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Supply Chain Management in Times of Supply Disruption Risk and Consumer Panic Buying: A Systematic Review

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Abstract

This paper provides a systematic review of supply chain management strategies in the context of supply disruption risk and consumer panic buying. A comprehensive literature search was conducted across major databases, including Web of Science, ScienceDirect, and Google Scholar, using Boolean operators to combine keywords such as "supply disruption", "panic buying", and "supply chain management". After manual screening based on titles and abstracts, 134 relevant studies were identified for the final analysis. The review examines how supply disruptions triggered by natural disasters, epidemics, or other unforeseen events lead to consumer panic buying, resulting in substantial fluctuations in demand. The study explores the underlying drivers of consumer panic-buying behavior, including information asymmetry, the perception of resource scarcity, social influence, and individual psychological factors like fear and anxiety caused by unknown risks. It further analyzes the multifaceted impact of panic buying on supply chain performance and social welfare, encompassing higher costs, inventory mismatches, price fluctuations, exacerbation of the bullwhip effect, reduced supply chain efficiency, and loss of consumer welfare. The paper reviews a spectrum of supply chain management strategies to mitigate these adverse effects, such as flexible inventory management, supply chain elasticity enhancement, dynamic production capacity adjustment, diversified supplier networks, and collaborative interventions by governments and retailers. The findings underscore the intricate interplay between supply chain dynamics and consumer panic-buying behavior, providing valuable insights for the development of resilient supply chains.

Keywords: supply chain management; supply disruption risk; consumer panic buying

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1. Introduction

Supply disruption risk causes multiple challenges for retailers' supply chain management. On the one hand, retailers need to adjust their procurement, inventory, and other operational strategies in light of the risk of future supply disruptions; on the other hand, the risk of supply disruptions caused by factors such as natural disasters and epidemics usually triggers panic-buying behavior in consumers, resulting in large demand fluctuations in a short time, further complicating the situation for retailers. In particular, under supply disruption risk, consumers are usually not sure whether the supply of goods in the future will be at a normal level or not, and fears of future supply shortages prompt some consumers to

stockpile significant inventories of goods. During the COVID-19 pandemic, panic-buying incidents were observed in many countries, such as Singapore, Japan, Australia, Italy, Israel, Spain, the United Kingdom, and the United States [1]. For example, in the spring of 2020, affected by the COVID-19 pandemic, citizens hoarded a large number of daily necessities, such as grain and oil, resulting in serious shortages of daily necessities in many supermarkets [2]. Market research indicates that in January 2020 alone, the demand for hand sanitizer among Chinese consumers skyrocketed by 1400% [2]. In situations of intensive panic buying, if retailers or the government do not undertake any intervention, substantial stock-outs may induce more panic buying and increase consumer anxiety about supply shortage, worsening the panic buying and stock-outs.

Retailers may employ multiple tactics to address panic buying stemming from supply chain disruption risks, such as maintaining safety stock in advance, increasing prices, imposing purchasing quotas, taking trans-shipment actions, and utilizing backup suppliers when observing intense panic buying by consumers. For example, under the impact of panic buying during the COVID-19 pandemic, Wellcome Supermarket in Hong Kong temporarily restricted the purchase of rice, eggs, toilet rolls, and other goods, limiting their purchase to two pieces per person [3]. Categories such as food and medical supplies saw significant price increases [4], with Argentina, Honduras, Colombia, Georgia, the Philippines, and other countries imposing price caps on basic foodstuffs. In addition, some retailers have tried to ease consumer panic-buying behavior by announcing that they are sufficiently stocked and ready for supply during extreme events [5,6]. Manufacturers can ramp up production to cope with a surge in demand [7]. The government can also impose many types of controls to intervene in consumer panic-buying behavior, for instance, censoring and controlling the spread of shortage rumors, regulating product price and shopping times, announcing sufficient support for future supply, and punishing sellers for breaking imposed rules. In addition, the Ministry of Commerce of China encourages consumers to stock up on a certain amount of daily necessities as needed in normal times in case of emergencies [8]. Research evidence has shown that mitigation strategies, such as purchase quotas and information transparency, can control intensive panic buying by consumers and protect social welfare by lowering consumer anxiety, reducing resource waste, and improving access to essential goods for vulnerable groups [9,10].

Since the outbreak of the COVID-19 pandemic, a growing number of studies have analyzed consumer panic-buying behavior under supply disruption risks. However, there remains a relative scarcity of review papers synthesizing this body of work. Existing reviews have primarily focused either on the psychological and behavioral aspects of panic buying during epidemics (e.g., [11–14]) while overlooking corresponding supply chain and operations strategies or on general supply chain management strategies during crises without specific attention on consumer panic buying (e.g., [15,16]). Following these streams of literature, this study reviews the literature on consumer panic buying amid supply disruptions, focusing on its impact on firms' supply chains and operations management strategies. The contribution of this study is twofold. First, the analysis yields novel critical perspectives on the management of supply disruption risks in conjunction with consumer panic buying. Second, the research analyzes the interaction between mitigation strategies for consumer panic-buying behavior and social welfare. By integrating these dimensions, the research establishes theoretical frameworks and actionable guidelines for the design of resilient supply chain strategies amid disruptions and consumer panic-buying behavior. Guided by this focus, the review addresses two core questions:

- What are the main reasons for and impacts of consumer panic-buying behavior under supply disruption risk?

- How can we effectively manage supply chains under supply disruption risk and consumer panic-buying behavior?

The remainder of the article proceeds as follows: Section 2 presents the systematic review methodology and execution process. Sections 3–5 synthesize the extant literature and its principal findings. Section 6 discusses the theoretical underpinnings, managerial applications, and emerging research avenues in supply disruption risk management.

2. Methodology

The methodology for this systematic review was designed in accordance with established PRISMA guidelines to ensure the rigor and systematic nature of the research process, with a completed checklist provided in Appendix A [17,18]. First, a targeted keyword search was conducted across major academic databases to identify the relevant literature. Our initial search strategy focused on two primary databases—Web of Science and ScienceDirect—due to their comprehensive coverage and ease of data export. To further ensure the comprehensiveness of the literature corpus, we supplemented the search with forward and backward reference checking via Google Scholar, along with manual selection of additional relevant publications. The core search keywords included "supply disruption", "panic buying", and "supply chain management"; the precise definition and scope of each are provided as follows:

- Supply disruption refers to the interruption of the normal production or distribution of products within supply chains. It can have various causes, for example, natural disasters, epidemics, and changes in government regulation [19,20].
- Panic buying is the irrational accumulation of goods beyond immediate needs, driven by uncertainty about future availability. This behavior is typically triggered by heightened anxiety and uncertainty, often exacerbated by external events such as pandemics, natural disasters, or geopolitical tensions [11,21].
- Supply chain management is the integrated management of the entire flow of goods, services, information, and finances, from raw material sourcing to product delivery to the end customer. Its scope spans demand planning, procurement, production, inventory management, logistics (transportation and warehousing), and distribution while emphasizing partner collaboration, sustainability, risk management, and technology-driven efficiency [15,16].

The research flow diagram in Figure 1 outlines the rigorous and multi-phase systematic review process adopted in this review paper. The process commenced with data collection from authoritative academic databases, using Boolean operators to search for key terms 'panic buying', 'supply disruption', and 'supply chain management'. The corpus consists of peer-reviewed articles, opinion pieces, discussion papers, and review articles. All the included literature was available online before 1 September 2025, including both formally published articles and preprints. Since studies analyzing consumer panic-buying behavior prior to 2010 are scarce, the review was limited to the period from 2010 to 2025. The search keywords and corresponding numbers of search results are summarized in Table 1, which shows that the initial search yielded 364 records from Web of Science and 958 records from ScienceDirect. After removing duplicates, 313 unique records remained from Web of Science. Additionally, 2260 records were retrieved from Google Scholar.

Next, following the PRISMA guidelines, the workflow proceeded to the screening and refinement phase. We manually screened and refined the retrieved records by carefully reviewing the titles and abstracts. Since the records from Google Scholar included many irrelevant entries and could not be exported directly into a file, we prioritized the refinement of records from Web of Science and ScienceDirect. The screening process is illustrated in Figure 2. Initially, we combined the 313 and 958 records retrieved from Web of Science

and ScienceDirect, respectively. Duplicates were then identified and removed using Zotero for reference management and deduplication, resulting in the exclusion of 52 duplicate entries. Subsequently, we manually refined the remaining records based on titles and abstracts to exclude off-topic and low-quality publications, resulting in a refined dataset of 121 high-quality studies for in-depth analysis. Finally, based on additional reference checking on Google Scholar, 13 supplementary publications were added to the corpus, resulting in a total of 134 articles for inclusion in the review.

The subsequent phase involved intensive reading and data extraction, where technical concepts were cataloged into a structured dictionary to identify core themes, such as behavioral drivers, mitigation strategies, and performance impacts. Connections between concepts were summarized through thematic synthesis, enabling the identification of patterns and relationships. This culminated in the output of analytical diagrams to visualize the findings and the formulation of evidence-based suggestions and future research directions, ensuring the review's contribution to both theory and practice in supply chain disruption risk management.

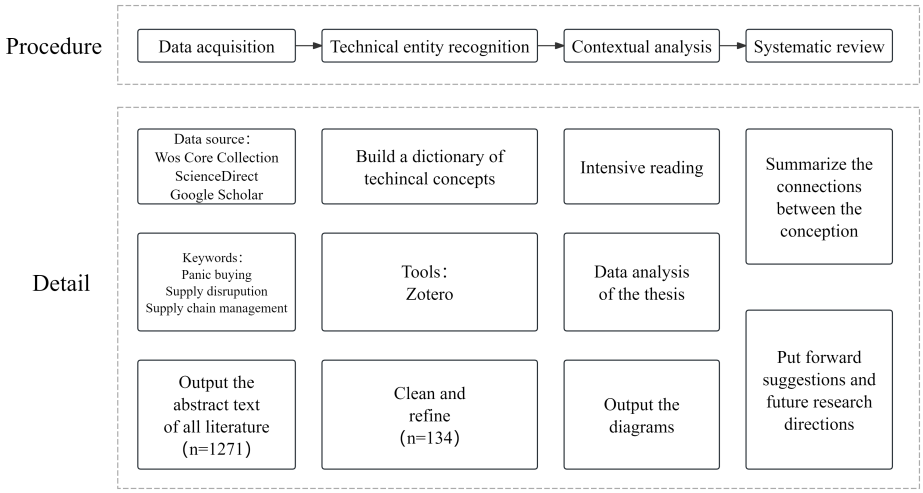


Figure 1. Research flowchart.

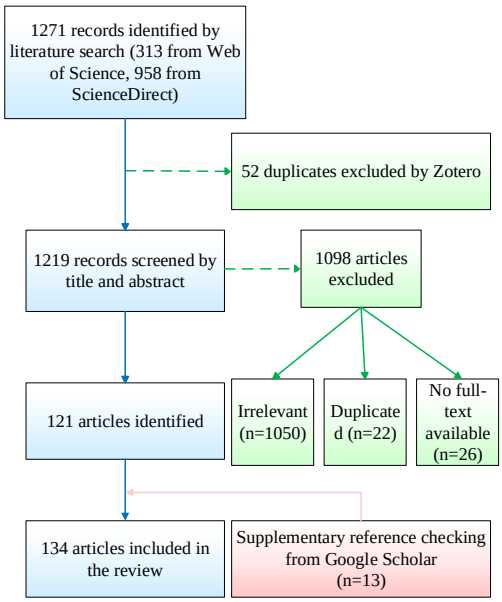


Figure 2. Literature search and screening flow diagram.

Table 1. Summary of the retrieved results (from 2010 to 2025; published articles and preprints).

Academic Platform	Keywords	Number Records
Web of Science	Supply disruption and panic buying	109
Web of Science	Panic buying and supply chain management	145
Web of Science	Managing consumer panic-buying behavior	110
Total after removing duplicates		313
ScienceDirect	Supply disruption and panic buying and supply chain management	958
Google Scholar	Supply disruption and panic buying and supply chain management	2260

Figure 3 illustrates the annual distribution of publications in the field of consumer panic buying and supply chain management from 2010 to 2025. The data reveal a dynamic and evolving research landscape, characterized by significant fluctuations in output over the 16-year period. From 2010 to 2019, publications were sparse (total of 10), indicating a nascent research field. A dramatic surge followed, peaking at 31 publications in 2021, which directly correlates with the global COVID-19 pandemic. Subsequently, output fluctuated: 15 in 2022, 27 in 2023, 20 in 2024, and 13 in 2025. This trend underscores the field's rapid reaction to crisis and its progression toward maturity. It also confirms the need for a systematic review of this stream of literature at the present stage.

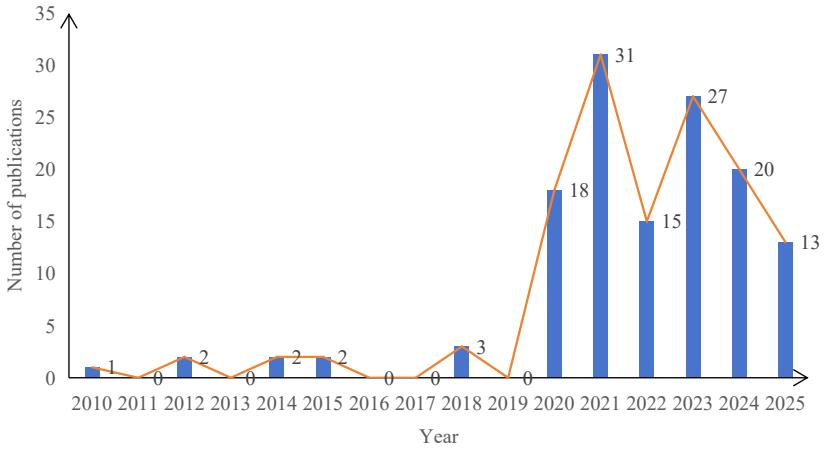


Figure 3. The annual number of related publications from 2010 to 2025.

The final sample of 134 publications is drawn from 95 distinct journals, reflecting a broad knowledge base. As shown in Table 2, the top eight journals in terms of number of studies contributed account for a significant portion of the total studies. The *Journal of Retailing and Consumer Services* is the most prominent source, with 11 articles, followed by the *International Journal of Production Research*, with 5. Six journals—the *International Journal of Production Economics*, the *Journal of Economic Behavior and Organization*, *Sustainability*, *Annals of Operations Research*, the *International Journal of Disaster Risk Reduction*, and *Omega—The International Journal of Management Science*—each contributed three articles, tying for third place. This concentration indicates that the field heavily relies on key outlets specializing in consumer studies, supply chain management, operations research, and sustainability. The remaining journals each contributed no more than two publications. Geographically, the articles are concentrated in a few key regions, as illustrated in Figure 4. The Netherlands (34 articles, 25.4%), the United Kingdom (25, 18.7%), and the United States (24, 17.9%) are the dominant hubs, collectively contributing to 61.9% of the sample. China ranks fourth, with 10 articles (7.5%), followed by Switzerland (6, 4.5%), Germany (5, 3.7%), and Singa-

pore (4, 3.0%). The "Other Countries" category (26 articles, 19.4%) includes multinational collaborations and regions with limited output.

Table 2. Top 8 journals by number of publications in the surveyed literature.

Journal Name	Number of Publications
Journal of Retailing and Consumer Services	11
International Journal of Production Research	5
International Journal of Production Economics	3
Journal of Economic Behavior and Organization	3
Sustainability	3
Annals of Operations Research	3
International Journal of Disaster Risk Reduction	3
Omega–The International Journal of Management Science	3

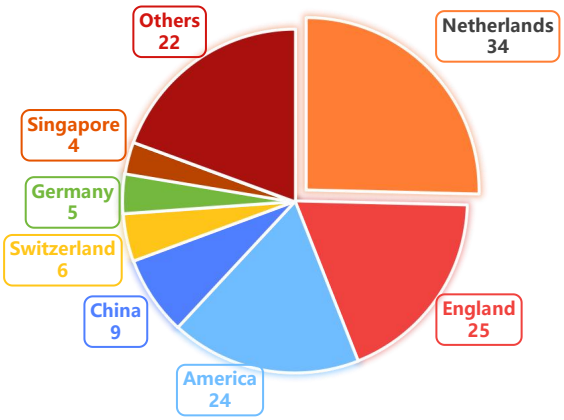


Figure 4. Distribution of the reviewed articles by journal country.

The methodological landscape of the surveyed literature, as detailed in Table 3, is characterized by empirical dominance (44.03%) and a substantial body of systematic reviews (22.39%), indicating a data-driven and maturing field. Complementary analytical rigor is provided by game theory and optimization models (12.69% each). The remainder (8.21%) includes conceptual papers and case studies, indicating diverse exploratory efforts.

Table 3. Statistical summary of research methods in the surveyed literature.

Research Method	Count	Percentage	Representative Papers
Empirical	59	44.03%	[22] Panic buying in the COVID-19 pandemic: A multi-country examination. (Survey/social media data analysis) [23] Impact of COVID-19 on impulse buying behavior. (Retail panel data econometric model)
Systematic Review	30	22.39%	[11] Panic buying research: A systematic literature review. (PRISMA framework) [15] Supply chain resilience during pandemics. (Bibliometric analysis)
Game Theory	17	12.69%	[24] Retailer hoarding in emergency situations: A game-theoretic analysis. (Nash equilibrium model) [25] Managing panic buying with Bayesian persuasion. (Signaling game)
Optimization	17	12.69%	[26] Production recovery under COVID-19. (Stochastic dynamic programming) [27] Dual-channel supply chain coordination. (Nonlinear programming)
Others	11	8.21%	[1] The anatomy of panic buying. (Conceptual framework) [28] Food insecurity and panic buying. (Case study)

3. Consumer Panic-Buying Behavior Under Supply Disruption Risk

Understanding consumer behavioral responses to supply disruption risks has become a critical area of research, particularly in the wake of the COVID-19 pandemic, which starkly revealed the profound impact of panic-driven actions on supply chains and societal well-being. Scholars have increasingly turned their attention to dissecting the mechanisms, classifications, and consequences of these behaviors. Prior research has delved into various facets of this phenomenon, including the distinct drivers and manifestations of panic buying versus rational stockpiling, the psychological and social triggers of hoarding, the resulting amplification of supply–demand mismatches, and the complex interplay between consumer stockpiling decisions and supply chain resilience strategies. This section synthesizes key findings on how consumers react to perceived or actual supply disruption risks, focusing on the nature of their stockpiling behaviors and the subsequent chain reactions within supply systems.

3.1. Consumers' Behavioral Responses to the Risk of Supply Disruption

Consumers' behavioral responses to supply disruption risks primarily manifest in the hoarding of products. In particular, hoarding behavior encompasses the identification of diverse types of stockpiling behavior, including irrational panic buying and rational stockpiling [21,29], as well as impulse buying and compulsive buying [30,31]. These behaviors are triggered by factors such as product shortage expectations, price fluctuations, social learning effects, and information asymmetry [22,32].

3.1.1. Behavioral Classification and Trigger Mechanisms

Panic buying is typically induced by sudden events (e.g., natural disasters or public health crises), reflecting irrational hoarding driven by uncertainty about future availability. For example, consumers rushed to purchase medical supplies and daily necessities during the early stages of the COVID-19 pandemic [11–13,22,33]. This behavior is contagious, spreading rapidly through social media or other networks, leading to "mass panic" [34].

Defined as the excessive and often irrational accumulation of goods beyond immediate needs, panic stockpiling is a subset of panic-buying behavior characterized by consumers purchasing large quantities of products due to fears of future scarcity or price increases. This behavior is typically triggered by heightened anxiety and uncertainty, often exacerbated by external events such as pandemics, natural disasters, or geopolitical tensions. Research indicates that consumers' expectations of shortage probability and holding costs are critical determinants: higher perceived shortage probabilities and lower holding costs incentivize increased stockpiling [21]. Yuen et al. [35] further emphasize that psychological factors, such as fear, anxiety, and a sense of loss of control, significantly contribute to panic stockpiling. Studies have highlighted that the perception of health risks and the influence of social media amplified panic-buying behaviors during the COVID-19 pandemic [35]. For instance, social media platforms often disseminated images of empty shelves, which further fueled consumer anxiety and prompted more stockpiling [36].

Impulse buying is defined as unplanned buying characterized by hedonically complicated, irresistible, and abrupt behavior. It involves inadequate deliberation and a lack of consideration of alternatives or consequences and is distinct from panic buying (situation-specific and episodic) and compulsive buying (chronic, anxiety-driven, and repetitive). Impulse buying is more triggered by external factors such as immediate contextual or social stimuli [23,37,38]. Naeem, M. [30] highlight that, unlike traditional impulse buying, which is driven by marketing efforts like discounts and promotions, impulse buying during COVID-19 was primarily fueled by social media-amplified fear, risk perception, and social conformity, even in the absence of retailer incentives.

Compulsive buying is a maladaptive consumption behavior driven by internal anxiety rather than external triggers. It involves recurrent, irresistible urges to purchase unnecessary items, often beyond one's financial means. This pattern leads to significant distress, time loss, and social or occupational dysfunction and frequently results in financial difficulties. It is distinguished from impulse buying (externally triggered and short-lived) and panic buying (situation-specific and episodic) [31]. Compulsive buying is internally driven by anxiety and worry and may become a repetitive, addictive pattern of behavior. Phang et al. [31] found that repeated engagement in panic buying under pandemic situations could evolve into compulsive buying.

Strategic buyers engage in rational stockpiling based on cost–benefit analyses, anticipating supply disruptions or price increases. For instance, semiconductor manufacturers hoard raw materials during supply shortages [29,39]. This behavior is influenced by inventory holding costs, price hikes, and the duration of shortages and involves dynamic decision making. Consumers compare utilities across periods (e.g., two-period consumption utility vs. holding costs) to determine optimal stockpile quantities [21]. Gangwar et al. [32] demonstrate that retailers' promotional strategies (e.g., limited-time discounts) can strategically induce rational stockpiling while mitigating panic-driven demand surges. The studies of Noda and Teramoto [39] and Ntontis et al. [40] demonstrate that even when consumers are fully rational in deciding whether to stockpile storable products, taking into account factors such as shopping costs and the probability of supply disruptions, their individually rational decisions can ultimately lead to collective panic hoarding and a surge in demand. In the study of Lindell [41], the term "crisis stockpiling" is proposed to replace "panic buying", as it more accurately describes a rationally motivated behavior influenced by diverse emotions like optimism and anger, rather than being solely fear-driven.

The above summarizes the panic buying-related concepts in the surveyed literature. Of these, panic buying is uniquely driven by external crises and collective anxiety over scarcity, distinguishing it from impulse, compulsive, or purely rational stockpiling. This paper adopts the term "panic buying", as it best captures the sudden, socially contagious hoarding behavior triggered by supply chain disruption risks, which is the core focus of our study.

3.1.2. Chain Reactions in the Supply Chain

Consumer stockpiling can intensify supply–demand imbalances, creating stockpiling-driven shortages [29]. Key impacts include the following.

Premature shortages: Strategic buyers' hoarding depletes inventory, leaving non-strategic buyers facing shortages earlier [19,42]. This was evident during the early stages of the COVID-19 pandemic, when panic buying of essential goods led to rapid depletion of supermarket stocks [11].

Vicious price cycles: Shortage expectations prompt manufacturers and retailers to raise prices, further stimulating hoarding. For example, cocoa price surges in 2024 triggered chocolate price hikes, leading to increased consumer stockpiling of chocolate products [21]. Retailers can mitigate these effects through dynamic pricing, inventory prioritization (e.g., prioritizing non-strategic buyers' real-time demand), or purchase restrictions [19]. Ivanov [43] proposes a resilience framework where supply chain actors dynamically adjust production and pricing to absorb stockpiling shocks. For example, purchase-limit policies (e.g., limiting purchases to one unit per customer) can curtail excessive hoarding but require the balancing of inventory capacity and consumer needs [29].

Understanding the nuances of panic buying and panic stockpiling, along with their triggers and impacts on the supply chain, is crucial for the development of effective strategies to manage supply disruptions and mitigate their adverse effects on consumers and retailers. Table 4 summarizes some key studies on consumer behavior under supply disruption risk.

Table 4. Summary of key studies on consumer behavior under supply disruption risk.

Author (Year)	Research Focus	Key Findings
Islam et al. [22]	Panic buying across countries during COVID-19	• Panic-buying intensity positively correlates with government lockdown policies. • Social media exposure moderates the relationships between scarcity messages and individual's perceived arousal.
Gangwar et al. [32]	Promotional strategies and rational stockpiling	• Time-limited discounts significantly increase stockpiling. • Rational stockpiling quantity is influenced by promotion duration and holding costs.
Li et al. [29]	Strategic stockpiling under price fluctuations	• Identified 5 optimal stockpiling timing scenarios (e.g., pre-price hike). • Inventory holding cost explains a big variance in buyers' stockpiling decisions.
Xu et al. [21]	Retailer ordering under panic buying	• In the absence of purchase restrictions, a large inventory capacity is always beneficial for a retailer to cope with unforeseen events. In the presence of such restrictions, however, the retailer can profit from consumer panic buying only when its inventory capacity is moderate.
Zheng et al. [19]	Social learning effects and inventory management	• Social learning may increase or decrease consumer demand, which depends on the panic intensity among consumers.
Ivanov [43]	Supply chain resilience modeling	• The paper models supply chain resilience as an immune system, with innate (preparedness) and adaptive (recovery) components. • Combining these immune-inspired responses with principles like diversity and redundancy can enhance supply chain resilience.
Yuen et al. [35]	Psychological mechanisms of panic buying	• Fear of unknown is one of the main factors influencing panic-buying behavior. • Individuals' perception of the threat of the health crisis and scarcity raises panic purchase.
Arafat et al. [44]	Panic buying during natural disasters	• Panic-buying behaviors vary across pre-disaster, disaster, and post-disaster phases. • Effective communication, including clear messaging from authorities and responsible media reporting, can help prevent panic buying during disasters.

3.2. Factors Affecting Consumer Panic-Buying Behavior

Consumer panic-buying behavior is influenced by a multitude of factors, and understanding these is crucial for grasping the dynamics of consumer behavior during times of crisis [37,45,46]. A four-dimensional motivation model has been developed in the psychology and behavior literature. It attributes panic buying to the following factors: perceived resource scarcity, triggering defensive stockpiling; the emergence of generalized fear and anxiety driven by unknown risks; stress-induced compensatory behavior; and the herd effect, triggered by social imitation. Li et al. [47] explored the factors influencing panic-buying behavior during the COVID-19 pandemic and found that panic buying is the result of both environmental stimuli and reflective thinking. Particularly, perceived susceptibility, severity, social influence, and social norms influence perceived scarcity and emotional

responses, leading to impulsive purchasing behavior. Moreover, a perceived lack of control, as part of the reflective system, directly influences and moderates the impact of emotional responses on panic buying. This section reviews the related literature and summarizes four main factors that affect consumer panic-buying behavior.

The first factor is information asymmetry. In situations of supply disruption, information asymmetry arises as consumers lack reliable information about the severity of disruption and the availability of future supply. This uncertainty about future product availability prompts consumers to infer future supply availability from the stockpiling actions of others, which may lead to herd behavior in terms of stockpiling [21]. For example, during the early stages of the COVID-19 pandemic, misinformation and limited data on the supply of essential goods like masks and hand sanitizers caused consumers to panic buy. They feared shortages and, thus, stocked up, not fully aware of the actual supply situation. In 2023, when Japan announced the discharge of radioactive water from the Fukushima Daiichi Nuclear Power Plant, there was misinformation and a lack of clear data on the safety of salt production. This led to panic buying of salt in China and South Korea. People feared that the salt supply would be contaminated, despite the fact that most of China's salt comes from well-mine salt and lake salt, which were not affected by nuclear pollution. As Avi Herbon [48] reported, disruptions can bring about uncertainties in supply, and when consumers have incomplete information, they are more likely to engage in panic buying.

The second factor is social influence. Social factors have a profound impact on consumers' panic-buying decisions. The behavior of peers can create a sense of urgency. In the case of social influence or social learning, consumers update their perceptions of shortage risks by observing others' purchasing behaviors, adjusting their decisions accordingly [22]. For instance, during the 2003 SARS outbreak, in the Chinese province of Guangdong and neighboring areas such as Hainan and Hong Kong, several rounds of panic buying of various products, including salt, rice, and face masks, took place. When some consumers saw others stockpiling, they felt pressured to imitate this behavior, assuming those stockpiling might have some information or foresight that they lacked. Social media and word of mouth also play a role. In the age of information, news and rumors spread quickly, which can trigger panic buying. In 2020, when the Japanese capital region's local governments called on people to reduce unnecessary outings during the pandemic, news spread on social media about potential shortages. This led to a large number of citizens in Tokyo rushing to supermarkets to buy food and daily necessities. Some people bought so much that certain items like cup noodles and frozen foods were quickly sold out in many supermarkets. Social media posts about shortages led to increased stockpiling in many regions [49]. Yoon et al. [50] discussed how consumers' panic-buying behavior, resulting from supply disruptions, is influenced by both single and multiple purchasing strategies. They found that consumers who had previous similar experiences were more likely to exhibit stronger panic-buying tendencies.

The third factor is network diffusion. Network diffusion describes a process facilitated by social media, through which various types of information (real, false, or negative) are spread. This process fuels consumer anxiety regarding product scarcity and leads to irrational hoarding. In contrast to information asymmetry, the mechanism of network diffusion relies on creating a group psychological resonance. This collective resonance, powered by the speed of information sharing, directly instigates large-scale and immediate rush purchases. Yuen et al. [35] found that misinformation on platforms like Twitter significantly increased hoarding during the COVID-19 pandemic. Wilk et al. [51] found that negative news and false information on social media further exacerbated public panic, causing consumers to be anxious about the uncertainty of the timely availability of products, which led to irrational hoarding behaviors. Naeem [52] empirically demonstrated that

social media amplified panic buying during COVID-19 by spreading uncertainties and insecurities, information on product scarcity, authorities' messages, and expert opinions, leading to collective stockpiling behavior. Utilizing daily supermarket sales data with parallel social media information on the Internet, Lwin et al. [53] empirically analyzed the purchasing behaviors of Singaporeans during the COVID-19 pandemic and verified the correlation between social media discourse and consumer stockpiling of staple and long-lasting canned foods.

Fourth are individual psychological factors. Personal psychological states, such as fear, anxiety, and the desire for control, contribute to panic buying. Consumers worry about not being able to meet their future needs, especially during uncertain times, and this fear of shortage drives them to purchase excessive amounts of products. Moreover, in uncertain situations with supply disruption risks, decision-making biases like risk aversion and loss aversion can intensify consumers' perception of resource scarcity, thereby promoting panic buying [54]. Schmidt et al. [55] found that risk-averse consumers tend to overestimate the likelihood of scarcity and perceive "being unable to obtain necessities" as an unbearable loss—a manifestation of loss aversion. They ascribe more weight in their decisions to this anticipated loss than to a rational cost–benefit analysis of over-purchasing, leading to an irrational surge in demand [56]. In 1973, during the toilet paper panic in the United States, consumers, driven by fear and anxiety about future shortages, bought large quantities of toilet paper [35]. Consumer panic-buying behavior is found to be heterogeneous across consumer demographics and product categories [57,58]. Some individuals may have a higher level of anxiety, making them more prone to panic buying; for example, people with a stronger sense of insecurity may be more likely to hoard supplies during a crisis. Women from larger families are less likely to engage in panic buying, tending to stockpile slightly more goods than usual. Interestingly, Park et al. [59] found that consumers may alleviate their negative emotions, like panic and anxiety, during pandemics through shopping. The studies of Wang and Hao [60] and Roos et al. [61] indicated that the primary driver of hoarding behavior was fear of infection, not perceived scarcity. It was also found that there was a higher incidence of hoarding among younger, higher-income urban households with children. Sadeque Hamdan [62] and Ana Alina Tudoran [63] showed that individual psychological factors play a vital part in consumer panic-buying behavior. Table 5 and Figure 5 summarize the main factors that influence consumer panic-buying behavior.

Table 5. Factors influencing consumer panic-buying behavior.

Factors	Key Examples and Findings	Sample References
Information Asymmetry	• Misinformation about salt contamination after the Fukushima nuclear discharge in 2023 triggered panic buying in China/South Korea, despite 80% of China's salt being unaffected mine/lake salt. • Incomplete supply information significantly increases hoarding probability.	[28,35,48,60,64,65]
Social Influence	• A 40% stockpiling surge during the 2003 SARS outbreak in Guangdong/Hong Kong due to peer behavior. • Social media rumors about shortages amplified Tokyo's 2020 panic buying	[19,49,66–71]
Network Diffusion	• Misinformation on platforms like Twitter significantly increased hoarding during the COVID-19 pandemic. • Social media amplifies panic buying by spreading uncertainties and insecurities, information on product scarcity, authorities' messages, and expert opinions, leading to collective stockpiling behavior.	[30,35,72–79]
Individual Psychology	• Fear of scarcity is a main factor resulting in panic-buying behavior. • High-insecurity individuals show higher hoarding propensity. • Exposure to online information about COVID-19 leads to information overload and cyberchondria, which, in turn, increase intentions to self-isolate and engage in unusual purchasing behavior.	[26,35,44,74,75,80–86]

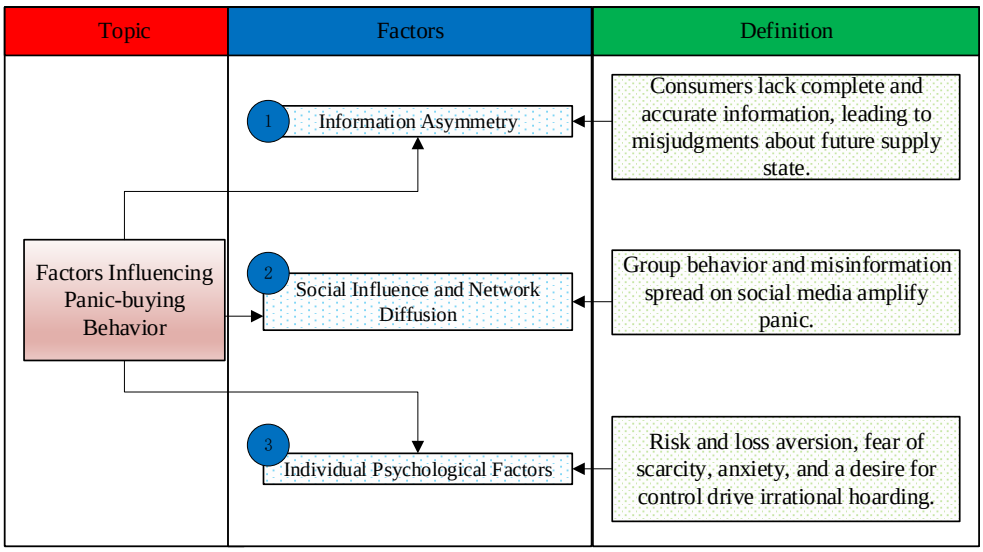


Figure 5. Factors affecting consumer panic-buying behavior.

4. Supply Chain Management Under Consumer Panic-Buying Behavior

4.1. How Does Supply Chain Strategy Affect Consumer Behavior?

Supply chain operational strategies such as product design, product quality, pricing strategies, inventory strategies, distribution channels, and return policies all impact consumer purchase behavior. In the context of panic buying, supply chain strategies influence consumer behavior through multiple mechanisms, including the asymmetry of price transmission, adaptive shifts in consumption channels, the regulatory effect of psychological expectations, and the buffering role of changing market structures. From the perspective of consumer behavior, the studies of Jothilingam and Kalaivani [87] and Stewart [88] highlight that the COVID-19 pandemic accelerated the shift toward online shopping, making inventory integration and delivery efficiency critical factors in curbing panic-driven demand. Rahman et al. [89] argues that supply instability in the supply chain weakens consumers' trust in the market and affects their long-term consumption behavior. Ref. [90] further revealed that inventory integration strategies can achieve a better match between supply and demand. Qi et al. [91] found that when consumers perceive a high level of inventory availability due to integration, they may be more inclined to delay purchases and wait for discounts, thereby altering their purchase timing. However, during periods of surging demand, the increased visibility of integrated inventory may paradoxically intensify panic buying, prompting consumers to stockpile goods in advance. The "online-visibility paradox" during panic buying stems from two key factors. First, consumers have a general lack of trust in the disclosed information when in a panic situation, undermining its intended calming effect and distorting purchasing decisions [81]. Moreover, when consumers perceive disclosed inventory levels as low, their fear of scarcity is sharply amplified, which, in turn, exacerbates rash buying behavior [85,92]. In general, supply chain strategies impact consumers' willingness to pay and their purchase behavior. In addition, consumers often consider two key decision-making risks: one is "action regret", that is, the psychological gap caused by the fact that the actual value of the product is lower than expected, and the second is "regret for inaction", that is, the opportunity-cost anxiety caused by them missing purchase opportunities [27].

4.2. How Does Consumer Behavior Affect Supply Chain Management?

Consumer behavior critically governs supply chain operations, shaping product development, production processes, and logistics systems. Shifting consumption preferences

generate demand volatility, necessitating recalibrations across demand planning, stock control, procurement strategies, and distribution infrastructure [93,94]. In a rational stockpiling situation, the price forecasting behavior of strategic consumers can smooth the fluctuation of demand by adjusting the purchase opportunity [95]. In contrast, panic hoarding is an irrational surge in demand, which breaks the conventional demand pattern and leads to fluctuations between demand and supply chain levels far exceeding the normal level [49]. Gupta et al. [23] investigated how the COVID-19 pandemic affected inventory and impulsive purchasing behavior among Indian consumers, revealing that the pandemic significantly impacted consumer behavior, influencing supply chain management and efforts to reduce consumer fear and anxiety. Roos et al. [61] introduced a framework for analyzing the impacts of panic buying on the supply chain, showing that products with inflexible production and postponed consumption, such as toilet paper and canned goods, were most severely affected by hoarding-induced bullwhip effects. Wang et al. [96] demonstrated that when consumers exhibit moderate price sensitivity, the bullwhip effect is significantly reduced. This suppression is particularly pronounced for goods with elastic demand. In panic-buying scenarios, consumers' fear of shortage may lead to higher price sensitivity and abnormal price fluctuation, which makes traditional forecasting models invalid. In addition, consumers' multi-period price dependence, where demand is influenced by historical pricing, and differences in channel loyalty, with some consumers remaining loyal to offline channels and others choosing online channels due to loss aversion, compel supply chains to adjust their forecasting models, such as by adopting linear or elastic demand frameworks. Zhang et al. [27] reveal that consumers' loss aversion leads to heightened sensitivity to inter-channel price disparities, driving them toward the lower-priced channel and creating a "price gap externality". In response, manufacturers may employ vertical restraints to widen price gaps and stimulate purchases, for example, by imposing minimum retail prices. Loss-averse consumers are highly sensitive to price disparities and tend to concentrate their purchases of non-perishable goods through online channels [97,98]. This behavior not only exacerbates inventory imbalances in offline channels but also introduces vertical coordination challenges within the supply chain due to the "externality of channel price differentials" [27]. Meanwhile, Ma et al. [99], examining consumer preferences for information transparency in supply chains, highlighted that blockchain technology can significantly enhance supply chain transparency regarding product quality.

4.3. An Example of Interaction Between Supply Chain Management and Consumer Behavior During the COVID-19 Pandemic

The COVID-19 pandemic inflicted unprecedented disruptions on global supply chains, affecting the entire process, from raw material procurement to final delivery. Following the outbreak, market demand patterns underwent dramatic shifts–demand for non-essential goods such as fashion apparel and automobiles plummeted, while demand for essentials like food, pharmaceuticals, masks, and personal protective equipment (PPE) surged [45].

Amid abrupt market volatility, the global supply network's core elements–procurement streams, consumption patterns, manufacturing operations, stock reserves, logistics flows, and delivery infrastructure–collectively encountered cascading disturbances. Manufacturers struggled to rapidly adjust production to accommodate extreme demand fluctuations [100]. Against the backdrop of raw material shortages, many firms failed to effectively scale up production, while consumer panic buying of high-demand goods further exacerbated supply–demand imbalances. For instance, concerns over supply shortages led consumers to hoard essential goods such as toilet paper, resulting in widespread market shortages [101]. Simultaneously, retail enterprises experienced significant reputation damage stemming from fulfillment failures during demand surges [102]. In the long run, COVID-19 had a

profound impact on the resilience and overall performance of global supply networks [26]. Lockdown policies triggered panic buying of basic necessities, yet supply chain systems struggled to respond effectively due to a lack of accurate dynamic demand forecasting, technological support, and robust infrastructure [103]. Rahman et al. [104] pointed out that supply chain managers failed to fully account for the pandemic's unique disruptive nature, creating significant challenges for supply chain recovery.

Despite the surge in demand for PPE (e.g., masks and hand sanitizer) and hygiene products, like toilet paper, some manufacturers attempted to ramp up production. However, large-scale factory shutdowns worldwide imposed substantial shortages on supply chains [105]. Moreover, the economic recession triggered by the pandemic further intensified operational pressures on businesses, leading to rising operational costs, increased debt burdens, and even liquidity crises. Consequently, many firms were forced into permanent closure, resulting in widespread unemployment and severe long-term damage to corporate reputations [106].

In crisis scenarios, the interaction between supply chain management and consumer behavior exhibits a complex and dynamic relationship. Panic buying, as a typical external shock, exacerbates supply chain vulnerability through irrational stockpiling driven by fear. In an attempt to mitigate uncertainty, consumers engage in excessive purchasing of essential goods, leading to demand forecasting failures, inventory imbalances, and the propagation of the bullwhip effect upstream in the supply chain. This, in turn, triggers raw material shortages and logistical breakdowns, setting off a chain reaction of disruptions. The vicious cycle created by such behavior not only intensifies product shortages and price volatility but also exposes fundamental weaknesses in traditional supply chains, particularly their reliance on just-in-time production and a lack of resilience buffers. At the same time, supply chain disruptions and information opacity further reinforce consumer anxiety, creating a self-perpetuating feedback loop of "panic buying–>supply chain disruption–>escalated panic". This phenomenon underscores critical challenges in crisis management and the need for enhanced supply chain resilience. Figure 6 illustrates the interaction between supply chain management under supply disruption risk and consumer behavior.

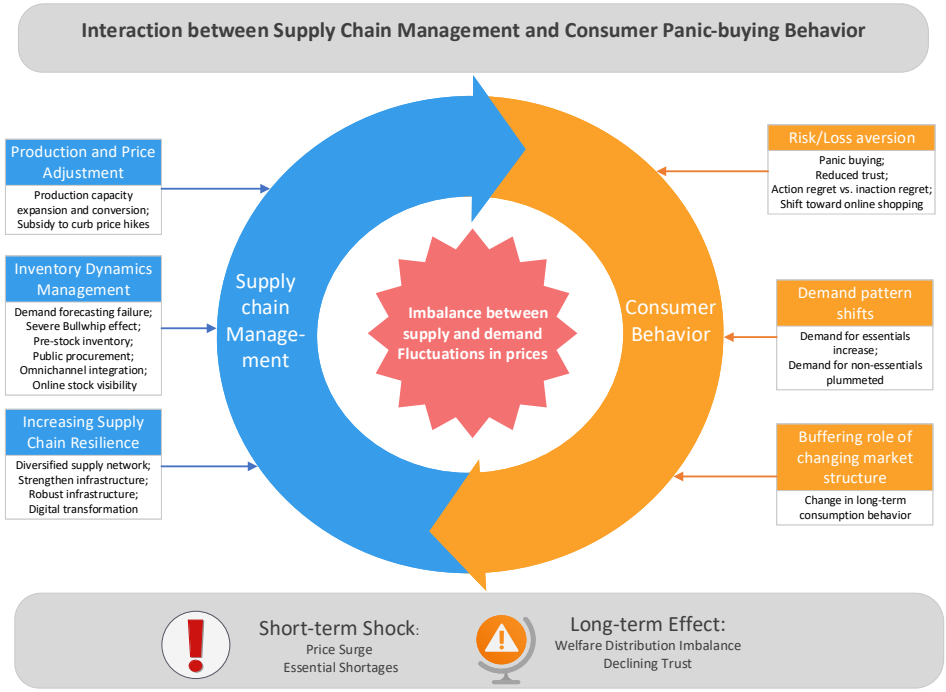


Figure 6. Interaction between supply chain management and consumer panic-buying behavior.

4.4. Supply Chain Management Strategies for Responding to Consumer Panic-Buying Behavior

During periods of panic buying triggered by emergencies, supply chain management strategies must dynamically adjust to nonlinear shifts in consumer behavior [107]. The following strategies for managing consumer panic-buying behavior are proposed based on the causal factors.

4.4.1. Strategies to Alleviate Consumers' Panic Psychology

Intervening in consumers' perceived loss of control from a psychological perspective is an effective long-term strategy. Based on Compensatory Control Theory (CCT), Barnes et al. [108] suggested that anxiety-induced feelings of loss of control drive compensatory hoarding behaviors. Therefore, providing alternative control mechanisms, such as encouraging participation in community support activities or enhancing individual self-efficacy through public health education, can reduce irrational purchasing behaviors. Liren et al. [109] proposed guiding consumers toward rational decision making through product labeling and informational campaigns. For instance, placing reminders such as "Purchase As Needed" on product packaging leverages psychological cues and information design to alleviate panic buying. This approach offers businesses and governments a low-cost, easily implementable intervention strategy. Additionally, Dulam et al. [42] developed a model demonstrating that short-term panic buying exhibits a "self-reinforcing" effect. They suggested that government-led public messaging –such as emphasizing the adequacy of supply –can break this psychological cycle and restore consumer confidence. Nguyen et al. [110] elucidated how AI-driven emotion decoding and sentiment analytics enhance demand prediction amid supply chain crises. Their examination of unstructured media streams demonstrated AI's capacity to mitigate panic purchasing through effective response mapping and precision intervention design. Transparent communication within the supply chain, such as real-time inventory information sharing, along with the implementation of purchase restrictions, can effectively alleviate consumer panic. Government interventions, including authoritative information dissemination and policy regulation, play a crucial role in reducing public anxiety and curbing panic-buying behavior. Barnes et al. [108], drawing on Compensatory Control Theory (CCT), found that official government announcements significantly reduce consumers' perceived loss of control, thereby decreasing hoarding tendencies. For instance, during the early stages of the COVID-19 pandemic, the Italian government's policy statements helped reassure the public, indirectly mitigating anxiety-driven purchasing behavior. In their study on hoarding behavior following the Great East Japan Earthquake, Kurihara et al. [111] found that excessive media emphasis on product shortages exacerbated panic, creating a vicious cycle of "panic–stockpiling–shortages". To prevent such escalation, governments and businesses must collaborate with media outlets to ensure objective reporting of supply conditions and avoid fueling unnecessary anxiety. Keane and Neal [112] highlighted that the real-time nature of social media can amplify panic effects, recommending the use of algorithmic filters to suppress misinformation while promoting authoritative data. Octaviani et al. [113] found that citizens' trust of governments can alleviate their anxiety during crisis and help curb panic buying.

4.4.2. Supply Chain Elasticity and Inventory Management

Supply chain flexibility and inventory management are crucial strategies for addressing panic buying [15,16,114–120]. Tsao and Raj [121] proposed two key approaches to balancing supply and demand during supply chain disruptions. First, product substitution strategies can enhance inventory flexibility, such as by repackaging bulk items into smaller units to accommodate varying consumer needs. Second, customer segmentation mechanisms allow businesses to prioritize order fulfillment for high-value customers, ensuring

optimal inventory allocation. This approach not only maximizes profitability but also mitigates panic-driven demand among lower-priority customers. Similarly, Dulam et al. [42] validated the effectiveness of quota policies through agent-based modeling. Their findings suggest that implementing purchase limits on essential goods, such as toilet paper, during a pandemic can prevent the self-reinforcing cycle of stockpiling and shortages, thereby stabilizing the market and reducing supply chain fluctuations. Herbon and Kogan [122] examined panic buying during crises, finding that manufacturer-led subsidies (to retailers or consumers) often fail to curb price hikes, as retailers adjust prices to offset discounts. Rahman et al. [89] predicted and proposed four strategies to optimize the supply chain during demand fluctuations, including flexibly adjusting the production capacity according to demand fluctuations, determining the optimal reordering points and order sizes through the use of an optimization model, dynamically adjusting inventory strategies, and optimizing distribution networks. Paul and Chowdhury [26] constructed a mathematical framework for optimizing production recovery strategies for high-demand and essential items during the COVID-19 crisis. Having multiple optional suppliers in a supply chain is also an important measure for coping with supply chain disruptions. For example, Prentice et al. [46] point out that governments can encourage diversified supply networks to reduce dependence on a single supplier. Gurnani et al. [9] propose that enterprises should establish an emergency purchasing network so that when the main supplier has a problem, the enterprise can quickly switch to backup suppliers. Jain et al. [123] demonstrated that while supplier diversification extends post-disruption restoration periods, cultivating long-term supplier alliances significantly shortens recovery cycles. Yoon et al. [50] analyzed how retailers adapt sourcing strategies in response to consumer stockpiling behavior when the retailer sells different substitutable products, while Tsao et al. [124] examined the impact of panic buying on retailers' optimal ordering quantities when they sell different substitutable products. In addition, several studies have proposed production conversion and expansion strategies for building resilient supply chains in times of emergency [125–127]. These strategies often include conversion of the production location, production line, storage, usage, distribution channels, and workforce skills, as well as digital transformation.

4.4.3. Government Intervention and Retailer Intervention

In addition to flexible supply chain control and inventory management, government policies and retailer measures are also essential in dealing with consumer panic buying; these work together to alleviate market imbalances and maintain social stability [4,128,129]. First of all, the government can control panic buying through price control, the use of emergency reserves, public procurement, and by releasing authoritative information. Gurnani et al. [9] pointed out that, in response to consumer panic-buying behavior, the government should implement price control measures to combat price gouging to prevent price fluctuations from exacerbating consumer panic. Joong Lee and Zhang [129] found that public procurement of face masks and essential hygiene products by governments can effectively mitigate panic buying. Arafat et al. [44] suggested that it is possible to establish a government—wholesaler cooperative emergency stockpile to plan the distribution of critical supplies in advance to ensure rapid supply after a disaster. Song et al. [25] studied the Bayesian persuasion problem with a signal sender, such as a retailer or government, for the management of consumer panic-buying behavior through signal release under supply disruption risk. Schmidt et al. [55] developed a dynamic model of consumers' purchase decisions under future supply disruption risk and proved that rational anticipation of a future supply shock can trigger panic buying, as consumers stockpile goods to avoid scarcity, leading to cascading excess demand and welfare losses. They propose that government provision of additional units during the shock can deter stockpiling and improve social welfare.

Calderon et al. [130] investigated the potential of trusted change agents (TCAs) to mitigate disaster-related buying behaviors (DRBBs) during the COVID-19 pandemic by encouraging consumers to limit their purchases of critical supplies. Using survey data from 1433 U.S. residents and advanced modeling techniques, the study identified firefighters, emergency responders, and health officials as the most trusted agents. It further demonstrates that appeals from these TCAs—particularly when combined—could persuade over 58% of respondents to restrict their purchasing, highlighting a practical strategy for alleviating shortage-inducing behaviors during crises.

At the retailer level, they can directly intervene in the market through demand-side dynamic regulation. Retailers can guide consumer behavior by restricting purchases, adjusting prices, preparing inventory in advance [24,131,132], implementing return policies, improving online supply chain capabilities, and developing digital platforms. For example, Prentice et al. [46] pointed out that retailers can respond to consumer panic buying through three measures. First, for high-demand products (e.g., toilet paper and disinfectant), implementing single-piece purchase restrictions (e.g., a limit of two packages per person) can alleviate the pressure of shortages in the short term. Second, they can reasonably adjust the price when the demand surges to balance the supply and demand but need to avoid the vicious circle of "panic –> price increase –>more panic" [10]. The third is to adjust the return policy to limit non-essential returns and reduce inventory waste. Similarly, Arafat et al. [44] suggest that retailers can implement single-item purchase limits while enhancing online supply chain capabilities to cope with demand shifts. Keane and Neal [112] state that large retailers can respond to initial demand surges by stocking additional inventory of key consumer goods in advance or restricting the number of items purchased, thereby preventing consumer panic at the earliest stage. Zheng et al. [19] proposed that retailers can take the impact of the social learning effect into account when preparing inventory in the situation of consumer panic buying. Through an empirical analysis, Lopez-Salido et al. [133] confirmed that limited price increases can effectively mitigate demand surge during a supply disruption crisis. Zheng et al. [10] proposed and compared the effectiveness of price increases and fixed quota policies for the management of consumer panic-buying behavior, finding that when consumers are in a middle level of panic, a price-increase policy outperforms a fixed quota policy, while if consumers are in very intense panic, retailers should implement a fixed quota policy to limit consumers' panic buying. In addition, Prentice et al. [46] proposed an innovative strategy of digitization and precision services, arguing that an online platform can be developed to provide inventory information, which can be used to guide consumers to stagger their purchases, thereby reducing the pressure of concentrated rush purchases, in addition to prioritizing the needs of vulnerable groups (e.g., the elderly and healthcare workers) by monitoring inventory levels in real time [134]. Gurnani et al. [9] also point out that companies can use data-driven methods to improve the accuracy of demand forecasting, thereby reducing consumer panic buying triggered by information asymmetry. Table 6 summarizes common strategies for managing consumer panic buying. Figure 7 further illustrates the relationships between key influencing factors and the corresponding supply chain strategies during supply disruptions.

Table 6. Summary of supply chain management strategies to intervene during panic buying.

Strategy	Concrete Measures	Sample References	Situations
Psychological Intervention and Calm Restoration	Encourage community engagement to enhance self-efficacy.	[108]	Panic buying driven by feelings of loss of control.
Transparency and Rational Guidance	Use "Purchase As Needed" labels to nudge behavior.	[109]	
	Publish information accurately and transparently.	[42,108]	
	Avoid media rumors of shortages.	[111]	Real-time information spreading on social media, causing panic buying.
	Encourage consumers to limit their purchases of critical supplies through the use of trusted agents, such as firefighters.	[130]	
Flexible Supply and Adjustments	Dynamic production capacity adjustment.	[21,89,135]	Low price elasticity of demand.
	Production conversion and expansion; digitization.	[125,126]	High emergency demand.
	Taking trans-shipment actions.	[127]	Demand surge in specific areas.
Priority Management	Customer segmentation for priority access.	[121]	Consumer behavior shows differentiation; protect disadvantaged groups.
Logistics and Supplier Networks	Build emergency procurement channels.	[9,136]	Disaster prevention and post-disaster recovery period.
	Diversify supplier networks to reduce dependency risks.	[46]	
Government Actions	Implement price controls during crises.	[9]	For high-demand products where market mechanisms fail.
	Establish joint emergency reserves.	[44]	Disaster prevention and post-disaster recovery period. Information asymmetry.
	Issue authoritative supply chain statements.	[25,108]	
	Increase public procurement.	[129]	
Retailer Measures	Adopt dynamic pricing and real-time inventory platforms.	[10,46]	High demand and consumers' perceived risk.
	Pre-stock key goods to curb early panic.	[19,112]	In times of disaster warning or at the early stage of occurrence, demand forecasting is easy, and products are easy to store.
	Implement purchase limits or quotas.	[10,137]	Demand is surging, inventory is insufficient, and panic is intense.

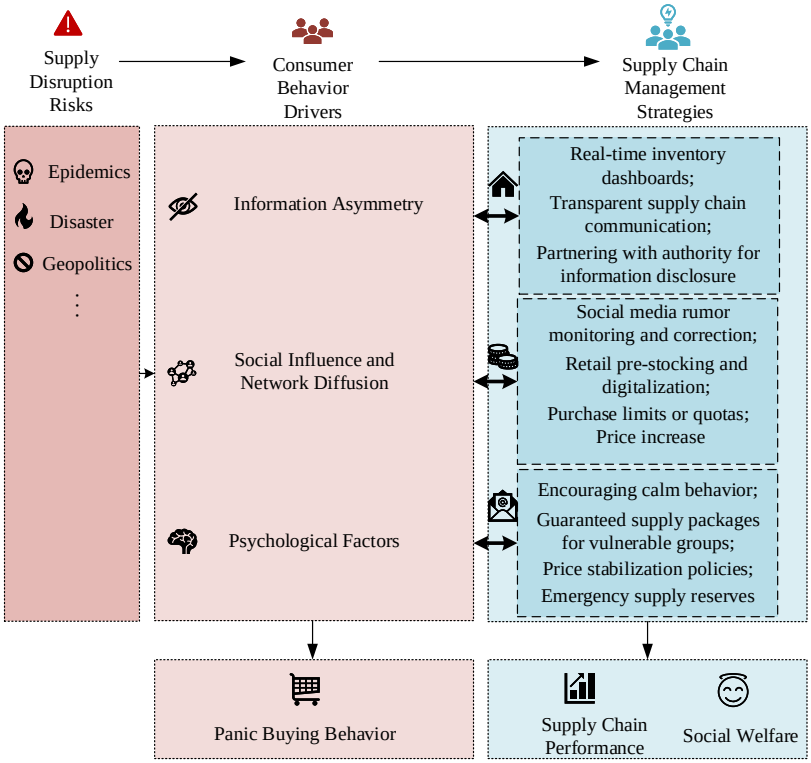


Figure 7. Supply chain management strategies under supply disruption risks and panic buying.

5. Impact of Panic Buying on Supply Chain Performance and Social Welfare

5.1. Impact of Panic Buying on Supply Chain Performance

Sudden demand surges often cause irreversible short-term damage to supply chain performance. Rahman et al. [89] found that panic buying leads to a significant increase in shortage costs, discount costs, inventory costs, and transportation costs in the supply chain. In the face of consumer panic buying, retailers and suppliers need to constantly adjust their orders to replenish their stocks on an emergency basis, which raises their costs of holding [138]. In addition, panic buying may lead to a surge in demand that exceeds the production and transportation capacity of the supply chain, leading to shortages. Furthermore, delays and uncertainty in supplier deliveries to retailers lead to backlogs or out-of-stocks, making it difficult for retailers to manage their inventories and ultimately making them susceptible to overstocking or under-ordering, which can directly increase costs [139]. Sometimes, it is difficult for enterprises to respond quickly to changes in consumer demand, resulting in a lack of supply chain flexibility, logistics disruptions, and exacerbation of the vulnerability of the supply chain [51], leading to a significant increase in the overall cost of the supply chain. Similarly, Sterman and Dogan [139] demonstrated that panic buying triggers a surge in orders, which increases upstream order volatility and exacerbates the bullwhip effect. This effect, as noted by Ovezmyradov [138], increases inventory costs and supply chain instability, thereby degrading overall performance. This dynamic is further intensified when supplier capacity constraints lead to delivery delays and product shortages, and the resulting scarcity prompts competitive hoarding, creating a vicious cycle that amplifies the bullwhip effect even further [138]. Chua et al. [45] showed that panic buying can lead to a significant reduction in supply chain performance due to price uncertainty triggered by consumer competition and demand surge. The price of some commodities is inflated, which can alleviate some of the cost pressures on retailers, but excessive stockpiling of perishable products is prone to waste, increasing production resources and energy consumption, which, in turn, raises the production cost and results in a net loss to society. Lim et al. [140] analyzed the impact of panic buying on retailers' revenue using real supermarket sales data. Their findings demonstrated that an increase in the number of new COVID-19 cases had a positive and significant effect on supermarket and grocery store revenue.

5.2. Impact of Panic Buying on Consumer Welfare

Consumers are both the initiators of panic buying and the ultimate bearers of its consequences. When individuals participate in panic buying to avoid the risk of shortage, their decision making is often caught in the paradox of "individual rationality" and "collective irrationality" [22]. Some studies suggest that a moderate initial panic intensity optimizes consumer decisions and social welfare through a moderate quantity of stockpiling, while excessive panic causes retailer stock-outs, resource misallocation, and loss of social welfare (see, e.g., [10,21]). However, other studies argue that panic buying is invariably detrimental to social welfare (see, e.g., [39,55]). These divergent findings can be attributed to differences in research contexts and model specifications. Social anxiety and psychological stress induced by panic buying can also further reduce consumer welfare [138]. Hoarding behavior leads to the off-sale of essential supermarket products, and prices rise due to the imbalance between supply and demand [114], increasing the cost of purchases for consumers [89]. Moreover, during product shortages, price increases or purchase restriction policies may result in consumers not being able to access essential goods, with a particularly significant impact on low-income earners [138]; therefore, panic-buying behavior can exacerbate social inequality by depriving others of access to goods. Chua et al. [45] also found that consumers

may overpay for non-essential goods or waste them due to excess inventory, which also increases their economic costs. Dulam et al. [42] found that products being out of stock leads to consumers being forced to adjust their purchasing behavior (e.g., multiple attempts at different stores), which also increases consumers' monetary and time costs. Sheu and Choi [141] found that retailers following a low-degree proactive hoarding strategy benefits both the retailers and society by mitigating price volatility and enhancing expected profits.

5.3. Interaction Between Supply Chain Performance and Consumer Welfare

The interaction between supply chain performance and consumer welfare is not a unidirectional causality but is embedded in the cycle of "panic → shortage → repeat panic". Chua et al. [45] show that supply chain disruptions trigger panic buying by consumers, which further exacerbates the pressure on inventories and creates a cycle of "shortage → rush to buy → more shortage", where consumers' uncertainty about future supply drives their hoarding behavior, which leads to an imbalance in supply chain resource allocation, thereby forming a vicious cycle. Rahman et al. [89] found that consumer panic-buying behavior leads to retailer inability to predict demand, which further distorts their supply chain decision making, resulting in higher product costs. These high cost pressures are transmitted to end-user prices, which reduces consumer welfare, and consumer panic and supply chain vulnerability reinforce each other, creating another cycle. The impact of panic buying on the supply chain and consumer welfare presents a complex, two-way interlocking effect. At the supply-chain level, demand surges amplify order volatility and intensify the bullwhip effect, forcing firms to bear excess inventory costs and contingency logistics premiums. At the same time, panic buying triggers resource mismatches, such as the waste of perishables, which contributes to a net loss to society. For consumers, individual rational decisions (e.g., avoiding shortages) lead to collective irrationality. Price inflation and shortages of necessities increase the economic burden, while the collapse of trust caused by social media anxiety and supply chain disruptions further erodes psychological well-being, and disadvantaged groups face greater inequality due to resource deprivation. Table 7 summarizes the impact of panic buying on supply chain performance and consumer welfare. Figure 8 illustrates some interesting aspects of supply chain management under supply disruption risk and consumer panic buying.

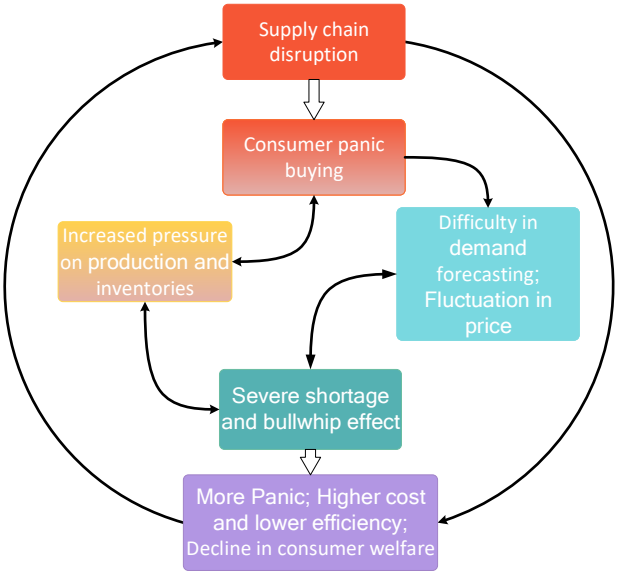


Figure 8. Supply disruption risk and panic buying.

Table 7. Impacts of panic buying on supply chain performance and consumer welfare.

Dimension	Specific Impacts	Concrete Expression	References
Supply Chain Performance	Reduced efficiency	Demand –response lags. Obstructed global circulation.	[45,51]
	Cost increase	Rising shortage costs, inventory costs, and transportation costs. Increased bullwhip effect.	[89,138,139]
	Resource mismatch	Overstocking leads to waste of resources; irrational demand leads to waste of energy and raw materials.	[45,89]
Consumer Welfare	Economic burden	Price increases. Additional cost increases. Wasteful spending.	[42,89,114]
	Psychological pressure	Social anxiety spreads to fuel panic. Consumers' long-term trust in markets collapses.	[51,89]
	Social inequality	Difficulty in accessing necessities for disadvantaged groups. Policies (limiting purchases/high prices) disproportionately affect low-income populations.	[45,138]
Two-way Interaction Mechanism	The "shortage→ rush→shortage" cycle; the "panic →shortage→ repeat panic" cycle	Supply chain disruptions trigger consumer panic buying, further exacerbating inventory pressures.	[45]
	Interaction between stocking, pricing, and panic buying	Adjusting price may balance the supply and demand but need to avoid the vicious circle of "panic –> price increase –>more panic". Active stockpiling may temporarily ease supply pressures, but excessive stockpiling prolongs recovery times.	[10,89]

6. Discussion

6.1. A Comprehensive Analysis of Supply Chain Disruptions, Consumer Panic Buying, and Mitigation Strategies

This study provides a comprehensive and structured examination of the intricate relationship between supply chain disruptions, consumer panic buying, and their subsequent effects on supply chain performance and consumer welfare. The systematic review reveals that supply chain disruptions stemming from natural disasters, pandemics, or other unforeseen events significantly influence consumer behavior, precipitating panic buying and stockpiling. This behavior, driven by factors such as information asymmetry, social influence, network diffusion, psychological uncertainties, and decision biases caused by risk and loss aversion, not only exacerbates supply –demand imbalances but also leads to increased costs, inventory mismanagement, and reduced supply chain efficiency. To mitigate these effects, an integrated approach combining supply-side, demand-side, and socio-behavioral strategies is essential. On the supply side, enhancing structural and operational flexibility through measures such as dynamic capacity adjustment, inventory buffering, strategic reservations, logistics optimization, and supplier diversification can significantly improve a system's ability to absorb shocks. On the demand side, interventions including purchase restrictions, transparent information dissemination, and calibrated pricing are crucial to curb irrational purchasing. Furthermore, incorporating behavioral insights –such as by encouraging community engagement to restore a sense of control and implementing customer segmentation for priority access –can directly address the psychological roots of panic buying. The development of digital supply chain platforms also plays a key role, offering real-time visibility and coordination for more responsive crisis management. Ultimately, this study underscores the value of integrated strategies that combine operational improvements with behavioral insights. Effective management during disruptions requires not only robust supply chain design but also proactive policy and communication measures that address the psychological drivers of panic buying.

6.2. Complex Impact of Panic Buying on Consumer Welfare and Supply Chain Performance

Our review highlights the complex and multifaceted impact of panic buying, which creates a vicious cycle that interlinks supply chain performance and consumer welfare. This dynamic is characterized by a self-reinforcing feedback loop: supply chain disruptions trigger consumer panic, which, in turn, exacerbates inventory pressure, creating a cycle of "shortage → rush to buy → more shortage". On the consumer side, the quest for short-term security through hoarding paradoxically leads to long-term detriment. It fuels price inflation and product shortages, increasing economic burdens and forcing consumers to incur additional monetary and time costs. Moreover, these disruptions exacerbate social inequality, as disadvantaged groups are often disproportionately deprived of access to essential goods. This situation exemplifies a profound social paradox where individually rational hoarding decisions lead to collectively irrational outcomes, ultimately reducing overall social welfare. While some studies suggest a moderate level of panic might optimize decisions in specific contexts, the prevailing evidence indicates that panic buying typically results in a net societal loss through resource misallocation and the waste of perishable goods. Therefore, breaking this vicious cycle is critical to enhancing both supply chain resilience and consumer welfare.

6.3. Limitations and Future Research Avenues

This systematic review offers a comprehensive synthesis of the literature on supply chain management strategies in the context of consumer panic buying during supply disruptions; however, several limitations should be acknowledged. First, the review primarily focuses on strategic and operational responses, with limited in-depth analysis of specific mathematical models, simulation approaches, or empirical validations that quantitatively evaluate the effectiveness of such strategies. Second, the literature search was conducted primarily in English-language databases (Web of Science, ScienceDirect, and Google Scholar), which may have resulted in the omission of relevant studies published in other languages or in regional databases. Thus, future research should prioritize the development and validation of analytical models such as stochastic inventory models, agent-based simulations, or game-theoretic frameworks to quantitatively assess intervention policies like dynamic pricing, quota systems, and inventory sharing. Additionally, there is a need to explore the integration of digital technologies like AI and blockchain for real-time demand sensing and transparent communication during crises. Cross-cultural comparative studies and interdisciplinary collaborations combining behavioral science and supply chain modeling will also be essential to advance theory and practice in building panic-resilient supply systems. Finally, future interdisciplinary collaborations could conduct research that integrates insights from behavioral science (e.g., the psychological drivers of panic buying) with supply chain modeling to build systems that are resilient to panic buying. These avenues will advance theory and practice by addressing existing gaps in quantitative rigor, technological application, cultural generalizability, and methodological integration. Table 8 outlines the proposed future research directions.

Table 8. Future research directions in panic buying and supply chain management.

Research Gap	Specific Direction	Recommended Methods
Quantitative Model Validation	Develop and validate analytical models to assess intervention policies (e.g., stochastic inventory models for shortage cost analysis, agent-based simulations for demand estimation, and game-theoretic frameworks for pricing–quota trade-offs)	Mathematical modeling combined with empirical data calibration; simulation and optimization
Digital Technology Integration	Leverage AI for real-time demand forecasting during panic spikes and blockchain to enhance supply chain transparency and trust among stakeholders	Agent-based simulation integrating IoT data; case studies of pilot implementations in retail or manufacturing sectors
Cross-cultural Comparative Studies	Compare panic buying thresholds, behavioral drivers (e.g., loss aversion), and policy effectiveness across diverse cultural and regulatory contexts	Multi-country survey data; comparative case studies controlling for exogenous factors
Interdisciplinary Collaboration	Integrate behavioral science with supply chain modeling to design behavior-aware inventory and pricing strategies	Mixed methods combining laboratory experiments, system dynamics modeling, and optimization

Author Contributions: Conceptualization, methodology, writing—original draft preparation, writing—review and editing, supervision, project administration, and funding acquisition, R.Z.; Methodology, validation, formal analysis, data curation and software, writing—review and editing, and visualization, B.G. and S.Y.; Writing—review and editing, supervision, project administration, and funding acquisition, K.K.L. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

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