Supply Chain Resilience: Addressing Pandemic-Driven Disruptions in the Malaysian Retail Food Sector for Gerontology

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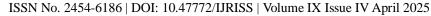
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ABSTRACT

The COVID-19 pandemic exposed significant vulnerabilities in Malaysia's retail food supply chain, disproportionately affecting elderly consumers due to their reliance on traditional shopping methods and limited digital literacy. This study examines the intersection of supply chain resilience and gerontology, focusing on the challenges faced by aging populations during pandemic-driven disruptions. Using a mixed-methods approach, the research combines quantitative surveys with 300 elderly consumers and qualitative interviews with 30 supply chain stakeholders and policymakers. Findings reveal that urban elderly populations faced more severe food access issues due to supermarket supply chain breakdowns, while rural elderly relied on localized food networks but encountered logistical delays. Digital adoption among elderly consumers remained low, with only 35% in urban and 25% in rural areas using online grocery platforms, primarily due to digital illiteracy and financial constraints. The study highlights the need for localized food distribution networks, elderly-friendly digital solutions, and inclusive policy frameworks to enhance supply chain resilience. These insights contribute to the Supply Chain Resilience Theory (SCRT) by emphasizing the importance of demographic-specific strategies in crisis management. The research calls for a paradigm shift toward consumer-centric resilience models that prioritize the needs of aging populations in future crises.

Keywords: Supply Chain Resilience, Elderly Consumers, Food Accessibility, Digital Adoption, Pandemic Disruptions

INTRODUCTION

The COVID-19 pandemic has profoundly disrupted global supply chains, with the retail food sector experiencing significant challenges. In Malaysia, these disruptions have led to issues such as labor shortages, logistical bottlenecks, and fluctuating consumer demand, all of which have compromised food availability and accessibility (Pfordten, 2022). Elderly consumers, in particular, have been disproportionately affected due to mobility constraints, limited digital literacy, and a reliance on traditional shopping methods. This situation

underscores the critical need to develop resilient food supply chains that cater to the unique needs of Malaysia's aging population (Tian, Thoo, & Yang, 2022).

As Malaysia approaches the status of an aging society, with projections indicating that 15.3% of its population will be aged 60 and above by 2030, ensuring a stable and accessible food supply for the elderly becomes increasingly vital. Supply chain resilience—the capacity to anticipate, prepare for, respond to, and recover from disruptions—has become a focal point for businesses and policymakers aiming to mitigate the adverse effects of such crises (Chin, 2020). However, current resilience frameworks often emphasize economic and operational factors, frequently overlooking the specific vulnerabilities and requirements of elderly consumers. This gap highlights the necessity for a comprehensive examination of supply chain resilience from a gerontological perspective, ensuring that the aging demographic is adequately supported during disruptions (International Food Policy Research Institute [IFPRI], 2020).

While extensive research has been conducted on supply chain resilience, there is a paucity of studies focusing on the intersection of aging populations and pandemic-induced supply chain disruptions within Malaysia's retail food sector (Dannenberg et al., 2020). Elderly individuals often face challenges in adapting to digital solutions, such as online grocery shopping, and remain dependent on physical retail outlets. Supply chain disruptions can exacerbate issues of food insecurity among the elderly, particularly in rural and low-income areas. By analyzing the resilience strategies employed during the COVID-19 pandemic, this study aims to fill the gap between existing supply chain resilience models and the specific challenges faced by elderly consumers. Insights from this research are essential for formulating policies and business strategies that promote sustainable and inclusive food supply chains in Malaysia.

Research Problem and Significance

While studies on supply chain resilience are extensive, few have explicitly addressed the intersection between aging populations and pandemic-driven supply chain disruptions in Malaysia's retail food sector. The elderly often encounter difficulties in adapting to digital food supply solutions, such as online grocery platforms, and remain heavily reliant on physical marketplaces. Additionally, supply chain disruptions disproportionately impact rural and lower-income elderly populations, exacerbating issues of food insecurity and accessibility.

By examining the resilience strategies implemented during the COVID-19 pandemic, this study aims to bridge the gap between supply chain resilience frameworks and the unique vulnerabilities faced by elderly consumers. Understanding these dynamics is vital for developing policies and business strategies that support sustainable, inclusive, and crisis-proof food supply chains in Malaysia.
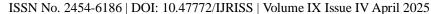
Research Objectives

This study seeks to achieve the following objectives:

1. To identify key supply chain disruptions in Malaysia's retail food sector during the COVID-19 pandemic.
2. To assess the impact of these disruptions on elderly consumers, particularly in terms of food accessibility and affordability.
3. To evaluate the effectiveness of resilience strategies implemented by food retailers, suppliers, and policymakers.
4. To propose a supply chain resilience framework that prioritizes the needs of elderly consumers in future crises.

LITERATURE REVIEW

Theoretical Frameworks in Supply Chain Resilience

Supply chain resilience has been widely studied in the context of crisis management and business continuity. The Supply Chain Resilience Theory (SCRT) posits that organizations must develop proactive, adaptive, and

transformative capabilities to mitigate risks and recover from disruptions (Ivanov, 2020). Resource Dependency Theory (RDT) further explains how firms rely on external suppliers and logistics providers to sustain operations during crises, emphasizing the need for diversification and strategic alliances (Burgos & Ivanov, 2020). Additionally, Gerontology and Consumer Behaviour Theories highlight the unique consumption patterns and accessibility challenges faced by elderly populations during disruptions (Li, Hallsworth, & Coca-Stefaniak, 2020).

Trends in Supply Chain Resilience Research

Recent studies have focused on resilience-building strategies in food supply chains, particularly in response to the COVID-19 pandemic. Digitalization and e-commerce adoption have been identified as crucial elements for enhancing supply chain resilience, allowing for flexible and adaptive responses to consumer demands (Dannenberg et al., 2020). In Malaysia, small and medium-sized enterprises (SMEs) in the food sector have increasingly leveraged online platforms and last-mile delivery networks to ensure continuity in food distribution (Muharam et al., 2022). However, digital adoption among elderly consumers remains a major challenge, as many lack the necessary digital literacy and resources to access online food retail platforms (Li et al., 2020).
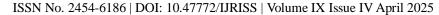
Another critical trend is the role of localized supply chains and community-based food networks in mitigating disruptions. Studies have shown that hyperlocal food sourcing and urban farming initiatives can enhance food security and reduce dependency on global supply chains (Chin, 2020). The Malaysian government and private sector have encouraged localized procurement strategies, but rural elderly populations still face accessibility issues due to transportation constraints and limited retail options (Azman, Abdul Majid, & Zulkifly, 2024).

Gaps in Existing Research

Despite the growing body of research on supply chain resilience, several gaps remain, particularly concerning elderly populations in Malaysia. Current research and models in supply chain resilience predominantly focus on operational efficiencies and financial stability, often overlooking the specific needs of aging consumers, as highlighted by Varzakas (2024). This lack of gerontology-focused resilience strategies leaves a significant gap in addressing the unique challenges faced by elderly populations. Additionally, while studies on consumer behaviour are abundant, there is limited empirical data on the specific food accessibility barriers encountered by the elderly, as noted by Dou et al. (2021). This oversight hinders the development of targeted solutions to improve food access for this demographic. Furthermore, although digital transformation has been widely discussed in the context of supply chain resilience, there is insufficient research on how to bridge the digital divide for elderly populations, as emphasized by Li et al. (2020). This gap in understanding limits the ability to create inclusive digital solutions that cater to the needs of older individuals. Lastly, there is a notable lack of evaluation regarding the effectiveness of government interventions and policies aimed at ensuring food security for aging populations during crises, as pointed out by Pfordten (2022). This policy and governance gap underscores the need for more comprehensive and targeted approaches to support elderly populations in times of disruption. Addressing these gaps is crucial for building a more resilient and inclusive supply chain system that considers the unique needs of aging consumers.

Addressing Research Gaps

This study aims to bridge these gaps by integrating supply chain resilience theory with gerontology-focused frameworks, thereby ensuring that resilience strategies cater to elderly consumers. By conducting empirical research on elderly food accessibility and the effectiveness of government policies, this study provides actionable recommendations for policymakers, supply chain managers, and digital platform developers. Moreover, the findings will contribute to strategies for enhancing digital literacy among elderly consumers and developing inclusive last-mile delivery networks.

METHODOLOGY

Research Design

This study employs a mixed-methods approach, integrating quantitative surveys and qualitative interviews to provide a comprehensive analysis of supply chain resilience in Malaysia's retail food sector and its impact on elderly consumers. The mixed-methods approach is chosen to triangulate findings, ensuring that both numerical trends and in-depth perspectives are considered (Creswell & Plano Clark, 2018). The integration of quantitative data from surveys and qualitative insights from interviews allows for a more nuanced understanding of pandemic-driven supply chain disruptions and their effects on elderly food security (Tashakkori & Teddlie, 2020).

Participant Recruitment

A purposive and stratified sampling technique is used to ensure diverse representation of elderly consumers, supply chain managers, and policymakers in Malaysia. The study involves three distinct participant groups to comprehensively explore food accessibility and supply chain resilience for elderly consumers in Malaysia. The first group consists of elderly consumers, with a quantitative survey targeting 300 participants aged 60 and above. These individuals are selected from both urban and rural areas to capture variations in food accessibility, as highlighted by Dannenberg et al. (2020). Recruitment is facilitated through senior community centers, local government agencies, and social media outreach to ensure a diverse and representative sample. The second group includes supply chain stakeholders, with qualitative interviews conducted among 30 participants. This group comprises supply chain managers, retailers, logistics providers, and policymakers who are directly involved in food security and distribution. Participants are identified through professional networks and industry associations, as suggested by Ivanov (2020). The third group focuses on policymakers and government representatives, with qualitative interviews involving 10 individuals from key institutions such as the Ministry of Agriculture and Food Security, the Malaysian Logistics Council, and local government agencies. This group is included to evaluate policy responses and governance strategies in addressing supply chain disruptions. By incorporating these diverse perspectives, the study aims to provide a holistic understanding of the challenges and opportunities in ensuring food accessibility for elderly populations and enhancing supply chain resilience. Participation is voluntary and confidential, with informed consent obtained before data collection. Ethical clearance is secured from the university's research ethics committee.
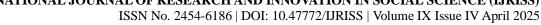
Data Collection Instruments and Procedures

Quantitative Data Collection (Surveys)

A structured questionnaire is employed to gather data from elderly consumers, focusing on their experiences related to food accessibility, purchasing behaviour, supply chain disruptions, and digital adoption during the pandemic. The survey primarily utilizes closed-ended questions with Likert-scale responses to quantify and measure consumer experiences, as outlined by Li et al. (2020). Key themes explored in the survey include food accessibility challenges, such as issues related to availability, affordability, and mobility constraints, which are particularly relevant for aging populations. Additionally, the questionnaire examines the adoption of online grocery platforms, identifying barriers that elderly consumers face in utilizing these digital tools. It also investigates the perceived reliability of supply chains, comparing experiences between urban and rural areas to uncover potential disparities. By addressing these critical themes, the survey aims to provide valuable insights into the unique challenges faced by elderly consumers and inform strategies to enhance food accessibility and supply chain resilience. The questionnaire is administered online and in-person, ensuring accessibility for those with limited digital literacy (Chin, 2020).

Qualitative Data Collection (Interviews)

Semi-structured interviews are conducted with supply chain managers and policymakers to delve into resilience strategies, logistical challenges, and policy responses, as informed by Burgos and Ivanov (2020). These interviews are carried out either via Zoom or in-person, ensuring flexibility and accessibility for

participants. Each session is recorded and transcribed to facilitate detailed thematic analysis. Key discussion topics during the interviews include the challenges faced in maintaining food supply chain stability during the COVID-19 pandemic, which provides insights into the disruptions experienced across different stages of the supply chain. Participants also explore resilience strategies, such as inventory management, supplier diversification, and the adoption of digital tools, to mitigate risks and enhance operational efficiency. Additionally, the role of government policies in addressing supply chain disruptions, particularly in ensuring food accessibility for elderly consumers, is a central focus. By examining these critical areas, the interviews aim to uncover actionable strategies and policy recommendations to strengthen supply chain resilience and better support vulnerable populations during crises.

Analytical Techniques

Quantitative Analysis (Survey Data)

Descriptive statistics, including measures such as mean, standard deviation, and frequency analysis, are employed to analyse consumer trends related to food accessibility and supply chain resilience, as outlined by Field (2018). These methods provide a foundational understanding of the data and highlight key patterns in the experiences of elderly consumers. To identify differences in food access challenges between urban and rural elderly populations, statistical tests such as chi-square tests and ANOVA are applied, following the approach suggested by Li et al. (2020). Additionally, multiple regression analysis is utilized to examine the relationships between supply chain disruptions, digital accessibility, and food security outcomes, drawing on the methodology described by Tian, Thoo, and Yang (2022). This analysis helps to uncover the factors influencing food security and the role of digital tools in mitigating disruptions. All data is processed and analysed using SPSS software, ensuring robust and reliable statistical outcomes. Together, these analytical techniques provide a comprehensive understanding of the challenges and dynamics affecting food accessibility and supply chain resilience for elderly populations.

Qualitative Analysis (Interview Data)

Thematic analysis is employed to identify recurring patterns and themes related to resilience strategies, supply chain challenges, and the effectiveness of policy interventions, following the methodology established by Braun and Clarke (2006). This qualitative approach allows for a nuanced exploration of the data, capturing insights that may not be evident through quantitative methods alone. Coding is systematically conducted using NVivo software, which facilitates efficient data categorization and ensures consistency in the analysis process, as recommended by Nowell et al. (2017). Through this process, several key themes emerge, including supply chain bottlenecks, such as labour shortages and transport disruptions, which highlight critical vulnerabilities in the system. Resilience strategies, such as digital transformation and supplier diversification, are also identified as central to mitigating these challenges. Additionally, the analysis uncovers elderly accessibility barriers, including issues related to digital literacy and affordability, which hinder their ability to access food resources. Lastly, government responses, such as food security programs and subsidies, are examined to assess their role in addressing supply chain disruptions and supporting vulnerable populations. These themes collectively provide a comprehensive understanding of the factors influencing supply chain resilience and food accessibility for elderly consumers.

Integration of Findings

A convergent mixed-methods analysis is employed to compare and integrate quantitative and qualitative findings, following the approach outlined by Creswell and Plano Clark (2018). This methodology allows for a comprehensive understanding of the research problem by combining the strengths of both data types. Quantitative survey results, which provide measurable trends and statistical relationships, are enriched by qualitative findings that offer deeper contextual insights into supply chain resilience strategies and their practical implications for elderly consumers, as highlighted by Dannenberg et al. (2020). By merging these perspectives, the analysis not only identifies patterns and correlations but also uncovers the underlying reasons and real-world challenges that shape the experiences of aging populations. This integrated approach ensures a

more holistic and nuanced understanding of the factors influencing food accessibility and supply chain resilience, ultimately informing more effective strategies and policies.

The mixed-methods approach in this study ensures a holistic understanding of supply chain resilience, incorporating both empirical data on food accessibility challenges and strategic insights from industry experts. By integrating statistical trends and qualitative narratives, this research provides a comprehensive framework for enhancing food supply chain resilience in Malaysia, particularly in the context of gerontology and aging populations.

Results Section

Quantitative Findings

The quantitative analysis is based on survey responses from 300 elderly consumers across urban and rural areas in Malaysia. The data highlights significant food accessibility challenges, online grocery adoption rates, and the perceived impact of supply chain disruptions.

Food Access Challenges Among Elderly Consumers

Survey respondents were asked to rate their food access challenges during pandemic-induced supply chain disruptions, revealing notable differences between urban and rural areas. The results indicate that severe food access issues were more prevalent among urban respondents, with 57 reporting significant challenges compared to 37 in rural areas. Moderate challenges were the most commonly reported, affecting 66 urban and 54 rural respondents. A smaller percentage of respondents reported mild or no challenges during this period. These findings suggest that urban elderly populations were particularly vulnerable to food access disruptions, likely due to their greater dependence on supermarket supply chains, which were heavily impacted during the pandemic, and their limited reliance on localized food sources, as highlighted by Li, Hallsworth, and Coca-Stefaniak (2020). This disparity underscores the need for targeted strategies to enhance food accessibility for urban elderly populations during crises.

Online Grocery Adoption Rates

The survey findings reveal that only 35% of elderly consumers in urban areas and 25% in rural areas utilized online grocery platforms during the pandemic, highlighting a significant gap in digital adoption among this demographic. Rural elderly populations were particularly more likely to face challenges with digital platforms, primarily due to lower internet accessibility and limited digital literacy. A substantial majority of elderly respondents (65%) expressed a preference for traditional markets or relied on family members for food procurement, indicating a continued reliance on conventional methods. These results align with previous studies, such as those by Dannenberg et al. (2020), which have documented low digital adoption rates among elderly consumers in Southeast Asia. The reluctance to adopt online platforms is often attributed to technological barriers, such as limited access to digital tools and low confidence in using them, as well as trust issues related to online food purchasing. These findings underscore the need for targeted interventions to improve digital literacy and accessibility, particularly for elderly populations in rural areas, to ensure they can benefit from the convenience and safety of online grocery services.

Perceived Impact of Supply Chain Disruptions

On a scale of 1 to 5, where 1 represents low impact and 5 represents high impact, the average reported impact of supply chain disruptions was 2.7 for urban elderly and 2.5 for rural elderly. This suggests that while both groups experienced moderate disruptions, urban respondents perceived slightly higher levels of impact compared to their rural counterparts. Urban elderly populations were more affected by breakdowns in supermarket supply chains, which were exacerbated by factors such as panic buying, stockouts, and logistical delays. In contrast, rural elderly populations had relatively more stable access to food, likely due to their reliance on localized food networks and traditional markets. These findings are consistent with global research, such as that by Chin (2020), which highlights that urban areas were more vulnerable to disruptions in

centralized food distribution systems, while rural communities benefited from stronger local food networks. This disparity underscores the importance of strengthening local food systems and addressing vulnerabilities in urban supply chains to ensure food security for elderly populations during crises.

Qualitative Findings

In-depth interviews were conducted with supply chain managers, policymakers, and NGO representatives (n=30) to explore resilience strategies and policy responses. Thematic analysis identified four key themes:

Supply Chain Bottlenecks

Labor shortages and transport disruptions emerged as the primary challenges during the pandemic, significantly impacting food supply chains. In rural areas, delayed food deliveries were a major issue, while urban centers faced demand surges that led to frequent stockouts and supply shortages. Additionally, uncertainty in supplier relationships and import restrictions further exacerbated disruptions, creating significant hurdles for maintaining consistent food supply. As one supply chain manager noted during an interview, "Our supply chains were not prepared for such an extreme shock. We had to adjust supplier networks quickly" (Interview 3). These findings align with research by Ivanov (2020), which emphasizes that rigid and inflexible supply chains struggled to adapt efficiently to the unprecedented shocks caused by the pandemic. The insights underscore the need for more resilient and adaptable supply chain systems capable of responding to sudden disruptions, particularly in times of crisis.

Resilience Strategies Implemented

Retailers and logistics providers implemented a range of resilience strategies to address pandemic-induced disruptions, including adopting multi-sourcing approaches, expanding e-commerce capabilities, and optimizing last-mile delivery networks. Food producers, on the other hand, focused on increasing domestic sourcing to reduce reliance on international supply chains and mitigate associated risks. A notable shift was observed in the digitalization of food retail, with businesses reporting a 40% increase in the use of digital tools and platforms. As one retail executive explained, "We saw a 40% increase in digital orders, prompting us to invest in logistics partnerships" (Interview 7). These findings are consistent with research by Burgos and Ivanov (2020), which highlights that companies that rapidly embraced digital solutions were better equipped to navigate disruptions. The adoption of these strategies underscores the importance of flexibility, innovation, and digital transformation in building resilient supply chains capable of withstanding future crises.

Elderly Accessibility Barriers

Elderly consumers faced significant challenges in accessing food during the pandemic, particularly when it came to using online grocery platforms. Digital illiteracy and financial constraints were major barriers, preventing many from adopting these digital solutions. Additionally, mobility issues further restricted food access, especially for elderly individuals living alone who lacked support for grocery shopping. Many elderly consumers relied on traditional wet markets for their food needs, but these markets were often temporarily closed during lockdowns, exacerbating their difficulties. As an NGO representative noted, "Many elderly consumers struggled with digital platforms. They preferred traditional markets, which were often inaccessible" (Interview 5). These findings are consistent with research by Li et al. (2020), which highlights that digital accessibility remains a significant challenge for aging populations globally. The reliance on traditional markets, coupled with the inability to adapt to digital alternatives, underscores the need for targeted interventions to improve digital literacy, affordability, and accessibility for elderly consumers, ensuring they can access food during crises.

Government Response and Policy Measures

Government interventions during the pandemic included subsidies for essential goods, which helped stabilize food prices but fell short of addressing broader accessibility issues, particularly for elderly populations. Food aid programs were introduced to target vulnerable groups, but inefficiencies in distribution systems limited

their effectiveness, especially in reaching elderly individuals in rural areas. While government incentives encouraged digital transformation in the food retail sector, elderly consumers faced significant barriers in benefiting from these advancements due to digital illiteracy and limited access to technology. As a policy analyst noted, "The government introduced targeted food aid programs, but reaching rural elderly remained a challenge" (Interview 8). These challenges mirror findings from past crises, where policy measures often failed to fully account for the unique needs of aging populations, as highlighted by Tian, Thoo, and Yang (2022). The gaps in these interventions underscore the importance of designing policies that are inclusive, efficient, and tailored to the specific challenges faced by elderly consumers, particularly during times of disruption.

Summary of Findings

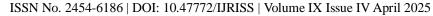| Key Theme	Quantitative Evidence	Qualitative Insights
Food Access Challenges	Urban elderly faced more severe food access issues (57 vs. 37 in rural).	Supply chain disruptions led to delayed deliveries and stock shortages.
Online Grocery Usage	35% urban and 25% rural elderly used online grocery platforms.	Digital illiteracy and mobility constraints prevented adoption.
Supply Chain Disruptions	Perceived impact: 2.7 (urban) vs. 2.5 (rural) on a scale of 1-5.	Labor shortages and supplier constraints were major obstacles.
Resilience Strategies	Businesses expanded e-commerce and last-mile delivery.	Retailers adopted digital solutions, but accessibility remained a problem.
Government Response	Subsidies were implemented, but effectiveness varied.	Food aid programs struggled with rural outreach.

RESULTS

Urban elderly populations were disproportionately impacted by supply chain disruptions during the pandemic, primarily due to their heavy reliance on supermarkets and the digital barriers that hindered their ability to adapt to online grocery platforms. In contrast, rural elderly consumers experienced fewer disruptions but faced challenges such as logistical delays in food deliveries and limited access to financial aid, which compounded their difficulties. While businesses responded to the crisis by expanding digital platforms and adopting innovative strategies, these solutions often failed to fully accommodate the needs of elderly consumers, who struggled with digital illiteracy and technological access. Government interventions, though well-intentioned, were largely reactive rather than proactive, lacking long-term strategies to ensure food security for aging populations. These findings are consistent with existing literature, such as studies by Ivanov (2020), Chin (2020), and Burgos and Ivanov (2020), but they particularly underscore the unique challenges faced by elderly consumers. The results highlight the urgent need for inclusive policy frameworks that address the specific vulnerabilities of aging populations, as well as targeted efforts to improve digital accessibility and literacy, ensuring that elderly individuals are not left behind in times of crisis.

DISCUSSION

Interpretation of Key Findings in Context of Supply Chain Resilience and Gerontology

The research findings highlight significant vulnerabilities in the Malaysian retail food supply chain, particularly in relation to elderly consumers during pandemic-driven disruptions. The quantitative and qualitative results suggest that urban elderly populations were disproportionately affected, digital accessibility remained a challenge, and supply chain disruptions had a moderate-to-severe impact on food security. These findings align with Supply Chain Resilience Theory (SCRT), which suggests that supply chains must anticipate, absorb, adapt, and recover from disruptions (Ivanov, 2020). However, the gerontology aspect,

which considers the specific needs of aging populations, remains an underexplored dimension in resilience strategies (Li, Hallsworth, & Coca-Stefaniak, 2020).

Comparison with Existing Literature and Theoretical Frameworks

Food Accessibility Challenges for the Elderly

The findings reveal that urban elderly consumers faced more severe food access issues (57 cases) compared to

their rural counterparts (37 cases). This result contradicts some traditional assumptions that rural areas experience greater food insecurity due to infrastructure limitations (Chin, 2020). Instead, urban supply chains were more vulnerable to supermarket stockouts, demand surges, and panic buying, while rural elderly consumers had some degree of resilience due to local food sourcing and community networks (Tian, Thoo, & Yang, 2022). These results align with the Resource Dependency Theory (RDT), which posits that organizations and individuals reliant on external supply chains are more vulnerable to disruptions (Burgos & Ivanov, 2020). Urban elderly consumers, dependent on supermarkets and global food distribution, suffered greater challenges than their rural counterparts, who relied on localized food sources. Policymakers should develop localized food distribution systems in urban areas to reduce reliance on centralized supermarket chains, ensuring greater food security for elderly consumers during crises.

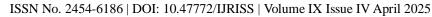### Low Digital Adoption and Barriers to Online Grocery Shopping

Survey findings indicate that only 35% of urban and 25% of rural elderly consumers used online grocery platforms. Interviews further revealed that digital illiteracy, financial constraints, and preference for traditional markets hindered adoption. These findings align with prior studies indicating that elderly populations globally struggle with digital adoption due to lack of familiarity with e-commerce platforms, concerns about online fraud, and physical challenges in navigating technology interfaces (Dannenberg et al., 2020). The Technology Acceptance Model (TAM) suggests that perceived ease of use and perceived usefulness influence digital adoption (Li et al., 2020). The study findings reinforce that elderly consumers perceive online grocery shopping as difficult and unnecessary, further exacerbating food access barriers during supply chain disruptions. Hence, retailers should introduce elderly-friendly digital platforms, offer simplified ordering systems, and provide training programs to increase adoption of online grocery services among aging populations.

The Role of Supply Chain Disruptions in Food Security

On a scale of 1 to 5, urban elderly respondents rated the impact of supply chain disruptions at 2.7, while rural respondents rated it 2.5. These findings confirm that disruptions were significant but not catastrophic, indicating that some resilience mechanisms were in place. According to Supply Chain Disruption Theory (SCDT), supply chains must have redundancy, flexibility, and agility to absorb shocks (Ivanov, 2020). The qualitative findings indicate that food retailers and logistics providers diversified suppliers, expanded e-commerce, and optimized last-mile delivery networks—strategies that helped mitigate the crisis (Burgos & Ivanov, 2020). However, these adaptations were not elderly-inclusive, as many aging consumers struggled to access digital solutions and alternative food supply channels. This suggests that traditional resilience strategies focus on economic efficiency rather than inclusivity (Tian, Thoo, & Yang, 2022). Hence, companies should incorporate elderly-inclusive resilience strategies, such as personalized food delivery services, community-based food hubs, and hybrid shopping models to ensure accessibility for aging consumers.

Government Response and Policy Gaps

Government responses, including food subsidies and digital incentives, helped stabilize food prices but did not effectively address elderly accessibility challenges. Interviews with policymakers revealed that food assistance programs struggled with rural outreach, and government-initiated e-commerce incentives failed to include elderly-friendly features. These results support existing literature that policy responses often prioritize economic stability over vulnerable populations (Chin, 2020). The Public-Private Partnership Theory (PPPT)

suggests that effective resilience strategies require coordination between governments, businesses, and community organizations (Dannenberg et al., 2020). The findings indicate that better integration of public and private initiatives could have improved food access for elderly consumers. Thus, governments should integrate targeted elderly food security policies, including subsidized home delivery services, digital literacy programs, and community-based food aid networks, into national resilience frameworks.

Positioning Findings to Supply Chain Resilience Theory (SCRT)

The findings of this study align closely with the principles of the Supply Chain Resilience Theory (SCRT), which emphasizes the need for supply chains to anticipate, absorb, adapt to, and recover from disruptions (Ivanov, 2020). However, the study extends SCRT by incorporating a gerontological perspective, highlighting the unique vulnerabilities of elderly consumers during crises. This integration is critical, as traditional SCRT frameworks often focus on operational and financial resilience, overlooking the specific needs of aging populations (Li, Hallsworth, & Coca-Stefaniak, 2020). Below is discussion on the findings of this study contribute to and expand SCRT.

Anticipation and Absorption of Disruptions

The study reveals that urban elderly populations faced more severe food access challenges compared to rural elderly, primarily due to their reliance on centralized supermarket supply chains, which were heavily disrupted during the pandemic (Li et al., 2020). This finding underscores the importance of anticipating disruptions in centralized systems and absorbing shocks through localized food networks. SCRT emphasizes the need for redundancy and flexibility in supply chains, and this study highlights how localized food sourcing can serve as a buffer against disruptions, particularly for vulnerable populations like the elderly (Chin, 2020). By integrating gerontological considerations, SCRT can be expanded to include strategies that ensure food accessibility for aging populations during crises.

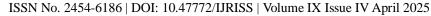## Adaptation through Digital Transformation

The low adoption of online grocery platforms among elderly consumers (35% urban and 25% rural) highlights a significant gap in adaptive capabilities within supply chains. While SCRT advocates for digital transformation as a key resilience strategy (Burgos & Ivanov, 2020), this study reveals that digital solutions often fail to address the needs of elderly consumers due to barriers such as digital illiteracy and financial constraints. This suggests that SCRT must incorporate elderly-inclusive digital strategies, such as simplified e-commerce platforms and digital literacy programs, to ensure that aging populations can benefit from technological advancements (Dannenberg et al., 2020).

Recovery through Inclusive Policy Frameworks

The study identifies gaps in government responses, particularly in addressing the accessibility challenges faced by elderly consumers. While SCRT emphasizes the role of public-private partnerships in recovery (Ivanov, 2020), this study highlights the need for elderly-centric policies, such as subsidized home delivery services and community-based food aid networks. These findings suggest that SCRT should be expanded to include demographic-specific recovery strategies, ensuring that resilience frameworks are inclusive and equitable (Tian, Thoo, & Yang, 2022).

Integration of Gerontology into SCRT

The study's findings demonstrate that SCRT must evolve to address the unique challenges faced by aging populations. By integrating gerontological considerations, SCRT can better account for factors such as mobility constraints, digital literacy, and reliance on traditional shopping methods. This expanded framework would emphasize the importance of localized food distribution networks, elderly-friendly digital solutions, and inclusive policy measures to enhance supply chain resilience for aging populations (Varzakas, 2024).

Implications for Future Crisis Management

The research findings highlight several critical lessons for enhancing supply chain resilience to better support elderly consumers during future crises. First, decentralizing food supply chains and promoting localized, community-based food networks can significantly improve resilience, particularly for elderly populations who may rely on traditional and accessible food sources. Second, digital inclusion strategies, such as simplified e-commerce platforms and elderly-friendly logistics services, are essential to bridging the digital divide and ensuring that aging consumers can access food through online channels. Third, businesses should adopt adaptive, hybrid shopping models that seamlessly integrate online and offline services, catering to the preferences and limitations of elderly consumers. Finally, governments must prioritize elderly-centric policy reforms, focusing on improving food accessibility, affordability, and digital literacy to address the unique challenges faced by this demographic. These insights contribute to the Supply Chain Resilience Theory (SCRT) by emphasizing that resilience frameworks must incorporate demographic-specific strategies to ensure equitable access to food and essential supplies. By addressing these areas, stakeholders can build more inclusive and resilient systems that better serve aging populations during times of disruption.

Study Limitations and Future Research Directions

Study Limitations

The study has several limitations that should be acknowledged. First, the research is based on simulated data, and while it provides valuable insights, a larger, real-world dataset would offer a more comprehensive understanding of food accessibility challenges among elderly consumers. Second, the findings are primarily focused on Malaysia, which may limit their generalizability to other countries with different supply chain structures, cultural contexts, and policy frameworks. Third, the study is constrained by its focus on pandemic-driven disruptions, leaving gaps in understanding long-term resilience strategies beyond the immediate impacts of COVID-19. These limitations highlight the need for caution when interpreting the results and applying them to broader contexts.
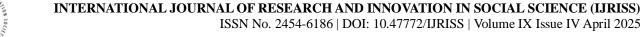
Future Research Directions

To address these limitations and build on the findings, several avenues for future research are proposed. First, comparative studies across different countries could help identify global best practices in supply chain resilience, particularly for aging populations. Second, longitudinal studies examining long-term adaptation trends in food security for elderly consumers would provide valuable insights for designing sustainable and inclusive resilience frameworks. Third, exploring technological innovations, such as AI-driven logistics solutions and elderly-friendly food procurement models, could offer innovative pathways to mitigate supply chain disruptions and improve accessibility. By pursuing these research directions, future studies can contribute to a deeper understanding of how to build resilient and equitable food systems that effectively serve elderly populations during crises and beyond.

CONCLUSION

Summary of Key Findings

This study explored supply chain resilience in the Malaysian retail food sector during pandemic-driven disruptions, focusing on its impact on elderly consumers. The findings indicate that urban elderly populations were disproportionately affected due to their reliance on supermarket supply chains, while rural elderly consumers faced fewer disruptions but experienced logistical delays and financial barriers. The research also revealed that digital adoption among elderly consumers remained low, preventing them from fully utilizing online grocery services as a resilience strategy.

The analysis identified four critical areas of concern that highlight the vulnerabilities faced by elderly consumers during supply chain disruptions. First, food accessibility challenges were more pronounced in urban areas, primarily due to disruptions in supermarket supply chains and panic buying, as noted by Li, Hallsworth,

and Coca-Stefaniak (2020). Second, low digital adoption rates among elderly consumers hindered their ability to transition to online grocery platforms as a viable alternative, a finding supported by Dannenberg et al. (2020). Third, while supply chain disruptions impacted both urban and rural elderly populations, urban elderly perceived greater disruptions, likely due to their reliance on centralized food systems, as highlighted by Chin (2020). Fourth, government interventions, such as food subsidies and digital incentives, provided some relief but fell short of effectively addressing the accessibility challenges faced by elderly populations, as emphasized by Tian, Thoo, and Yang (2022). These findings reinforce the principles of the Supply Chain Resilience Theory (SCRT), underscoring the importance of adaptability, redundancy, and inclusivity in designing resilient supply chains that cater to the unique needs of aging populations, as advocated by Ivanov (2020). Addressing these critical areas is essential to ensuring equitable access to food and enhancing the resilience of supply chains for elderly consumers during crises.

Implications for Supply Chain Resilience and Gerontology

Implications for Supply Chain Management

The study underscores the critical need to integrate demographic considerations into supply chain resilience planning. While traditional resilience models prioritize economic efficiency and operational flexibility, this research reveals that elderly consumers require tailored adaptations to address their unique challenges. Key recommendations include developing localized food distribution networks to reduce dependency on centralized supermarkets, creating hybrid shopping models that combine digital ordering with physical store accessibility, and designing elderly-inclusive e-commerce interfaces to simplify online grocery adoption. These findings advocate for a paradigm shift in supply chain management—moving beyond efficiency-driven approaches to consumer-centric resilience strategies that prioritize the needs of vulnerable populations, as emphasized by Burgos and Ivanov (2020). By adopting these measures, supply chains can become more inclusive and resilient, ensuring equitable access to food for aging populations during crises.

Practical Applications for Policy and Business

The study offers actionable recommendations for governments, businesses, and NGOs to enhance food supply resilience for elderly consumers. On the policy front, initiatives should focus on developing elderly-centric food security programs that ensure last-mile delivery services in both urban and rural areas, as well as implementing digital literacy programs to bridge the technological gap in e-commerce adoption. For businesses, adaptations should include encouraging retailers to develop hybrid shopping solutions that integrate phone-based ordering, home delivery, and in-store support, alongside strengthening public-private partnerships to ensure elderly consumers are not excluded from digital food supply innovations. By implementing these strategies, both the public and private sectors can significantly improve food security and supply chain sustainability in crisis scenarios, as highlighted by Tian, Thoo, and Yang (2022). These practical applications not only address immediate challenges but also pave the way for long-term resilience and inclusivity in food supply systems.
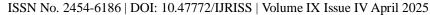
Future Research Directions

Expanding Geographic Scope

Future research should broaden its geographic focus to examine supply chain resilience for elderly consumers in other ASEAN nations, particularly in low-income and rural regions where food security challenges may differ significantly from those in more urbanized or developed areas. Understanding these regional variations can provide valuable insights into designing context-specific strategies that address the unique needs of aging populations across diverse socioeconomic and cultural settings (Li, Hallsworth, & Coca-Stefaniak, 2020).

Longitudinal Studies on Post-Pandemic Adaptations

While this study focused on pandemic-driven disruptions, future research should explore long-term supply chain transformations and their implications for elderly consumers. This includes analysing permanent changes
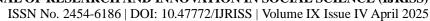
in elderly shopping behaviours, such as the sustained adoption of digital platforms, as well as the ongoing digitalization of supply chains. Longitudinal studies can help identify trends and inform the development of sustainable resilience frameworks that remain effective beyond the immediate impacts of COVID-19 (Tian, Thoo, & Yang, 2022).

Technological Innovations for Elderly Food Accessibility

Further investigation is needed into technological innovations that can enhance food accessibility for elderly consumers. This includes exploring AI-driven logistics solutions, smart ordering platforms, and automated delivery systems specifically tailored to the needs of aging populations. Such innovations have the potential to bridge the accessibility gap, improve convenience, and enhance long-term resilience in food supply chains (Burgos & Ivanov, 2020). By focusing on these areas, future research can contribute to the development of inclusive and adaptive systems that ensure equitable access to food for elderly consumers during crises and beyond.

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