into two segments: the internal supply chain, which includes the patients (clients), the patient care unit, and hospital process units; and the external supply chain, which includes vendors, producers, and supply centers.

Following the study of Kholaif and Ming (2022b), we utilize the social cognitive theory to describe the uncertainty-fear of COVID-19. The idea of social cognition combines environmental, individual, and behavioral effects to explain human behavior (Milaković 2021). Fear and uncertainty about COVID-19 have been linked in new ways by social cognitive theory, which describes how the global epidemic circumstance has created an impetus for companies to adopt environmental and green techniques, including those associated with GSCM, in order to safeguard their clients', workers', and general societal protection (Kholaif et al. 2022a; Milaković 2021).

Moreover, the stakeholder theory supports a pragmatic, economical, effective, and moral approach to handling businesses in a dynamic and uncertain context (Harrison and Freeman 2015). The stakeholders' theory offers new perspectives on the pressure being applied in support of green practices to protect patients and healthcare professionals during a pandemic (Govindan et al. 2020). Consequently, Kholaif and Ming (2022a) argued that during the current crisis, organizations' uncertainty-fear toward COVID-19 prompted the re-evaluation of green practices toward SCs.

Crowley et al. (2021) described a rational, intellectual response to the pandemic that causes anxiety and cognitive ambiguity as "uncertainty toward COVID-19." Because of the highly contagious virus, the absence of a cure, and the fluctuating number of infections and deaths, the world has been plunged into a vulnerable state and uncertainty (Jian et al. 2020). Fear of COVID-19, on the other hand, is a negative emotional state that generates anxiety and despair because of the pandemic's prospective effects (Qiu et al. 2020). The pandemic's high contagious capacity and death rates increased people's sense of insecurity and fear (Paek and Hove 2020). People's attitudes, behaviors, and social standards can be adapted to alleviate their fears and concerns about hazards and natural disasters (Crowley et al. 2021). Fear of natural calamities, for example, can lead to a greater sense of well-being and a more altruistic outlook on the environment, society, and life (Chan 2017). Similarly, According to Song et al. (2021), implementing GSCM strategies can help promote environmental consciousness between clients and service providers. Thus, we can develop the first hypothesis as follows:

> H1: Uncertainty-fear of COVID-19 has a significant positive effect on GSCM.

The moderate role of BDA

Our study employs the "resource-based view theory" as an acceptable foundational theory for presenting the concept of BDA capabilities as a moderator (Wang et al. 2020). The resource-based view theory is a managerial paradigm that helps businesses identifies the strategic resources they may deploy to gain a long-term competitive edge (Barney 1991). The resource-based view theory states that enterprises with different resource mixtures have varied strategies, which means they are heterogeneous (Lumpkin and Waring 2001). Thus, the company's internal assets, aptitudes, skills, and abilities are examined to find a competitive edge that can be gained through the resource-based perspective theory.

Based on the resource-based view theory, BDA capabilities can be defined as the company's ability to capture, integrate, and use data analytics–based assets alongside promotional resources and skills (Akter et al. 2016). Analyzing big data will help organizations acquire detailed data, boost prediction accuracy, and enhance decision-making skills (Wang et al. 2020). BDA also helps service providers observe swift changes in the external environment (Özkan et al. 2014; Dubey et al. 2019) and recover the capabilities to spot deficiencies in current business operations (Chen et al. 2015; Wang et al. 2020). Thus, BDA allows firms to be more inclined to re-think SCM's uncertainty perceptions in this environment of uncertainty and fear, thus increasing the chances of adopting GSCM (Grida et al. 2020).

Moreover, BDA can assist businesses in computing precisely and forecasting the information of GSCM (Tiwari et al. 2018), which enable business firms to generate greater introduced values toward the SC practices. In such a situation, Wang et al. (2020) pointed out that firms applying BDA have a more positive stance and focused goals on overcoming the uncertainty and fear induced by the COVID-19 pandemic and improving their environmental practices, thus reinforcing the influence of adopting GSCM. Also, they pointed out that analyzing information from BDA helps boost companies' data collection capabilities and aiding companies to precisely foresee the potential threats and external uncertainties and react quickly to the environmental changes during the pandemic. Based on the previous, the authors propose the following hypothesis:

> H2: BDA moderates the relationship between uncertainty-fear of COVID-19 and GSCM

GSCM and service quality (SERVQUAL model)

This study utilizes the "theory of needs" by showing the impact of healthcare GSCM on the customers' perception of the provided services' quality based on the SERVQUAL model. According to the "theory of needs," the perceived service quality is the customer's opinion and evaluation of the product's or service's overall superiority, based on the awareness of what they got and what they were promised (Zeithaml 1988; Gualandris and Kalchschmidt 2014; Pitkänen and Linnosmaa 2021). Based on the previous, we use the service quality "SERVQUAL" model developed by Parasuraman et al. (1985) to assess the healthcare service quality as it is proved to be a fruitful background in the healthcare services sector (Al-damen 2017; Ali et al. 2022). According to Saleh and Ryan (1991), SERVQUAL is considered one of the most significant and commonly used models to measure healthcare service quality because of its extensiveness and practicality (Ali et al. 2022). It comprises five aspects of service quality:

Reliability

Saleh and Ryan (1991) and Al-damen (2017) defined service reliability as the capability to do the promised service reliably and precisely. According to Nimanpure and Sohani (2013), service reliability is often perceived as the most significant part of healthcare service quality. The reliability criteria is also among the most influential factors related to the GSCM, as it measures the probability of the service provider's eco-friendly and error-free performance and rendering of the service for a defined and pre-planned period, taking into consideration the environmental and social aspects (Taghizadeh and Hafezi 2012; Duque-uribe et al. 2019). Moreover, the ILO (2020) argued that throughout the COVID-19 pandemic accordingly, GSCM environmental practices play an essential role in increasing service reliability. Ferrara (2020) pointed out that healthcare companies with GSCM environmental practices can redesign their current business model despite their cognitive uncertainties. Based on the previous literature, we can develop the H3a hypothesis as follows:

> H3a: GSCM has a significant positive effect on service reliability.

Furthermore, Çankaya and Sezen (2019) pointed out that GSCM practices can make it simpler for businesses to alter their mental models and preceding attitudes toward offering more reliable services to clients in terms of the ecological and social aspects. Meanwhile, it is expected that companies with GSCM will face more scrutiny from their external stakeholders, resulting in them creating more appropriate policies to satisfy the needs of their customers, which in turn helps them develop trustworthy green products and services (Thong and Wong 2018). Therefore, we argue that GSCM supports firms to meet the external environment's needs during the pandemic, thereby overcoming the uncertainty and anxiety toward COVID-19 and facilitating the offering of

green and more reliable services. Thus, it will mediate the association between COVID-19 uncertainty-fear and service reliability. So, for the mediating effect of GSCM, we can develop the second hypothesis as follows:

> H3b: GSCM mediates the relationship among uncertainty-fear of COVID-19 and service reliability

Tangible items

Tangible items comprise the facilities, machinery, staff, supplies, and the external physical appearance (Saleh and Ryan 1991; Nimanpure and Sohani 2013; Al-damen 2017). Based on Özkan et al. (2014), GSCM is the method of handling materials, products, physical assets, facilities, equipment, money, and data among the manufacturers, suppliers, distributors, retailers, and consumers. According to Kros et al. (2019), all of these items are members of the value chain, such that products end up with the customer from the raw material supply to processing and delivery. Vasiliki and Maditinos (2017) pointed out that green practices will bring more attention to the firm's tangible items and facilities. The healthcare companies will try to adjust the external appearance of the facilities and equipment and the staff to comply with the environmental and social standards required by the government and other external stakeholders (Çankaya and Sezen, 2019). Thus, GSCM environmental practices will have a positive impact on the firm's tangible items; we can develop the following hypothesis:

> H4a: GSCM has a significant positive effect on service tangible items.

Also, GSCM environmental practices will be critical during the pandemic in enhancing business attention toward its tangible items. It will also have a mediation effect on uncertainty-fear of the pandemic and the firm's tangible items (ILO 2020; Ferrara 2020). Thus, we claim that GSCM will have a mediation relationship between the uncertainty and anxiety caused by the pandemic and the tangible items of the firm. Thus, this study develops the following hypothesis:

> H4b: GSCM mediates the relationship among uncertainty-fear of COVID-19 and service tangible items.

Empathy

Saleh and Ryan (1991) and Al-damen (2017) defined empathy as the actions and behavior of delivering caring and personalized attention to the customer. Moreover, in the context of SCs, empathy is defined as the ease and convenience of service supplier access and the effectiveness of customer–supplier communication (Nimanpure and Sohani

2013; Kros et al. 2019). According to Brandon-Jones et al. (2010), GSCM environmental practices affect empathy toward customers, where the term "empathy" is presented as an external behavioral representation of this type of service provider's attitude. Similarly, Wieseke et al. (2012) and Kros et al. (2019) pointed out that GSCM can promote empathy toward the customer, which is described as the service provider's tendency to demonstrate an understanding of and willingness to interact positively with the ecological, social, and financial needs, preferences, and general well-being of the clients. Thus, we can develop the following hypothesis:

> H5a: GSCM has a significant positive effect on service empathy.

Furthermore, GSCM will hold an essential role in enhancing empathy toward patients (Russell et al. 2015); during the COVID-19 pandemic, the environmental practices of the GSCM will enhance customer–supplier communication and the attitudes toward rendering personalized courtesy to customers, thus increasing empathy. Therefore, GSCM will mediate the connection between uncertainty and anxiety of COVID-19 and empathy (ILO 2020; Ferrara 2020). Based on the previous, we claim that the GSCM will have a mediation relationship between the uncertainty and anxiety caused by the pandemic and the client's empathy. Thus, this study develops the following hypothesis:

> H5b: GSCM mediates the relationship among uncertainty-fear of COVID-19 and service empathy.

Responsiveness

Nimanpure and Sohani (2013) and Al-damen (2017) defined responsiveness as the readiness to help customers and render approachable service on a timely basis. Duque-uribe et al. (2019) pointed out that a green supply chain can help healthcare organizations portray a more positive picture to stakeholders, community, consumers, and staff by rendering more responsive service to clients. Moreover, GSCM will reduce environmental damage and uncertainty for the patients (Gunasekaran et al. 2008; Xie and Breen 2012; Zaini et al. 2014). The GSCM's positive public image is critical to retaining and attracting both customers and employees (Reichhart and Holweg 2007). According to other research, the environmental practices of GSCM could improve the company's image by increasing service responsiveness, resulting in improved customer satisfaction (Reichhart and Holweg 2007; Laosirihongthong et al. 2013). Thus, this study develops the following hypothesis:

> H6a: GSCM has a significant positive effect on service responsiveness.

Moreover, the ILO (2020) and Ferrara (2020) pointed out that during COVID-19, GSCM will contribute significantly to the healthcare service's responsiveness to the customers by helping render the customers' needs quickly and on a timely basis while considering the health and safety perspective. Consequently, GSCM will mediate the connection among uncertainty-fear toward COVID-19 and service responsiveness. Hence, we can in this study develop the following hypothesis:

H6b: GSCM mediates the relationship among the uncertainty-fear of COVID-19 and service responsiveness.

Assurance

Assurance refers to the employees' expertise, courtesy, and capability to induce confidence and trust (Saleh and Ryan 1991; Al-damen 2017). According to Nimanpure and Sohani (2013) and Kros et al. (2019), assurance is the adequate competence to carry out the service, courteousness of supplier's behavior, supplier's reliability, and service safety. Azapagic (2003) pointed out that in order to produce goods and services, enterprises, including healthcare providers, use finite resources and pollute the air, soil, and water. Jraisat (2013) pointed out that GSCM in healthcare encompasses all measures to minimize the environmental impact of the company's products and services and to assure that the healthcare staff knows to accomplish the quality of products and services based on the environmental and social standards. According to Eltayeb et al. (2011), these attempts positively impact assuring and improving healthcare facilities' ecological performance by minimizing the solid/liquid waste levels and hazardous materials, reducing environmental accidents, and improving communities' health. Thus, the following hypotheses can be developed:

H7a: GSCM has a significant positive effect on service assurance.

Other studies like Lee (2009) claimed that the GSCM environmental practices assure the employees' better ecological performance and reduce production waste. Similarly, Çankaya and Sezen (2019) stated that GSCM activities positively affect healthcare service assurance. Moreover, Ferrara (2020) pointed out that during COVID-19, GSCM will be essential in enhancing the healthcare service's assurance by reducing the healthcare company's medical waste. Thus, it can mediate the association between uncertainty, fear, and service assurance. Thus, this study develops the following hypothesis:

H7b: GSCM mediates the relationship among the uncertainty-fear of COVID-19 and service assurance.

Figure 1 shows the research framework and hypothesis development.

Methodology

The sample and the questionnaire procedures

Our empirical study focuses on primary data from Egyptian healthcare institutions and hospitals. We collected our data by surveying a random sample of 539 personnel in Egypt. Using a survey method, we developed and sent a questionnaire to survey participants, either directly or through the personal email and social networking applications such as WhatsApp and Viber. The data were obtained between May 18 and July 9, 2021. Before carrying out the survey, 8 professors, researchers, and 7 SC managers and practitioners

Fig. 1 Hypotheses development, and research framework
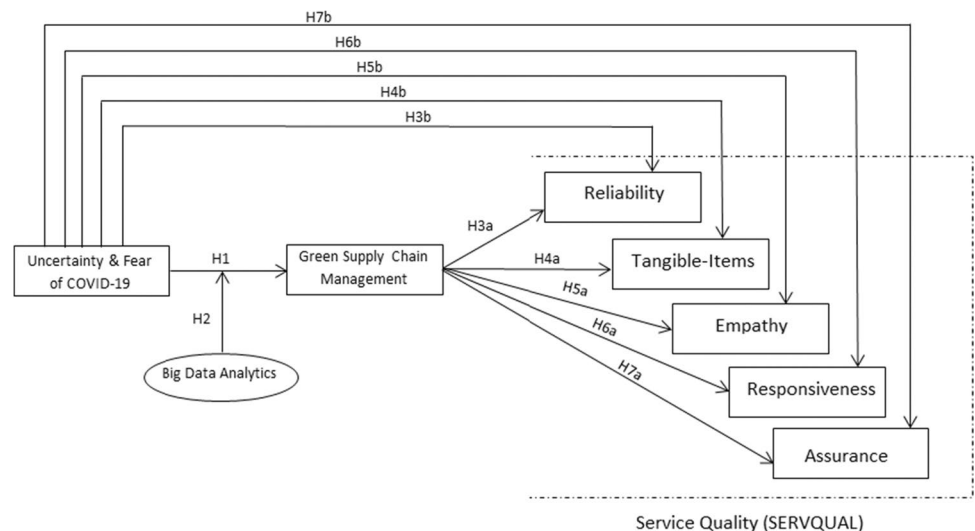
verified the questionnaire items to ensure that all scale items were understood. After we made the final adjustments, the survey was sent via email or filled out by direct contact. Respondents were clients/patients and healthcare providers (top-, middle-, and operation-level managers) familiar with supply chain management concepts.

In order to prevent the possibility of common method bias (CMB) and perceived bias across subjectively evaluated constructs for variables, the researcher collected particular information from a variety of sources (Podsakoff et al. 2012). Explicitly, (1) top- and middle-level managers supplied information about GSCM practices; (2) patients and clients gave data regarding the SERVQUAL five perceived service quality dimensions; (3) top and middle managers provide data about the BDA capabilities; and (4) finally, managers and customers provided information regarding the pandemic's uncertainty and fear.

There were 300 completed surveys returned, with a response rate of 55.66%, which we used to conduct subsequent analysis in this research. Around 52% of our sample are males, while 48% are females. Also, around 68% of our sample are in the age category from 30 to 60 years old, while 14% are less than 30 years old and 18% are more than 60 years old. We illustrate additional, comprehensive sample information in Table 1.

Measurement and variables' explanation

We adopted all measures from validated scales in previous literature. Our study has eight variables: uncertainty-fear toward COVID-19, GSCM, BDA capabilities and service reliability, tangible items, empathy, responsiveness, and assurance.

Table 1 Demographics of respondents

Variable	Items	Frequency	Percentage
Gender	Male	157	52%
	Female	143	48%
Age	Less than 30	42	14%
	30 to 40	63	21%
	41 to 50	87	29%
	51 to 60	53	18%
	More than 60	55	18%
Education	Below Bachelor's degree	22	7%
	Bachelor's degree	124	41%
	Master's degree	113	38%
	Above Master's degree	31	10%
Position	Senior manager	37	12.3%
	Middle manager	51	17%
	Low-level manager	66	22%
	Clients/patients	146	48.7%

Four statements from Jian et al. (2020) make up our independent variable, "uncertainty-fear of COVID-19." The items reflect the respondent's level of worry and discomfort with COVID-19 and their perception of the disease's setting as extremely complicated or unexpected. The Cronbach alpha result for the reliability test of the scale was 0.866.

BDA and GSCM's capacities are the middle variables. GSCM is composed of five elements derived from Longoni et al. (2018) and Chenxiao Wang et al. (2020). For example, it shows the degree to which the healthcare clients think the provider designed the service to evade or decrease the dangerous materials usage and/or production, reduce the use of toxic material consumption, develop a common understanding of responsibilities, cooperate with patients and clients for environmental objectives, and develop a common sympathetic of ecological performance obligations for clients; the business collaborates with clients to meet environmental goals. The value of Cronbach's alpha was 0.845.

Second, BDA capabilities consist of six items adapted from Dubey et al. (2019). For instance, the healthcare provider utilizes advanced tools for information investigation; we use the knowledge obtained from many data processing sources. We use data visual analytics tools to assist the healthcare service provider to comprehend detailed data derived from massive datasets. We use dashboards to view data that is useful for conducting required diagnoses. The interface applications or details have been linked to the manager's communication system. The value of Cronbach alpha value was 0.88.

The independent variable is service quality, consisting of five variables adapted from Parasuraman et al. (1988) and Al-damen (2017). First, reliability consists of 4 items; for example, the hospital delivers accurate services and procedures. The hospital pays particular attention to the issues and concerns of its patients. The patient is at ease when seeking medical treatment. The hospital submits correct data and reports/services. The hospital is timely in delivering care. The value of Cronbach alpha value was 0.805.

Second, tangible items consist of 3 items; for example, the hospital's medical equipment is up to date; the patient waiting areas are in good condition, and there is a safe atmosphere in the hospital. Cronbach's alpha was found to be 0.722, which indicates high reliability.

Third, empathy has a total of four components. For example, the hospital is available conveniently for patients; the hospital considers the community's overall values; the hospital prioritizes the patients' needs; the medical staff handles patients' complaints. The value of Cronbach alpha value was 0.866.

Fourth, responsiveness consists of 4 items; for example, the hospital staff reacts rapidly to patients' needs; patients are monitored regularly; doctors and nurses quickly respond

to patient requests; the hospital has a robust feedback system. Cronbach's alpha value is 0.801.

Fifth, assurance consists of 2 items to show the extent to which patients have confidence in the physicians' and nurses' knowledge and abilities; the hospital's patients feel safe when they use its facilities. The value of Cronbach alpha value was 0.734.

Respondents were asked to use a 5-point Likert scale, ranging from 1 = totally disagree to 5 = totally agree.

Non-response bias

The non-response bias is defined by Kock (2015) as a phenomenon that results in an incorrect evaluation of the construct variables. The researchers conducted a *T*-test to see if the mean scores of the first and final respondents vary considerably on the factors. It was found that there was no non-response bias because there were no significant disparities in this experiment.

Common-method bias

To identify and reduce the CMB, Harman's single-factor assessment is used on all items in the questionnaire (Podsakoff et al. 2012). As part of their assessment of the CMB, researchers conducted a full-collinearity test. The VIF value fell below Kock's (2015) predetermined limit of 3.3, as shown in Table 2.

Factor analysis and model assessment

Tests for reliability and validity have been carried out, as shown in Table 2. Three model evaluation and factor analysis criteria were employed to establish the scales' convergent validity. As a first criterion, the authors accounted for all of the formative indicator's contribution to its construct, defined by the outer loadings, which, according to Hair et al. (2019), were over 0.50. The second criteria, the results for all indicators' composite reliability, are over 0.7 exhibiting good internal consistency, as stated by Hair et al. (2019). The third criteria, Latent variable AVE, was evaluated and determined to be above 0.5, which is considered acceptable, as suggested by Fornell and Larcker (1981).

Cronbach's alpha was used to evaluate the reliability of each indication scale. According to the results, the indicator measuring scales showed a high degree of reliability over 0.7, as suggested by Hair et al. (2019). Also, as shown in Table 2, Rho A was also measured for the indicators.

First, the discriminant validity is evaluated by the indicator item cross-loadings in Table 3. Secondly, Fornell and Larcker's (1981) matrix is shown in Table 4. Thirdly, for conceptually distinct constructs, the Heterotrait-Monotrait ratio has to be less than 0.85, while for conceptually comparable

constructs, it has to be less than 0.90 (Hair et al. 2019), which is shown in Table 5.

Results

Hypotheses testing

A partial least squares structural equation model is used in our research to test the hypothesis (Hair et al. 2019). Tables 6 and 7 provide a summary of the findings, which are also shown in Fig. 2.

The T-statistics value for the H1 hypothesis is 2.405, beyond the threshold of 1.96, which indicates a substantial positive association; as a result, the H1 hypothesis is supported. Thus, uncertainty-fear toward COVID-19 has a significant positive effect on GSCM. This result is similar to that of Kholaif and Ming (2022a), which states that a positive impact on GSCM practices is brought about by the apprehension and fear surrounding the pandemic, which causes businesses and individuals to embrace green, eco-friendly methods in their operations and supply chain activities. The H2 hypothesis has a T-statistics value of 2.126, which indicates a statistically significant connection between the two variables. So, hypothesis H2 is accepted. Thus, BDA moderates the relationship between the uncertainty-fear of COVID-19 and GSCM. This result agrees with Wang et al. (2020) and Roozbeh Nia et al. (2021). They argued that using BDA for data analysis helps organizations gain precise data, enhance forecasting accuracy, and boost decision-making abilities throughout a pandemic, all of which benefit GSCM operations.

The T-statistics for the H3a and H3b hypotheses were 1.083 and 0.896, respectively, providing no evidence of a significant relationship. No evidence supports the hypotheses of H3a and H3b, respectively. Because of this, GSCM does not influence service reliability, and GSCM does not play a mediating role between uncertainty and fear of COVID-19 and service reliability. These results came similar to Wang et al. (2020) and Chawla et al. (2020), which show that instead of emphasizing individuals and their working circumstances, GSCM strategies typically emphasize relationships with suppliers and other stakeholders. This will lessen the impact of the GSCM on the reliability of the service being delivered. Also, due to the nature of the workplace in Egypt, GSCM's environmental initiatives have a negligible effect on staff morale and, thus, minimal bearing on the quality of services (Kholaif and Ming 2022a).

T-statistics values of 1.046 and 0.858 for the H4a and H4b hypotheses also indicated an insignificant correlation. Therefore, it is impossible to maintain both the H4a and H4b hypotheses. Thus, GSCM has no bearing on service tangible items, nor does it act as a mediator between COVID-19

Table 2 Measurement model

	Items	Loadings	Inner VIF	AVE	CR	Rho_A	Cronbach's alpha
Uncertainty-fear toward COVID-19	U-F COVID 1	0.853	1.415	0.712	0.908	0.874	0.866
	U-F COVID 2	0.83					
	U-F COVID 3	0.869					
	U-F COVID 4	0.823					
GSCM	GSCM 1	0.781	2.099	0.619	0.89	0.847	0.845
	GSCM 2	0.865					
	GSCM 3	0.77					
	GSCM 4	0.755					
	GSCM 5	0.756					
Big data analytics	BDA 1	0.765	1.757	0.624	0.909	0.885	0.88
	BDA 2	0.762					
	BDA 3	0.8					
	BDA 4	0.815					
	BDA 5	0.804					
	BDA 6	0.793					
Reliability	REL 1	0.724	1.051	0.625	0.869	0.879	0.805
	REL 2	0.803					
	REL 3	0.88					
	REL 4	0.746					
Tangible items	TI 1	0.835	1.559	0.644	0.844	0.722	0.722
	TI 2	0.828					
	TI 3	0.741					
Empathy	EMP 1	0.877	1.741	0.715	0.909	0.874	0.866
	EMP 2	0.881					
	EMP 3	0.854					
	EMP 4	0.763					
Responsiveness	RESP 1	0.761	3.066	0.622	0.868	0.812	0.801
	RESP 2	0.83					
	RESP 3	0.763					
	RESP 4	0.798					
Assurance	ASU 1	0.898	1.037	0.79	0.882	0.738	0.734
	ASU 2	0.879					

All item loadings > 0.5 indicates indicator reliability (Hair et al., 2012; Kock 2015)

VIF is less than the threshold of 3.3 (Kock, 2015)

All average variance extracted (AVE) > 0.5 as indicates convergent reliability

All composite reliability (CR) > 07 indicates internal consistency (Hair et al. 2019)

All Cronbach's alpha > 0.7 indicates indicator reliability

uncertainty-fear and service's tangible items. Our results came similar to Alzgool et al. (2021), which noted that COVID-19's detrimental influence on most firms' economic performance in emerging economies limits their capability to invest more in tangible products.

The T-statistics for the H5a and H5b hypotheses were 8.955 and 2.319, respectively, indicating a strong connection. So, there is enough evidence to back up both the H5a and the H5b hypotheses. As a result, GSCM increases service empathy significantly, and GSCM mediates the relationship between the uncertainty-fear of COVID-19 and service empathy. These results are similar to Ferrara (2020), which states that the GSCM will enhance consumer and service provider safe interaction during the outbreak, increasing the service's capacity for empathy. Similarly, the T-statistics for the H6a and H6b hypotheses were 15.306 and 2.456, demonstrating a substantial correlation between the two.

Consequently, both hypotheses H6a and H6b are accepted. Thus, GSCM has a significant positive effect on service responsiveness, and GSCM mediates the relationship between uncertainty-fear of COVID-19 and service responsiveness. These results are similar to Ferrara (2020), who pointed out that GSCM significantly improved healthcare

Table 3 Indicator items cross loading

	Uncertainty-fear toward COVID-19	GSCM	Big data analytics	Reliability	Tangible items	Empathy	Responsiveness	Assurance
U-F COVID 1	**0.853**	0.33	0.447	−0.051	0.037	0.313	0.457	0.249
U-F COVID 2	**0.83**	0.25	0.334	−0.045	−0.037	0.253	0.387	0.155
U-F COVID 3	**0.869**	0.319	0.419	−0.045	−0.016	0.269	0.43	0.224
U-F COVID 4	**0.823**	0.275	0.397	−0.082	−0.011	0.218	0.368	0.195
GSCM 1	0.256	**0.781**	0.418	0.001	0.038	0.376	0.477	0.387
GSCM 2	0.272	**0.865**	0.436	−0.084	0.022	0.409	0.55	0.418
GSCM 3	0.327	**0.77**	0.427	−0.101	0.033	0.33	0.495	0.431
GSCM 4	0.259	**0.755**	0.324	−0.097	0.067	0.452	0.659	0.463
GSCM 5	0.265	**0.756**	0.403	−0.099	0.054	0.353	0.512	0.356
BDA 1	0.348	0.408	**0.765**	−0.088	0.027	0.361	0.46	0.261
BDA 2	0.324	0.323	**0.762**	−0.093	0.053	0.336	0.368	0.183
BDA 3	0.389	0.355	**0.8**	−0.087	0.03	0.304	0.47	0.242
BDA 4	0.422	0.426	**0.815**	−0.039	0.011	0.36	0.492	0.296
BDA 5	0.354	0.398	**0.804**	−0.113	0.048	0.31	0.472	0.28
BDA 6	0.407	0.469	**0.793**	−0.09	0.039	0.406	0.567	0.35
REL 1	−0.016	−0.051	−0.063	**0.724**	0.109	−0.053	−0.033	0.049
REL 2	−0.026	−0.096	−0.076	**0.803**	0.029	−0.088	−0.076	−0.049
REL 3	−0.094	−0.093	−0.097	**0.88**	0.195	−0.108	−0.056	0
REL 4	−0.046	−0.048	−0.101	**0.746**	0.142	−0.023	−0.03	0.067
TI 1	−0.012	0.036	0.021	0.015	**0.835**	−0.018	−0.026	0.043
TI 2	0.016	0.04	0.023	0.121	**0.828**	−0.016	0.013	−0.007
TI 3	−0.017	0.056	0.059	0.229	**0.741**	−0.053	0.03	0.059
EMP 1	0.272	0.43	0.374	−0.036	−0.053	**0.877**	0.567	0.298
EMP 2	0.311	0.439	0.423	−0.108	−0.016	**0.881**	0.553	0.306
EMP 3	0.256	0.43	0.384	−0.116	−0.085	**0.854**	0.544	0.439
EMP 4	0.22	0.358	0.303	−0.063	0.042	**0.763**	0.5	0.365
RESP 1	0.439	0.457	0.487	0.023	−0.022	0.403	**0.761**	0.338
RESP 2	0.394	0.468	0.525	−0.044	0.013	0.555	**0.83**	0.461
RESP 3	0.329	0.751	0.421	−0.094	0.085	0.517	**0.763**	0.537
RESP 4	0.397	0.398	0.487	−0.079	−0.094	0.538	**0.798**	0.38
ASU 1	0.185	0.492	0.317	0.017	0.058	0.38	0.501	**0.898**
ASU 2	0.258	0.44	0.3	−0.004	0.011	0.353	0.494	**0.879**

The values in bold represent the items cross loadings for their own indicator which should be the highest values in each column

U-F COVID anxiety-uncertainty toward COVID-19, *GSCM* healthcare GSCM, *BDA* big data analytics, *REL* reliability, *ASU* assurance, *EMP* empathy, *RESP* responsiveness, *TI* tangible items

services' responsiveness to the customers' needs during the pandemic by helping to quickly and effectively answer their demands.

Finally, the T-statistics for the H7a and H7b hypotheses were 9.146 and 2.295, indicating a substantial association. Thus, the result has supported both the H7a and H7b hypotheses. Thus, when it comes to service assurance, GSCM has a substantially positive impact and acts as a bridge mediator between the uncertainty-fear of COVID-19 and assurance. Our results came similar to Çankaya and Sezen (2019), who stated that GSCM initiatives improve healthcare service assurance by lowering medical waste generated by the

healthcare organization and ensuring that clients receive more environmentally friendly services.

Moderating effect

In order to examine BDA's moderating role in the relationship between COVID-19 and GSCM, a moderating analysis was conducted. Results are shown in Table 6 and Fig. 3, which show that:

Hypothesis H2 intended to determine BDA's moderation impact on COVID-19's uncertainty-fear and GSCM. GSCM and COVID-19 uncertainty-fear correlations are positively moderated by BDA, according to the findings

Table 4 Discriminant validity (Fornell and Larcker criteria)

	Uncertainty -fear toward COVID-19	Tangible items	Big data analytics	Empathy	GSCM	Reliability	Responsive-ness	Assurance
- Uncertainty-fear toward COVID-19	0.844							
- Tangible items	−0.005	0.803						
- Big data analytics	0.476	0.043	0.79					
- Empathy	0.315	−0.036	0.442	0.845				
- GSCM	0.351	0.055	0.509	0.492	0.787			
- Reliability	−0.065	0.152	−0.107	−0.096	−0.098	0.791		
- Responsiveness	0.49	0.007	0.604	0.641	0.69	−0.066	0.788	
- Assurance	0.248	0.04	0.347	0.413	0.525	0.008	0.56	0.889

*The diagonal is the square root of the AVE of the latent variables and indicates the highest in any column or row

Table 5 Discriminant Validity (HTMT)

	Uncertainty-fear toward COVID-19	Tangible Items	Big data analytics	Empathy	GSCM	Reliability	Responsive-ness	Assurance
- Uncertainty-fear toward COVID-19	1							
- Tangible items	0.051	1						
- Big data analytics	0.538	0.055	1					
- Empathy	0.358	0.082	0.499	1				
- GSCM	0.407	0.072	0.584	0.57	1			
- Reliability	0.074	0.239	0.127	0.106	0.122	1		
- Responsiveness	0.588	0.095	0.713	0.764	0.792	0.1	1	
- Assurance	0.308	0.082	0.422	0.522	0.662	0.072	0.707	1

For conceptually similar constructs: HTMT < 0.90

For conceptually different constructs: HTMT < 0.85 (Hair et al. 2019)

Table 6 Direct relationships hypothesis testing

Hypothesis	Relationship	Std beta	Std error	|t-value|^	Decision	97.5% CI LL	97.5% CI UL
H1	Uncertainty-fear toward COVID-19—> GSCM	0.126	0.053	2.405**	Supported	0.019	0.223
H2	Uncertainty-fear toward COVID-19 × big-data analytics—> GSCM	−0.099	0.041	2.126**	Supported	−0.181	−0.016
H3a	GSCM—> reliability	−0.089	0.079	1.083**	Not supported	−0.215	0.102
H4a	GSCM—> tangible items	0.061	0.062	1.046**	Not supported	−0.061	0.191
H5a	GSCM—> empathy	0.437	0.049	8.955**	Supported	0.346	0.533
H6a	GSCM—> responsiveness	0.591	0.039	15.306**	Supported	0.507	0.66
H7a	GSCM—> assurance	0.501	0.055	9.146**	Supported	0.39	0.6

**p < 0.01; *p < 0.05

($B = −0.099$, $t = 2.126$, $p = 0.034$). However, this study's findings reveal (see Fig. 3) that the uncertainty-fear of COVID-19 had less of an influence at greater BDA than at lower BDA, where it had a more significant impact on healthcare GSCM.

Mediation analysis

After completing a mediation analysis, we determined whether or not the GSCM was able to mediate the association between COVID-19 uncertainty-fear and service quality

Table 7 Mediation relationships hypothesis testing

Total effect		Direct effect		Indirect effects					Decision
ß	P-value	ß	P-value	Hypothesis	ß	SD	T-value	p-value	
−0.047	0.568	−0.035	0.678	H3b: Uncertainty-fear toward COVID-19—>GSCM—>reliability	−0.012	0.012	0.896	0.371	Not supported
−0.021	0.717	−0.029	0.62	H4b: Uncertainty-fear toward COVID-19—>GSCM—>tangible items	0.008	0.01	0.858	0.391	Not supported
0.216	0	0.161	0.004	H5b: Uncertainty-fear toward COVID-19—>GSCM—>empathy	0.055	0.024	2.319	0.021	Supported
0.36	0	0.285	0	H6b: Uncertainty-fear toward COVID-19—>GSCM—>responsiveness	0.074	0.031	2.456	0.014	Supported
0.136	0.037	0.073	0.246	H7b: Uncertainty-fear toward COVID-19—>GSCM—>assurance	0.063	0.028	2.295	0.022	Supported

$^{**}p<0.01$; $^*p<0.05$

(using the SERVQUAL model). The findings are as follows (see Table 7).

First, regarding H3b, we find that the aggregate impact of uncertainty-fear regarding COVID-19 on reliability is insignificant ($B = -0.047$, $t = 0.571$, $p = 0.568$). Incorporating a mediating variable (GSCM), the effect of uncertainty-fear toward COVID-19 on reliability remains insignificant ($B = -0.035$, $t = 0.416$, $p = 0.678$). Also, we discovered that the indirect impact of uncertainty-fear of COVID-19 on reliability via GSCM is negligible ($B = -0.012$, $t = 0.896$, $p = 0.371$), showing that GSCM does not mediate the correlation among uncertainty-fear of COVID-19 and reliability.

Second, concerning hypothesis H4b, the total effect of uncertainty-fear toward COVID-19 on tangible items is negligible ($B = -0.021$, $t = 0.363$, $p = 0.717$). Incorporating GSCM as a mediating variable, the impact of uncertainty-fear toward COVID-19 on tangible items still insignificant ($B = -0.029$, $t = 0.496$, $p = 0.62$). Also, we discovered that the indirect impact of uncertainty-fear of COVID-19 on tangible items via GSCM is insignificant ($B = 0.008$, $t = 0.858$, $p = 0.391$), demonstrating that GSCM does not mediate the connection between COVID-19 uncertainty-fear and tangible items.

Third, for hypothesis H5b, uncertainty-fear about COVID-19 had a significant total effect on empathy ($B = 0.216$, $t = 3.789$, $p < 0.001$). The effect of uncertainty-fear about COVID-19 on empathy is still substantial after including the mediating variable (GSCM) ($B = 0.161$, $t = 2.87$, $p = 0.004$). Likewise, we observed that the uncertainty-fear of COVID-19 had a substantial indirect influence on empathy via GSCM ($B = 0.055$, $t = 2.319$, $p = 0.021$), showing that GSCM mediates the correlation among uncertainty-fear toward COVID-19 and empathy.

Forth, for hypothesis H6b, uncertainty and apprehension about COVID-19 had a substantial aggregate effect on responsiveness ($B = 0.36$, $t = 6.481$, $p < 0.001$). The significance of the association holds even after accounting for the mediating effect of GSCM ($B = 0.285$, $t = 5.93$, $p < 0.001$). The findings demonstrate that uncertainty-fear related to COVID-19 has a strong mediating effect on responsiveness via GSCM ($B = 0.074$, $t = 2.456$, $p = 0.014$), showing that GSCM mediates the association among uncertainty-fear toward COVID-19 and responsiveness.

Fifth, for hypothesis H7b, the full effect of uncertainty-fear regarding COVID-19 on assurance was substantial ($B = 0.136$, $t = 2.086$, $p = 0.037$). However, with the presence of GSCM as a mediating variable, the relation turns insignificant ($B = 0.073$, $t = 1.163$, $p = 0.246$). The findings revealed that the indirect effect of uncertainty-fear toward COVID-19 on service assurance through GSCM is significant ($B = 0.063$, $t = 2.295$, $p = 0.022$), indicating a mediation effect of GSCM on the correlation among uncertainty-fear toward COVID-19 and assurance.

Fig. 2 Hypothesis testing; bootstrapping; direct and indirect effect results
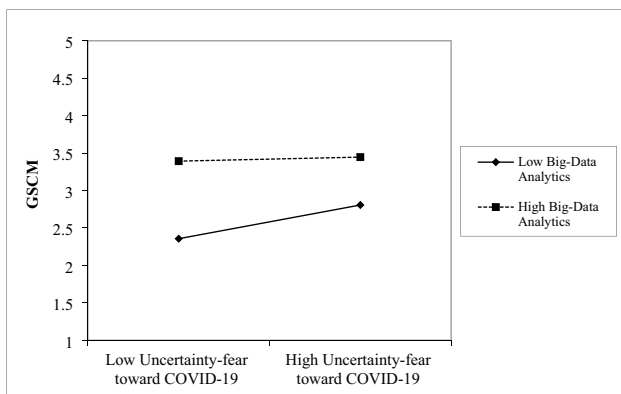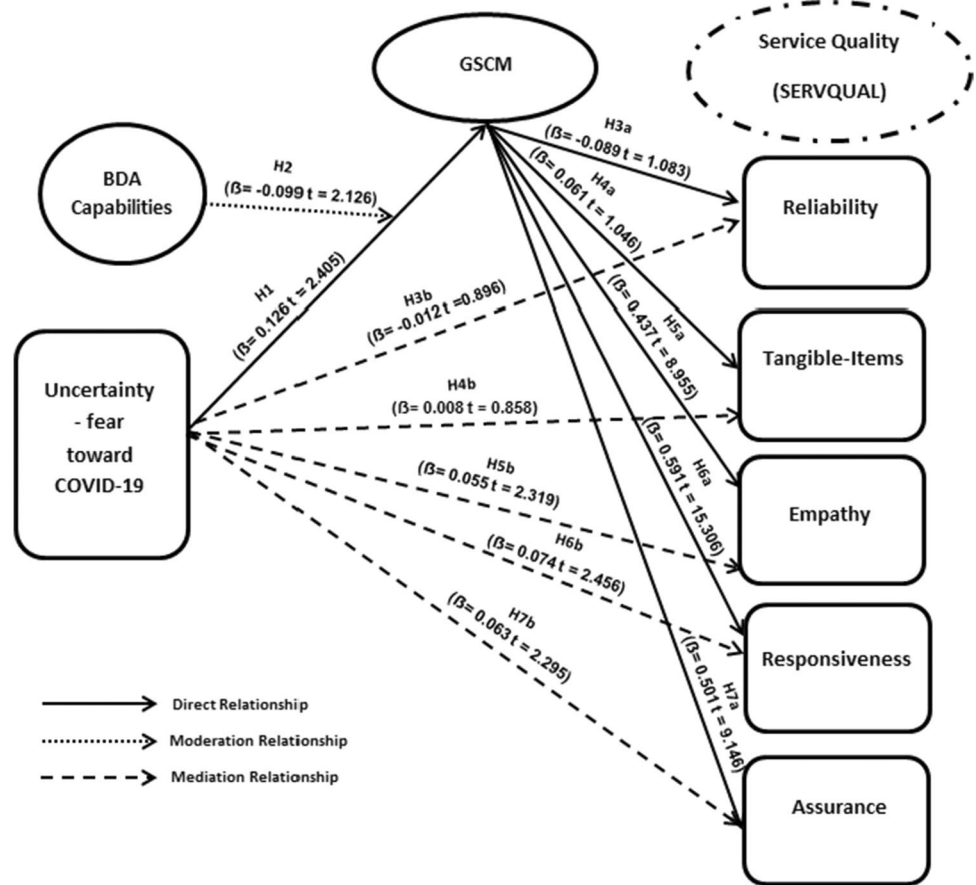
Fig. 3 BDA's moderating effect on the correlation between uncertainty-fear toward COVID-19 and GSCM

Discussion

Our research aims to examine the relationship between uncertainty-fear of COVID-19, GSCM, and service quality according to the SERVQUAL model (reliability, empathy, assurance, responsiveness, and tangible items). Also, it tests the moderating effect of BDA capabilities on the

correlation among uncertainty-fear toward COVID-19 and the GSCM, with the application in the healthcare sector. Built on a sample of 300 healthcare providers' managers and customers, we found that uncertainty-fear of the pandemic positively affects GSCM. This result is similar to that of Kholaif and Ming (2022a), which state that the fear-uncertainty of the epidemic leads to a change in the companies and individual behavior toward adopting green eco-friendly practices in their operations and in supply chain activities, which leads to a positive effect on the GSCM practices. This finding also aligns with Ahorsu et al. (2020) and Jian et al. (2020), indicating that persons who dread natural catastrophes tend to enhance their general health and strengthen their altruistic behavioral attitudes toward more eco-friendly and eco-friendly green behaviors. Additionally, our research demonstrates that BDA moderates the relationship among uncertainty-fear of COVID-19 and GSCM. This conclusion agrees with Wang et al. (2020), who pointed out that analyzing information from BDA capabilities helps firms obtain detailed data, increase prediction precision, and improve decision-making skills during the pandemic.

Moreover, our results reveal that GSCM positively impacts the perceived services' quality (empathy,

responsiveness, and assurance). These results are similar to the findings of Wieseke et al. (2012) and Kros et al. (2019) who pointed out that GSCM can increase customer empathy, which is defined as the service provider's awareness of and readiness to connect constructively with the clients' economic, ecological, social, and environmental needs, desires, and the overall well-being. Also, studies like Reichhart and Holweg (2007) and Laosirihongthong et al. (2013) mentioned that the GSCM practices positively affect responsiveness, improving the company's image and enhancing customer loyalty and satisfaction. In the same vein, regarding the service's assurance, Jraisat (2013) and Kim et al. (2016) pointed out that GSCM practices will affect positively on the services' assurance by covering all efforts to cut the contrary impacts of the healthcare company's goods and services on the environment, thus ensuring that the healthcare personnel understand how to achieve quality services based on environmental and social criteria.

Furthermore, our findings indicate that GSCM has no substantial impact on reliability and tangible items dimensions. This result came in the same vein as other studies. For instance, in private Thai hospitals, Yousapronpaiboon et al. (2013) investigated the perceptions of outpatient service quality; their results found that the most strongly correlated dimension with overall patient care quality was assurance, followed by empathy, and responsiveness, while both the tangible items and reliability came last. Also, in a public university hospital in Ghana, Essiam (2013) researched quality and patient satisfaction dimensions. The results showed that the perceived responsiveness accounted for the most patient satisfaction, followed by perceived empathy and safety, while the perceived tangibility of products and perceived reliability came at the end.

Moreover, GSCM plays a substantial mediation function in the relationship between the uncertainty-fear of COVID-19 and the service quality dimensions (empathy, responsiveness, and assurance). These results are similar to Ferrara (2020) and supported by the ILO (2020), which states that during the pandemic, the GSCM environmental initiatives will improve customer and service provider communication which leads to developing attitudes toward rendering personalized courtesy to the clients, thus increasing the service's empathy. Also, Ferrara (2020) pointed out that throughout the pandemic, GSCM played a critical role in improving healthcare service responsiveness to the clients by assisting in meeting customers' demands swiftly and on a timely basis while keeping health and safety in mind. In the same vein, regarding service assurance, our results came similar to Çankaya and Sezen (2019), who stated that GSCM activities positively affect healthcare service assurance. Also, Ferrara (2020) pointed out that during COVID-19, GSCM will be important to improve the healthcare service's assurance by

reducing the healthcare company's medical waste and ensuring more eco-friendly services to the clients.

Our results also show that GSCM has a negligible mediation impact on the correlation between uncertainty-fear of COVID-19 and reliability. The reason may be that the reliability is related mainly to the healthcare sector employees (Nimanpure and Sohani 2013; Kros et al. 2019). These results came similar to Chawla et al. (2020) and Wang et al. (2020), who show that GSCM environmental practices through COVID-19 usually focus more on the external stakeholders and the relations with suppliers rather than the employees and their work conditions. This will limit the effect of the GSCM on the provided service reliability. Also, these results are supported by Kholaif and Ming (2022a) as the Egyptian work environment leads GSCM ecological actions to have little influence on employees and thus a limited impact on service reliability. The essence of the Egyptian labor market is labor-intensive, with the majority of occupations being informal and irregular (Assaad and Kraff 2013). In the same vein, these results return to the same reasons mentioned by Kholaif et al. (2022a) of the unawareness of the Egyptian employees of the operational standards code of ethics. Thus, there is a gap between GSCM operations during the COVID-19 epidemic and their impacts on the service quality model's reliability dimension, leaving the employees unable to meet the customer's health and ecological needs. This result is similar to that of Séhier (2019), which states that labor-intensive industries did not follow the work conditions' code of ethics for the firm's operations in underdeveloped countries.

Moreover, our results show that GSCM has a small role in mediating the correlation between uncertainty-fear toward COVID-19 and the tangible-item dimension. Our results came similar to Alzgool et al. (2021). They stated that the pandemic's negative impact on most businesses' economic performance in developing economies limits their ability to invest in more tangible items. Also, Kholaif et al. (2022a) stated that the government's lockdown and sanction rules have also thrown several developing countries' economies, including Egypt and enterprises, into disarray, leaving the healthcare business firms unable to invest in tangible facilities. Moreover, our results aligned with Grida et al. (2020). They stated that the preventive measures taken by countries to limit the spread of the virus and control the situation disrupt the global SCs and negatively impact the financial condition of service providers, which negatively affects the firm's ability to invest in tangible assets during the pandemic. Besides, some argue that green operations have an extra cost. For instance, the green purchasing process increases costs, affecting firms' financial performance (Nollet and Beaulieu 2003; Song and Yu 2017). Also, environmental GSCM practices have no significant impact on short-term sales and profitability (Çankaya and Sezen 2019).

Contributions and implications

Theoretical contributions

This study has several theoretical contributions. This research is academically significant since it contributes to the previous studies as it focuses on the GSCM and the perceived service quality during the pandemic. The previous research is limited as it only focused on firm-level green performance rather than the effect of the pandemic on service quality perceived by the consumer. Also, it only revealed COVID-19's distortions on SCs. Thus, our study extended the previous work of Çankaya and Sezen (2019), Jian et al. (2020), and Lin et al. (2021). It also bridges the gaps emphasized by Nasrollahi (2018), Hao et al. (2020), and Noar and Austin (2020) by studying the mediation effect of GSCM between uncertainty-fear and the perceived service quality and associating the various dimensions by exploring the moderate effect of BDA capabilities and gives empirical proof from Egypt's healthcare institutions and hospitals on the effect of the COVID-19 on GSCM, and perceived service quality.

Moreover, this research adds to the current theories as follows. Firstly, this research contributes to social-cognitive theory by shedding new light on the relationship among uncertainty-fear and COVID-19 and GSCM. Unlike prior studies demonstrating the negative impact of the pandemic on SCs, this study demonstrates the opposite (Grida et al. 2020). Our study demonstrates how uncertainty and worry regarding the pandemic prompt a re-evaluation of the environmental measures in healthcare SCs to capture the current situation's opportunities to enhance the healthcare perceived service quality. Secondly, we add to the "stakeholder theory" to show how COVID-19 may drive stakeholders to exert pressure in favor of green practices to protect both the clients and the healthcare service providers during the COVID-19 pandemic (Kholaif and Ming 2022a). Thirdly, our research contributes to the GSCM "resource-based view" idea. It contributes to our understanding of the relationship between BDA capabilities and GSCM environmental activities by exhibiting the moderating impact of BDA on the correlation between uncertainty-fear regarding COVID-19 and GSCM. Based on Wang et al. (2020), the resource-based views' notion provides a new understanding of efficiently using BDA to meet GSCM environmental requirements. Finally, we add to the "theory of needs" (Solomon et al. 1985) by presenting the impact of healthcare GSCM on the perceived services' quality, using the five SERVQUAL model dimensions.

Furthermore, our research adds to the GSCM literature by empirically analyzing the association between GSCM and the service quality (SERVQUAL) model during the pandemic situation in the Egyptian context. This research is considered one of the few studies that considered this relationship in the Egyptian and developing countries' context during COVID-19. So, it is crucial to test the effects of GSCM on customers' perception of the healthcare services' quality provided in Egypt during the pandemic.

Practical implications

Although our application was to the healthcare sector, our practical implications can be extended to all the service sectors. First, Govindan et al.'s (2020) argument supports that service providers, including healthcare providers, must understand the SCs' green practices. Service firms are responsible for environmental, ecological, and community performance inside their own company and throughout the whole supply chain. GSCM can assist healthcare firms in addressing their clients' global environmental concerns during COVID-19. As a result, they will meet their needs while enhancing their service quality and business success (Govindan et al., 2020). Comparable to Al-Sheyadi et al.'s (2019) arguments, through GSCM practices, service providers, including healthcare, will answer questions about ensuring their customers' safety and satisfaction. How are the service delivery procedure and the service itself eco-friendly? How is the waste disposal method safe and environmentally friendly? Moreover, According to Özkan et al. (2014) and Ferrara (2020), answering all of these concerns is crucial during this epidemic and will guarantee the safety of all stakeholders, both internal and external. So, service providers must have the proper perspective on GSCM and implement its environmental practices.

Second, service providers, including healthcare, should effectively utilize BDA capabilities. According to Wang et al. (2020), BDA positively impacts communal and ecological performance toward the customers and is beneficial for applying the GSCM in the healthcare industry. Supported by Dubey et al. (2019), service providers should foster BDA utilization as beneficial for both external and internal stakeholders. Using BDA capabilities in a consistent manner is something that management teams should work on to gain information that helps solve stakeholders' issues, especially during the pandemic. Managers should focus on environmental practices and openly disclose their steps to ensure the safety of their staff and customers throughout the COVID-19 outbreak.

Conclusion, limitations, and future research opportunities

Conclusion

The results of this study suggest that COVID-19-related doubt and dread have a beneficial effect on healthcare-GSCM by prompting people to adjust their practices and beliefs in response. Also, there is a correlation between uncertainty and fear of COVID-19 and GSCM, and BDA moderates this correlation. Likewise, GSCM positively affects the perceived services' quality (empathy, responsiveness, and assurance). However, it has an insignificant effect on reliability and tangible items' dimensions. Moreover, an important mediation effect of GSCM exists between the uncertainty-fear of COVID-19 and the service quality parameters (empathy, responsiveness, and assurance). However, GSCM has a negligible mediating effect on the link between COVID-19-related uncertainty-fear and reliability. The reason may be that the reliability is related mainly to the healthcare sector employees. The essence of the Egyptian labor market is labor-intensive, with the majority of occupations being informal and irregular where the Egyptian employees are unaware of the operational benchmarks for moral conduct, creating a gap among GSCM operations through the epidemic and their impacts on the service quality model's reliability dimension, leaving the employees unable to meet the customer's health and ecological needs. Furthermore, the role of GSCM as a mediator between uncertainty-fear about COVID-19 and the tangible-item dimension is minimal, since most firms in developing economies have seen a decline in economic performance as a result of the epidemic, limiting their ability to invest in more tangible materials and items.

Limitations and future research opportunities

Even though the direct result of the epidemic seems to be evident, there are worries regarding the long-term effects on healthcare GSCM and the services. What are the long-term healthcare GSCM prospects and issues in the aftermath of such an epidemic? Will a short-term alteration in practices lead to a long-term alteration in ethical conduct, and if so, how? What effect will the pandemic have on the environmental practices of healthcare organizations? Furthermore, our research has significant limitations that could lead to new research opportunities in the future. First, our study examines the environment of Egyptian healthcare businesses. Future research throughout other, more advanced nations may thus offer information on the parallels and/or differences with other surroundings. Second, we gathered evidence at a specific point in time and lacked access to longitudinal data to investigate the causal relationships over a longer time frame. The interplay between uncertainty-fear regarding COVID-19, healthcare GSCM, BDA, and the quality of the service should therefore be better understood by a long-term study. Third, to investigate the impact of uncertainty-fear regarding COVID-19 on healthcare GSCM, this study considers BDA as a moderator. Future research may also take into account additional variables to further study these topics, including corporate social responsibility, social media use, and blockchain technology.

Author contribution Mr. Moustafa Mohamed Nazief Haggag Kotb Kholaif: conceptualization; methodology; software; data curation; writing—original draft preparation; visualization.

Professor Xiao Ming: visualization, investigation, supervision.

Data Availability Datasets are available from the corresponding author on request.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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