PANIC BUYING: HUMAN PSYCHOLOGY AND ENVIRONMENTAL INFLUENCE

EDITED BY: S. M. Yasir Arafat, Sujita Kumar Kar and Russell Kabir

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PANIC BUYING: HUMAN PSYCHOLOGY AND ENVIRONMENTAL INFLUENCE

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Editorial: Panic Buying: Human Psychology and Environmental Influence

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Editorial on the Research Topic

Panic Buying: Human Psychology and Environmental Influence

Panic buying (PB) is an emerging Research Topic. During this COVID-19 pandemic, it has got attention even though it has been noticed since a long time back during the crises (1, 2). Although there are several challenges newer studies have been coming out during this COVID-19 pandemic exploring several aspects of PB (1, 2). This Research Topic was aimed to highlight the different perspectives of panic buying comprehensively as much as possible which in turn can be used as a reference point for stakeholders. We targeted to discuss its historical perspectives, psychological explanations, sociological aspects, marketing dimensions, economics, supply chain management, industrial buying behavior, regional distributions and variation, disaster and emergency preparedness, the role of digital and social media, and preventive strategies. To our best knowledge, it is the first of its kind to approach organizing the possible thoughts on different perspectives of panic buying which would be useful for policymakers to prevent as well as manage panic buying incidents in future events if such an emergency arises.

As an issue, PB has got the recent attention of the academics and research community (1). It is defined as a "phenomenon of a sudden increase in buying of one or more essential goods in excess of regular need provoked by adversity, usually a disaster or an outbreak resulting in an imbalance between supply and demand" (3). Usually, it starts after an adverse environmental stimulus such as disaster, war, policy change; people buy necessary goods in excess amounts and creates a supply-demand imbalance (Arafat et al.; Arafat et al.). We proposed a complex interaction between several factors mentioned as primary, secondary, and tertiary factors (Arafat et al.) (**Figure 1**). As per our proposed *environmental stimuli and human psychology interaction* model adverse stimuli is the primary event to start PB behavior (Arafat et al.). One study replicated the concept that assessed PB in Bangladesh both in COVID-19 and non-COVID-19 context (Arafat et al.). The study revealed that the PB events in Bangladesh were precipitated by adverse environmental stimuli; identified that the people buy staples; and describe the implemented prevention strategies (Arafat et al.). Another study from China assessed the relationship of scarce consumption behavior with materialism and the need to belong during public health emergencies (Jin et al.). The study identified that the severity of the emergency event is positively associated with materialism, scarce consumption, and the need to belong even though the effect is transient (Jin et al.). This phenomenon is also explained by the *environmental stimuli and human psychology interaction* model. During this COVID-19 pandemic, adherent, and dysfunctional safety behaviors mediate the consumption pattern (Weismüller et al.). Mass media

FIGURE 1 | Environmental stimuli and human psychology interaction model [Adapted from (Arafat et al.)].
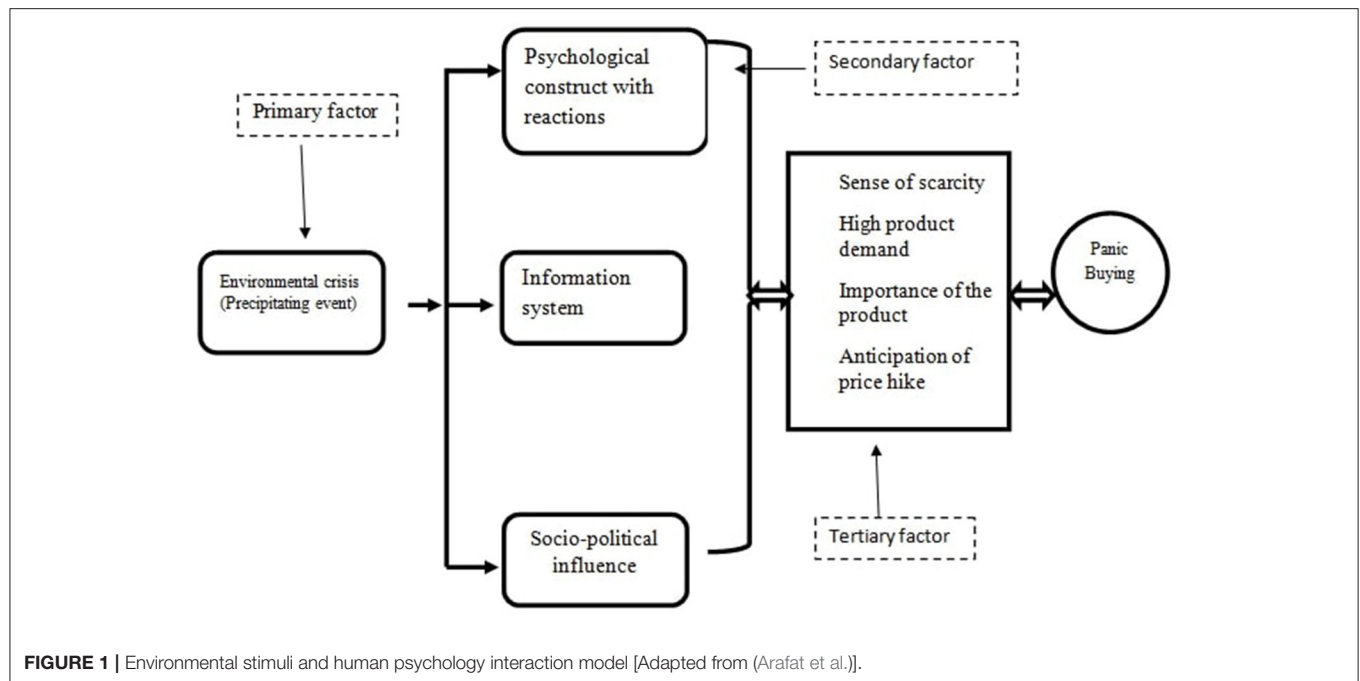
communication and long-term trust in the government affect safety behaviors during public health emergencies (Weismüller et al.). These factors also affect the PB behavior in several aspects and fit with the *environmental stimuli and human psychology interaction* model (Arafat et al.). It has also been explained from the perspective of certain behavioral and psychodynamic explanations (Cooper and Gordon). Supply restriction results in the generation of negative emotions in the consumers, which in turn result in PB behavior. Rajkumar, had attempted to explain the panic buying behavior from the perspective of the bio-psycho-social model. Biologically the panic buying behavior has a resemblance with the compulsive and hoarding phenomenon which might be due to shared neurobiological factors. Psychological explanation of panic buying might be explained on the basis of attachment to objects. The attachment becomes very crucial at the time of scarcity of the object. From the social perspective, panic buying can be understood. As per this, social exclusion and lack of social support are associated with excessive buying and stocking (Rajkumar). Group panic buying has also been reported during this COVID-19 pandemic. The propagation model to a greater extent explains the PB behavior (Fu et al.). The spread of negative information (both on online platforms and offline forums) evokes panic among people, compelling them to panic buying (Fu et al.). A study from the Iraqi Kurdistan region has revealed that lack of sensibility in social media posts may increase panic buying behavior (Arafat et al.). It has been seen that individuals

who have more pandemic-related health fears and those who experience intense stress due to scarcity of products and restrictions in their availability are more likely to involve in panic buying (Georgiadou).

Still, there remains controversy that, whether panic buying should be considered as a diagnosable entity (i.e., pathology) or a normative behavior in its extreme at the face of stress (i.e., contextual phenomenon). This phenomenon is poorly studied in past; however; there is extensive research during this COVID-19 pandemic, to understand the phenomenon. The collection of this Research Topic still identifies that prevention of PB has got little attention despite being a common incidence during public health/environmental emergencies. More articles are coming out discussing the theoretical and phenomenological aspects whilst ignoring the prevention aspects. As PB is a closely related event of a public health emergency, prevention of PB should be considered as a regular package of emergency preparedness. Without the prevention of PB, the distressed people during public health emergencies wouldn't be benefitted. Then, all the scientific efforts would seem meaningless.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Responsible Factors of Panic Buying: An Observation From Online Media Reports

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Background: Panic buying is an erratic human behavior that has been reported irregularly and episodically. There is a dearth of studies exploring the identifiable factors accounting for it. We aimed to identify the factors responsible for panic buying extracted from online media reports.

Methods: We scrutinized the media reports published in English discussing the different aspects of panic buying. We collected data until May 30, 2020, and searched the possible mentioned reasons responsible for panic buying.

Results: We analyzed a total of 784 media reports. The majority of the reports were found in Bing (18%), Ecosia (12.6%), Google (26.4%), and Yahoo (12.5%). Panic buying was reported in 93 countries. Among the 784 responses, a total of 171 reports did not explain the responsible factors of panic buying. Therefore, we analyzed the remaining 613 reports to identify the same. A sense of scarcity was reportedly found as the important factor in about 75% of the reports followed by increased demand (66.07%), the importance of the product (45.02%), anticipation of price hike (23.33%), and due to COVID-19 and its related factors (13.21%). Other reported factors were a rumor, psychological factors (safety-seeking behavior, uncertainty, anxiety reduction, and taking control), social learning, lack of trust, government action, and past experience.

Conclusions: The study revealed the responsible factors of panic buying extracted from media reports. Further, studies involving the individuals indulging in panic buying behavior are warranted to replicate the findings.

Keywords: panic buying, media report analysis, content analysis, COVID-19, pandemic

INTRODUCTION

Panic buying (PB) is an erratic human behavior that has been reported irregularly and episodically; however, PB has been reported since long before and appeared especially during a major emergency event (1–3). It has been noticed and reported in online media during this COVID-19 pandemic in several countries in the world (1, 4, 5). It has been explained as "the phenomenon of a sudden

increase in buying of one or more essential goods in excess of regular need provoked by adversity, usually a disaster or an outbreak resulting in an imbalance between supply and demand" (4). A group of authors speculatively described it as a manifestation of underlying conflict and uncertainty during the pandemic, a way of coping with a stressful condition, gaining control, and social pressure to conform to alike behaviors (5). Theoretically, few mental processes have been discussed such as the perception of scarcity of necessary goods, way to gaining control, uncertainty, insecurity, herd behavior, primitive behavior, media influence, and lack of confidence in authorities (6). A recent systematic review also revealed some psychological factors responsible for PB mentioned such as (a) perceived threat and scarcity of the goods, (b) fear of the unknown resulting from negative emotions and uncertainty, (c) coping behavior such as anxiety reduction and gaining control, and (d) social–psychological issues (7). Singh and Rakshit mentioned PB as herd behavior (8) and Tsao et al. mentioned supply chain disruption (9). Again, Chen et al. (2) described that disturbed judgments resulting from improper information during a crisis are responsible for PB where authors tried to explain it with economics and psychology theories. The endowment effect and commodity and prospect theories have been proposed to explain PB based on economics (2). Additionally, the authors hypothesized three mental processes mentioning autonomy, relatedness, and competence as attributing factors for PB (2).

Although newer studies are coming out, there is a dearth of empirical studies exploring the identifiable factors responsible for it. However, there are also challenges to studying the phenomenon systematically as it is erratic, irregular, episodic, sudden, unpredictable, and mostly happens during emergency situations (10). Interestingly, PB is a newsworthy issue and has been frequently reported (1, 4). Therefore, we aimed to evaluate the responsible factors of PB extracted from online media reports.

MATERIALS AND METHODS

Study Setting and Data Collection

This was a prospective analysis of 18 internet search engines (**Table 1**), all of which were identified a priori by the team of investigators. Three different investigators equally divided the search engines and simultaneously carried out the search using only the term "panic buying"; no combination was used to minimize missing media report that discussed PB. We scrutinized the media reports published in English discussing the different aspects of PB with special attention to attributable factors of it. We searched and collected data from 1 to 31 May 2020 in *Google Form*. Data were collected from any report from the media covering the blogs, personal views, opinions, and news. We excluded social media posts as social media posts are more of personal views and very often emotionally biased. People may post/repost things that are trending just to appear active online without really understanding its impact. Conformity bias and groupthink could act as other sources of potential biases. Subsequently, two other investigators did

TABLE 1 | Search details.

Search engine	n	%
Aol.com	28	3.6
Baidu	6	0.8
Bing	141	18.0
Duckduckgo	36	4.6
Ecosia	99	12.6
Exalead	11	1.4
Excite	13	1.7
Gigablast	4	0.5
Google	207	26.4
Lycos	3	0.4
Mojeek	8	1.0
Qwant	9	1.1
Startpage.com	52	6.6
Swisscows	28	3.6
Webcrawler	13	1.7
Yahoo	98	12.5
Yandex	14	1.8
Yippy	14	1.8
Total	784	100

cross-checks of the data and data cleaning. Duplications were checked and removed by tracing the date of publication and title of the reports. Data collectors were well trained through frequent Zoom meetings by the team of investigators before starting the study. Doubts on whether to include a report were sorted out by mutual discussion with a senior author (SMYA, SKK). In case they were unable to reach an agreement, the issue was resolved by involving all authors in a group discussion. The above methodology was adapted from previous media-based studies on PB that used a single keyword search strategy (1, 4).

The Instrument

Based on the existing literature (3, 5, 6) and our previous works (1, 4), the team formulated the questionnaire through the Zoom meeting. The instrument had two sections consisting of (a) the identification section and (b) the attributed factors section. The identification section comprised the name of the country from where the report was published, the name of the country to which the report referred, type of newspaper, name of the newspaper, dates of publication, and the primary scarce object for PB. All the reports were scrutinized by careful reading, and all the mentioned attributable factors were identified and documented in the second section. We aimed to identify all the possible factors and the majority of the reports discussed several factors.

Statistical Analysis

We used simple descriptive statistics (frequency and percentages) to depict extraction such as the number of relevant reports identified from different search engines as well as various reasons for PB. A word cloud analysis was used to summarize

FIGURE 1 | Flow chart showing study sample selection.
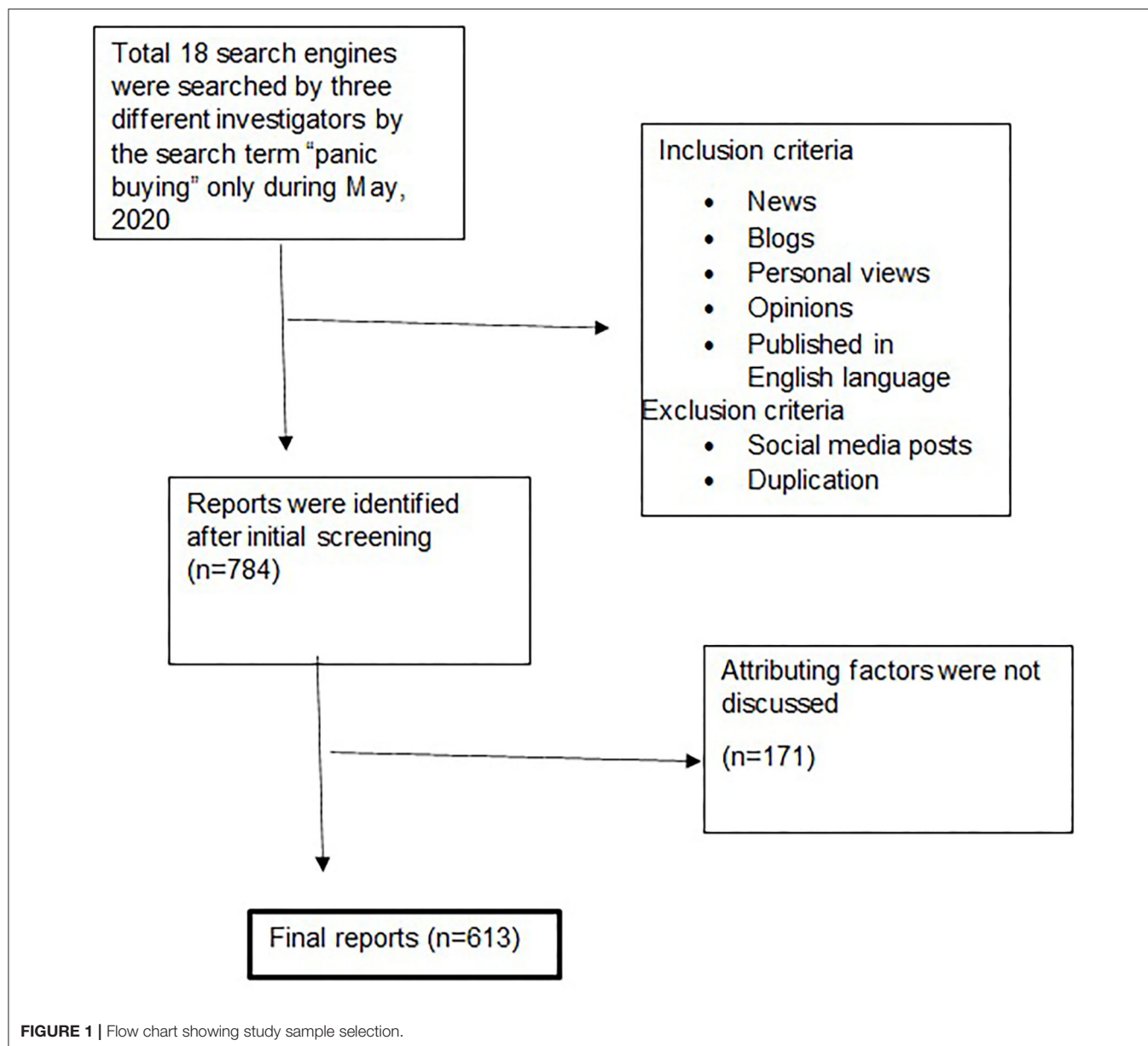
search results in terms of frequency of PB reports from different countries.

Ethics Statement

The study was conducted complying with the declaration of Helsinki (1964). As we analyzed the publicly available media reports, no formal ethical approval was obtained.

RESULTS

We analyzed a total of 784 media reports (**Figure 1**). The majority of the reports were found in Bing (18%), Ecosia (12.6%), Google (26.4%), and Yahoo (12.5%) (**Table 1**). PB was reported in 93 countries (**Figure 2**). Among the 784 responses, a total of 171 reports did not explain the responsible factors of PB. Therefore,

we analyzed the rest 613 reports to identify the responsible factors of PB. We considered extracting as many as possible attributing factors from the contents. Therefore, a single report had multiple responses when the factors were segregated. A sense of scarcity was reportedly found as the important responsible factor of PB that was found in about 75% of the reports ($n = 456$) followed by increased demand (66.07%), the importance of the product (45.02%), anticipation of price hike (23.33%), and due to COVID-19 and its related factors (13.21%). The rumor was mentioned as responsible factors in 53 reports (8.65%). We considered safety-seeking behavior ($n = 5$), uncertainty ($n = 6$), anxiety reduction ($n = 24$), and taking control ($n = 15$) as psychological factors, which constituted 8.16% ($n = 50$) of reports. Other reported factors were social learning, lack of trust, government action, and past experience (**Table 2**).

FIGURE 2 | Word cloud showing countries reporting panic buying behavior.

TABLE 2 | Reasons of panic buying (*n* = 613).

Reasons of PB	*n*	%
Scarcity	456	74.39
Increased demand	405	66.07
Necessary goods	276	45.02
Anticipated price hike	143	23.33
COVID-19, lockdown, planned,	81	13.21
Rumor	53	8.65
Psychological	50	8.16
Social learning	15	2.45
Lack of trust	6	0.98
Government's action	6	0.98
Past experience	3	0.49
Total	613	100

DISCUSSION

PB is a contemporary issue with a dearth of empirical studies regarding the responsible factors behind the behavior. We aimed to evaluate the responsible factors of PB extracted from online media reports. The study revealed that PB has been reported in 93 countries. Previous studies reported the distribution of the countries; however, none of the studies mentioned such wide distributions (1, 2, 4, 5).

The study revealed several responsible factors, i.e., a sense of scarcity, increased demand, the importance of the goods, the anticipation of price hike, COVID-19 pandemic, rumor, safety-seeking behavior, uncertainty, anxiety reduction, taking control, social learning, lack of trust, government action, and past experience as the responsible factors for PB (**Table 2**). A high rate attribution was mentioned in reports among few factors such as perceived scarcity (75%), increased demand (66%), the importance of the product (45%), and anticipation of price hike (23%). The COVID-19 pandemic and related issues were attributed to about 13% of the reports. The rumor was mentioned as responsible factors in 53 reports (8.65%). A recent systematic review identified the factors grossly in four domains, namely, perception, fear of the unknown, coping strategy, and psychosocial factor (7). The authors also subdivided the gross areas into different parts. Others mentioned the responsible factors as a mismatch between routine work and uncertainty, coping strategy, gaining control, social learning, and supply chain disruption (5, 8, 9). It can also be due to any perceived or real external threat and/or own nervousness (11).

Perceived scarcity has been mentioned repeatedly by different groups of authors as an important responsible factor for PB (2, 6, 7). However, perception of threat and/or perception of risk have also been mentioned as a factor that has not been found in the current study (3, 7). We speculate that there might have been some overlaps between the perception of risk and our included psychological factor, which covers safety-seeking behavior, uncertainty, anxiety reduction, and taking control.

The second most important attributing factor has been identified as increased demand that was mentioned in about 66% of the responses. It is quite interesting, and it could be a result rather a causative factor because in a normal equilibrium, the demand should not be increased until an adverse and/or precipitating event occurs. It can be explained by taking consideration of the proposed definition by Arafat et al. (4). The phenomenon starts with a sudden increase in buying precipitated by adversity, usually a disaster or an outbreak resulting in a shortage of supply (4). The supply shortage can precipitate the rise of demand (9). Furthermore, the shortage of necessary goods is widely circulated by the media, which in turn creates insecurity,

uncertainty, and more PB. Therefore, increasing demand can be explained by the precipitating events and results of the dissemination of shortage news.

The third important identified factor is the importance of the product that has been attributed to about 45% of the reports. It is quite plausible because PB mostly happens in cases of essential goods that are supposed to be used in the immediate future. Previous studies also mentioned similar factors (4, 5).

The fourth important identified factor is the anticipation of the price hike that was attributed to about 23% of the reports. A complex interaction should be warranted in case of anticipation of price hike, because the precipitating event such as the COVID-19 pandemic, perception regarding the supply chain, media propagation, rumors, and personal experience may have interaction to bear the perception of price hike (2).

Other responsible factors are the COVID-19 pandemic, rumor, safety-seeking behavior, uncertainty, anxiety reduction, taking control, social learning, lack of trust, government action, and past experience as the responsible factors for PB (**Table 2**). All the factors could explain the previous explanations (2–7, 12–14).

FIGURE 3 | Causal model of panic buying.
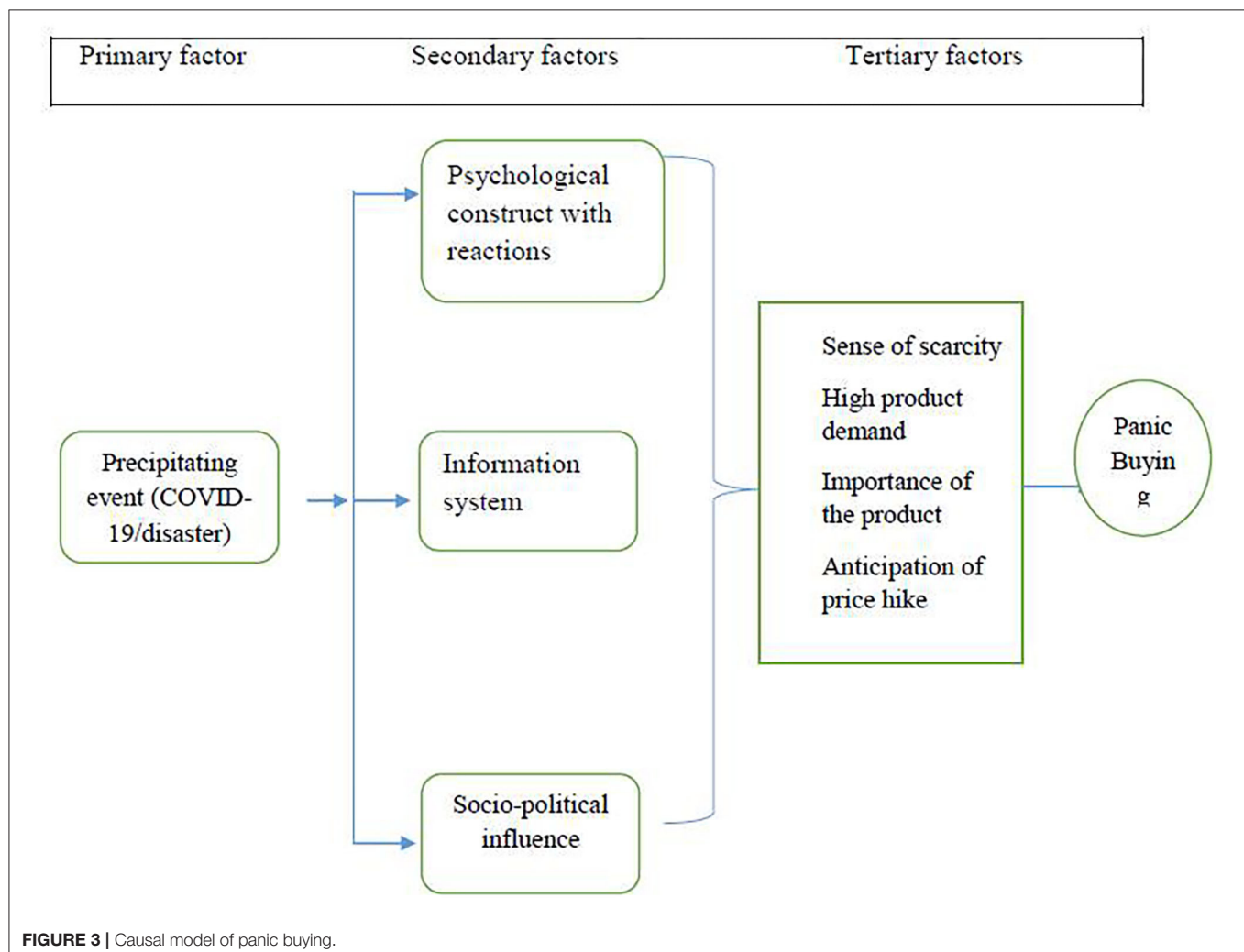
Here, we theorized the adverse or precipitating event as the primary causative factor; psychological construct with reactions, social structure, and information system are the secondary factors; and subsequently, other factors such as sense of scarcity, increased demand, the importance of the product, and anticipation of the price hike are the tertiary factors (**Figure 3**). There is a complex constant interaction between the primary, secondary, and tertiary factors.

Strengths of the Study

There is a dearth of empirical studies exploring different aspects of PB. To the authors' best knowledge, this is the first empirical study exploring the responsible factors of the behavior.

Limitations

The current study has several limitations. Everyone should be aware of the scientific quality of data as we analyzed any sort of media reports that may not be considered as scientific data. We also included only media reports published in English and excluded reports published in other languages. We only searched with a single keyword, "panic buying," without considering the synonyms, which may reduce the number of reports.

CONCLUSION

The study revealed the factors responsible for PB extracted from media reports, which include a sense of scarcity, increased demand, the importance of the product, the anticipation of price hike, COVID-19, rumor, psychological factors (safety-seeking behavior, uncertainty, anxiety reduction, taking control), social learning, lack of trust, government action, and past experience.

The extracted factors can be theoretically explained based on the previous reports revealing a complex interaction among a precipitating stimulus, personality construct, and environmental influences. Practically, adequate actions targeting the reasons could be beneficial for the prevention of PB. Preparedness for future episodes should have a special focus on the identified factors to reduce the panic among the general population. Further, empirical studies involving the individuals indulging the PB behavior are warranted to replicate the findings and/or nullify it. Qualitative studies could be a potential option to explore the psychological aspects responsible for the behavior.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study was conducted complying with the declaration of Helsinki (1964). As we analyzed the publicly available media reports, no formal ethical approval was obtained.

AUTHOR CONTRIBUTIONS

SA contributed to the idea, concept, design, data analysis, and writing. SK and RK contributed to the concept. VM contributed to concept, design, and writing. AA-M, SM, and CK contributed to the data enumeration. All authors contributed to the article and approved the submitted version.

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The Impact of COVID-19 and Public Health Emergencies on Consumer Purchase of Scarce Products in China

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Objectives: During public health emergencies, people often scramble to buy scarce goods, which may lead to panic behavior and cause serious negative impacts on public health management. Due to the absence of relevant research, the internal logic of this phenomenon is not clear. This study explored whether and why public health emergencies such as the COVID-19 pandemic stimulate consumers' preference for scarce products.

Methods: Applying the questionnaire survey method, two online surveys were conducted on the Credamo data platform in China. The first survey was launched in February and collected psychological and behavioral data from 1,548 participants. Considering the likelihood of population relocation due to the pandemic, a follow-up survey was conducted in August with 463 participants who had participated in the first survey and had not relocated to other cities between February and August. The hypotheses were tested with these data through stepwise regression analysis, bootstrapping, and robustness testing.

Results: Pandemic severity was found to positively affect scarce consumption behavior and the effect was found to be situational; this indicates that the impact of the pandemic on scarce consumption was only significant during the pandemic. Further, it was found that materialism plays a mediating role in the relationship between pandemic severity and scarce consumption. Finally, the need to belong was found to play a moderating role between pandemic severity and materialism.

Conclusion: This study findings imply that the scarce consumption behavior during public health emergencies can be reduced by decreasing materialism and increasing the need to belong. These findings may aid government leaders in managing public health emergencies.

Keywords: public health emergencies, COVID-19, scarce consumption, materialism, need to belong, China, panic buying

INTRODUCTION

The COVID-19 pandemic is a global public health emergency characterized with high infectivity, a high mortality rate, and a long incubation period. It affects people's psychology and behavior intensively. One of the most typical behavior during the COVID-19 pandemic is panic buying, which refers to the behavior of buying unusually large amounts of products based on the need of coping with public health emergency (1). Although panic buying has appeared worldwide, there is a dearth of empirical studies explaining it (2). Many scholars pointed out it is important to discuss panic buying from the perspective of psychology; loss of control, insecurity, social learning, and fear of scarcity may become the core factors that cause panic buying, providing a good inspiration for panic buying research (3, 4).

Given that panic buying is a complex behavior, with multiple psychological foundations, an accurate understanding and management of panic buying requires an in-depth analysis from different psychological perspectives (4, 5). Prior research from various social learning perspectives showed that in social existence, people sometimes measure the intensity of the crisis through the reaction of those that surround them. Faced with a crisis, they tend to behave in consistence with the behavior of others to cope with external shocks, which is described as conformity consumer behavior in the field (6). Research, from the perspective of decision-making mode, shows that in times of emergency, people will indulge in behaviors necessary for survival, which may lack rational thinking and lead to impulsive panic buying (7).

In fact, significant characteristics of scarce consumption (SC)—a preference for panic buying goods that are rare and only available in limited quantities—also have been observed. For example, Japanese residents anticipated that "paper products would be in short supply due to the pandemic." As a result, they began to irrationally purchase toilet paper rolls, which caused their prices to skyrocket by a factor of 10, and they immediately went out of stock (8). Similarly, in the United States, "limited supply" or "sold out" signs on food, water, and cleaning products compelled residents to buy these items, resulting in shortages, and even social conflicts (9, 10). Due to scarcity of masks, many Chinese residents recklessly chose informal channels to purchase masks, resulting in increased fraud cases and flow of unsafe masks into the market, thus making pandemic prevention efforts even more difficult (11). For these cases, the purchase was due to scarcity rather than for pandemic prevention, as the purchase quantity surpassed the actual need; these behaviors caused a substantial panic, which negatively impacted public health management. Although SC has already exhibited significant characteristics and studies have shown that the perception of scarcity is closely related to panic buying behavior (3, 12), there have been limited research conducted from the perspective of scarcity, causing a lack of sufficient explanation for why a pandemic could cause a frantic pursuit of scarce products and how to ease panic behavior related to scarcity.

Current research tends to believe that perceived scarcity would motivate individuals to engage in panic buying due to psychological reactance and anticipated regret. Research based on the reactance theory found that health crises are likely to threaten or restrict people from buying products. Such signals will stimulate psychological resistance, which in turn will increase people's attention to products and cause panic buying (13, 14); those based on the anticipated regret theory indicates that people may regret not making panic purchases due to perceived scarcity, aiming to avoid this kind of uncomfortable feeling they will increase scarce consumption (15). Although these studies do show that scarcity and panic buying are inextricably linked, reactance and anticipated regret are broader theories, which means that they may also be applicable to the pursuit of scarce resources in other contexts. Therefore, it is necessary to conduct research on panic buying from a contextual perspective (5). In response, from a new theoretical perspective, we propose a research model of scarce consumption based on terror management theory, materialism theory, and need to belong theory, which is more suitable for panic-buying in the context of a public health crisis, aiming to explore whether and why the COVID-19 pandemic has stimulated SC, thereby enriching the research on panic buying and providing reference for crisis-response and public health emergency management.

HYPOTHESIS

Scarce Consumption in Public Health Emergencies

The COVID-19 pandemic is a typical public health emergency—unpredictable and threatening. Furthermore, due to its sudden and unexpected occurrence, resources required to deal with this external threat could not be prepared sufficiently in time. Consequently, it triggered negative feelings such as death anxiety, insecurity, and fear concerning resource scarcity (16, 17). These are all uncomfortable feelings that people desire to reduce or compensate for through a series of defensive behaviors (18). Consumption is an important defensive behavior. Although this kind of behavior does not help solve actual dilemmas, it may help people cope with threats from a psychological perspective. For instance, people have opted for conformity consumption during the COVID-19 pandemic to obtain a sense of belonging and security from the group, thereby alleviating inner fear (6). Therefore, in public health emergencies, behavior is not only affected by the actual needs related to the emergencies, but also by the psychological need to alleviate negative feelings; previous studies have indicated that SC can alleviate negative psychology. The scarcity of an item (decreased quantity and limited access) can symbolize it as precious and even increase the perceived value of almost all available similar items, especially when they convey desirable attributes (19). Compared with other types of consumption, SC can compensate more for feelings associated with lack of resources, and even alleviate insecurity (20). Therefore, this study speculates that the COVID-19 pandemic may affect SC, which increases with the pandemic severity (PS).

Hypothesis 1 (H1): Pandemic severity positively affects the scarce consumption behavior.

As SC is generated by a psychological need to alleviate negative feelings caused by a public health emergency, the effect in Hypothesis 1 is situational. Once a pandemic eases and people are less affected by external threats, they no longer desire to alleviate negative feelings through SC. Hence, the following hypothesis is proposed:

Hypothesis 2 (H2): After the pandemic eases, the effect of pandemic severity on scarce consumption behavior will diminish.

Materialism

Materialism (MA) is a value that is placed on the importance of possessing material wealth in life (21). Individuals with strong MA tend to be more self-centered and their focus in life is on the pursuit of material wealth with the intent of deriving pleasure and happiness (22). There are many causes of MA, including childhood poverty experiences (23), social learning (24), and insecurity (25). Fear of death is also a major source of MA (26). Terror management theory asserts that individuals usually activate the self-esteem defense mechanism after facing the threat of death. Possessing material wealth may be an effective way to boost self-esteem (27). By possessing material wealth, individuals can also enhance the sense of life's meaning and reduce death anxiety (24). Therefore, fear of death can stimulate MA to act as a buffer and to protect the mental health. The COVID-19 pandemic exposed people to a sudden threat of death, increasing fear, insecurity, and anxiety; to reduce these uncomfortable feelings, people increased their materialistic tendencies. The following hypothesis is proposed:

Hypothesis 3 (H3): Pandemic severity positively affects materialism.

Consumption is a significant behavior where individuals obtain material resources, and those with strong MA tend to consume more to meet various inner needs (28), even excessively (29). They typically pay more attention to valuable products (30) and find it difficult to resist the enticement of valuable attributes (31) Compared with ordinary goods, scarce goods contain more economic and emotional value (19). Therefore, driven by MA, people are more likely to be enticed by scarce goods. The following hypothesis is proposed:

Hypothesis 4 (H4): Materialism positively affects scarce consumption behavior.

The need to cope with threats from the COVID-19 pandemic, such as the threat of death, can stimulate MA (24, 27). When MA is stimulated, people are more eager to pursue valuable goods (30, 31); they may indicate a preference for scarce goods that contain more economic and emotional value. Therefore, the following hypothesis is proposed:

Hypothesis 5 (H5): Materialism can play a mediating role between pandemic severity and scarce consumption behavior.

Need to Belong

The terror management theory also asserts that people further cope with the threat of death by enhancing close relationships (32). Establishing and maintaining close relationships with others, seeking togetherness, intimacy, attachment, and affiliations alleviate the anxiety associated with death. Therefore, individuals demonstrate various coping mechanisms when faced with threats. To enhance security and reduce risks, individuals may increase their own resources by acquiring and possessing material wealth or obtaining resources or emotional attachments from others by seeking close relationships. The former will enhance the pursuit of wealth and status, while the latter will enhance social and altruistic tendencies (33). During the COVID-19 pandemic, people have adopted various methods to cope with the threat. Some prefer to acquire material possessions, while others seek close relationships to strengthen their unions and social support systems by increasing contact with relatives, donating, participating in social assistance, and other pursuits.

Baumeister and Leary (34) defined the need to belong (NTB) as a basic social necessity for forming and maintaining interpersonal relationships. Establishing contact with others or integrating into a group not only offers objective support, such as survival resources and group shelter, but also psychological support, such as emotional attachment and security (35). Compared with those with weak NTB, people with strong NTB generally have a stronger need to establish contact with others or integrate into groups. They are more active in enhancing social connections (36) and are more inclined to comply with social norms (37). Faced with a pandemic, people with strong NTB will more likely opt to enhance close relationships as a coping mechanism, while people with a weak NTB will more likely opt to obtain material resources that enhance MA and SC. Therefore, we hypothesize that NTB can reduce the impact of PS on materialism:

Hypothesis 6 (H6): Need to belong can play a moderating role between pandemic severity and materialism.

Based on above hypotheses, a psychological mechanism model for public health emergencies affecting irrational consumer behavior is proposed, as shown in **Figure 1**.

MATERIALS AND METHODS

Participants and Procedure

Credamo is a professional data platform with a sample database of more than 1.5 million participants, which can provide large-scale data collection services and has been recognized by international top journals in the fields of psychology, management, sociology, and environmental science. We used it to conduct two online survey in China, one during the pandemic and one after the pandemic eased.

In the first survey, Credamo randomly distributed questionnaires in 31 provinces of China (excluding Hong Kong, Macao, and Taiwan) according to a quota of about 50 copies in each province. The survey lasted from February 15 to February 20, 2020 to covering 1,548 participants from 31 provincial-level administrative regions (excluding Hong Kong, Macao, and Taiwan) and 297 prefecture-level cities, which could accurately and comprehensively describe the psychology and behavior of Chinese citizens during the pandemic. The data was used to empirically test whether and why PS can affect SC during the COVID-19 pandemic.

FIGURE 1 | Theoretical model.
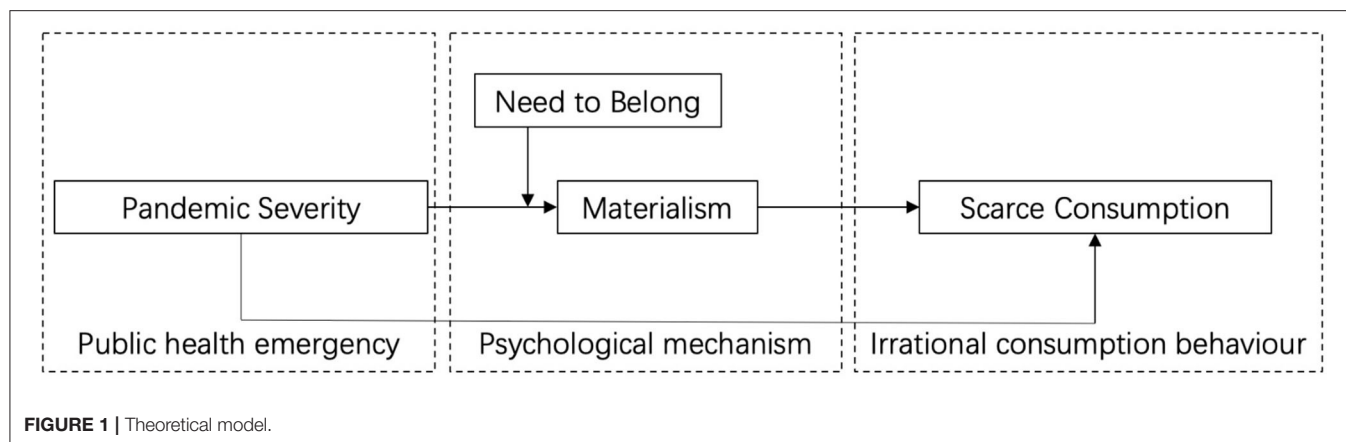
TABLE 1 | Demographic information ($N = 1,548$).

Items	Options	Sample	Percentage %	Items	Options	Sample	Percentage %
Gender	Male	863	55.7	Monthly income	<3,000RMB	546	35.3
	Female	685	44.3		3,000–6,000RMB	777	50.2
Education level	High school or below	362	23.4		6,000–10,000RMB	159	10.3
	Bachelor	1,046	67.6		>10,000RMB	66	4.3
	Master or above	140	9	Monthly expenses	<1,000RMB	344	22.2
Age	<25	731	47.2		1,000–3,000RMB	551	35.6
	25–40	716	46.3		3,000–5,000RMB	465	29.5
	>40	101	6.5		>5,000RMB	197	12.7

To verify that the impact of PS on SC was only pertinent during the pandemic, we conducted a follow-up survey after the pandemic eased. As the COVID-19 pandemic had eased in China by August 2020, with practically no emerging cases, we distributed a follow-up survey lasting from August 3 to August 6, 2020. Considering that participants who moved location may be affected again by the pandemic severity in a new location, we used Credamo to randomly distribute the questionnaire to 500 participants who participated in the first survey, whose location had not changed between February and August. Out of these, 463 questionnaires were filled out and submitted, giving a recovery rate of 92.6%.

The questionnaire has passed the audit of Credamo, which guaranteed that it would not cause negative psychological effects on participants. As for the consent of participation, only those who agreed and volunteered to participate in surveys will access the questionnaire and corresponding remuneration. At the beginning of the questionnaire, we once again emphasized that "the survey results are only used for academic research, and the personal privacy of participants will be protected. If you agree and are participating voluntarily, start answering questions; if you disagree or are unsure, please exit." Besides, to ensure the validity of the questionnaire, we set up test items to assess whether participants would input the answers carefully. Questionnaires that failed this test were not included in our database. **Table 1** shows the demographic information of the database.

Measure

The PS varied in different Chinese cities; therefore, we considered measuring it using official pandemic indicators issued by the National Health Commission of the People's Republic of China for different regions, namely "the cumulative number of confirmed cases per city" and "the number of new confirmed cases per city." Among these official indicators, "the cumulative number of confirmed cases per city" focus on the cumulative dimensions and seems to be more suitable for reflect the current situation of the pandemic than "the number of new confirmed cases per city," which concentrate on the growth dimensions. Therefore, the former was used to reflect pandemic severity for hypothesis testing, while the latter was used for robustness testing. Therefore, we select them to measure pandemic severity, which not only meets the needs of diverse sources of indicators but is also very representative. Specifically, in the first survey, we recorded the dates when participants submitted the questionnaires and the cities where they lived. Then, we searched for the official pandemic indicators in the same timeframe and same places and included these data in the database to match the corresponding psychological and behavior data.

To measure SC, we designed a three-item scale based on the research by Sharma and Alter (20), as no SC scale in the unique context of a pandemic has been developed yet. The results were as follows: In the first and second survey, the Cronbach's alpha was 0.823 and 0.865, respectively. To measure MA, we used an

TABLE 2 | Fitting indexes of competition models ($N = 1,548$).

Model	χ^2	df	χ^2/df	NFI	IFI	TLI	CFI	RMSEA
Three-factor model	161.634	132	1.225	0.983	0.997	0.996	0.997	0.012
Two-factor model 1	2,319.579	134	17.310	0.752	0.763	0.729	0.763	0.103
Two-factor model 2	2,794.010	134	20.851	0.702	0.712	0.670	0.711	0.113
Two-factor model 3	2,807.056	134	20.948	0.700	0.711	0.669	0.710	0.114
One-factor model	3,619.073	135	26.808	0.614	0.623	0.572	0.622	0.129

Three-factor model is NTB, MA, SC. Two-factor model 1 is NTB+MA, SC. Two-factor model 2 is NTB, MA+SC. Two-factor model 3 is NTB+SC, MA. One-factor model is NTB+MA+SC.

eight-item scale adapted from Richins (21) and used by Okazaki et al. (38); in the first and second survey, the Cronbach's alpha was 0.859 and 0.860, respectively. To measure NTB, we used a ten-item scale adapted from Leary et al. (39); in the first and second survey, Cronbach's alpha was 0.659 and 0.798, respectively. All measurements used a 5-point Likert scale with endpoints labeled "strongly agree" and "strongly disagree."

We also measured gender, age, education level, monthly income, monthly expenses, household size, outing frequency, and degree of social isolation. As these variables may affect SC, they were used as control variables. Among them, the gender variable was dummy coded (female = 0); income, expense, and household size were logarithmised to reduce heteroscedasticity.

RESULTS

Confirmatory Factor Analysis

Considering the sample's large size, which could cause chi-square expansion, we used the Bollen-Stine bootstrapping technique (5,000 bootstrapping samples) for correction (40). The fitting indexes of the measurement model in **Table 2** showed that the three-factor model had the best fitting indexes and that all indexes met the eligibility criteria. The constructs in this study are independent of each other and have good discrimination validity.

Common Method Biases

The common method bias is widely used in psychology and behavioral science research to eliminate systematic errors that arise due to similarity in the data source, measurement environment, project context, and characteristics of the project itself. We used Harman's single factor test to conduct factor analysis on all variables. The variation of the unrotated first factor was 24.52%, which is less than the critical standard of 40% and less than half of the total variation (55.06%). This variation indicated that the common variance is well-controlled.

Correlation Analysis

Pearson's correlation coefficient was used to examine potential associations between the study variables. Results showed that SC correlated significantly with PS ($r = 0.123$, $p < 0.001$), MA ($r = 0.386$, $p < 0.001$), and NTB ($r = 0.183$, $p < 0.001$). Both MA ($r = 0.094$, $p < 0.001$) and NTB ($r = 0.060$, $p < 0.05$) correlated significantly with PS, indicating potential associations between the variables.

Hypothesis Tests

Analysis of Main Effect

We used the cumulative number of confirmed cases as an indicator to measure PS and built regression Models 1–2 to verify whether the main effect is established and whether it is situational. Results showed that PS had a significant positive impact on SC during the pandemic ($\beta = 0.109$, $p < 0.001$), but when the pandemic eased, PS had no significant influence on SC ($\beta = 0.008$, $p = 0.792$), indicating that PS only positively affects SC during the pandemic (see **Table 3** for details).

Therefore, H1 and H2 were verified. Pandemic severity can positively affect the scarce consumption behavior. When the pandemic becomes more serious, scarce consumption behavior will become stronger. However, the effect will diminish after the pandemic eases, indicating that it is situational.

Analysis of Mediating Effect

By applying the regression analysis method proposed by Baron and Kenny (41), we built Models 3–5 to test the mediating role of MA between PS and SC. Results showed that PS had a significantly positive impact on MA ($\beta = 0.111$, $p < 0.001$), which had a significantly positive impact on SC ($\beta = 0.352$, $p < 0.001$). After the addition of MA, PS had a significant impact on SC ($\beta = 0.070$, $p < 0.01$) indicating that MA played a partially mediating role between PS and SC during the pandemic (see **Table 3** for details).

Following Preacher et al. (42), we used a bootstrap procedure to re-verify the mediating effect. We calculated a 95% confidence interval (CI) of the total, direct, and indirect effects through 5,000 sampling. If the CI was not zero, this mediating effect was verified as significant. Results showed that the CI of the total effect ($\beta = 0.063$, 95% CI: 0.032–0.094), indirect effect ($\beta = 0.023$, 95% CI: 0.012–0.034), and direct effect ($\beta = 0.040$, 95% CI: 0.012–0.069) were not zero, indicating that MA actually played a partial mediating role between PS and SC during the pandemic.

Therefore, H3–H5 were verified. Pandemic severity can positively affect materialism and materialism can positively affect scarce consumption behavior. Pandemic severity will affect scarce consumption behavior by affecting materialism, resulting materialism plays a mediating role between pandemic severity and scarce consumption behavior.

Analysis of Moderating Effect

We built regression Models 6–10 to analyze the moderating effect of NTB between PS and MA. We centralized all variables to

TABLE 3 | The result of stepwise regression analysis (N = 1,548).

Variable	SC						MA			
	Model 1	Model 2	Model 3	Model 6	Model 7	Model 8	Model 4	Model 5	Model 9	Model 10
Gender (female = 0)	−0.053	0.068	−0.031	−0.064*	−0.061*	−0.034	−0.056*	−0.064*	−0.085***	−0.082***
Age	−0.094**	−0.032	−0.042	−0.082**	−0.079*	−0.039	−0.160***	−0.149***	−0.124***	−0.121***
Education level	0.105***	0.136**	0.098***	0.099***	0.099***	0.097***	0.018	0.019	0.006	0.007
Monthly income	−0.005	0.013	0.013	−0.005	−0.009	0.009	−0.017	−0.052	−0.051	−0.055
Monthly expenses	0.127***	0.065	0.066*	0.132***	0.134***	0.073*	0.171***	0.172***	0.182***	0.184***
Household size	−0.053*	−0.037	−0.048	−0.058*	−0.056*	−0.049	−0.022	−0.015	−0.024	−0.022
Degree of social isolation	−0.041	0.034	−0.035	−0.051	−0.051	−0.039	−0.008	−0.016	−0.036	−0.037
Outing frequency	0.046	0.016	0.031	0.040	0.040	0.030	0.036	0.042	0.029	0.029
CNC	0.109***	0.013	0.070**	0.098***	0.095***	0.067**		0.111***	0.089***	0.086***
MA			0.352***			0.330***				
NTB				0.170***	0.171***	0.059*			0.339***	0.340***
CNC*NTB					−0.057*	−0.040				−0.052*
R^2	0.061	0.061	0.037	0.089	0.093	0.182	0.048	0.059	0.172	0.174
Adj.R^2	0.055	0.055	0.017	0.083	0.086	0.175	0.043	0.053	0.166	0.168
F	10.227***	1.798	30.586***	13.882***	13.106***	26.223***	8.945***	9.900***	29.325***	27.140***

* <0.05; ** <0.01; *** <0.001(two-tailed).

TABLE 4 | The result of robustness test (bootstrapping times = 5,000, N = 1,548).

Methods	Effect	Values of NTB	Standardized estimate	S.E.	95% confidence interval	
					LLCI	LLCI
Robustness test 1	Total effect	–	0.073	0.021	0.031	0.114
	Direct effect	–	0.052	0.020	0.013	0.091
	Indirect effect	−SD = 2.849	0.041	0.012	0.019	0.065
		M = 3.333	0.020	0.008	0.005	0.035
		+SD = 3.817	−0.002	0.011	−0.022	0.019
Robustness test 2	Total effect	–	0.073	0.019	0.036	0.110
	Direct effect	–	0.053	0.018	0.018	0.088
	Indirect effect	−SD = 2.849	0.024	0.009	0.008	0.042
		M = 3.333	0.015	0.006	0.004	0.027
		+SD = 3.817	0.006	0.009	−0.012	0.023

Robustness test 1 refers to the method of replacing the CNC with the NNC; robustness test 2 refers to the method of deleting the data of "Hubei" and "Tibet"; −SD, M, +SD, respectively, represent the value of NTB is one standard deviation lower than the average, equal to average, and one standard deviation higher than the average.

reduce multicollinearity between them. The results showed that the interaction had a significantly negative effect on SC (β = −0.057, p < 0.05) and MA (β = −0.052, p < 0.05). However, after adding MA as a mediating variable, the effect of MA on SC was significant (β = 0.330, p < 0.001), but the effect of the interaction on SC was no longer significant (β = −0.040, p > 0.05), thus, NTB passed the test indicating that MA plays a moderating role (see **Table 3** for details).

The bootstrap procedure was used to calculate the magnitude of the mediating effect and resulted in a 95% CI when the moderating variable was equal to average—one standard deviation above and one below average. The moderating effect was then re-verified through 5,000 sampling. Results showed that the interaction had a significantly negative impact on MA (β = −0.051, p < 0.05, 95% CI: −0.097 −0.004). Only when the

value of NTB was one standard deviation higher than average was the indirect effect of PS on SC insignificant (β = 0.006, 95% CI: −0.010–0.022), indicating that NTB passed and MA plays a moderating role.

Therefore, H6 was verified. When people have a strong need to belong, the impact of pandemic severity on materialism will be reduced, resulting need to belong plays a moderating role between pandemic severity and materialism.

Robustness Testing

We used two methods to test for and confirm the robustness of our conclusions. For the first test, we used the number of new confirmed cases per city to replace the cumulative number of confirmed cases and ensure that the effect was still stable under different indicators. For the second test, we eliminated

the influence of the extreme regions in the sample, which were the most severely affected geographic area, Hubei, and the least severely affected area, Tibet. Results shown in **Table 4** are consistent with the results of hypothesis testing indicating that the effect is robust.

DISCUSSION

Conclusions

These results indicate that pandemic severity is positively associated with materialism, need to belong, and scarce consumption. Pandemic severity positively affected the scarce consumption during the COVID-19 pandemic, and the effect was situational, which means it diminished as the pandemic eased. Materialism mediates the relationship between pandemic severity and scarce consumption. When the pandemic is severe, people demonstrate increased materialism to cope with the threat of death and, therefore, consume scarce goods. The need to belong plays a moderating role between pandemic severity and materialism, and influences people's choices in coping with death threats. People with a weak need to belong are more inclined to materialism and respond to threats by possessing scarce goods, while people with a strong need to belong prefer to cope with threats by seeking close relationships.

Theoretical Contributions

Firstly, previous studies of public health have focused primarily on infection prediction, risk assessment, and health behaviors (16, 17, 43); however, in a public health crisis, panic behavior are inevitable for humans, and the psychological and behavioral impacts related to them also need urgent attention (44). We revealed the psychological mechanism of panic buying related to scarcity in a more in-depth way—examining whether and why public health emergencies prompt consumers to seek scarce goods—to provides a new perspective to the research of public health. Furthermore, this psychological mechanism is contextual. This makes our research different from previous studies in marketing that focused primarily on uniqueness and wealth insecurity (20, 45). We found that scarce consumption is also an important means of alleviating death threats from public health emergencies; because this research is more contextual on the basis of explaining scarcity, it is also different from those that explain scarcity based on the theory of reactance and anticipated regret (13–15).

Moreover, Arafat pointed out that panic-buying behavior may be speculatively affected by socio-cultural status, personality traits, and environmental factors, all of which needs to be empirically tested (5). We found that public health emergencies as a special social situation can stimulate materialism, while previous studies regarded it as a relatively stable personality factor (46), indicating that the psychological/behavioral constructs, linked with the personality factors, could contextually affect panic-buying behavior.

Finally, we discussed the different implications of two coping strategies in the context of pandemic. Although improving self-esteem and seeking social connections are both important coping mechanisms (32), they have different effects on mental health and public health management during a pandemic. The first approach results in materialism and scarce consumption; however, materialism is often considered as a negative social value, which negatively influences psychology and behavior leading to stinginess, jealousy, and excessive consumption (29, 47). Scarcity may activate competition orientation, leading consumers to consider their own welfare and predisposing them to act more selfishly (48) and even violently (49). Therefore, the first approach can trigger negative social behavior and hinder the management of public health. For example, according to Fox News, there were two episodes of violent conflict caused by scarce consumption of goods in the United States on March 12 alone (10). On the contrary, the second approach enhances individual social tendencies and altruistic behaviors, which can add positive and constructive significance to global health challenges (33).

Practical Implications

The conclusions are likely to be valuable and useful to crisis-response and public-health managers. Although panic buying caused serious consequences during the pandemic, it is still easily ignored by managers. This may have been due to the belief that health needs should be given priority, rather than emergency purchases, during the COVID-19 pandemic period. Our research shows that these two goals are not conflicting and are even potentially consistent. The findings verified that the need to belong can moderate the approach witch people cope with public health emergency, thereby alleviating the panic buying related to scarcity. Moreover, the need to belong can actually increase prosocial behavior (50, 51), which is essential for the allocation of health resources in global health challenges. In other words, when people desire to obtain a sense of belonging from others or groups, they will be more inclined to think from the perspective of others or collectives. This will not only reduce the competition for scarce resources, but also increase prosocial behavior, including mutual encouragement, voluntarily helping others, even donating supplies.

In terms of specific implementation, since one of the important psychological basic for panic buying is scarcity, reducing perceived scarcity may be an effective crisis management strategy. Therefore, in order to avoid unnecessary damage to the market when fighting the pandemic, it is important for the government to inform people which products can help them cope with the pandemic and which products are unnecessary in time. It can also encourage the establishment of production, transportation and warehousing cloud platforms to realize digital management, and to realize material support more efficiently through real-time data sharing. Media should reduce the negative reports related to scarcity and replace them with healthy and positive information. To dispel rumors and reduce anxiety over shortages, business associations or organizations should cooperate with media to release information regarding production and supply; shops can adopt quota measures but try to avoid posting particularly obvious "restricted purchases" and "sold out" slogans.

On the other hand, intervention in psychological mechanisms of scarce consumption can also alleviate panic buying. The findings showed that it is effective to formulate policies or

measures based on the strategy of reducing materialism and increasing need to belong. Encouraging people to increase exercising, participate in anti-pandemic topic discussions, or communicate online with relatives or friends may help to shift their attention from the material to the spiritual. In addition, public health managers should give full play to the role of the community in disseminating information, organizing activities, and distributing anti-epidemic materials, to form an atmosphere of solidarity. For example, the community can establish an information platform to provide residents with an opportunity to exchange views, while publishing material information. Further, it can encourage residents to participate in rewarded community check-in activities such as volunteer services, and regularly deliver supplies to residents isolated at home.

Limitations and Future Research Directions

In terms of generalization of the model, this study selects China as a representative for research. Although psychological/behavioral constructs are general, they may also be affected by social-cultural factors and show certain particularities. In the future, research can focus on the comparison of different countries with different social cultures. Besides, the COVID-19 pandemic is a public health emergency with a violent and direct death threat. However, there are many types of public health emergencies, some of which pose peaceful and indirect threats. Whether these threats will lead to this kind of reactionary behavior remains to be studied.

Although exploring psychological mechanisms is important for people to understand and manage panic buying (3, 4), the influence of the media on panic buying cannot be ignored. This is because, psychological factors may in turn be influenced by the media (52) and panic buying can also be caused by unbalanced media coverage. For example, when media display the photos of empty shelves indicating the scarcity, they help to increase tension, anxiety, and fear among the general population, resulting in further increase in panic buying (2). However, this study lacks adequate consideration of the media. It did not evaluate the duration of reading or watching news. Whether there is any association between the duration of watching news and panic-buying behavior remains to be studied. In addition, people will not only be influenced by the official media but seek information from various media sources during a pandemic. Therefore, future research can also explore the impact of different media sources reporting on panic buying as well as the psychological mechanism behind it. Furthermore, we indicated that reducing the perception of scarcity and increasing the need to belong can alleviate scarce consumption behavior. But how to translate this discovery into actionable measures to a greater extent? Studies have shown that the media can spread rumors as well as health information, thus the formulation and implementation of media guidelines may help control the episodes of panic buying (52). We suggest that the combination of media and psychological guidance strategies can be studied from the perspective of policy measures in the future.

Finally, we found that after excluding the impact of social isolation, our model is still significant. This shows that although the government's isolation and restrictive policies can cause panic (53), they are not entirely responsible for causing panic, which is influenced by various factors. Future research may be carried out from the perspective of panic sources, such as the public, experts, and media, to explore the effects of these sources on panic-buying behavior, which will help to clarify the psychological mechanism of panic buying in more detail, and propose targeted strategies or policies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Materials**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Jilin University; Credamo Data Research platform. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

XJ, JL, and TZ were involved in the conceptualization, methodology and investigation referred to in this paper. XJ provide leadership to the team and was responsible for revising the article. JL wrote the first draft of the paper and all authors provided a written contribution and approved the final version. WS revised the manuscript. All authors agreed the final version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2020.617166/full#supplementary-material

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Different Correlates of COVID-19-Related Adherent and Dysfunctional Safety Behavior

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Introduction: Safety behaviors are key elements in reducing the spread of the COVID-19 virus, but have also assumed excessive proportions in form of panic buying groceries. This raises the question whether these behaviors are independent or related to each other. Adherent safety behavior including increased hygiene and physical distancing appears inherently adherent and prosocial, while dysfunctional safety behavior such as panic buying most probably emerges from other motives and contextual variables.

Methods: Data from 15,308 participants collected from March 10 to May 4, 2020, during the COVID-19 acute period in Germany, was analyzed to assess whether adherent and dysfunctional safety behavior are predicted by the same or divergent variables. Two multiple regression models are presented including various sociodemographic, trait, attitudinal, and COVID-19-specific variables as predictors.

Results: Some variables similarly predict both, adherent and dysfunctional safety behavior. Yet, adherent safety behavior is stronger predicted by COVID-19-related fear than generalized anxiety, while a trend toward a reverse pattern emerged for dysfunctional safety behavior. Adherent safety behavior was also related to higher trust in governmental actions to face COVID-19, subjective level of information, as well as use of public media and TV to remain informed on COVID-19. Higher age was related to dysfunctional, but not adherent safety behavior. Respondents living in rural communities report more adherent safety behavior than urban dwellers.

Discussion: Divergent psychological variables underlie adherent and dysfunctional safety behavior. This hints toward a theoretical separation with practical relevance in behavioral engineering and public health campaigning.

Keywords: COVID-19, safety behavior, fear & anxiety, mental health, trust in government, subjective level of information, panic buying

INTRODUCTION

In the very early days of the COVID-19 pandemic outbreak, fear and anxiety rapidly spread across the population in Germany (1–3). In turn, people started to hoard toilet paper and canned foods or even stole disinfectants from hospitals. To curtail infection rates, governmental authorities announced contact prohibitions, lockdowns, and most prominently mandatory

mask-wearing. Some safety behaviors like hand-washing and physical distancing are adherent and actively prescribed by government authorities. An adherence to such safety behaviors is socially desirable and requires individuals to incur an immediate cost for the sake of society. However, panic buying and hoarding are rather egoistic behaviors as resources are limited and deprive others of them. Hence, while fear is spreading across the population (2), motives to wash hands seem to differ from motives to panic buy and hoard. Higher vulnerabilities to the virus caused by, e.g., cancer or chronic somatic diseases, but also mental illnesses, can increase fear and anxiety, which eventually leads to some safety behavior (4–6). The current strongly increasing numbers of new infections during the "second wave" on one hand, and political demonstrations against COVID-19 protection-regulations on the other hand, indicate the strong necessity to understand underlying motives for distinct safety behaviors.

Recent research on the behavioral-psychological impact of COVID-19 reveals the prevalence of safety behaviors like panic buying strongly increased since the onset of political measures during the COVID-19 crisis (3, 7–9). Especially panic buying has recently been a matter of strong interest for the public, the government, and research. Arafat et al. (10) showed that ∼80% of the media reports on COVID-19 focused on the impact and causes of panic buying. Over half of these reports showed images of empty shelves to illustrate the topic. Furthermore, a quarter highlighted the rumor about panic buying and the remedial measures. Investigating the causes for panic buying, Arafat et al. (7) showed that a sense of scarcity seems to be the most prominent factor alongside an increased demand and importance of a product and the anticipation of rising prices facilitated this effect. Furthermore, the authors reported rumors, safety-seeking behavior, uncertainty, anxiety reduction, and taking control, but also social learning and lacking trust in governmental actions to face the pandemic as reasons for panic buying [see also (11)]. Müller and Rau (12) recently reported a link between present-bias and panic buying, while patience was associated to staying at home and avoiding crowds. On the other hand, the same study showed that all safety behaviors appear to be linked to fear, or at least COVID-19-related concern. In a systematic review, Yuen et al. (9) defined four factors that caused panic buying during a health crisis: a perception of threat and scarcity of products, fear of the unknown, panic buying as a coping behavior to deal with anxiety and to regain control, and social psychological factors.

However, Oosterhoff (13) showed that the belief that COVID-19 is a severe disease was associated with physical distancing. Self-interest was negatively associated with physical distancing, yet positively with hoarding behavior. Also, disinfection behavior was linked to greater social responsibility, while hoarding was negatively related to social responsibility and social trust. Yet, panic buying and hoarding seem to be rather related to impulsive and egoistic motives, which are particularly amplified by uncertainty [see also Chen et al. (14)]. Also, Nivette et al. (15) found that people scoring high on antisocial behaviors exhibit less compliance with public health measures such as frequent disinfection. Campos-Mercade et al. (16) showed clear associations between pro-sociality and norm-compliance.

Sanitizer and face-mask use and self-isolation are self-imposed measures to stay safe oneself, but also to protect members of the community. Hence, it appears that the underlying motive may include adherence, trust toward authorities, as well as altruism.

Taken together, panic buying seems to differ from other safety behaviors. Dysfunctional safety behaviors like panic buying and hoarding maintain individual safety while neglecting possible cost for others. However, adherent safety behaviors are those that slow the spread of COVID-19, while reducing individual life-quality. They highly conform with governmentally recommended public health measures.

No research has yet directly investigated a possible distinction of these constructs with predictive or associative dynamics, although this separation would have an immense practical value. If safety behavior was one-dimensional, good policies should find an optimal tipping point at which people comply with public health measures. Yet, a conceptual distinction would propose more specific interventions to reduce panic buying and other dysfunctional behaviors on one hand, and increase adherent safety behaviors on the other hand. For instance, tailor made information or behavioral intervention campaigns could attempt to target specific risk groups which have shown increased dysfunctional safety behavior, but refuse to comply with hygiene measures. It is thus necessary to understand the psychological and environmental influences and underpinnings of both, dysfunctional safety behaviors like panic buying and adherent safety behaviors like mask wearing.

The present study assesses whether adherent and dysfunctional safety behaviors actually share the same correlates, or whether they are embedded into very different behavioral, attitudinal, intra-, and inter-individual contexts. Based on the literature, it is hypothesized that adherent and dysfunctional safety behaviors are two different sub-constructs, which are both correlated and particularly linked fear and anxiety, but show different demographic, psychological, behavioral and contextual correlates. This would suggest that political interventions by governmental authorities should very specifically aim at certain groups of individuals and adapt interventions in accordance to their motives in order to promote adherent while preventing dysfunctional safety behavior at the same time.

METHODS

Data Collection and Participants

Data collection was performed from March 10 to May 4, 2020 in a Germany-wide online survey. During this time, Germany underwent unprecedentedly rapid changes in regulations of public space and personal freedom. For instance, schools and borders were closed and public gatherings were prohibited. Face-mask wearing became obligatory in public and commercial locations. Due to the initial success in curbing the infection rate, the German government enacted the reopening of schools, day-care centers and most commercial spaces on May 4.

Participant recruitment took place via radio, TV, social media, and newspaper. In detail, the study was announced and the respective online link to the survey was explicitly stated twice in the regional public German radio (Westdetuscher Rundfunk

(WDR) 2, Lokalzeit Ruhr) on March, 12. An interview with the whole research team was shown on TV in the local public news (WDR 1, Lokalzeit Ruhr) on March, 18. Then, the head of research was interviewed by Laura Wontorra, a German TV show moderator and influencer on Instagram on April, 10. Last, the study was mentioned and its link was posted along with an interview with the head of the Clinic for Psychosomatic Medicine and Psychotherapy in the local public newspaper [Westdeutsche Allgemeine Zeitung (WAZ)] on April, 25. Of course, the link was also posted alongside a short statement on the study in health related groups in other social media platforms such as Facebook and Whatsapp.

Of 16,380 participants who commenced the survey, 15,308 completed it (completion rate = 81.02%). Due to an additional missing value, 15,307 participants will be considered for the following analyses. Informed consent was given by all participants. The study was conducted in accordance with the Ethics Committee of the Essen Medical Faculty (20-9307-BO).

Material

Participants were asked about basic demographics, their reactions and attitudes toward the COVID-19-virus, as well as their mental health and personality. Demographic information included questions on gender (male, female or other), age in categories, education (university degree, high school diploma, secondary school degree, no secondary school degree and other form of education), current occupational status (clustered into unemployed, physician, nurse, public service – police, firefighting and paramedic), and size of the community the participants live in (metropolis with >100,000 inhabitants, medium-sized city with 100,000–20,000 inhabitants, small town with 5,000 to 20,000 inhabitants and rural community with below 5,000 inhabitants). To evaluate participants' personal hazard in case of a COVID-19 infection, the survey also assessed the presence of a high-risk morbidity for a severe course of COVID-19 (diabetes, chronic heart disease, hypertension, and chronic pulmonary disease).

The feeling of safety is of particular importance in times of crises. Safety depends on trust in authorities, subjective transparency, and knowledge. Accordingly, two self-generated scales were added measuring the trust in governmental actions to face COVID-19 (3 items, 7-point Likert-scaled) and the subjective level of information of the participants (4 items, 7-point Likert scaled; see **Supplementary Material**). Moreover, one item assessed COVID-19-related fear.

Safety behavior (8 items, 7-point Likert-scaled) was separated into two dimensions based an oblique factorial analysis (see **Supplementary Material**) – *adherent* and *dysfunctional safety behavior* including behaviors like hand-washing or physical distancing, and hoarding hygiene products or canned groceries, respectively. Cronbach's α for the scales revealed reasonable internal consistency of $\alpha = 0.65$ for *trust in governmental actions* and $\alpha = 0.80$ for *subjective level of information* (correlation between functional and dysfunctional safety behavior: $r = 0.38$).

It is a robust finding that media exposition might drive fear [(17–19); see also (20)]. Thus, the survey assessed which medium the participants use to remain up to date on the current happenings during the COVID-19-crisis. Single binary items (yes vs. no) were presented for information via TV, digital media, newspapers, social networks, radio, websites from public bodies, friends and family, or physicians.

The current mental health status was measured using the Patient Health Questionnaire (PHQ-2; 2 items, 4-point Likert-scaled) for depressive symptoms (21, 22) and the General Anxiety Disorder (GAD-7; 7 items, 4-point Likert-scaled) for generalized anxiety (23, 24). The survey further included the Locus of Control for its relevance in risk perception and safety behavior (25, 26), as well as the big−5 personality traits for their centrality in human behavior in general and their associations with psychopathology [Rosenström et al. (27)], measured using the Big Five Inventory (BFI-10; 10 items, 5-point Likert-scaled).

Data Analysis

First, an oblique factorial analysis was performed to verify the two dimensions of safety behavior. Following, internal consistencies were tested for all scales. Then, all demographic, psychometric and COVID-19-related characteristics were regressed on *adherent* and *dysfunctional safety behavior*. This approach was chosen to reduce potential confounding of raw associations and take into account the contribution of other variables. Regression coefficients were treatment-coded. Yet, variable-wise F-tests are reported to illustrate each variable's overall importance. Variables were generally z-standardized to avoid multi-collinearity. Still, multi-collinearity was assessed using variance inflation factors with a criterion of 5. It was assumed that normality of residuals leaves estimates largely unbiased at large sample sizes such as the present (28). The assumption of homoskedasticity was tested using Breusch-Pagan-Tests. When homoscedasticity was violated, heteroscedasticity-robust regressions were supplemented to ensure that the results were equivalent [using the HC3 command from the R package sandwich, see also (29)].

Marginal effects are reported in the **Supplementary Material**. For an adequate interpretation of regression results at such high sample sizes, 95%-confidence intervals of regression weights, and effect sizes of marginal effects are reported in addition to *p*-values (30, 31). Furthermore, an effect size of <0.1 for group-wise comparisons was considered irrelevant, even if the *p*-value was below 0.05.

To find a small f² of 0.02 (32) in a comparison between the actual regression model and a null model with a power of 0.99, about 3,000 participants are necessary. Given criterion of standardized regression coefficients being equal or larger than 0.1 for a meaningful interpretation, a simulated power analysis reveals that around 8,000 participants are necessary to reach a power of 0.99. Hence, the analysis is very well powered.

RESULTS

Table 1 shows the aggregated characteristics of the sample.

To define which features were predictive of the two safety behavior dimensions, all variables, including demographic, behavioral, trait- and attitudinal variables were regressed on *adherent* and *dysfunctional safety behavior*. In both models,

TABLE 1 | Demographic information (gender, age, education, occupation, area of residence, and health status) of the study sample.

	Overall (%)
N	**15,308**
Gender	
Female	10,824 (70.7)
Male	4,433 (29.0)
Other	51 (0.3)
Age (%)	
18–24 years	2,127 (13.9)
25–34 years	3,796 (24.8)
35–44 years	3,515 (23.0)
45–54 years	2,902 (19.0)
55–64 years	2,177 (14.2)
65–74 years	670 (4.4)
above 75 years	121 (0.8)
Education	
University Degree	6,544 (42.7)
High School Degree	5,002 (32.7)
Secondary School Degree (Realschule)	2,791 (18.2)
First School Degree (Hauptschule)	665 (4.3)
No School Degree	48 (0.3)
Other	258 (1.7)
Occupation	
Unemployed	1,566 (10.2)
Physician	553 (3.6)
Nursing staff	1,682 (11.0)
Police/Firefighting/Paramedic	346 (2.3)
Student	1,987 (13.0)
Other	9,173 (59.9)
Area	
Large City (>100,000 inhabitants)	8,525 (55.7)
Medium-sized city (>20,000 inhabitants)	3,453 (22.6)
Small town (>5,000 inhabitants)	1,690 (11.0)
Province area (<5,000 inhabitants)	1,640 (10.7)
Risk disease (diabetes, blood pressure, cardiovascular disease, chronic pulmonic disease)	11,922 (77.9)
Mental illness	2,006 (13.1)

Percent values in parentheses are relative to the total N = 15,308.

the assumption of homoscedasticity did not apply (Breusch-Pagan test: $p < 0.001$). Results of a heteroscedasticity-robust regression, however, yield almost identical results to the ordinary least squares regression (see **Supplementary Material**). None of the predictors showed a critical multi-collinearity with variance inflation factors above 5. Treatment-coded regression parameters are displayed in **Table 2**.

The regression estimates and the marginal effects revealed similar, as well as divergent correlates of *adherent* and *dysfunctional safety behavior*. **Figure 1** illustrates the marginal effects for the most pronounced differences in the regression models. *COVID-19-related fear* is positively associated with both, *adherent* and *dysfunctional safety behavior* (F-test in the *adherent safety behavior* model: $F_{(1, 15262)} = 2673.15$, $p < 0.001$, F-test in the *dysfunctional safety behavior* model: $F_{(1, 15262)} = 430.53$, $p < 0.001$, see **Figure 1A**). Yet, this association was more pronounced in the model predicting *adherent safety behavior* with non-overlapping confidence intervals. On the other hand, while *generalized anxiety* showed a positive relationship with both safety behaviors [$F_{(1, 15262)} = 47.70$, $p < 0.001$, for *adherent* and $F_{(1, 15262)} = 99.82$, $p < 0.001$, for *dysfunctional safety behavior*], the association with *dysfunctional safety behavior* appeared to be stronger (see **Figure 1B**) even though confidence intervals slightly overlapped (see **Table 2**).

Trust in governmental actions to face COVID-19 showed a strong positive relationship with *adherent safety behavior* [$F_{(1, 15262)} = 442.43$, $p < 0.001$], but a negative relationship with *dysfunctional safety behavior* [$F_{(1, 15262)} = 75.33$, $p < 0.001$, see **Figure 1C**]. Similarly, the *subjective level of information* was positively related to *adherent safety behavior* [$F_{(1, 15262)} = 136.28$, $p < 0.001$], but showed a negative association with *dysfunctional safety behavior* [$F_{(1, 15262)} = 26.51$, $p < 0.001$, see **Figure 1D**].

Age was differently associated with both safety behaviors. Although there was an upward trend in *dysfunctional safety behavior* across age [$F_{(6, 15262)} = 15.59$, $p < 0.001$], only small differences were found when predicting *adherent safety behavior* [$F_{(6, 15262)} = 3.87$, $p = 0.001$]. More specific, *dysfunctional safety behavior* increased for aged higher than 34 (see **Figure 1E** and **Supplementary Material**).

Similarly, respondents from smaller-sized communities showed more *adherent safety behavior* [$F_{(3, 15262)} = 38.37$, $p < 0.001$]. There was a gradient from metropoles to rural communities. Only the difference between small towns and rural communities was not significant (see **Supplementary Material**). Such a gradient did not emerge for *dysfunctional safety behavior* [$F_{(3, 15262)} = 2.58$, $p = 0.052$, see **Figure 1F** and **Supplementary Material** for marginal effects].

Pronounced differences also occurred across professional groups in predicting *adherent safety behavior* [$F_{(1, 15262)} = 10.86$, $p < 0.001$]. Predominantly, physicians, nursing staff, and people working as paramedics, firefighters and policemen showed less *dysfunctional safety behavior* than people having other occupations. Likewise, people indicating current unemployment showed more *dysfunctional safety behavior* than the other groups, except the group with other occupations (see **Table 2** and **Supplementary Material**).

Respondents who indicated to watch TV and visit websites of public institutions to stay informed on COVID-19 showed more *adherent safety behavior* (all F-values > 98, $p < 0.001$), while respondents receiving information from acquaintances showed more *dysfunctional safety behavior* [$F_{(1, 15262)} = 14.32$, $p < 0.001$]. Finally, the presence of a mental disease predicted *adherent safety behavior* positively [$F_{(1, 15262)} = 13.89$, $p < 0.001$], but *dysfunctional safety behavior* negatively [$F_{(1, 15262)} = 53.03$, $p < 0.001$].

DISCUSSION

The COVID-19 pandemic challenged individual lives and still do to this date. While individuals were obliged to isolate themselves and showing correct hygiene behavior, others hoarded toilet

TABLE 2 | Regression coefficients, 95%-confidence intervals, and *p*-values for all predictors of the regression analysis with either *adherent safety behavior* or *dysfunctional safety behavior* as dependent variables.

Predictors	Adherent safety behavior			Dysfunctional safety behavior		
	Estimates	CI	p	Estimates	CI	p
(Intercept)	−0.24	−0.30 to −0.18	<0.001	−0.18	−0.25 to −0.11	<0.001
Male	−0.04	−0.06 to −0.01	0.019	0.01	−0.02 to 0.05	0.456
Other Gender	−0.23	−0.44 to −0.01	0,037	0.08	−0.16 to 0.33	0.495
Dysfunctional safety behavior	0.21	0.19 to 0.22	<0.001			
Fear of COVID19	0.38	0.37 to 0.40	<0.001	0.19	0.17 to 0.21	<0.001
25–34 years	−0.04	−0.09 to 0.01	0.137	0.06	0.00 to 0.11	0.046
35–44 years	0.00	−0.05 to 0.05	0.968	0.22	0.16 to 0.28	<0.001
45–54 years	0.01	−0.04 to 0.07	0.628	0.19	0.13 to 0.25	<0.001
55–64 years	0.07	0.01 to 0.13	0.022	0.14	0.07 to 0.21	<0.001
65–74 years	0.05	−0.03 to 0.13	0.240	0.25	0.16 to 0.34	<0.001
+75 years	0.10	−0.05 to 0.25	0.213	0.35	0.17 to 0.52	<0.001
High School Degree	0.00	−0.03 to 0.03	0.939	−0.03	−0.06 to 0.01	0.135
Secondary School Degree (Realschule)	0.02	−0.02 to 0.06	0.319	−0.05	−0.09 to −0.00	0.029
First School Degree (Hauptschule)	0.03	−0.03 to 0.10	0.309	−0.06	−0.13 to 0.02	0.129
No School Degree	−0.03	−0.25 to 0.19	0.766	−0.07	−0.32 to 0.19	0.606
Other	0.00	−0.09 to 0.10	0.96	0.00	−0.11 to 0.11	0.943
Unemployed	0.06	0.01 to 0.10	0.014	0.04	−0.02 to 0.09	0.179
Physician	−0.13	−0.20 to −0.06	<0.001	0.04	−0.03 to 0.12	0.265
Nursing staff	−0.07	−0.12 to −0.03	0.001	−0.01	−0.06 to 0.04	0.643
Police/Firefighting/Paramedic	−0.20	−0.28 to −0.11	<0.001	0.01	−0.08 to 0.11	0.773
Student	−0.06	−0.11 to −0.02	0.010	−0.05	−0.11 to 0.01	0.083
Medium-sized city (>20,000)	0.08	0.04 to 0.11	<0.001	0.03	−0.00 to 0.07	0.090
Small town (>5,000)	0.15	0.11 to 0.19	<0.001	−0.01	−0.05 to 0.04	0.747
Rural area (<5,000)	0.19	0.15 to 0.23	<0.001	−0.04	−0.09 to 0.01	0.09
Yes	0.08	0.04 to 0.12	<0.001	−0.18	−0.22 to−0.13	<0.001
Yes	−0.02	−0.05 to 0.01	0.158	0.04	0.00 to 0.08	0.033
Generalized Anxiety (GAD-7)	0.07	0.05 to 0.09	<0.001	0.12	0.09 to 0.14	<0.001
Depressive Symptoms (PHQ-2)	0.02	0.00 to 0.04	0.048	−0.02	−0.04 to 0.00	0.066
Trust in governmental actions	0.16	0.15 to 0.18	<0.001	−0.08	−0.10 to −0.06	<0.001
Subjective level of information	0.09	0.07 to 0.10	<0.001	−0.04	−0.06 to −0.03	<0.001
External Locus of Control	0.03	0.02 to 0.04	<0.001	−0.04	−0.06 to −0.03	<0.001
Internal Locus of Control	−0.02	−0.03 to −0.00	0.011	0.02	−0.00 to 0.03	0.051
TV	0.14	0.12 to 0.17	<0.001	0.06	0.03 to 0.09	<0.001
Websites of public institutions	0.14	0.11 to 0.17	<0.001	−0.02	−0.05 to 0.02	0.311
Radio	−0.03	−0.06 to −0.01	0.009	−0.02	−0.05 to 0.01	0.106
Friends and acquaintances	−0.05	−0.09 to −0.02	0.003	0.10	0.06 to 0.14	<0.001
Physicians	0.00	−0.03 to 0.03	0.960	−0.01	−0.04 to 0.03	0.746
Social Networks	0.01	−0.02 to 0.04	0.439	0.02	−0.01 to 0.05	0.198
Digital Media	0.06	0.03 to 0.08	<0.001	0.03	0.00 to 0.06	0.044

(Continued)

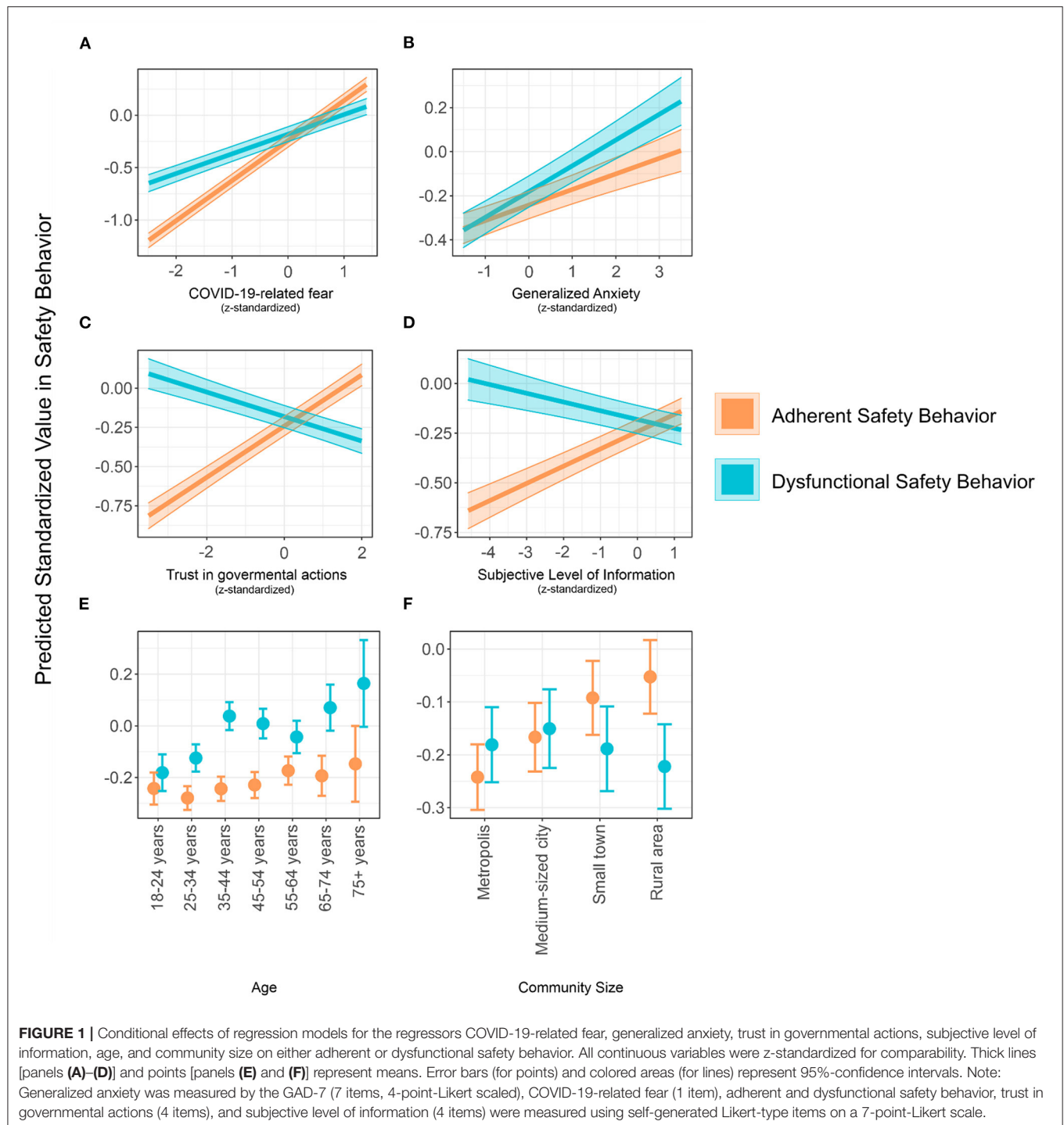| Predictors	Adherent safety behavior			Dysfunctional safety behavior		
	Estimates	CI	p	Estimates	CI	p
Newspapers	−0.02	−0.05 to 0.00	0,096	0.05	0.02 to 0.08	0.001
BFI—Agreeableness	0.01	−0.00 to 0.02	0,123	−0.06	−0.07 to −0.04	<0.001
BFI—Neuroticism	−0.03	−0.05 to −0.02	<0.001	0.01	−0.00 to 0.03	0.146
BFI—Openness	0.02	0.01 to 0.04	<0.001	−0.01	−0.02 to 0.01	0.295
BFI—Extraversion	−0.03	−0.04 to −0.01	<0.001	0.02	0.00 to 0.03	0.017
BFI—Conscientiousness	0.02	0.01 to 0.04	<0.001	−0.03	−0.05 to −0.02	<0.001
Adherent Safety Behavior				0.27	0.25 to 0.29	<0.001
Observations	15,307	15,307				
R^2/R^2 adjusted	0.411/0.409	0.228/0.226				

paper and groceries. These *adherent* and *dysfunctional safety behaviors* may be manifestations of different motive structures and contexts. The necessary question arises, how governmental authorities can encouraged *adherent safety behavior* while attenuating *dysfunctional safety behavior*.

To investigate this highly relevant question, we hypothesized that both types of safety behaviors are associated with different set of features in terms of socio-demographics, psychopathology, personality, and COVID-19-specific attitudes. We were able to collect the largest data sample in Germany and one of the largest worldwide on the impact of COVID-19 on mental health. We specifically asked for *adherent* and *dysfunctional safety behaviors* during the COVID-19 pandemic. Despite the exploding amount of literature on the current pandemic, no other study has yet been able to report a comparable dataset profoundly investigating distinct safety behaviors in times of COVID-19 in such a detailed manner. In line with the hypothesis, the current results show that adherent and dysfunctional safety behaviors mostly differed in some of their correlates and even revealed opposite associative directionalities with others. However, some correlates were similar.

Certainly, fear and anxiety are to some degree causal for safety-oriented and preventive behaviors. Here, *COVID-19-related fear*, as well as *generalized anxiety*, separately showed positive associations with both safety behaviors. It is important to keep in mind that regression parameters are already conditioned on each other: fear and anxiety-related estimates represent the isolated contribution of each of these dimensions of safety behavior. Also, recent literature suggests a distinction between the fear of COVID-19 and anxiety (2, 5, 6, 33, 34). Importantly, the link between *COVID-19-related fear* and *adherent safety behavior* appears to be more pronounced than the link between *COVID-19-related fear* and *dysfunctional safety behavior*. A reverse pattern is observed for *generalized anxiety* – although the confidence intervals slightly overlap: the regression coefficient for *generalized anxiety* is steeper in *dysfunctional safety behavior* compared to the *adherent safety behavior*. These findings tentatively suggest that *dysfunctional safety behavior* originates

from a more omnipresent feeling of threat, while *adherent safety behavior* results from a direct concern about COVID-19. Even more broadly, *dysfunctional safety behavior* could be a rather egoistic response to the feeling of overall threat. Indeed, the link between the feeling of threat, stress, and selfish behavior is being discussed for over a century now. Since Cannon (35) defined the concept of fight-or-flight, it is still found up to this point that people under acute and chronic stress incline toward less altruism, less moral decision making, and more egoistic choices (36–39). Furthermore, during the initial course of the COVID-19 pandemic, many communities suffered from shortages of goods due to previous panic-buying [see, e.g., (40)]. The perception of the risk of material deprivation may have been amplified by the subjective feeling of stress (2, 41). Thus, d*ysfunctional safety behavior may* neutralize the subjective feeling of threat by ensuring long-term material security.

The finding that *adherent safety behavior*, but not *dysfunctional safety behavior* is related to the *subjective feeling of information* and *trust in governmental intervention* fits well to the fact that *adherent safety behavior* is also rather related to fear and concern about COVID-19. *Adherent safety behavior* could arise as a product of the person's engagement with the pandemic, which would lead to overall *higher levels of information*, higher *trust in governmental actions* (perhaps even due to a higher level of information), and overall higher levels of concern. Positive associations between *adherent safety behavior* and media consumption for the sake of staying informed on COVID-19 further support the argument that more personal engagement with the COVID-19 pandemic results in more *adherent safety behavior*. Media consumption may spark fear itself, but could also function as a reassuring safety behavior itself. More engaged individuals would more likely attempt to remain up to date on recent developments to evaluate risks and regain a feeling of control. This idea is in line with the negative correlation between generalized anxiety and subjective levels of information regarding COVID-19 [(42), but see also (19)]. Again, there is some evidence that hints toward a difference in quality between *COVID-19-related fear* and *generalized*

FIGURE 1 | Conditional effects of regression models for the regressors COVID-19-related fear, generalized anxiety, trust in governmental actions, subjective level of information, age, and community size on either adherent or dysfunctional safety behavior. All continuous variables were z-standardized for comparability. Thick lines [panels **(A)**–**(D)**] and points [panels **(E)** and **(F)**] represent means. Error bars (for points) and colored areas (for lines) represent 95%-confidence intervals. Note: Generalized anxiety was measured by the GAD-7 (7 items, 4-point-Likert scaled), COVID-19-related fear (1 item), adherent and dysfunctional safety behavior, trust in governmental actions (4 items), and subjective level of information (4 items) were measured using self-generated Likert-type items on a 7-point-Likert scale.

anxiety during the COVID-19 pandemic (5, 33, 34). On the other side, we only find meaningful associations between acquiring information on COVID-19 from acquaintances and *dysfunctional safety behavior*.

In the data, further differences in *adherent* and *dysfunctional safety behavior* occur between age groups. While respondents' age hardly shows any association with *adherent safety behavior*,

older respondents (i.e., older than 34) indicate to engage in more *dysfunctional safety behavior*. Such increase in dysfunctional safety behavior might reflect an age-related feeling of threat by the virus [see (2) for a detailed insight of the distribution of fear across age groups]: from early on, it has been evident that people of higher age have an increased likelihood to suffer from an unfavorable course of COVID-19, which could eventually result

in death (43). Thus, in anticipation of even longer self-isolation in case of infection than in younger people, preparation seems legitimate. Also, elderly are oftentimes less mobile than younger people and lockdowns make longer trips to grocery shops even more difficult. Finally, the pandemic could have cemented already pre-existing consumption styles with elderly individuals tending to buy more of some hygiene products (44).

A rather unexpected finding is that inhabitants of metropoles exhibit less adherent safety behavior than inhabitants of small towns and rural dwellers, a pattern which is not present in dysfunctional safety behavior. Here, pragmatic reasons might contribute the most: rural dwellers could simply have less difficulties to avoid crowds. Perhaps their decision threshold to even use public transit or travel around is also higher due to more autarky. Otherwise put, people living in large cities are more reliant on public transit, and partly, avoidance of crowds is hardly possible. Furthermore, Peters (45) describes the countryside as more vulnerable to potential COVID-19 outbreaks due to a lack of health services. Causes for an increased dysfunctional safety behavior could be manifold. Yet again, it is important to keep in mind that such differences cannot be explained by direct confounding via e.g., occupation or age. These variables have been conditioned upon in the regression model.

Summarizing, the presented results hint toward a differential associative, and thus contextual, embedding of adherent and dysfunctional safety behavior. Both behaviors appear to be independent of each other, which makes a differentiation theoretically and practically reasonable. People with high levels of adherent safety behavior show higher levels of authoritative trust and subjective information levels. They indicate more specific fear of COVID-19 and seem to gather more information via public news channels. Thus, adherent safety behavior could be promoted by increasing governmental responsibility, medial education, and by inducing realistic highly specialized and justified respect of a possible infection with COVID-19. Contrary to that, generalized anxiety is rather associated with panic buying and other dysfunctional safety behaviors. Accordingly, the present data suggest that governmental actions and COVID-19-specific elucidation campaigns should not target the people's general fears triggering dysfunctional safety behavior. They should rather very carefully provide profound information about virus-specific risks and possible protective countermeasures aiming for adherent safety behavior.

Limitations

The current study has been among the few that captured the atmospheric picture during the acute period of the first COVID-19 wave in Germany. Accordingly, the study investigated the largest dataset in Germany to our knowledge and is thus of high importance for the understanding of the pandemic's impact on mental health. However, the rapid reaction to the pandemic, related quickly-evolving political decisions, and the individuals' reactions naturally comes at some negligible methodological costs.

First, and most importantly, it has to be kept in mind that all data presented here was collected via an online survey, which holds several limitations. For once, there is absolutely no way

to control the participants' response rate causing the risk of a participant bias. Thus, more anxious people or those suffering from more risk factors may have responded preferentially to the survey. These points, of course, may hamper the generalizability of the present sample.

Second, at the time of the initial COVID-19 outbreak in Germany, no validated instruments were available to assess fear of COVID-19. The first questionnaire assessing COVID-19-related fear was presented after the survey had already been launched (33). The Preventive COVID-19 Behavior Scale, an instrument to measure safety behaviors [PCV-19BS, see (33, 46)], was based on recommendations by the WHO in April 2020 (47). Due to this fact, some of the scales of the survey were self-generated and COVID-19-related fear was furthermore measured by one single item.

Last, the data were collected from March 10 to May 4, 2020 and thus refer to the very first early stage of the pandemic in which people were most anxious and overstrained. By now, however, the public and governments may have adapted to the situation, which could reduce the study's relevance. However, data during just this time is rare and may thus be of special importance for socio-psychological research, even after the vulnerable phase itself. Furthermore, the second wave in Germany including a second lock-down with closed cinemas, pubs, and even boarder is happening right now in December 2020. Likewise, people begin to show panic buying behavior again, which again highlights the current data's impact.

Although some of these limitations cannot be retrospectively improved, the large sample of the current data set provides a strong variability that may legitimate an interpret a generalization and interpretation. Furthermore, safety behavior, especially during a worldwide pandemic, has not yet been investigated in comparable detail and magnitude. Apart from that, the scales used to measure *adherent* and *dysfunctional safety behavior* show decent psychometric properties (see **Supplementary Material**). Certainly, selection bias could play a role due to a relatively large proportion of participants, e.g., living in metropoles or pursuing medical professions. Again, a regression analysis is usually capable of partializing out such influences if considered in the model. Still, sources of confounding can be manifold [see, e.g., (48)].

Conclusion

The present results are the first and due to data's sample size to our knowledge the most reliable in Germany to point toward two different sub-constructs of safety behavior during COVID-19. While the people's trust in governmental actions leads to adherent safety behaviors like mask wearing, anxiety may trigger panic buying and possibly increase the threshold for other-regarding welfare. These results should affect future political awareness campaigns and interventions. Especially at the present time when infection rates are raising again, political leaders now have the ability to use this data to promote preventive action and thereby avoid the further spread of COVID-19 without unfavorable backfiring.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Essen Medical Faculty (20-9307-BO). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

BW and AS: planning, study design, data collection, data analysis and interpretation, and manuscript writing. ND, VM, MF, and HK: data interpretation and editing. E-MS, MT, and AB: planning, study design, and supervision. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh. 2020.625664/full#supplementary-material

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Panic Buying in Bangladesh: An Exploration of Media Reports

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Background: As an erratic human behavior, panic buying is an understudied research area. Although panic buying has been reported in the past, it has not been studied systematically in Bangladesh.

Aim: This study aimed to explore the characteristics of panic buying episodes in Bangladesh in comparison to current concepts.

Methods: A retrospective and explorative search were done using the search engine *Google* on November 6, 2020, with the search term "panic buying in Bangladesh." All the available news reports published in the English language were extracted. A thorough content analysis was done focusing on the study objectives.

Results: From the initial search, a total of 30 reports were extracted. However, six reports were not included based upon the exclusion criteria, resulting in an analysis of 24 reports. Five panic buying episodes were identified, discussing the precipitating events, responsible factors, goods acquired through panic buying, and prevention measures. Flood, curfew, COVID-19, and export ban were found to be precipitating events. Media reports frequently mentioned prevention strategies, expert opinion, supply chain status, rationing, and government action. The reported goods that were panic bought were items necessary for daily living such as rice, oil, spices, and safety products such as hand sanitizer and masks.

Conclusion: The study revealed preliminary findings on panic buying in Bangladesh; however, they are aligned with the current concept of it. Further empirical studies are warranted to see the geographical variation, precise factors, and to test the culturally appropriate controlling measures.

Keywords: panic buying, Bangladesh, news reports, content analysis, COVID-19

INTRODUCTION

Panic buying (PB) is an erratic human behavior that has been noticed in at least 93 countries all over the world during the COVID-19 pandemic (1). Outbreaks of infectious diseases can trigger feelings of uncertainty and violate an individual's sense of control (2, 3). Fueled by concerns about running out of certain items and goods, people tend to indulge in panic buying which gives them a semblance of control over a situation (1). Panic buying has been defined as "the phenomenon of a sudden increase in buying of one or more essential goods in excess of regular need provoked by adversity, usually a disaster or an outbreak resulting in an imbalance between supply and demand" (4). Several important aspects have been considered for PB, such as a sharp increase in the purchase of important necessary goods in excess of needs, usually precipitated by adverse events. It may be impulsive or well-planned (5).

A previous study also postulated a causative model of PB mentioning that any adverse precipitating event usually stimulates this behavior (1). As per the model, the adverse

stimuli act as precipitating events and initiate the behavior (1). Subsequently, secondary factors (psychosocial construct and information system), and tertiary factors (increased demand, the necessity of the product, supply chain, and anticipation of price hike) interact and shape it (1) (**Figure 1**). Several psychological factors have been postulated such as perceived scarcity, gaining control, fear of uncertainty, media influence, social behavior explaining the PB (1, 2). One study identified that a perceived scarcity, increased demand, necessary goods, the anticipation of price hike, any adverse situations, rumors, psychological reactions, social influences, a lack of trust in authority (government action), and experience were the attributed factors of PB (1).

PB has many negative effects such as disruption of supply chains, artificial commodity shortages, and stoke price rise. Furthermore, large crowds and queues appearing in retail spaces and stores could result in further clusters. Some prevention strategies have been proposed such as responsible media reporting, kinship promotion, rationing, assurance from the authority, some psychological measures to prevent the episodes (6, 7).

FIGURE 1 | Responsible factors for panic buying [adapted from (1)].

FIGURE 2 | Flow chart showing study sample selection.
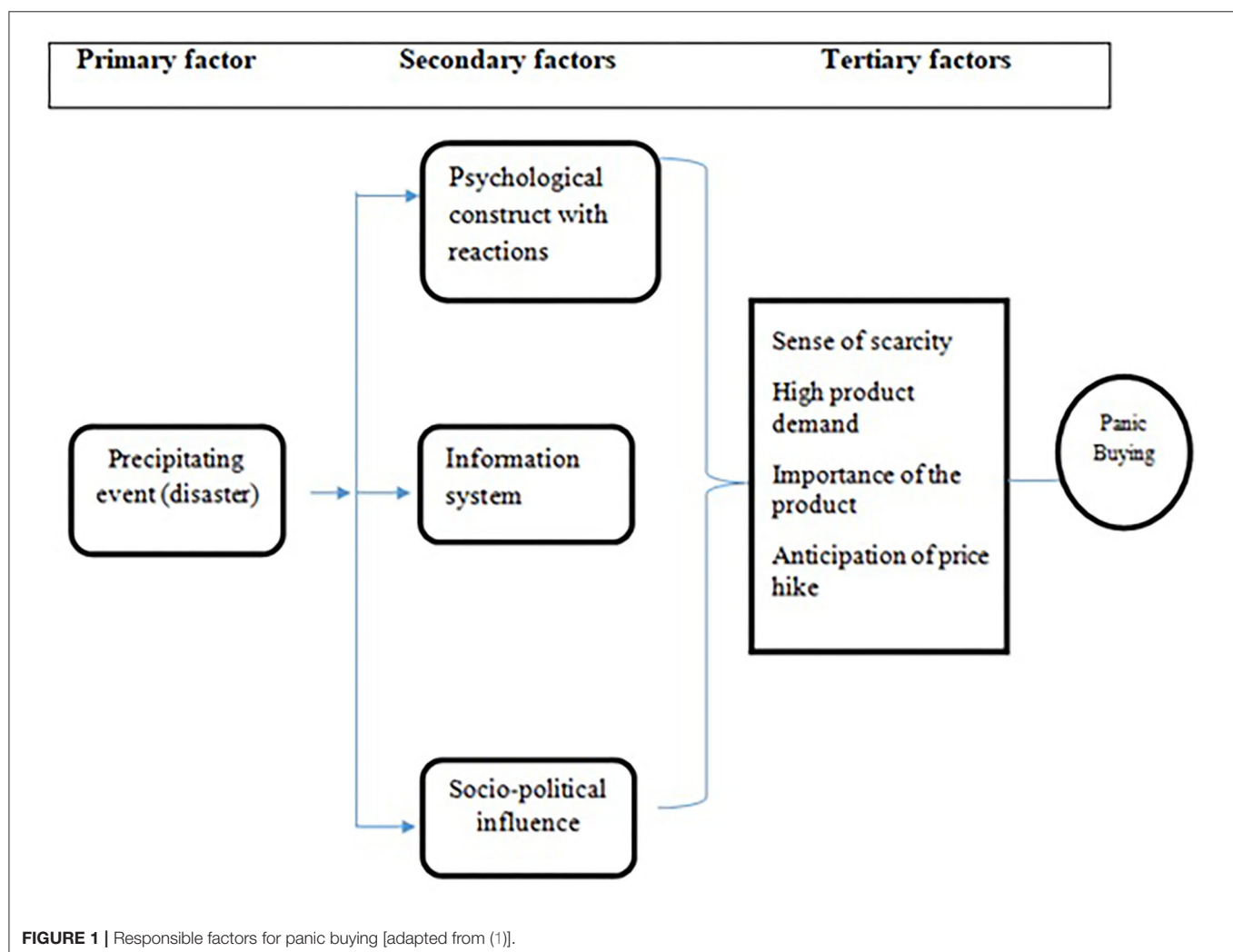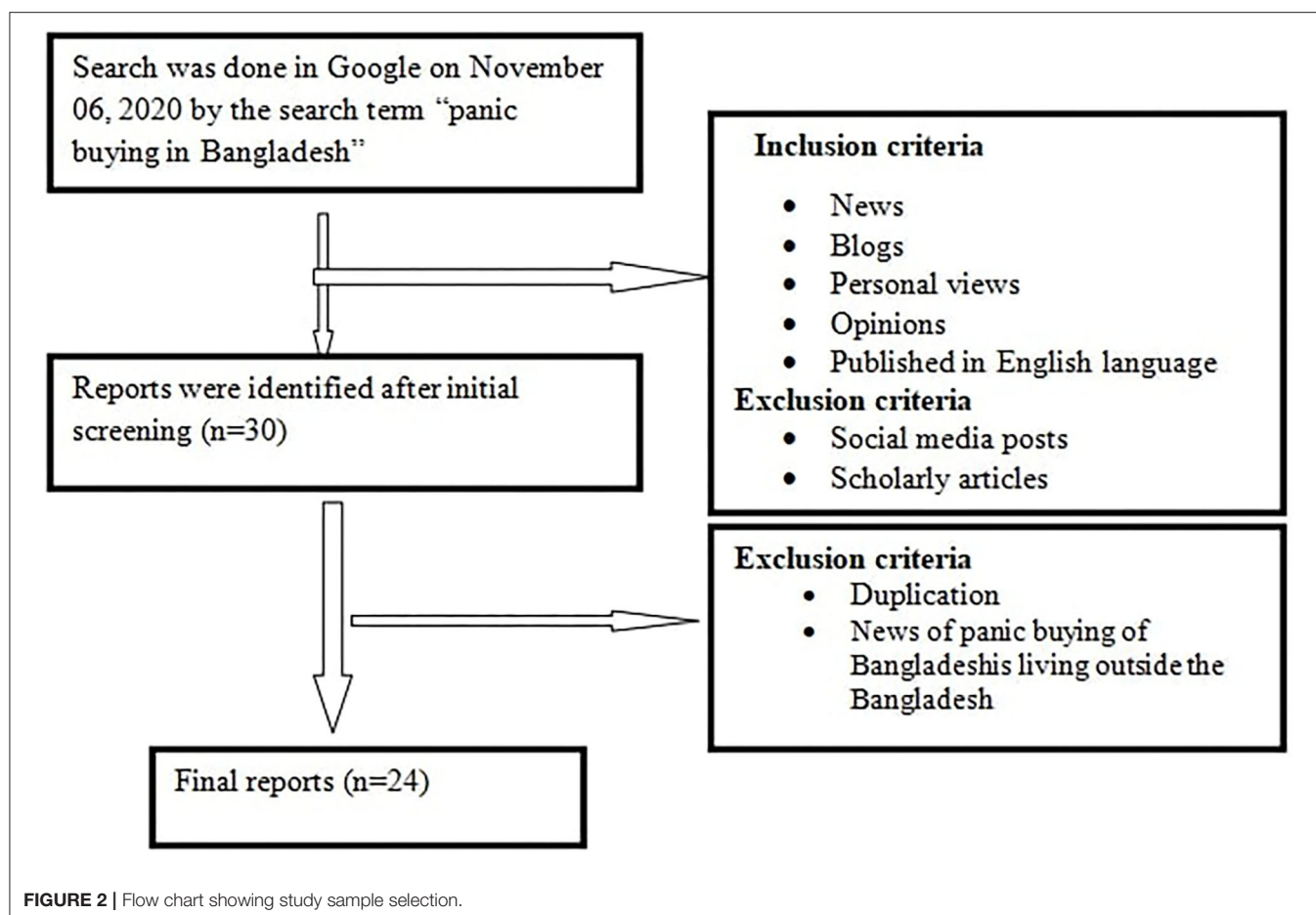
Given this scenario, there is a need for further research into the precipitating factors of PB, evaluating the responsible factors, and possible mitigating strategies. Country specific research on PB is limited though, and it is crucial to consider prevention strategies. Against this background, we conducted the present analysis to assess the characteristics of panic buying episodes in Bangladesh, a populous country in South-East Asia. In particular, we aimed to evaluate precipitating events, responsible factors, goods of panic buying, and control strategies. Driven by previous research methods in PB, we used media reports to identify articles related to PB for analysis. The goal was to provide country-specific data that may inform management and prevention strategies to control PB.

MATERIALS AND METHODS

Data Collection

A retrospective and explorative search were done in Google on November 6, 2020, with the search term "panic buying in Bangladesh." All the available news reports published in the English language were extracted. A thorough content analysis was done focusing on the study objectives. A method of three previous similar studies was followed to extract the reports, analyze the contents, identify the panic buying goods, assess the

media reports, trace the responsible factors, and mention the controlling strategies (1, 4, 6). The detailed data extraction is outlined in **Figure 2**.

Inclusion Criteria

The inclusion criteria for this analysis include reports from any report discussing panic buying from the media covering news, blogs, personal views, opinions that were published in English. Vernacular (Bangla) reports were not considered due to a lack of specification of the exact Bangla word for "panic buying."

Exclusion Criteria

Social media posts, scholarly articles, duplications, and news of the panic buying behaviors of Bangladeshis living outside Bangladesh were excluded from the study. Social media posts were excluded because they are supposed to be more emotionally charged and are very often biased. We excluded scholarly articles because we aimed to assess primary observations reported in the media. Various types of scholarly articles with various objectives would dislocate the research focus. Moreover, conformity bias, group-thinking, and herd behavior may be considered as potential sources of biases in social media posts (1).

Statistical Analysis

We used the Microsoft Excel spreadsheet 2019 version for data coding. As a preliminary explorative study detail, statistical analysis was not performed.

Ethical Statement

The study was conducted in compliance with the declaration of Helsinki (1964). As we analyzed publicly available media reports, no formal ethical approval was obtained.

RESULTS

From the initial extraction, a total of 30 reports were retrieved. However, six reports were dropped after considering the exclusion criteria, resulting in the analysis of 24 reports (**Figure 1**). From the 24 reports, five panic buying episodes were identified and the precipitating events, responsible factors, goods of panic buying, and prevention measures were discussed.

Precipitating Events

From the reports, flood, curfew, COVID-19, and export bans (2) were found to be precipitating events that initiated the PB. All the reported episodes had a precipitating event like a flood, curfew, COVID-19, and export ban of onion (**Table 1**).

Responsible Factors

Several attributing factors were identified from the reports such as rumor of danger (flood), curfew, policy ban, uncertainty, the anticipation of an impending lockdown, increased demand, anticipation of price hike, and anticipation of short supply (**Table 1**).

Goods of Panic Buying

The reported goods are necessary for daily living such as rice, sugar, salt, onion, pulse, potatoes, spices, masks, sanitizers, toilet paper, flour, lentil, pulse, oil, milk powder, chicken, fish, beef, egg, garlic, ginger, biscuits, baby diaper, mosquito coils, soaps, hygiene products, noodles, drugs (antibiotics, cough syrup, and anti-cold pills, fever medicine, hydroxychloroquine, dexamethasone, ivermectin, montelukast, doxofylline, salbutamol, some vitamin tablets), and pulse oximeter (**Table 1**).

Prevention Strategies

Media reports frequently mentioned prevention strategies, expert opinion, supply chain status, rationing, and government action. Raising awareness, selling goods at a lower price by the government, formulation of the special monitoring team, punishment to maleficent sellers, dissemination of stock status to the general people, assurance of stocks, import from alternative sources, reduced use of goods (onion), rationing while selling from the super shops, publishing circulars in newspapers to raise awareness, and a reduction of import duty were the controlling measures identified by the analysis.

DISCUSSION

Panic buying is an under-researched area even though it is common behavior during emergencies. This study aimed to identify the characteristics of panic buying episodes in Bangladesh in comparison to current concepts. We checked 24 published news reports (**Table 1**) to identify the precipitating events, products, events, responsible factors, goods of panic buying, and prevention measures. Five panic buying episodes were identified.

Current Concepts of PB

From the available evidence, we established that PB usually starts with an adverse stimulus, and people usually buy necessary goods in response to several psychological reactions (1–4). Media has a bidirectional role on PB which can either control or exacerbate (6, 7). Controlling media reporting, kinship promotion, the rationing of the products, assurance regarding safe supply, policy change, raising awareness, selling goods at a subsidized price have been noted as prevention strategies (6, 7).

Main Findings of the Study

The first episode happened in 1998 where a flood acted as a precipitating event. During this event rice, wheat, sugar, salt, onion, pulse, potatoes, and spices were brought, and assurance of adequate stocks was disseminated (8). The second episode happened in 2007 where curfew due to student riot acted as a precipitating event and necessary goods were brought (9). The third episode happened in 2019 where the export ban of the onion of a neighboring country acted as a precipitating event (10). The fourth episode was precipitated by the COVID-19 pandemic (11–29). The fifth episode was precipitated by another export ban of the onion by India (30, 31). Media reports frequently mentioned prevention strategies, expert opinion, supply chain status, rationing, and Government action (**Table 1**). The reported goods are necessary for daily living, for example, medications and safety products (**Table 1**). Several controlling measures were practiced in Bangladesh during the episodes and the government used initiatives. The episodes describing the characteristics of PB fit with the existing concept of panic buying in regards to precipitating events, responsible factors, goods, and measures. Although the episodes covered two different times (COVID-19 and others) the characteristics are similar.

The study revealed primitive characteristics of panic buying episodes, where it starts with adverse stimuli, have an extra buying of necessary goods, resulting in disruption of supply chains supporting the existing causative model of PB proposed by Arafat et al. (1). The practiced prevention strategies have also been supported by previous recommendations (31). Other studies also reported on items sought panic buying which are usually daily necessities (4, 32). The media reports have positive reporting characteristics, as revealed by recent studies (6).

TABLE 1 | Detail contents of reports (*n* = 24).

	Date of publication	News outlet	Main theme	Responsible factors of PB	Circulation	Goods	Events	Prevention strategy	Precipitating event
Panic buying pushes food prices up in Bangladesh (8)	Sep 11 1998	ReliefWeb	It reported a PB event and prevention activity	Rumor of flood	International	Rice, wheat, sugar, salt, onion, pulse, potatoes, spices	Increase demand and price, people buying extra amount	Assurance of stocks	Flood
Bangladesh imposes curfew after three days of student riots (9)	Aug 22 2007	The Guardian	It mentioned PB in response to the curfew	Curfew due to student riot	International				Curfew
Soaring onion prices create panic in Bangladesh (10)	Nov 22 2019	Global Voices	The report discussed the PB episode and government's action to prevent it	India banned the export of onions	International	Onion		Import from alternative sources, reduced use of onion	Export ban
Panic buying triggers mask, sanitiser crises (11)	Mar 9 2020	The Independent	It described an episode of PB	Detection of the first COVID-19 case	Local	Masks, sanitizers	Increase demand and price, stock out		COVID-19
Panic buying pushes up prices of masks, hand sanitiser (12)	Mar 9 2020	The Daily Observer	Discussed an panic buying episode	Detection of COVID-19 in Bangladesh	Local	Masks, toilet paper, hand sanitizer	Increase demand and price		COVID-19
Yarn prices soar as virus fear triggers panic buying (13)	Mar 10 2020	The Daily Star	It describes the effect of PB on industry buying increasing the price of Yarn	COVID-19 pandemic	Local	Yarn	Increase demand and price, stock out		COVID-19
Virus outbreak fears spark panic buying in Bangladeshi capital (14)	Mar 11 2020	Arab News	It reported the PB event and prevention activity	Uncertinity due to COVID-19 pandemic	International	Masks, sanitizers	Increase demand, stock out	Rationing	COVID-19
City people go for panic buying, govt says there's ample supply (15)	Mar 17 2020	Newage	It reported the PB event and prevention activity	COVID-19 pandemic	Local	Rice, rice, flour, lentil, pulse, oil, salt, sugar, hand-wash,sanitizers	Increase demand, increased price, people buying extra amount	Assurance of stocks from the Government, Rationing from the super shops	COVID-19
Minister's assurance ignored, panic buying spree continues (16)	Mar 18 2020	The Business Statndard	The report discussed the Government's initiatives to stop PB	COVID-19 pandemic	Local	Rice, lentil, sugar, milk powder	Increase demand, increased price, people buying extra amount	Raising awareness, selling goods in lower price by the Govt., formulation of monitoring, punishment to maleficent sellers, dissemination of stock status to the general people	COVID-19
First coronavirus death news prompts panic buying (17)	Mar 18 2020	The Business Standard	It reported the PB event and prevention activity	First death due to COVID-19	Local	Soybean oil, chicken, fish, milk powder, rice	Increase demand, increased price, people buying extra amount	Raising awareness, formulation of special team to monitor, punishment to maleficent sellers, dissemination of stock status to the general people	COVID-19

(Continued)

TABLE 1 | Continued

	Date of publication	News outlet	Main theme	Responsible factors of PB	Circulation	Goods	Events	Prevention strategy	Precipitating event
Panic buying pushes commodity prices up (18)	Mar 19 2020	Financial Express	The report discussed the PB episode and government's action to prevent it	COVID-19 pandemic	Local	Rice, pulses, flour, potato, beef, egg, spices, onion, garlic, ginger, biscuits, baby diaper, toilet paper and mosquito coils	Increase demand, increased price, people buying extra amount	Raising awareness, selling goods in lower price by the Govt., formulation of monitoring team, punishment to maleficent sellers, dissemination of stock status to the general people	COVID-19
Coronavirus triggers panic buying in Dhaka as stocks drop to 7-year low, gold prices fall (19)	Mar 19 2020	BDNews24.com	The report discussed the PB episode and government's action to prevent the PB	COVID-19 pandemic	Local	Rice, lentil	Increase demand, stock out	Raising awareness, dissemination of stock status to the general people	COVID-19
Panic buying on amid coronavirus fear in Bangladesh (20)	Mar 20 2020	Newage	It reported a PB event and the Government's action to control	First death due to COVID-19	Local	Rice, onion, garlic, lentil, potato, masks, hand sanitizers, hand rubs, soaps, hygiene products, noodles, oil, sugar, salt	Increase demand, increased price, people buying extra amount	Formulation of monitoring team, punishment to maleficent sellers, assurance of stocks	COVID-19
Online sales jump on panic buying	Mar 20 2020	The Finance Today	It describes the increased orders in ecommerce business	anticipation of an impending lockdown due to COVID-19	Local	rice, lentil, sugar, hand sanitizers	Increase demand		COVID-19
Onion prices double due to coronavirus panic-buying (21)	Mar 20 2020	Jagonews	It discussed an panic buying episode	COVID-19 pandemic	Local	Onion, ginger, garlic, potato			COVID-19
Coronavirus: Panic buying doubles onion prices in Dhaka (22)	Mar 21 2020	UNB NEWS	It described an episode of PB	COVID-19 lockdown	Local	Onion, garlic, rice, potato, egg, soybean oil, lentil	Increase demand, increased price, people buying extra amount	Mentioned the Government's action to control it	COVID-19
No panic buying, says PM (23)	Mar 21 2020	Somoy News	The report discussed the prevention steps of the Government for PB	COVID-19 pandemic	Local	Rice, pulse, egg and onion		Raising awareness, assurance about the stock	COVID-19
Online shopping gets momentum in BD for Corona panic (24)	Mar 21 2020	Daily Industry	The report discussed the effects of PB on online markets	COVID-19 pandemic	Local	rice, lentil, sugar	Increase demand		COVID-19

(Continued)

TABLE 1 | Continued

	Date of publication	News outlet	Main theme	Responsible factors of PB	Circulation	Goods	Events	Prevention strategy	Precipitating event
Panic buying prompts large jump in rice price (25)	Mar 23 2020	ProthomAlo	It reported the PB event of rice and recommended Governmental action to control	anticipation of an impending lockdown due to COVID-19	Local	Rice, Onion, garlic, potato, Soybean, lentil, eggs	Increase demand, increased price, people buying extra amount		COVID-19
Panic buying of medicines, self-prescription on rise (26)	Mar 25 2020	Bangladesh Post	It reported the PB event of medications and expert opinion	COVID-19 pandemic	Local	Antibiotics, cough syrup and anti-cold pills, fever medicine, Alatrol, Histasin, Paracetamol and C vitamins	Increase demand	Raising awareness	COVID-19
Covid-19: Panic buying drives pulse oximeter price up (27)	Jun 16 2020	DhakaTribune	It described a PB episode	COVID-19 pandemic	Local	Pulse oximeter	Increase demand, increased price		COVID-19
Panic-buying creates shortage of "Covid-19 drugs" in the market (28)	Jun 21 2020	DhakaTribune	It described a PB episode of medications, their side effects, and Government's action	COVID-19 pandemic	Local	Hydroxychloroquine tablets, dexamethasone, azithromycin, ivermectin, paracetamol, montelukast, doxofylline, salbutamol, fexofenadine, and some vitamin tablets	Increase demand	The Government published circulars in newspapers to raise awareness	COVID-19
Cease panic buying, enough in supply (29)	Sep 17 2020	NewsToday	The report discussed the prevention steps of the Government of a PB episode	export ban of Onion of India	Local	Onion		Import from alternative sources, reduced use of onion	Export ban
Tipu: Dishonest traders, panic buying behind onion price hike (30)	September 17 2020	Business outlook	It discussed the prevention steps of the Government of a PB episode of onion	export ban of Onion of India	Local	Onion	Increase demand, increased price	Raising awareness, selling goods in lower price by the Government, dissemination of stock, supply and price situation to the general people, reduction of import duty	Export ban

Strengths of the Study

This is the first systematic assessment of panic buying in Bangladesh and reveals preliminary explorative findings that could help to formulate prevention strategies in future.

Limitations

Data were extracted from media reports which are not of scientific quality. The sample size was small. Data extraction and the search were done by a single person (first author). No structured instrument was used to extract the data. Only English language reports were studied.

CONCLUSION

The study revealed preliminary findings of panic buying in Bangladesh. However, they are aligned with the current concept of panic buying. Further empirical studies are warranted to explore geographical variation, demographics (e.g., education, income), consumption behavior, precise factors, and to test culturally appropriate control measures.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study was conducted complying with the declaration of Helsinki (1964). As we analyzed the publicly available media reports, no formal ethical approval was obtained.

AUTHOR CONTRIBUTIONS

SA contributed to the concept, design, data analysis, and writing. All authors contributed to manuscript writing, revision, read, and approved the submitted version.

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A Biopsychosocial Approach to Understanding Panic Buying: Integrating Neurobiological, Attachment-Based, and Social-Anthropological Perspectives

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The global COVID-19 pandemic has focused the attention of researchers, civil authority and the general public on the phenomenon of "panic buying," characterized by the excessive purchase of specific materials—particularly food and hygiene-related products—in anticipation of an expected shortage. This phenomenon has been well-documented in response to several natural and man-made disasters, but its global scope and severity in the context of COVID-19 are unprecedented. This response can negatively impact health, food security, and disease prevention efforts. Attempts to modify such behaviors are more likely to succeed if they are based on insights from both the biomedical and the social sciences. From a biological perspective, the phenomenological overlap between panic buying and psychological disorders such as hoarding disorder and compulsive buying raises the possibility of a shared neurobiological underpinning. Evolutionary models suggest that these behaviors represent an attempt to enhance individual and group survival in the face of a threatened scarcity of resources. These phenomena may be influenced by specific genetic variants which are also implicated in hoarding-related psychological disorders. From a psychological perspective, attachment theory provides a conceptual framework that serves as a bridge between prior life adversity, current deprivation, and an increased attachment to material objects. Such a framework is of relevance when considering panic buying during the COVID-19 pandemic, which has been associated with significant disruptions in attachment bonds. From a social-anthropological perspective, hoarding and related behaviors have been associated with social exclusion and rejection, as well a lack of social support. These risk factors have affected large sections of the general population in the context of the COVID-19 pandemic and the governmental responses to it. This perspective also emphasizes the symbolic significance of the hoarded objects themselves. In this paper, an attempt is made to integrate these three perspectives and thereby formulate a biopsychosocial model of panic buying in response to this global health crisis. The existing scientific literature on panic buying is examined in the light of this model. Finally, suggestions are proposed as to how this model might inform social strategies aimed at preventing or reducing panic buying.

Keywords: COVID-19, panic buying, obsessive-compulsive disorder, 5-HTTLPR, hoarding disorder, compulsive shopping, attachment theory

INTRODUCTION

The Phenomenon of "Panic Buying" During the Global COVID-19 Pandemic

For the past 1 year, the world has faced a global outbreak of acute respiratory illness of unprecedented extent and impact. This illness, caused by the novel betacoronavirus SARS-CoV-2, has been designated COVID-19. Clinical manifestations of COVID-19 range from asymptomatic viral carriage to severe respiratory illness, with the latter outcome being more common in the elderly and those with significant medical comorbidities (1). At the time of writing this paper (January 12, 2021), over 86 million cases of COVID-19, and over 1.8 million deaths due to this disease, have been reported globally (2).

In an effort to contain the spread of this disease, local and federal authorities worldwide have resorted to large-scale containment measures such as lockdowns, "stay-at-home orders," and restrictions on commercial, educational, religious, and other public activities. Though deemed necessary by governments and experts, these measures have often led to widespread socioeconomic disruption, difficulties in accessing healthcare, and shortages of food and other essential supplies (3).

Against this background, a significant proportion of the general population has experienced various forms of psychological distress, such as symptoms of anxiety, depression, and post-traumatic stress. The frequency, severity and correlates of these phenomena have already been documented extensively in several systematic reviews (4–6). Besides these well-recognized phenomena, reports of "panic buying" in response to the COVID-19 pandemic have been reported in the literature since March 2020, with the earliest published reports coming from Asian countries (7–9). Wang et al. (9). Panic buying, also referred to as "stockpiling," is characterized by the purchase of "unusually large amounts of products," in anticipation of or during a natural or man-made disaster, related to a fear of shortage of unavailability of the concerned products, which are usually food or hygiene-related items (10, 11). Panic buying has been documented as a local response to phenomena such disease outbreaks or typhoons (12, 13), but has occurred on an unprecedented scale in the context of COVID-19 and the attendant restrictions imposed in an attempt to contain the spread of the disease (14).

Various explanatory models have been advanced to account for this phenomenon (11, 14). Before examining these, a brief review of the existing literature on the scope of this phenomenon, and the factors associated with it, is in order.

Frequency and Correlates of Panic Buying

Changes in purchasing behavior during the COVID-19 pandemic were commonly reported in the general population; in a study of Spanish consumers, over 60% reported such changes. However, only a small proportion of them exhibited actual panic buying (15). A review of media reports (14) found descriptions of panic buying from over 20 different geographical regions, encompassing both developing and developed countries. This paper found a predominance of reports (97.6%) from countries with a high level of urbanization and industrialization, though this may simply reflect a reporting bias. A study from Portugal reported stockpiling in 36% of respondents (16). In a report from the United States, the most common stockpiled materials were toilet paper (63%), canned foods (59%), staple foods such as rice and bread (53–57%), bottled water (57%), and medications (53%) (17).

A number of factors have been associated with an increased risk of panic buying. These may be conveniently classified as follows:

- *Individual factors*: male sex (18); increased extraversion and neuroticism; low conscientiousness and openness (19); need to belong (20); need for safety or reassurance (21–23); anxiety or worry (8, 21, 23); reduced adherence to social distancing (17); conservative attitudes (17);
- *Social and economic factors*: local severity of the pandemic (13, 20); perception of scarcity or of an increase in price (21); lack of trust in public authorities (19, 21); misinformation (20, 21); restrictions on internal movement (13); pre-existing psychiatric illness (24).

Proposed Explanations for Panic Buying and Their Limitations

Alongside the descriptive research on panic buying, summarized above, several authors have speculated on the possible causes or mechanisms underlying this complex behavior. From the perspective of survival psychology, acquiring essential supplies during an actual or threatened disaster is an adaptive behavior; however, when this behavior is influenced by excessive anxiety or fear of the "unknown," or of "losing control" over the situation, the result is irrational decision-making and panic buying (8, 11, 21). Alchin (25) has suggested that excessive exposure to displays of "panic buying" by others, either directly or through the media, can lead to the activation of evolutionarily primitive brain pathways which suppress higher-level "pro-social" behaviors, leading to a behavior is socially inappropriate. His model has also highlighted the potential role of social learning or imitation in reinforcing maladaptive cognitions regarding the risk of food shortage or scarcity of other essential supplies. From a broader socioeconomic perspective, Keane and Neal (13) have highlighted the role of local and international patterns of viral transmission, as well as government-imposed restrictions on internal (but not external) movement, in influencing panic buying.

While these explanations have a great deal of merit to them, they are deficient in three aspects. First, they are—to a certain extent—unduly reductive, and fail to consider the way in which biological, individual and social factors may interact. As a result, suggestions to improve panic buying that are derived from one model, such as excessive anxiety, may not be effective in areas where social factors are of greater significance. Second, these models fail to account for the significant variability in panic buying that has been reported across individuals, regions and countries. Third, these models do not explain the specific phenomenon of panic buying, which is a unique and discrete behavior pattern—at best, they provide general explanations

for psychological distress and maladaptive coping during the COVID-19 pandemic.

In order to address these limitations, an outline for a more comprehensive model was proposed by Arafat et al. (21). In this model, the precipitating event (a disaster, such as a pandemic or earthquake) interacts with psychological processes (appraisal and processing of the event) and social factors (such as cultural and political variables) to produce a sense of threat (resource scarcity) leading to panic buying. However, they have noted that this model needs to be verified by further research.

This paper takes the position that the broad outline proposed by these authors is essentially correct. However, it may be possible to refine it further and define areas for research, prevention and intervention by taking into account recent advances in the biological and social sciences. These advances and their implications will be discussed in section Divergent Theoretical Perspectives on Panic Buying below, and an attempt to integrate them will be presented in section Summary: Integrated Biopsychosocial Model of Panic Buying.

DIVERGENT THEORETICAL PERSPECTIVES ON PANIC BUYING

Neurobiology

From a biological perspective, Alchin (25) has attempted to explain panic buying in terms of the polyvagal theory proposed by Porges (26). According to this theory, perception of threat by the brain generates "primitive" fearful responses through activation of the autonomic nervous system and hypothalamic-pituitary-adrenal axis; however, if a situation is subsequently determined to be safe, this response can be overridden through a putative "social engagement system" (SES), mediated through the vagus nerve, which dampens stress responses and facilitates prosocial behaviors. However, exposure to continuous threatening stimuli—especially through the media, including social media—may overwhelm the SES, leading to maladaptive behaviors that are socially harmful. This theory, though plausible and backed by advances in neuroscience, functions better as a general theory of maladaptive behavior during the COVID-19 pandemic, and does not explain why a specific form of behavior (panic buying) should arise.

A more fruitful approach may be obtained by examining the similarities between panic buying and certain known psychological disorders—more specifically, obsessive-compulsive disorder (OCD) and related conditions such as hoarding disorder and compulsive buying. These latter conditions are considered to lie on the "OCD spectrum" and share genetic and neurobiological links with it (27–30). Hoarding disorder, whether considered as a discrete entity or as a subset of OCD, is characterized by the irrational accumulation of materials, usually of a non-essential nature, to an extent that causes functional impairment (31). Though the symptoms of these disorders are recognized as irrational and excessive by sufferers, they can also be understood from an evolutionary perspective as a dysfunctional variant of adaptive behaviors related to threat detection and harm avoidance (32). More

specifically, hoarding behavior has been conceptualized as a form of altruistic behavior that helps in maintaining a supply of scare resources, particularly in the face of a large-scale disaster or other cause of scarcity (33, 34). The argument, in brief, runs as follows: individuals with an innate tendency to hoard essential materials during a crisis would ensure a survival advantage for both individuals and their community as a whole, particularly in more "primitive" or traditional societies. On the basis of analogies with animal behavior, a similar hypothesis has been proposed by Miguel and Ligabue-Brown (35); their proposal requires no putative link to OCD.

From this perspective, it is possible to understand the emergence of stockpiling behavior in the face of actual or anticipated disasters, and especially in the context of a global crisis such as COVID-19. However, this explanation is missing a crucial factor: what causes this behavior to cross the "threshold of rationality" and take on an excessive form, namely panic buying? A number of neurobiological factors may underlie this phenomenon, including a paradoxical increase in prefrontal gray matter (36) and over-activation of specific brain regions, such as the anterior cingulate and dorsolateral prefrontal cortices (37). A similar model implicating under-activity of the medial prefrontal cortex and overactivity of nucleus accumbens has been postulated for compulsive buying (38). These changes may be reflected in higher-order constructs such as difficulties in emotion regulation, and intolerance of uncertainty or distress. From this viewpoint, the numerous uncertainties and negative emotions associated with the COVID-19 pandemic and its attendant socioeconomic changes may trigger aberrant neural activity in susceptible individuals, leading to an aberrant form (panic buying) of an otherwise useful behavior (purchasing essential materials) (39).

In addition, regional or cross-national variations in panic buying may be explicable in terms of genetic variations influencing brain structure and function, which account for 36% of the variance in hoarding disorder (40); further, there is a correlation of over 40% between genetic vulnerability for hoarding disorder and OCD (41). In this context, it is worth noting a consistent association between the long (l) allele of the serotonin transporter functional polymorphism 5-HTTLPR, located on chromosome 17, and vulnerability to OCD in certain subgroups (42). This genetic variant is of particular significance to behavioral responses to the COVID-19 pandemic, as there is some evidence that it was subject to selection pressures caused by infectious disease, and that it may influence behavioral responses to the threat of infection (43). These aspects will be discussed further in section Summary: Integrated Biopsychosocial Model of Panic Buying.

It can be argued that though phenomenologically similar, panic buying may not necessarily exist on a continuum with OCD; to date, no literature has reported an association between the two, or an increased risk of panic buying in OCD patients. This could be explained by the alternate hypothesis that hoarding may have different evolutionary roots from OCD in general (35). In the model proposed by these authors, human genes homologous to those involved in hoarding behavior in birds may be activated via epigenetic modification during traumatic or threatening situations. This would trigger a tendency to

accumulate possessions and derive a sense of safety from them. Another neurobiological hypothesis arises from the similarity of panic buying to compulsive buying. In situations where opportunities for natural rewards from the environment are lacking (due to containment measures or social distancing), repeated shopping or buying might activate the mesolimbic dopaminergic pathway, leading to a perception of reward and reinforcing this behavior.

Attachment Theory

If hoarding behavior has remote evolutionary origins, and can be triggered by a low tolerance to (or an inability to self-regulate) psychological distress, what are the specific psychological mechanisms or pathways linking distress and panic buying? In examining this association in the context of COVID-19, a useful perspective can be obtained from the field of attachment theory, as formulated by John Bowlby (44, 45). According to attachment theory, many psychological disorders have their origins in disruptions of attachment bonds in early childhood, and can be triggered or exacerbated by the disruption of attachment bonds later in life (46). Contemporary neuroscience has identified a certain degree of overlap between the brain regions involved in attachment behavior and those implicated in hoarding disorder, such as the anterior cingulate cortex (37, 47). Further, there is evidence that parental abuse, neglect or separation in early childhood, which are all associated with significant disruption of attachment bonds, are associated with an undue emotional attachment to possessions, which in turn is linked to the severity of subsequent hoarding behavior (48). Similarly, later experiences of social exclusion (49), trauma in interpersonal relationships (50), or poor social support (51) have been associated with the development and maintenance of hoarding behavior in adult life. This may be mediated through insecure adult attachment, leading to negative affective states which in turn trigger an increased attachment to, and desire to accumulate, certain possessions (51, 52). Similar phenomena have also been reported in compulsive buyers, though they are less well-characterized (53, 54).

The addition of these facts to the neurobiological framework discussed in section Neurobiology allows a more complete picture to emerge. In a given individual, genetic vulnerability interacts with disruption in early attachment bonds to influence the structure and function of discrete brain regions implicated in hoarding disorder, which is manifested in higher-order psychological constructs such as difficulties in emotion regulation, distress tolerance and tolerance of uncertainty, or a heightened attachment to possessions. However, the emergence and persistence of hoarding symptoms requires further disruptions or deficits in interpersonal attachment in later life (adolescence or adulthood). This is particularly relevant to the COVID-19 pandemic, where infection control measures have led to the disruption of existing interpersonal bonds on a global scale (3, 45). In such contexts, even individuals who had never previously exhibited hoarding behavior may develop an increased attachment to, and urge to accumulate, certain possessions—leading, not to hoarding disorder *per se*, but to panic buyi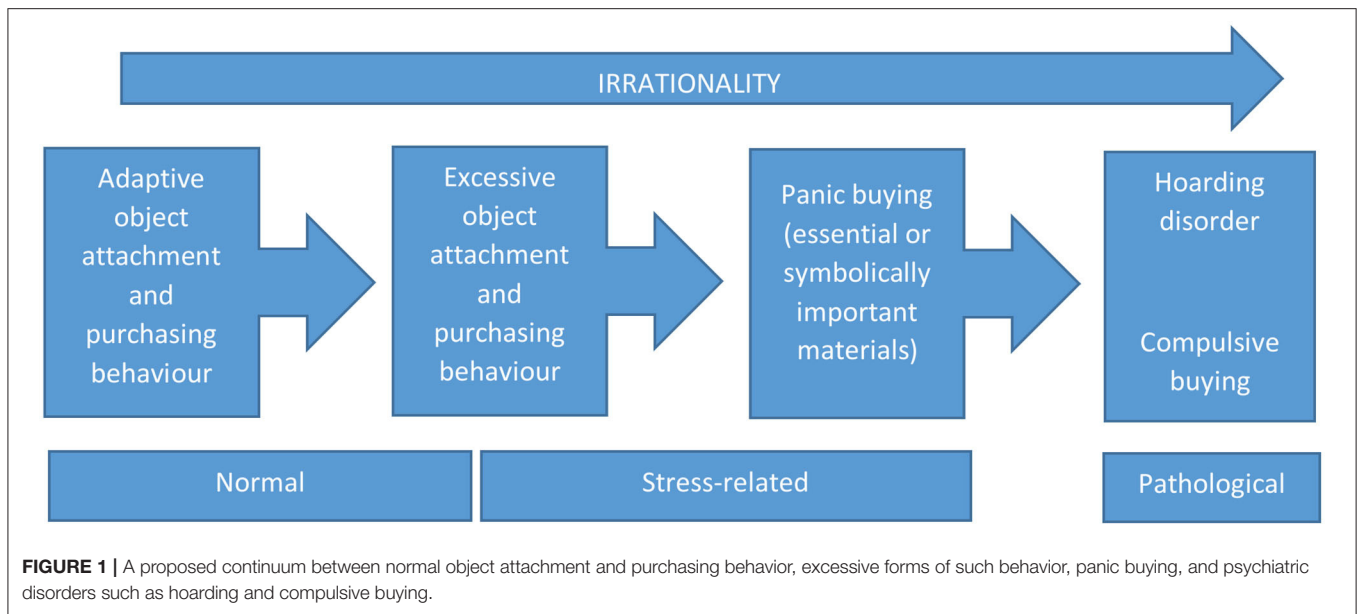ng. In this context, it is worth noting that many of the individual psychological variables identified as being linked to panic buying, such as high neuroticism and low openness and conscientiousness (17), have been specifically associated with disturbances in attachment both in children and in young adults (55).

Though this model is both evidence-based and plausible, it remains deficient in one significant aspect. Hoarding disorder is characterized by the accumulation of materials which are non-essential, while panic buying is characterized by the accumulation of objects which are actually or potentially essential; though excessive, it is not pathological because lacks the irrationality which is characteristic of hoarding disorder; neither is it unrelated to external threats, as in compulsive buying disorder. In order to explain this discrepancy, it is now necessary to turn to social-anthropological perspectives on these phenomena.

Social and Anthropological Perspectives

Hoarding disorder is characterized by a pathological form of attachment to material objects; however, object attachment varies significantly across individuals and cultures, and is influenced by a variety of factors. These include exposure to specific life events, individual and cultural beliefs, physical health, and cognitive functioning. From an anthropological perspective, an object that appears "non-essential" or even "worthless" may have a symbolic significance for a given individual (56, 57). In other words, it may be unduly reductive to create a dichotomy between "essential" and "non-essential" forms of object accumulation. Instead, these behaviors may exist on a spectrum or continuum, ranging from normal object attachment, to rational stockpiling of essential supplies in the face of threat, to excessive stockpiling of essential supplies in the same context, to overt panic buying, and finally to hoarding disorder or compulsive buying where the element of rationality is almost completely absent (16, 53, 57) (see **Figure 1**). In support of this notion, it is useful to note that the materials hoarded in panic buying may vary significantly in perceived "usefulness" across cultures. For example, the hoarding of guns and ammunition, which have symbolic significance in terms of safety and self-defense, may occur in certain Western countries (17) but not in Asian countries (21). Moreover, the value attached to possessions in general varies across cultures. Western countries generally assign a higher level of importance to material possessions, which are often portrayed as linked to success, happiness and popularity (58); compulsive shopping has been reported more frequently in such cultures (59), as has panic buying (14, 21).

These theories of symbolic meaning must be placed in the broader social framework of the COVID-19 pandemic, which has been characterized not only by large-scale disruptions of social bonds (as outlined in section Attachment Theory) but by economic disruptions leading to unemployment and poverty (60, 61). In turn, these disruptions have been associated with increased rates of specific social problems, such as domestic violence (62) and social exclusion or stigmatization (63) at the individual level. The large-scale social unrest and hardship occasioned by this pandemic is thus "translated" into a number of individual-level stressors, most of which have been associated with the initiation or maintenance of hoarding behavior (49–51).

FIGURE 1 | A proposed continuum between normal object attachment and purchasing behavior, excessive forms of such behavior, panic buying, and psychiatric disorders such as hoarding and compulsive buying.

At a symbolic level, a lack of trust in local or federal authorities—which may be worsened by the disruption of social bonds (45)—can further increase the likelihood of panic buying, as can a social learning effect based on imitation (25). The interactions between these factors are likely to be complex and non-linear.

With these details in place, it is now possible to formulate a more comprehensive model.

SUMMARY: INTEGRATED BIOPSYCHOSOCIAL MODEL OF PANIC BUYING
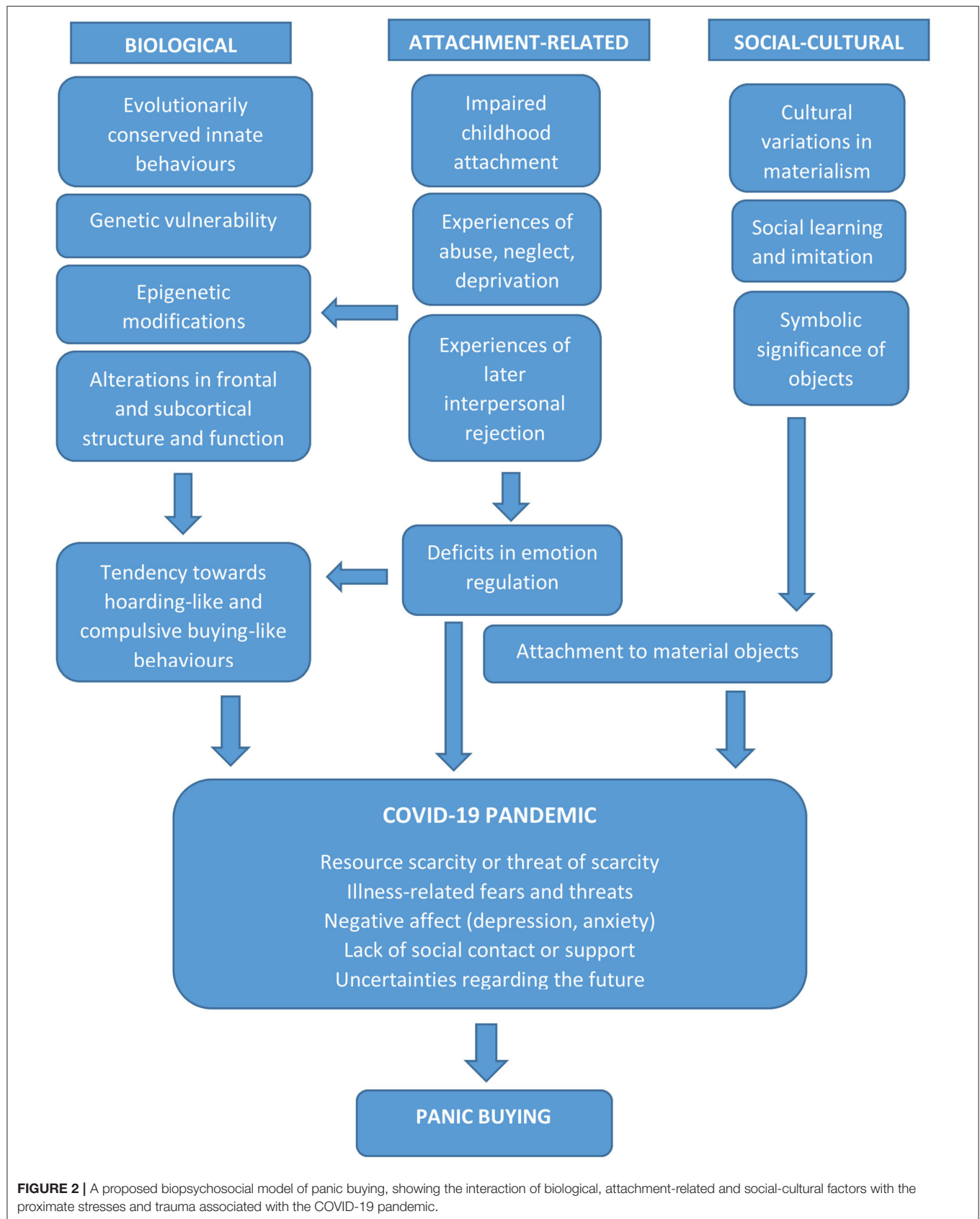
In brief, what is being proposed in this paper can be outlined in the following three propositions (**Figure 2**):

- At the most basic level, stockpiling behavior has distant evolutionary roots, and probably evolved as a response to actual or threatened scarcity of resources in primitive or traditional societies. This behavior exists on a continuum with more pathological forms (obsessive-compulsive disorder, hoarding disorder) and is at least partly determined by genetic and epigenetic factors. The neural circuitry underlying this behavior—both in its adaptive and maladaptive forms—is complex, and involves higher-order brain regions such as the dorsolateral prefrontal and anterior cingulate cortices. This "instinctive" response is activated by the perception of a threatened or actual scarcity, and has been reported on a greater or lesser scale in a variety of disaster-related contexts.
- At the individual, higher-order level, stockpiling behavior—and its pathological variants, hoarding and compulsive buying—also serve secondary psychological functions such as the regulation of negative emotions, low self-esteem, or distress related to uncertainty. Individual susceptibility

to these behaviors is influenced by both genetic factors and early childhood adversity involving the disruption of attachment bonds. In adult life, the actual or threatened disruption of attachment bonds through social isolation, exclusion, disharmony, aggression or a general lack of support is an important trigger—and maintaining factor—for these behaviors.
- At the social level, the large-scale social and economic disruptions caused by the COVID-19 pandemic and governmental responses to it lead to an increase in actual or threatened disruptions of family and community bonds. This leads to stockpiling, and in extreme cases, panic buying, the severity of which is related to individual biological and psychological diatheses. Additional social factors influencing this behavior include social learning through imitation, and a lack of trust in the ability of civil authorities to ensure an adequate supply of essential products. Cultural factors may both influence the likelihood of panic buying and the nature of the materials purchased, some of which may have symbolic significance.

Though the exact extent of the relative contributions of biological, psychological and social factors remains an open question, the framework outlined above provides a useful guide to further research on this phenomenon. It is also worth nothing that some factors may operate at multiple levels. For example, at an individual level, the serotonin transporter polymorphism 5-HTTLPR influences the susceptibility to obsessive-compulsive and related behaviors. However, at a broader level, it also appears to influence cultural patterns, with the *l* allele predominating in more individualistic societies and the *s* allele in societies characterized by a higher degree of collectivism; further, these cross-national variations may themselves have arisen as a result of survival advantages conferred during outbreaks of infectious disease (43).

FIGURE 2 | A proposed biopsychosocial model of panic buying, showing the interaction of biological, attachment-related and social-cultural factors with the proximate stresses and trauma associated with the COVID-19 pandemic.

Further, it should be emphasized that though the model presented here draws on research into certain psychiatric disorders, panic buying itself is neither a psychiatric disorder nor a symptom of one. Rather, it is an excessive form of a "normal" adaptive behavior (63) that may lie on a continuum with certain disorders, just as sadness and grief exist on a continuum with depression (64). As a majority of the research on panic buying has arisen in the context of this pandemic, it is possible that the proposal outlined here may require correction in whole or in part in the light of further evidence (65). It is also important to note that panic buying does not occur in a vaccum. The attitudes, emotional responses and behaviors of merchants and civil authorities during a pandemic need to be studied in order to obtain a more complete picture of how these factors influence, and are influenced by, the behavior of "panic buyers" (66).

RESEARCH FINDINGS EXPLAINED BY THE INTEGRATED MODEL

Though research explicitly focused on the model presented here does not exist yet, there are several findings from the existing literature that lend support to it:

- Several studies have reported either a fresh onset of OCD symptoms (67) or an increase in pre-existing OCD symptoms (68, 69) during the COVID-19 pandemic. This is predicted by the current model which views panic buying and OCD-related behaviors (hoarding and buying) on a continuum. The countries represented in these reports are those (such as Canada, the United States, and European countries) which have also reported increases in panic buying (8, 14).
- The onset of OCD symptoms during the COVID-19 pandemic has been associated with an intolerance of uncertainty and distress (70) as well as with an increase in and a higher level of perceived threat (71, 72) have both been associated with the emergence of *de novo* OCD symptoms during the pandemic. These psychological mechanisms are related to both hoarding behavior (73) and panic buying (21), which would be expected if these behaviors have common psychological roots.
- The majority of media reports of panic buying have come from countries where the *l* allele of the serotonin transporter polymorphism 5-HTTLPR is predominant (21, 43). This genetic variant has been associated with OCD and related conditions (41, 42).
- A need for reassurance has been identified as one of the key variables influencing panic buying (14, 24); this variable is also a key mediator of the link between negative mood states and the emergence of OCD symptoms (74).
- Perceived scarcity of resources and lack of access to them have both been linked with panic buying (13, 21, 66). This finding is consistent both with the psychological and social aspects of this model, in which the accumulation of objects symbolizes safety and security, as well as with the postulated evolutionary roots of hoarding and related behaviors (32, 35).
- A qualitative study of reports from retailers dealing with "panic buyers" during the initial phase of the pandemic found many commonalities with the factors highlighted in

this model: exaggerated threat perception, intolerance of uncertainty, a need for safety, disrupted social bonds, social learning, and an actual or symbolic value assigned to the objects purchased (66).
- An in-depth study of individuals indulging in impulsive buying outside the context of the COVID-19 pandemic outlined the specific psychological and social factors reported as important by these individuals: a need to control negative mood states, the perceived actual or symbolic value of the objects purchased, and a perceived lack of availability of the purchased objects (75). These factors were similar to those reported by individuals indulging in panic buying during the pandemic (21, 24).

AVENUES FOR FUTURE RESEARCH AND PRACTICAL IMPLICATIONS

If this model is wholly or partly correct, it has important implications for strategies aimed at minimizing or preventing it. There are a number of avenues for research that would serve to either confirm or refute the model proposed here, either entirely or partly. At an individual level, the occurrence of panic buying in patients with OCD, hoarding disorder and compulsive buying could be examined. Similarly, the occurrence of panic buying at a higher rate in the relatives of individuals with these conditions would support a possible link between them. Genetic and brain imaging studies could identify potential overlapping factors between panic buying and these disorders, though these should be conducted in strict adherence to ethical guidelines. Studies of childhood and adult attachment in individuals exhibiting panic buying, in relation to a control group, could clarify the role of interpersonal and object attachment. Finally, multi-national studies could identify the role of cultural and symbolic factors in influencing both the occurrence of panic buying and the nature of the objects that are preferentially purchased.

When considering the real-world applications of this model, it is worth noting that many of the risk factors for panic buying identified by researchers can be accommodated within this framework. Individual factors such as neuroticism, need for reassurance and a high level of anxiety are—as would be predicted by the literature on hoarding disorder—associated with higher levels of panic buying (19, 21, 23, 24), as are local conditions characterized by higher levels of social isolation or interpersonal stress (13, 21). The model proposed here is also entirely consistent with the frameworks outlined by Alchin (25) and Arafat et al. (21) and is in many senses complementary to them; while Alchin's model highlights the role of threat perception and social learning in panic buying, and Arafat et al.'s model integrates psychological and social factors, the current model provides further insights regarding possible biological, psychological and social processes that underpin these constructs.

Though the biological and early childhood factors identified in this paper may not be directly amenable to intervention during the COVID-19 pandemic, the psychological and social factors identified as triggering or maintaining panic buying

provide fruitful avenues for strategies aimed at preventing or minimizing this behavior (76, 77). These may be briefly enumerated as follows:

- Concerted efforts must be made by civil authorities—both at the local and federal level—to mitigate the economic hardships caused by the COVID-19 pandemic. This may take the form of direct financial assistance, strategies aimed at ensuring a reliable and equitable supply of essentials to communities, providing alternative forms of temporary employment, and the like. The exact nature of these interventions may vary according to local economic and cultural conditions.
- Given the key role played by anxiety and intolerance of uncertainty in influencing these behaviors, accurate information on the pandemic and the measures necessary to contain it must be disseminated in a form that is understandable and culturally appropriate (76). Myths and misconceptions which may lead to stigmatization, exclusion or social avoidance should be corrected. The preparation of educational materials should be done in collaboration with experts in the fields of public health, infectious disease, and health psychology. These materials should also frame adherence to safety measures as an altruistic or even heroic act, to ensure a "positive" form of social learning (77).
- When infection control measures are necessary, these should be explained in advance, and should not be enforced in an arbitrary or unduly punitive manner, to avoid undermining public trust. Instead of punishments for "offenders," positive incentives for adherence to hygienic measures or social distancing may be offered.
- As pre-existing psychological and social vulnerabilities may exacerbate the impact of the pandemic and trigger these behaviors, the above two interventions should be provided more urgently in areas already characterized by high rates of economic deprivation, unemployment, or social unrest.
- Given the hypothesized inverse relationship between social support and panic buying, efforts must be made to ensure at least a certain degree of social contact between individuals, while respecting basic safety precautions. Particular attention must be paid to institutions with a particular social or cultural significance, such as schools, colleges and places of worship. A balance should be struck between reasonable safety measures and continued access to these, given their direct and symbolic importance to large numbers of individuals.
- The media should avoid undue sensationalism and speculation when reporting on the pandemic, and should ensure the accuracy of all published information to the farthest extent. As is done for other social problems such as suicide, they should provide information on avenues for help or assistance and not merely highlight problems or present them as insoluble (76).
- Continued access to healthcare, especially for those with pre-existing psychiatric disorders on the anxiety or obsessive-compulsive spectrum, should be ensured. Though telemedicine-based models may be useful in this regard,

they are not always feasible in certain settings, and direct consultations may need to be offered, while ensuring adherence to hygienic measures.

- Healthcare workers interacting with individuals who indulge in panic buying, or who are communicating with the public on this matter, should try to understand the above perspectives. When doing so, they should attempt to provide clear information and reassurance; to link distressed individuals with available physical and psychological resources; and to explain this behavior as an understandable but excessive response to a crisis rather than taking a judgmental or medicalizing stance. They must also attempt to teach anxiety reduction or stress management techniques where applicable, as these might regulate the putative psychological and epigenetic factors related to panic buying.
- Some of these suggestions are in line with the existing recommendations of experts from various countries (76, 77). These medically and socially oriented proposals should ideally be implemented alongside more logistic, supply chain-related solutions. The latter have already been implemented in several countries (78), though their efficacy requires further evaluation.

CONCLUSIONS

Though it may be viewed as an extreme response to an extreme situation, the phenomenon of panic buying shines a light on the evolutionary roots of long-standing, conserved patterns of behavior, their primary and secondary functions, and their sensitivity to individual and social stressors. Panic buying is in itself not a pathological condition but an excessive form of an adaptive behavior (79, 80). However, it may share common roots with certain psychiatric disorders. It may be possible to prevent or minimize panic buying through social strategies informed by an integrated bio-psycho-social model, as has been outlined in this paper. As the model presented here is of a theoretical nature, it should be interpreted and applied with prudence until it is subjected to more rigorous empirical testing. If this does occur, is hoped that the insights presented here would aid both the scientific and the larger human community when confronted with future disease outbreaks or other disasters.

AUTHOR CONTRIBUTIONS

RR developed the concept for this review, carried out the literature search, wrote the paper, and proofread it. This paper represents the author's original work and has not been submitted for publication elsewhere.

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Who Was Shopping More During the Spring Lockdown 2020 in Germany?

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Background: During the lockdown, governmental restrictions resulted in changes to the day-to-day routines of many individuals. Some people appear to cope with stress by panic buying in an attempt to stockpile specific goods, resulting in empty supermarket shelves. Moreover, e-commerce experienced significant growth during this period. We aimed to investigate potential changes in shopping frequencies and preferred shopping type (offline/online) and their relationship with pandemic-specific anxiety and stress during the 2020 spring lockdown in Germany.

Methods: To address this question, we assessed self-reported changes in shopping behavior in a German sample *via* an online survey conducted during April and May 2020.

Results: A total of 3,122 adults were included in the analysis. Of the total sample, 35% reported no changes in their shopping behavior, 46.8% shopped less, while 18.2% shopped more during the lockdown. The groups differed with respect to sociodemographic variables, and those participants who were shopping more reported greater pandemic-related health fears and stress due to the restrictions. Moreover, they shopped online more often during the lockdown than the other two groups.

Conclusion: While the majority of the sample reported no changes in their shopping behavior or even shopped less during the 2020 spring lockdown, a subgroup of individuals was shopping more during this time, especially food and drugstore products. It is important to understand which factors influenced individuals to shop more so that policy makers can target this group and prevent panic buying, especially during subsequent waves of infection. It is also important to inform vulnerable persons about the risk of developing a buying–shopping disorder.

Keywords: panic buying, buying-shopping disorder, lockdown 2020, Germany, COVID-19

INTRODUCTION

The rapid spread of the coronavirus disease 2019 (COVID-19) pandemic led to the widespread introduction of social distancing rules, including full lockdowns. As in the majority of countries across the world, the German government implemented a lockdown that began in all 16 partly-sovereign federal states by March 23, 2020. During this lockdown, various restrictions were

imposed, such as closures of schools and non-systemically relevant facilities (e.g., restaurants, shopping malls), social and physical distancing requirements, travel bans, border closures, and cancellation of various events (e.g., cultural and sport events). These restrictions resulted in people being isolated for long periods and changes to their day-to-day routines. Since meetings with colleagues and social contacts during this period were limited, the use of Internet technology grew significantly. Video calls replaced face-to-face interactions with colleagues, family, and friends alike.

The Internet provides many opportunities for shopping where buyers can get immediate reward and emotion regulation. It provides the opportunity to buy 7 days a week/24 h a day, to shop from home and to use payment systems that can lead to inadvertent expenses (1) and, in extreme cases, to online buying–shopping disorder (2). Individuals with buying–shopping disorder are preoccupied with consumption of goods, diminished control over their spending behavior, and have the inability to normalize it even when faced with negative consequences such as debt, family conflict, and significant psychosocial impairment (3, 4). They spend money mainly for appearance-related goods or products that signal status (e.g., clothes, shoes, jewelry, makeup, art, and electronic devices) to satisfy emotional needs (1, 3–5). About one third of the patients seeking treatment for a buying–shopping disorder met the criteria for addictive online shopping (2). It is noteworthy that prevalence estimates of about 5% (6) suggest a high occurrence of buying–shopping disorder in the general population.

During the lockdown, we have encountered empty supermarket shelves. Some people seemed to cope with their stress by panic buying, attempting to stock up on toilet paper, hand soap, pasta, and other specific goods. Panic buying is explained as the "phenomenon of a sudden increase in buying of one or more essential good in excess of regular need provoked by adversity, usually a disaster or an outbreak" (7). Typical goods that are bought excessively in the context of panic buying are for instance food (e.g., rice, oil, and spices) and drugstore products (e.g., soap, toilet paper, masks, and hand sanitizers) (8). The German Federal Statistical Office reported for the period of the spring lockdown an increase in demand for soap of 337% and 221% increase in demand for toilet paper in comparison with that of the previous 6 months (9). Arafat et al. (10) analyzed English language media reports concerning aspects of panic buying and reported a sense of scarcity as being the most important cause of panic buying. Further aspects were the increased product demand, importance of the products, and anticipation of price hikes due to the pandemic. In addition, rumor, psychological factors (safety-seeking behavior, uncertainty, anxiety reduction, and taking control), social learning, lack of trust, government action, and past experience were identified as important variables that contribute to panic buying (10). The authors proposed a causal model where an adverse event or disaster (e.g., COVID-19 pandemic) causes panic buying through the abovementioned responsible factors (10). According to a recent review (11), factors that influence panic buying include the individual's perception of the health crisis and scarcity of products, fear of the unknown and negative emotions, coping behavior to relieve

anxiety, and social psychological factors such as (mis)trust in government. Panic buying represents a phenomenon often seen in faces of disasters that has been investigated by different academic domains, whereas, more than three quarters (85.71%) of the research output on panic buying has occurred in the wake of the COVID-19 pandemic Arafat et al. (12).

To the best of our knowledge, it remains unclear which individuals shopped more often during the spring lockdown in Germany and how shopping behavior changed. An important question concerns potential pandemic-related changes in offline/online shopping preferences and whether the lockdown has accelerated the shift toward an increased use of digital technologies and e-commerce. While Internet use has many positive aspects (e.g., simplified access to information, increasing contact through social networks, and reducing loneliness), it can also have a negative impact on some individuals. Behavior such as gambling, use of social media and online pornography, or simply surfing the Internet can be used to reduce stress as non-problematic coping strategies but may also contribute to the development of unhealthy and potentially addictive habits (13). The same may be true for online shopping. Research indicates that specific e-commerce features such as anonymity, availability, accessibility, and affordability contribute to the development of unhealthy shopping habits or can even result in online buying–shopping disorder (1, 14–16). One may expect that many consumers switched from offline to online shopping during the lockdown due to the temporary closure of bricks-and-mortar stores. In addition, the change from offline to online shopping may have psychological aspects. Based on literature, we developed the hypothesis that in a subgroup of individuals, pandemic-specific anxiety, and stress have contributed to changes in shopping frequencies and preferences. To address this issue, we conducted an online survey investigating the relationship between self-reported changes in shopping behavior and opinions and feelings concerning the COVID-19 pandemic in a German community sample during the spring 2020 lockdown.

METHODS

This study was part of a larger online survey study conducted during the 2020 spring lockdown. Our analyses focused specifically on self-reported changes in shopping behavior during the lockdown. The survey was created using SoSci Survey Version 2.5.00-i (SoSci Survey GmbH, Munich, Germany). Aside from the assessment of changes in shopping behavior during the lockdown, participants' alcohol consumption, tobacco usage (17), media use (18), and gambling behavior as well as their eating and sport habits were investigated. The survey was promoted *via* print and social media channels as well as radio interviews and was posted from April 8 to May 11, 2020. A total of 3,122 participants (voluntary response sample) between the ages of 18 and 80 years were included in the analysis. The cover page of the survey included information about the study and its anonymous nature in accordance with the principles of the Declaration of Helsinki and the EU General Data

Protection Regulation. The study protocol was approved by the ethics committee of the University of Heidelberg (registration number: 2020-552N).

Assessment Instrument

The survey was developed in the Department of Psychiatry and Psychotherapy at the Paracelsus Medical University Nuremberg, and the Department of Addictive Behavior and Addiction Therapy at the Central Institute of Mental Health Mannheim, Germany. It included categorical assessments of several sociodemographic variables. Shopping behavior was assessed with questions concerning the preferred shopping type (preformulated answers: predominantly offline, predominantly online, both equally—online and offline) for the periods before and after the beginning of the lockdown. Participants were further asked about changes in the amount of shopping after the beginning of the lockdown (preformulated answers: a lot less, somewhat less, about the same, somewhat more, a lot more) and about concerns relating to their shopping behavior ("Have you or someone among your family and friends or a doctor been worried about your shopping behavior or suggested that you should shop less?"; preformulated answers: no concerns; yes, before the lockdown; yes, during the lockdown; yes, before and during the lockdown). Furthermore, participants were asked to answer questions regarding their opinion of the control of the pandemic in Germany ("Do you think that the corona crisis will be managed successfully in Germany?"; four-point Likert scale: 1 = certainly not, 4 = certainly yes), the importance of the restrictions ("In your opinion, are the restrictions important for the successful control of the corona virus?"; four-point Likert scale: 1 = certainly not, 4 = certainly yes), and the estimated duration of the lockdown (in weeks). Additional questions referred to pandemic-related health fears ("Are you afraid for your health or for the health of those close to you?"; 1 = not at all, 11 = yes, very much) and perceived stress due to the restrictions during lockdown ("Do you feel stressed by the restrictions?"; 1 = not at all, 11 = yes, very much).

Statistics

Statistical analyses were conducted using the IBM SPSS statistical package, version 21.0 (IBM Corporation, Armonk, New York). Means, standard deviations, and frequencies were computed to profile the sociodemographic, shopping-specific and pandemic-related variables of the total sample and the subgroups. To assess self-reported changes in the preferred shopping type (offline vs. online vs. both equally), we performed the McNemar–Bowker test. To test for differences between the shopping groups (assembled based on the self-reported changes in shopping behavior) for categorical data, x^2 test or—if the assumptions were not fulfilled—Fisher's exact test were performed with Cramer V as effect size. To explore significant associations between the groups and the categorical variables further, we performed post-hoc tests and calculated standardized residuals for the cells of the crosstabs, which quantify the standardized difference between observed and expected (from the marginal distributions) numbers. To calculate between-group differences in opinions and feelings concerning the COVID-19 pandemic, we performed

multivariate analyses of variance (MANOVAs) and Bonferroni post-hoc analyses with η_p^2 as effect size. The significance level for all tests was set at $p = 0.050$. To counteract the problem of multiple comparisons, we used the Bonferroni–Holm method.

RESULTS

Self-Reported Changes in Shopping Behavior

While 1,092 (35.0%) of the participants did not change their shopping behavior during the lockdown, 1,462 (46.8%) reported shopping less (912 somewhat less and 550 a lot less), and 568 (18.2%) reported shopping more (458 somewhat more and 110 a lot more).

Sociodemographic Variables

Three groups were formed to compare participants who shopped more, less, and the same. The groups differed significantly concerning gender ($p < 0.001$, Cramer V = 0.08), age ($p < 0.001$, Cramer V = 0.10), years of schooling ($p < 0.001$, Cramer V = 0.07), and changes in employment status during the lockdown ($p < 0.001$, Cramer V = 0.08). Sociodemographic data are presented in **Table 1**. When looking at post-hoc tests and standardized residuals, we observed that females were found less often in the shopping same group, while males were found more often in the shopping same group and less often in the shopping less group than expected. In the shopping more group, participants between 18 and 34 years old were found more often than expected and participants over 55 years old less often. In the shopping less group, we found participants aged between 55 and 64 years old more often than expected. Participants with fewer than 11 years of schooling featured more in the shopping same group and featured less in the shopping less group, while participants with more than 13 years of schooling were found in the shopping less group more often than expected. Furthermore, participants with changes in their employment status during the lockdown were observed more often in the shopping same group.

Feelings and Opinions Regarding the COVID-19 Pandemic

Results of the MANOVA with opinions and pandemic-related health fears as dependent variables suggest a significant difference between the three groups [Wilk's L = 0.97, $F_{(10,2,364)} = 8.22$, $p < 0.001$, $\eta_p^2 = 0.02$]. The ANOVA revealed a significant difference between the groups concerning participants' opinions concerning the successful control of the coronavirus [$F_{(2,2,368)} = 6.20$, $p = 0.002$, $\eta_p^2 = 0.01$], with the shopping more group (M = 2.49, SD = 0.89) reporting lower scores than the shopping less group (M = 3.09, SD = 0.79). The groups differed significantly in their opinion of the importance of the restrictions [$F_{(2,2,368)} = 6.22$, $p = 0.002$, $\eta_p^2 = 0.01$], with the shopping more group reporting lower scores (M = 3.35, SD = 0.94) than the shopping same group (M = 3.50, SD = 0.80) and the shopping less group (M = 3.51, SD = 0.80). Moreover, the groups differed regarding perceived stress due to the restrictions [$F_{(2,2,368)} = 31.24$, $p < 0.001$, $\eta_p^2 = 0.03$] and pandemic-related health fears

TABLE 1 | Sociodemographic description of the total sample and group differences.

	Shopping more (n = 568) n (%)*; Std. Res	Shopping same (n = 1,092) n (%)*; Std. Res	Shopping less (n = 1,462) n (%)*; Std. Res	Statistics	Total sample (N = 3,122) N (%)*
Gender					
Female	387 (68.1)[a]; 1.2	623 (57.1)[b]; −2.9	990 (67.7)[a]; 1.7	$X^2 = 38.15$**	2,000 (64.1)
Male	178 (31.3)[a]; −1.7	467 (42.8)[b]; 3.9	469 (32.1)[a]; −2.3	df = 4	1,114 (35.7)
Other	3 (0.5)[a]; 1.3	2 (0.2)[a]; −0.5	3 (0.2)[a]; −0.4	**p < 0.001**‡	8 (0.3)
				Cramer V = 0.08	
Age					
18–24 years old	85 (15.0)[a]; 2.1	131 (12.0)[a,b]; 0.1	156 (10.7)[b]; −1.4	$X^2 = 56.05$	372 (11.9)
25–34 years old	188 (33.1)[a]; 2.6	302 (27.7)[b]; 0.2	363 (24.8)[b]; −1.8	df = 10	853 (27.3)
35–44 years old	132 (23.2)[a]; 1.0	232 (21.2)[a]; −0.1	303 (20.7)[a]; −0.5	**p < 0.001**‡	667 (21.4)
45–54 years old	100 (17.6)[a,b]; −1.0	192 (17.6)[a]; −1.4	314 (21.5)[b]; 1.8	Cramer V = 0.10	606 (19.4)
55–64 years old	50 (8.8)[a]; −3.9	167 (15.3)[b]; 0.1	255 (17.4)[b]; 2.3		472 (15.1)
>65 years old	13 (2.3)[a]; −2.8	68 (6.2)[b]; 2.0	71 (4.9)[b]; 0.0		152 (4.9)
Living arrangements					
Alone	152 (26.8)	279 (25.6)	335 (23.1)	$X^2 = 21.07$	766 (24.6)
With partner	178 (31.4)	410 (37.6)	487 (33.5)	df = 10	1,075 (34.6)
With children	30 (5.3)	40 (3.7)	60 (4.1)	p = 0.021	130 (4.2)
With partner and children	117 (20.6)	216 (19.8)	344 (23.7)		677 (21.8)
With parents	44 (7.8)	68 (6.2)	89 (6.1)		201 (6.5)
Other forms	46 (8.1)	77 (7.1)	137 (9.4)		260 (8.4)
Years of schooling					
<11 years	193 (34.2)[a]; 1.4	375 (34.7)[a]; 2.2	389 (26.8)[b]; −2.8	$X^2 = 31.24$	957 (30.9)
$11 < x \leq 13$ years	144 (25.5)[a]; 1.0	254 (23.5)[a]; 0.0	328 (22.6)[a]; −0.7	df = 4	726 (23.4)
>13 years	227 (40.2)[a]; −1.9	453 (41.9)[a]; −1.9	735 (50.6)[b]; 2.8	**p < 0.001**‡	1,415 (45.7)
				Cramer V = 0.07	
Having a systemically relevant profession***					
Yes	231 (41.9)	447 (42.0)	595 (41.6)	$X^2 = 0.04$	1,273 (41.8)
No	320 (58.1)	618 (58.0)	836 (58.4)	df = 2	1,774 (58.2)
				p = 0.978	
Employment status before the lockdown					
Full-time	297 (52.4)	593 (54.4)	762 (52.2)	$X^2 = 13.52$	1,652 (53.0)
Part-time	134 (23.6)	226 (20.7)	353 (24.2)	df = 8	713 (22.9)
School/university/in training	74 (13.1)	121 (11.1)	153 (10.5)	p = 0.095	348 (11.2)
Not working****	48 (8.5)	130 (11.9)	149 (10.2)		327 (10.5)
Other	14 (2.5)	21 (1.9)	43 (2.9)		78 (2.5)
Changes in employment status during the lockdown					
Yes	264 (54.2)[a]; 2.7	426 (44.0)[b]; −0.9	578 (44.3)[b]; −0.9	$X^2 = 16.42$	1,268 (45.9)
No	223 (45.8)[a]; −2.5	543 (56.0)[b]; 0.8	728 (55.7)[b]; 0.8	df = 2	1,494 (54.1)
				p < 0.001‡	
				Cramer V = 0.08	

*Sums of individual items may not be equal to totals due to rounding. **Fisher exact test. ***E.g., work in the waste management industry or a hospital or a supermarket ****Incl. Retired, Unemployed, Homemaker.
‡Significant after Bonferroni–Holm correction.
Bold values indicate significant difference.
[a,b]Values with different superscripts are significantly different (post-hoc tests).

$[F_{(2,2,368)} = 7.78, p < 0.001, \eta_p^2 = 0.01]$, with the shopping more group reporting higher scores than the two other groups. The Results are presented in **Table 2**.

Shopping Specific Variables
Worries About Shopping Behavior
Of the total sample, 96.1% reported no concerns about their shopping behavior, while 3.9% did report concerns at some point (1.7% before the beginning of the lockdown, 0.9% after the beginning of the lockdown, and 1.2% before and after the beginning of the lockdown). Participants who were shopping more, the same, or less differed significantly ($x^2 = 81.20, p < 0.001$, Cramer V = 0.13) in their concern about their shopping behavior. When looking at *post-hoc* tests and standardized residuals, we observed that participants who reported concerns before the lockdown as well as before and during the lockdown featured more in the shopping more group and less so in the shopping less group. Participants with concerns before or during the lockdown were featured more in the shopping same group. Furthermore, participants with concerns only before the lockdown featured more in the shopping less group than expected (see **Table 2**).

TABLE 2 | Feelings and opinions regarding the COVID-19 pandemic and shopping-specific variables.

	Shopping more (n = 568)	Shopping same (n = 1,092)	Shopping less (n = 1,462)		Total sample (N = 3,122)
	M (SD)	M (SD)	M (SD)	Statistics	M (SD)
Feelings and opinions regarding the COVID-19 pandemic					
Do you agree that the corona crisis will be managed successfully in Germany? (n = 2,911)	2.94 (0.89)[a]	3.05 (0.81)[a,b]	3.09 (0.79)[b]	$F_{(2,2,368)} = 6.20$ **p = 0.002** $\eta_p^2 = 0.01$	3.01 (0.83)
In your opinion, are the restrictions important for the successful control of the corona virus? (n = 3,022)	3.35 (0.94)[a]	3.50 (0.80)[b]	3.51 (0.80)[b]	$F_{(2,2,368)} = 6.22$ **p = 0.002** $\eta_p^2 = 0.01$	3.42 (0.87)
In your opinion, how many weeks will the lockdown continue in its current form? (n = 2,545)	7.30 (8.81)	6.82 (8.37)	6.40 (7.79)	$F_{(2,2,368)} = 2.07$ $p = 0.127$	6.82 (8.38)
Are you afraid for your health or the health of those close to you? (n = 3,122)	6.61 (2.81)[a]	6.03 (2.70)[b]	6.07 (2.76)[b]	$F_{(2,2,368)} = 7.78$ **p < 0.001** $\eta_p^2 = 0.01$	6.13 (2.80)
Do you feel stressed by the restrictions? (n = 3,096)	6.32 (3.23)[a]	4.91 (3.28)[b]	5.15 (3.13)[b]	$F_{(2,2,368)} = 31.24$ **p < 0.001** $\eta_p^2 = 0.03$	5.42 (3.29)
Shopping-specific variables	***n* (%)**	***n* (%)**	***n* (%)**		***N* (%)**
Preferred shopping before lockdown					
Predominantly online	59 (10.4)[a]; 1.9	101 (9.2)[a]; 1.3	95 (6.5)[b]; −2.2	$\chi^2 = 34.98$ df = 4	255 (8.2)
Predominantly offline	261 (46.0)[a]; −2.2	535 (49.0)[a]; −1.7	847 (57.9)[b]; 2.8	**p < 0.001†**	1,643 (52.6)
Both equally, online and offline	248 (43.7)[a]; 1.7	456 (41.8)[a]; 1.3	520 (35.6)[b]; 1.3	Cramer V = 0.08	1,244 (39.2)
Preferred shopping during lockdown					
Predominantly online	322 (56.7)[a]; 9.3	346 (31.7)[c]; −1.3	393 (26.9)[b]; −4.7	$\chi^2 = 185.73$ df = 4	1,061 (34.0)
Predominantly offline	107 (18.8)[a]; −6.9	392 (35.9)[c]; −0.2	635 (43.4)[b]; 4.5	**p < 0.001†**	1,134 (36.3)
Both equally, online and offline	139 (24.5)[a]; −2.3	354 (32.4)[b]; 1.7	434 (29.7)[b]; 0.0	Cramer V = 0.17	927 (29.7)
Have you or someone among your family and friends or a doctor been worried about your shopping behavior or suggested that you should shop less?					
No concerns	517 (91.0)[a]; −1.2	1074 (98.4)[c]; 0.8	1409 (96.4)[b]; 0.1	$\chi^2 = 81.20^*$ df = 6	3,000 (96.1)
Yes, before the lockdown	10 (1.8)[a]; 0.1	7 (0.6)[b]; −2.7	37 (2.5)[a]; 2.3	**p < 0.001†**	54 (1.7)
Yes, during the lockdown	20 (3.5)[a]; 6.4	1 (0.1)[b]; −2.9	8 (0.5)[b]; −1.5	Cramer V = 0.13	29 (0.9)
Yes, before and during the lockdown	21 (3.7)[a]; 5.2	10 (0.9)[b]; −1.0	8 (0.5)[b]; −2.4		39 (1.2)

†Significant after Bonferroni–Holm correction. Bold values indicate significant difference.

[a,b]Values with different superscripts are significantly different (post-hoc tests).

Preferred Shopping Type

The groups differed significantly in their preferred shopping type before ($\chi^2 = 34.98$, df = 4, $p < 0.001$, Cramer V = 0.08) as well during the lockdown ($\chi^2 = 185.73$, df = 4, $p < 0.001$, Cramer V = 0.17). When looking at *post-hoc* tests and standardized residuals, we observed that the shopping more group featured more individuals who were buying during the lockdown predominantly online and fewer shopping online and offline equally. Moreover, participants who preferred offline shopping before the lockdown were found less often in the shopping more group. The shopping less group more often featured participants who were shopping predominantly offline before the lockdown and less often those shopping predominantly online before the lockdown. Furthermore, in the shopping less group were found fewer participants who were shopping predominantly online during the lockdown and more often those shopping predominantly offline than expected (see **Table 2**).

The distribution of the preferred shopping type before and after the beginning of the lockdown for the total sample differed significantly (McNemar–Bowker test $x^2 = 906.38$, $p < 0.001$). The results are presented in **Table 3**. While the majority of the participants were shopping predominantly offline (52.6%) and only 8.2% predominantly online

TABLE 3 | Distribution of preferred shopping before and during the lockdown (N = 3,122).

	During the lockdown			
	Predominantly online	**Predominantly offline**	**Both equal, online, and offline**	**Total**
Before lockdown				
Predominantly online	228 (7.3%)	13 (0.4%)	14 (0.4%)	255 (8.2%)
Predominantly offline	264 (8.5%)	1,029 (33.0%)	350 (11.2%)	1,643 (52.6%)
Both equal, online, and offline	569 (18.3%)	92 (2.9%)	563 (18.0%)	1,224 (39.2%)
Total	1,061 (34.0%)	1,134 (36.3%)	927 (29.7%)	3,122 (100%)

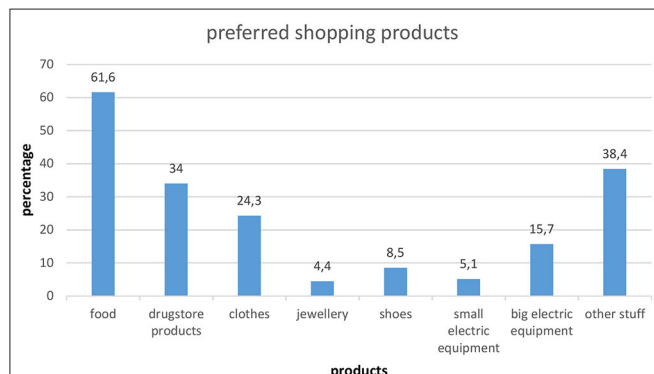*Sums of individual items may not be equal to totals due to rounding.*

FIGURE 1 | Preferred shopping products of the participants who shopped more after the beginning of the lockdown (n = 568). Multiple choice option.

before the lockdown, after the beginning of the lockdown, 36.3% were shopping predominantly offline and 34.0% predominantly online.

Preferred Shopping Products of the Participants Who Shopped More

The preferred shopping products of the shopping more group are presented in **Figure 1**. Participants who shopped more after the beginning of the lockdown were predominantly buying more food (61.6%). Of the 568 participants who shopped more, 38.2% (n = 217) reported shopping more only for food and/or drugstore products.

DISCUSSION

In the present study, we aimed to examine self-reported changes in shopping behavior during the 2020 spring lockdown in Germany. A majority of the participants reported no changes in their shopping behavior or shopping less during the lockdown. However, a subgroup of the total sample (18.2%) admitted shopping more, especially food and drugstore products.

A comparison of groups who shopped more, less, or the same during the lockdown showed significant differences regarding gender. Women were less likely to continue shopping the same during the lockdown. Instead, they were shopping more or less during the lockdown. In contrast, a study in

Brazil (19) reported that men exhibited higher levels of panic buying than women. In our study, men were more likely to maintain their shopping behavior. It appears therefore that there were differences in shopping behavior during the pandemic between different countries, with respect to gender. Moreover, younger individuals, especially those between 18 and 34 years of age, as well as participants who reported changes in their employment status were more likely to shop more. Additionally, participants with fewer years of schooling and who may have a lower socioeconomic status (e.g., lower income and higher job insecurity) featured less in the shopping less group. Instead, they were shopping the same or even more during the lockdown. For this particular group, shopping more can lead to an additional financial burden that may, in the middle and long term, increase their concerns about their financial situation, potentially leading to greater emotional stress.

Moreover, participants who shopped more reported greater subjective stress due to the restrictions and greater pandemic-related health fears. Even though we did not assess anxiety and mood disorders with standardized questionnaires, it seems that this particular subgroup was more affected emotionally than the others. In a previous survey, researchers aimed to investigate the relationship between the perceived threat of COVID-19, personality traits, and stockpiling (toilet paper) (20). They report that the perceived threat of COVID-19 was related to toilet paper stockpiling. Emotionality (fearfulness, anxiety, dependence, and sentimentality) was associated with the perceived threat of COVID-19 and thereby indirectly affected stockpiling (20). In our sample, individuals who shopped more were less convinced that Germany would successfully manage the COVID-19 pandemic and that the restrictions taken by the government were not decisive in the control of COVID-19, when compared with individuals from the shopping same and shopping less groups. According to Yuen et al. (11), these are factors that may influence panic buying. Their perception of the health crisis, fear of unknown, negative emotions, and lower trust in the government seem to make individuals vulnerable to panic buying. Fear and anxiety are emotions that people may experience during a pandemic outbreak (21). Social and political mistrust seem to be associated with panic buying (11). Our results regarding the association between specific pandemic-related opinions/feelings and shopping more consumer goods are also in line with the model of panic buying proposed by Arafat et al. (10). The COVID-19 pandemic led to several social

restrictions and individual psychological responses that may have interacted and shaped panic buying (10).

Arafat et al. (22) reported possible explanations for panic buying in society during the lockdown. They mentioned that fear of scarcity, losing control over the environment, insecurity, and social learning are factors responsible for panic buying. In our study, the most preferred products were food and drugstore goods. These products indicate that individuals were shopping more of goods that were rather necessary for their daily living. This is in line with findings from other studies, where the products that were purchased in the context of panic buying were food, drugstore, or pharmacy products (8, 23). However, in our study, only 38.2% of the shopping more group reported buying more of these products alone. The majority were also buying more of other consumer goods such as electric equipment (20.8%), clothes (24.3%), jewelry (4.4%), and shoes (8.5%). Regarding these products, it is less likely that people shopped for them through fear of empty shelves or fear of scarcity. An alternative explanation could be that they purchased such things in order to cope with feelings of losing control over the environment and insecurity. Buying large quantities of consumer goods is maladaptive (24) because it might worsen the shortage of supplies available. However, it may confer on some individuals an indirect sense of control over the situation (11), though for some others, it may cause additional worries. In our study, participants who shopped more reported more worries during the lockdown or before and during the lockdown concerning their shopping behavior than the other two groups. Concerns can arise for various reasons, e.g., implicate problematic shopping behavior, financial problems, or different opinion in the household about the amount of shopping goods that are needed or stockpiled.

As we expected, the results indicate an overall decrease in offline shopping and an increase in online shopping during the lockdown, which can be explained by the closure of many bricks and mortar shops during the lockdown (e.g., boutiques). Additionally, the shopping groups differed significantly in preferred shopping type before as well as during the lockdown. Results indicate that participants in the shopping more group were more often buying predominantly online or both equally (online and offline) before the lockdown and less often predominantly offline than the shopping less group. While the total sample showed an increase in predominantly online shopping and a decrease in predominantly offline shopping during the lockdown, we see differences between the shopping groups. While most individuals in the shopping more group were buying online, most individuals in the shopping less group were continuing to buy offline and less frequently online. On one hand, participants who shopped more might have increased or switched to online shopping in order to reduce physical contacts with other people. On the other hand, an increase in maladaptive online activities that may worsen and become addictive is currently expected by mental health professionals (25–27). While online activities and particular shopping on the Internet provide many opportunities for easy and comfortable purchasing, they can contribute to addictive shopping habits and, in some cases, even to the onset of online buying–shopping disorder (1, 13–16). Especially in people at risk from an Internet use disorder or those with a preexisting behavioral addiction (such as buying–shopping disorder), the pandemic-related restrictions may increase the severity of the problematic behavior (25). Unfortunately, we did not include standardized measures to assess specific Internet use disorders or buying–shopping disorder in our survey, which is a shortcoming.

Panic buying is a social and psychological phenomenon caused by an adverse event or disaster (10), which should be differentiated from a mental disorder (28). We expect that the majority of individuals in our study who were shopping more, especially those who were buying more food and/or drugstore goods due to homeworking or schooling, will normalize their shopping behavior after the end of the lockdown. However, we should keep in mind the possibility that some individuals became more prone to addictive shopping during the lockdown. It is worth mentioning that the buying more group reported purchasing not only food or drugstore products but also electric equipment, clothes, shoes, etc. Such non-essential goods are often excessively bought in the context of buying–shopping disorder (1, 3–5). We cannot exclude that in some participants of this group, buying more was driven by emotional and identity-related motives. Some variables that are associated with shopping more in our study are variables that are also associated with a higher risk of buying–shopping disorder. For instance, a negative emotional state (29, 30), the desire to regulate negative feelings (31), female gender (6), and younger age (6) are associated with buying–shopping disorder. Studies showed that panic buying is positively correlated with impulse buying and risk perception (19). Similarly, research indicates positive correlations between buying–shopping disorder and impulsivity (5) as well as a tendency to act rashly while in a positive or negative mood (32). Moreover, certain e-commerce features can contribute to an online buying–shopping disorder (14, 15). Suffering from a buying–shopping disorder with a predominantly online form is related to higher levels of anxiety and depression, with younger patients having a higher propensity for an online buying–shopping disorder and those who preferred online shopping being at greater risk of higher severity of buying–shopping disorder in general (2). Although for the vast majority, Internet use is adaptive and should not be pathologized, a subgroup of vulnerable individuals is at risk of developing problematic usage patterns (13).

Nevertheless, consumers are likely to learn or develop new shopping routines due to a crisis such as the COVID-19 pandemic (33). Lockdown, isolation, loss of employment, financial insecurity, and stress can contribute to a fertile terrain in which behavioral addictions flourish (34). Also, the unavailability of many bricks and mortar shops during the lockdown and the many opportunities afforded by e-commerce can contribute to higher risks of developing a buying–shopping disorder that can lead to severe consequences for some individuals and should therefore not be underestimated. Availability of accurate information to the public can reduce both panic buying and risk for shopping addiction. The

(social) media have a critical role in influencing a crisis. Pictures of empty shelves can increase fear of scarcity that may encourage panic buying. A group of multidisciplinary and multinational experts in the problematic usage of the Internet have made practical recommendations that may help to reduce the risks of increased, maladaptive online activities (13). Promoting shopping as a coping strategy or commercial messages such as "maintaining distance is easier online" can contribute to some individuals suffering harm in times of crisis.

LIMITATIONS

Our results should be interpreted in the context of certain limitations. Although the results presented are derived from a large number of participants from the general population, it must be kept in mind that the sample in our survey is a voluntary response sample with a relatively high proportion of young, well-educated females, and the recruiting methods exclude the "offline" population that does not use the Internet. Because of the sampling method, no information about non-responders is available, which may affect the generalizability of our findings (35). Furthermore, the cross-sectional design of our study prevents any causal interpretation, and reported effect sizes are small to moderate. We did not assess information about the motivation for shopping more during the lockdown and have not used standardized questionnaires. Future longitudinal studies should address both risks as well as protection factors for panic and addictive buying during lockdown situations, investigate the long-term effects of panic buying, and investigate the phenomenological characteristics, especially of participants who are at risk of developing an (online) buying–shopping disorder.

CONCLUSION

While supermarket shelves were empty during the lockdown, we would expect this to be the result of many people stockpiling. However, our results indicate that this is a consequence of the shopping behavior of a subgroup of people. Moreover, this subgroup was shopping more food and drugstore products and reported greater subjective stress due to the restrictions and greater pandemic-related fears. Furthermore, results indicate an overall decrease in offline shopping and an increase in online shopping during the lockdown. It is important to understand which factors influence those people to shop more so that policy makers can target this group and prevent panic buying—especially in the case of subsequent waves of infection—and also to inform them about the risks of developing a buying–shopping disorder.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study protocol was approved by the ethics committee of the University of Heidelberg (registration number: 2020-552N). The patients/participants provided their consent to participate in this study.

AUTHOR CONTRIBUTIONS

EG analyzed data and prepared the first draft. All authors designed the survey, provided comments, and revised the manuscript.

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Understanding Panic Buying Through an Integrated Psychodynamic Lens

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Previous literature has identified panic buying as often being a response to environmental stressors. In early 2020, we saw an increase in panic buying as a response to a real and/or perceived lack of resources due to COVID-19. Although panic buying has a long history, there is a lack of literature to provide a psychological understanding of the phenomenon. During the early days of COVID-19 clients presented with fear and uncertainty. These negative emotions were, in part, a response to a real shortage of basic supplies. However, the panic response led to behaviors that, for some individuals, resulted in atypical buying patterns. From a therapeutic perspective, one can consider behavioral and psychodynamic explanations and interventions, and how this impacts the associated behaviors. This article will focus on psychodynamic understandings of panic buying as a response to events that result in negative emotions. By providing a psychodynamic understanding of panic buying, authors hope to contribute to the therapy of clients presenting with related behaviors and their associated negative affect.

Keywords: panic buying, COVID-19, psychological understanding, psychodynamic, interventions

In early 2020, we saw an increase in panic buying as a response to a real and/or perceived lack of resources due to COVID-19 (1–11). During the early days of COVID-19 clients presented with fear, panic, anxiety, and uncertainty (8). These negative emotions were, in part, a response to a real shortage of basic supplies. Within the availability of media coverage, there was a global witnessing of shortages of toilet paper, hand sanitizer, and groceries (4, 10). However, the panic response led to behaviors that, for some individuals, resulted in an increase in atypical buying patterns (1).

DEFINITION OF PANIC BUYING

Previous literature has identified panic buying as often being a response to environmental stressors or during distressing and uncertain circumstances (12), including pandemics, war, governmental policy changes, or natural disasters (1, 3, 8, 11, 12). Panic buying has been defined as a behavioral phenomenon of a sudden increase in consumption and quantity of one or more necessary goods which is provoked by an adverse situation, which results in a disparity between supply and demand (1, 3, 4). In defining panic buying, it should be noted that the key difference in panic buying and other atypical consumer behaviors is the underlying motivation of the buying and the negative emotions that are associated with panic buying (8).

PSYCHOLOGICAL CAUSES OF PANIC BUYING

With the emergence of COVID-19 and the access to social media and information at our fingertips, panic buying has rapidly become a worldwide occurrence. With this worldwide occurrence brought the increase in research regarding panic buying; yet it remains under-researched (1, 9, 11), with a

lack of empirical studies, which would further identify factors associated with panic buying (3) and different aspects of panic buying (1). Although panic buying has a long history, there is a lack of literature to provide a psychological understanding of the phenomenon (2). There is an absence of studies measuring the correlation between negative feelings and unpredictable events, which may lead to maladaptive purchasing behaviors (8, 11). Previous studies have highlighted key themes which are correlated with panic buying: uncertainty, fear and anxiety, a lack of trust, the perception of the crisis, social behaviors and conformity, a means of coping and a means of gaining control. Throughout times of crisis there is a heightened level of uncertainty that is experienced (3, 4, 7, 8, 10, 12). This includes uncertainty of when there would be an end to the crisis (2, 12) and uncertainty on whether or not there would be enough supplies to survive the duration of the crisis (7, 8, 12). Additional negative emotions that are correlated with panic buying include fear and anxiety, which are powerful drives in consumer behavior (3, 4, 8–10). This level of fear and anxiety are often associated with witnessing universal fear (12), the unknown (3, 11), and the future (8). Thirdly, negative emotions associated with this behavior include mistrust in the government during times of crisis, which may be impacted by previous governmental actions that were taken through times of crisis (2, 3, 10).

In evaluating panic buying, the individual's perception of the stressor is an important component. The perception of threat (2–4, 11), scarcity of goods (2–4, 11) risk (3), threat of losing control of the environment (2) or future and social demands (8), and feelings of insecurity and instability (13) all impact how the individual behaviorally reacts to the stressor.

The act of panic buying can symbolize several aspects in the individual. For instance, panic buying may be an attempt to conform to society (3, 4, 12). The act of mimicking witnessed behaviors is a means of herd conformity (1), measuring the intensity of the crisis by how others are reacting (7), and relying on social trust (11). Secondly, the act of panic buying been recognized as a coping and defense mechanism that individuals are engaging in (3, 7, 8, 11, 12). Through the use of panic buying, individuals are attempting to cope with the feelings of insecurity (2, 7) and to alleviate negative feelings (7). Lastly, the act of panic buying also symbolized a form of gaining control over a control-less situation (2–4, 7, 9, 12). By controlling the consumption patterns and available supplies, there is a decrease in the perceived lack of control.

According to Yuen et al. (11), the correlation associated with fear and increased purchasing can be further explained by one's mood congruency. The author's proposed that with negative emotions or heightened levels of stress, an individual's judgment to circumstances is negatively altered (11). Additionally, Jin et al. (7) found that the need to belong can influence how one copes with public health emergency, thus reducing panic buying. Working through interpersonal dynamics and systems with the individual allows for improvement in communication styles, correction of cognitive distortions relating to previous interactions, and an increase in traits including patience, empathy and tolerance (6). Further, the role of past experiences is associated with the patient's present behavior and defense

mechanisms (6). Thus, if the individual is utilizing panic buying as a defense mechanism in order to create more adaptive coping mechanisms it is crucial for the clinician and the individual to process how the past is impacting the present.

Several sources have suggested that by providing adequate and consistent information on the situation, implementing purchase policies and governmental policies may prevent panic buying (1, 4, 10, 11). Notably, despite the understanding of the psychological background of panic buying that has been described throughout this article, there seems to be a lack of available guidelines and interventions for clinicians to utilize in therapy for clients presenting with these symptoms. This absence is highlighted by Arafat et al. (1), who noted that there is little evidence for the management of panic buying and that even though previous authors have proposed an online cognitive behavioral therapy (CBT) model for panic buying it lacks testing. In making therapeutic interventions available, there is a possibility of reduction in post-traumatic disorders following times of crisis, or to "combat the effects of pandemic-related fear" [8, p. 5]. Additionally, it has been noted to be difficult to breaking the cycle of panic buying (12), therefore interventions may reduce panic buying, while increasing adaptive coping mechanisms (10).

Adding to the psychological effects of COVID-19 comes the sudden shift in mental health treatment styles or availability, making the feasibility and practicality of treatment during a crisis an additional concern. Ingram and Best (6) acknowledged these shifts by discussing the impacts of psychiatric inpatient and outpatient facilities either closing or witnessing a lower census due to clients distancing from treatment centers; as well as the rapid shift from in-person therapy to tele-psychiatry. In considering the treatment of clients, it is crucial for clinicians to have an understanding of the impact that clinical restructuring to tele-psychiatry can have on both the clinician and the client.

Clinicians have verbalized concerns with tele-psychiatry due to the heavy reliance on non-verbal communication that it diminished through remote treatments (6). Clinicians have further demonstrated how tele-psychiatry is impactful in treatment through the example of help-rejecting clients (6). Reportedly, tele-psychiatry has exaggerated the act of help-rejecting clients rejecting efforts of reassurance provided (6).

In addition to the concerns of the clinical restructuring, many clinicians and clients have faced changes in the structuring of the sessions. Many clinicians have had to adjust their treatments toward practical considerations with client concerns being single- minded fear (6). With this single-minded fear, Ingram and Best (6) identified themes that have been discussed in therapeutic sessions including, the irony of feeling separate within a pandemic in which is being experienced globally, the new shift in the client's reality and the overwhelming sense of loss, mourning and isolation.

As previously stated, authors have proposed utilizing behavioral techniques and interventions in attempts to target specific groups who may be at risk of demonstrating, orr have a history of demonstrating behaviors associated with panic buying (10). With Arafat et al. (3) acknowledging the "erratic, irregular, episodic, sudden, unpredictable, and mostly happens during emergency situations (p.1)" nature of panic buying

FIGURE 1 | Integrated psychodynamic model.
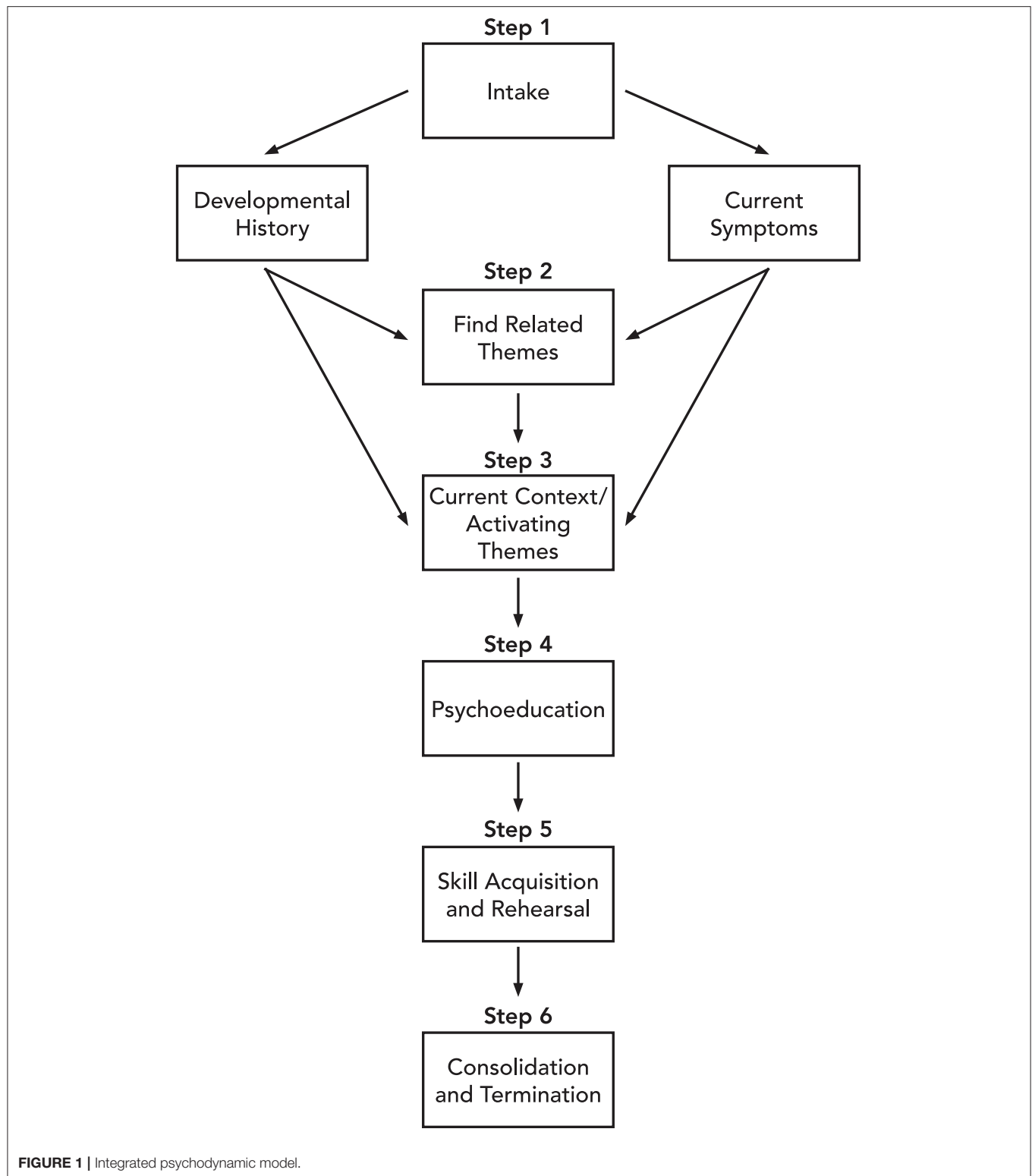
and the importance of practicing preventative measures (4), it provides the opportunity for clinicians to utilize behavioral interventions including safety planning for at risk clients. Along with behavioral therapy, clinicians can utilize the CBT intervention of distraction through exercise, non-pandemic related conversations, and shifting their attention away from the pandemic and material items (7), as well as by utilizing CBT skills including thought challenging and gathering evidence in order to reduce panic buying behavior (14). Further, studies have demonstrated that focusing on regret and worries is a prediction

of panic buying; while focusing on the present moment, and the here-and- now is negatively correlated with panic buying (8). Thus, clinicians could incorporate Mindfulness Based Cognitive Therapy (MBCT) to educate the client on remaining in the present moment.

The term panic buying is compromised of the words "panic" and "buying;" which reflects both the affective and behavioral components of the occurrence (1). Therefore, though cognitive-behavioral and behavioral techniques can be useful, clinicians may consider using an integrated approach including a psychodynamic approach in therapy. In doing so, clinicians can use techniques to address cognitive distortions while further evaluating the negative affect of the individual and the impact of the shift in interpersonal relationships that may be being fueled by the distortions (14). Specific techniques that have been utilized by psychodynamic clinicians thus far have including "checking-in" at the commencement of sessions, being active rather than passive in session, universalize the situation in order to assist in normalizing their experience, provide validation of emotions and defense mechanisms, and be willing to disclose on your personal "new normal" (6). Additional techniques and interventions which have been utilized have included "crisis intervention therapy," and "reality testing therapy" in order for the clinician to address the current, real needs of the individual (6).

PSYCHODYNAMIC APPROACH

Given the benefit of the research that has recently been produced to understand panic buying as a response to COVID−19, we can start to pair the findings of this research to areas of clinical inquiry for an integrated therapy approach. For settings that are not time limited in nature, this would allow the clinician to better understand how the client's history impacts their response to the pandemic and ultimately how it impacts panic buying behavior.

As previously stated, panic buying may be a form of coping and/or a defense mechanism (3, 7, 8, 11, 12). Considering this perspective, an integrative approach may work to understand the client's developmental history and historic use of coping strategies and defense mechanisms. For instance, does the client have a history of intellectualization or focusing on the intellectual part of something to avoid the emotions associated with it? Does the client engage in "acting out" behaviors? Our ability to understand the client's patterns may help us to understand the underlying coping mechanism or defense of the panic buying behavior.

In addition to understanding the coping or defense mechanisms, we can utilize the knowledge of the developmental history of the client to understand what negative experiences they had and which of the associated emotions or cognitions are similar to what they are experiencing during the pandemic. Research has indicated that uncertainty, fear, anxiety, lack of trust, perception of the crisis, social behaviors, conformity, a means of coping or gaining control, and uncertainty (3, 4, 7, 8, 10, 12), threat of losing control of the environment (2) or future and social demands (8), and feeling of insecurity and instability (15) are all associated with panic buying. This provides

us important guidance as we identify these themes in our client's history including negative affect, unsafe environments, lack of resources, etc. This will help us to understand if our clients may be vulnerable to similar negative affect which may result in the coping behaviors or defense mechanisms associated with panic buying. In addition to understanding the affective history of our clients we may also want to consider systemic oppression. Research suggests that mistrust in government and political measures are associated with panic buying (2, 3). Some clients will have experienced systemic oppression or belong to groups that have been historically mistreated by government and/or disproportionately negatively impacted by politics. We may also be mindful of how our own industry may have inappropriately treated individuals and how this may impact their engagement in the therapeutic process.

Figure 1 provides a visual representation of the integrated treatment model. Step 1 Intake, is where we collect the current symptoms, including physiological reactions, as well as the developmental history. In Step 2 Finding Related Themes, we determine the related themes between the developmental history and current symptoms. Then, in Step 3, Current Context/Activating Themes, we work with the client to understand how and when the current context, COVID 19, is activating themes from their developmental history and what associated physiological symptoms manifest at these times. Step 4, Psychoeducation, provides psychoeducation including mindfulness training to help manage the symptoms and ameliorate any physiological manifestation. In Step 5, Skill Acquisition and Rehearsal, we assign the skills as homework and ask the client to record progress until amelioration of symptoms is achieved to the point that the client can end treatment. Finally, Step 6, Consolidation and Termination, is an opportunity to provide consolidation of the work that has been done.

LIMITATIONS

As with all therapeutic approaches there are limitations. First, clients may not approach therapists for the treatment of panic buying. Second, the condition may not require treatment as prevention can be carried out by alternate public measures. Third, this psychodynamic approach may take more time and be prohibitive for some clients or within some clinical settings.

CONCLUSION

Important work is being done to understand panic buying and provide treatment models to assist clients when panic buying surfaces in therapy settings. Recent literature has highlighted the experience of individuals engaging in panic buying. Additionally, we have gained therapy models like a CBT model that may provide much needed relief for clients during this time of stress.

In addition to the rapidly developing literature, this article has discussed that working through the client's developmental history may help the client better understand their reaction to the pandemic and the associated behaviors they engage in.

This knowledge may facilitate therapy and encourage their engagement in the tools or skills the therapist can integrate into the therapeutic plan based on the model provided. Furthermore, this may better prepare them for future unpredictable events. Utilizing an integrated therapy approach may provide the client with an increased understanding of themselves while still providing the practical components necessary to address panic buying behaviors.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author/s.

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AUTHOR CONTRIBUTIONS

MC and JG contributed to concept and development of the article and wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Propagation Model of Panic Buying Under the Sudden Epidemic

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The sudden outbreak of COVID-19 at the end of 2019 has had a huge impact on people's lives all over the world, and the overwhelmingly negative information about the epidemic has made people panic for the future. This kind of panic spreads and develops through online social networks, and further spreads to the offline environment, which triggers panic buying behavior and has a serious impact on social stability. In order to quantitatively study this behavior, a two-layer propagation model of panic buying behavior under the sudden epidemic is constructed. The model first analyzes the formation process of individual panic from a micro perspective, and then combines the Susceptible-Infected-Recovered (SIR) Model to simulate the spread of group behavior. Then, through simulation experiments, the main factors affecting the spread of panic buying behavior are discussed. The experimental results show that: (1) the dissipating speed of individual panics is related to the number of interactions and there is a threshold. When the number of individuals involved in interacting is equal to this threshold, the panic of the group dissipates the fastest, while the dissipation speed is slower when it is far from the threshold; (2) The reasonable external information release time will affect the occurrence of the second panic buying, meaning providing information about the availability of supplies when an escalation of epidemic is announced will help prevent a second panic buying. In addition, when the first panic buying is about to end, if the scale of the second panic buying is to be suppressed, it is better to release positive information after the end of the first panic buying, rather than ahead of the end; and (3) Higher conformity among people escalates panic, resulting in panic buying. Finally, two cases are used to verify the effectiveness and feasibility of the proposed model.

Keywords: panic buying, group decision-making, sudden epidemic, behavior spread, propagation model

INTRODUCTION

At the end of 2019, COVID-19 swept the world, causing many panic buying behaviors. At present, the long-term epidemic and the overwhelmingly negative news have made people panic about the future. Driven by this panic, panic buying has been rampant everywhere. For example, there has been news that toilet paper and masks are the same raw material, and the shortage of masks will inevitably lead to a shortage of toilet paper, which has triggered a panic buying of toilet paper

in Japan, Australia, and other places (1). The panic buying boom quickly spread to more people through social media, and further amplified people's panic about the shortage of materials, and resulted in offline large-scale panic buying. Therefore, panic buying not only seriously endangers social order and environmental safety, but also easily causes insufficient social supply. Therefore, it is of important theoretical and practical significance to analyze the key factors affecting panic buying and explore the underlying reasons for its formation.

Arafat et al. (2) believes that panic buying may refer to the phenomenon of a recent increase in business of one or more essential goods in excess of regular need promoted by advertisement, usually after a disaster or an outbreak, resulting in an imbalance between supply and demand. Tahir et al. (3) also mentioned that panic buying usually occurs after consumers face or perceive disasters. After the occurrence of COVID-19, scholars have generally observed the impact of COVID-19 on commodity supply and need (4) and public mental health (5), which has led to a surge in panic buying incidents around the world (6). Herd mentality promotes the further spread of panic buying behavior (7). However, current research is mostly qualitative explanations without quantitative analysis. In addition, most of the research methods are statistical analysis methods, such as stepwise regression (8) or structural equation (9). This type of method only reflects historical conditions and cannot reflect changes in real conditions, and cannot restore the panic buying phenomenon or study it from appearance through to development to disappearance.

The suddenness and severity of sudden disaster events will trigger people's ultra-large-scale need for basic materials in the short term, which will cause a certain impact on the supply chain of survival necessities such as food, and even interrupt the supply chain. The ensuing imbalance of supply and need has further aggravated the panic buying behavior of people. Forbes (10) took the Christchurch earthquake in 2011 as an example, and deeply studied the change of consumer preferences caused by disasters; they found that consumers bought more practical products necessary for survival after disasters. Upton and Nuttall (11) proposed an agent-based model to simulate the transient need of the supply chain and consumers under the fuel crisis event and verified it with the fuel panic crisis events in the UK in 2000 and 2012, which provided practical suggestions for the panic buying of fuel. Arafat et al. collected media reports with the keyword of 'panic buying' (2), and found through statistical data analysis (12) that the sense of product scarcity was an important factor leading to panic buying during COVID-19. In addition, there were also factors such as increased demand, importance of products, anticipation of price hike, etc. To investigate the mechanism of urban consumers' food hoarding behaviors, Wang and Holly (13) took three cities in China as samples and used the multivariate probit model to study. They found that people's food on hand and their expectation of the possibility of COVID-19 infection were the main factors affecting food hoarding. The above literature explains the occurrence of panic buying from the perspective of imbalance between supply and need. After a sudden epidemic such as COVID-19, the public's need for food and other practical commodities surged. Due to insufficient

market supply, commodity shortages and price increases have occurred, intensifying panic buying behavior. Compared with other disasters, the particularity of COVID-19, that is, the risk of contracting the virus, will have an important impact on people's panic buying behavior. Therefore, when studying panic buying behavior under the sudden epidemic, it is necessary to consider both physiological (material) and safety needs.

Sudden disaster events often trigger negative emotions among people. Some scholars have interpreted panic buying behavior from an emotional perspective. Thomas and Monica (14) took the September 11 attacks in the United States as an example, and pointed out that panic buying was a kind of self-protection behavior taken by the public in response to terrorism in panic. Sneath et al. (15) took Hurricane Katrina in 2005 as an example, and proposed a structural model based on the life event theory. The results showed that event-induced stress affects depression, which in turn leads to impulsive and compulsive buying behavior. Based on the stimulus-body response (SOR) model, Pandita et al. (16) adopted qualitative research methods, such as personal interview, and found that COVID-19 would lead to students' psychological problems, such as academic anxiety and fear, and behavioral problems such as panic buying. Bacon and Corr (17) conducted a questionnaire survey of British respondents and found that people were experiencing a psychological conflict between the urge to stay safe and the desire to maintain a normal, pleasurable life, and panic buying was one of the ways to improve this psychological conflict. Christian and Ronn (18) used the health anxiety scale and open-ended questions to conduct online surveys on people's feelings, thoughts, and behaviors during the period of strengthening community isolation, and constructed the spectrum of panic consequences caused by COVID-19, including panic buying (18). Yuen et al. (19) systematically reviewed the psychological causes of panic buying and pointed out that people would regard panic buying as the behavior of relieving anxiety and re-controlling a crisis. Jezewska et al. (20) used logistic regression analysis on the data of 1,033 Polish adults, and found that stress and trust in different information sources can lead to people's fear of limited food, and then lead to panic buying behavior. Arafat et al. (21) systematically reviewed the psychological explanations behind panic buying in critical moments and found that fear of scarcity and losing control over the environment, insecurity (which could be because of fear), social learning, and exacerbation of anxiety, are the basic primitive responses of humans responsible for the panic buying phenomenon. The above literature describes the emotional state of people's panic, anxiety, and depression after a disaster and the aggravating effect of these emotions on panic buying behavior. However, the research methods are mostly qualitative research, such as questionnaires and interviews, and there is limited research on the quantitative relationship between emotion and behavior. At the same time, the existing quantitative relationship research does not consider the influence of commodity supply and need on emotion.

Panic buying behavior is easy to spread in social groups, and this behavior spreading phenomenon is closely related to people's herd psychology. Charles (22), a British scholar, used a large number of factual cases to show that when an individual was in

a group environment, he was quick to show extreme imitation and gregariousness. Pochea et al. (23) used quantile regression analysis as an estimation method, and found evidence of herding behavior in all central and Eastern European countries, except Poland and Romania: when the market rises, investors will follow each other in buying transactions, but when the market turns down, investors will not follow each other. Ahmed et al. (24) used the multivariate method based on the structural equation model to study the data of 889 consumers and found that peer purchase and other factors had an important impact on the impulsive purchase mode. Zheng et al. (25) pointed out that consumers tend to imitate others, and social media posts can play an important role in the diffusion of imitation and purchase behavior. Chen et al. (26) used the Susceptible-Exposed-Infected-Removed (SEIR) model to describe the state transition of individuals, studied the spread of public opinion in combination with the heterogeneity characteristics, such as individual herd, and verified the rationality and effectiveness of the model with the pricing event of the COVID-19 vaccine independently developed in China. Li et al. (27) integrated the particularity of panic buying public opinion, established a model of panic buying public opinion transmission, and analyzed the material panic buying problem caused by panic in an uncertain environment through computational simulation experiments. The above literature explains the reasons for the spread of panic buying behavior from the perspective of public psychology, and points out that social network media has become the main carrier of the rapid spread of panic. However, the above research has the problem of too much qualitative analysis and too little quantitative analysis.

It can be seen from the above analysis that current scholars explain the external causes of panic buying from the perspective of commodity supply and need balance, the internal causes of panic buying from the perspective of individual emotions, and the spread of panic buying from the perspective of public psychology. However, the perspective of supply and need only points out the impact of material need without considering the safety need that people should worry about while going out shopping, so it cannot fully fit the background of the epidemic. The perspective of the relationship between need and emotion is not identified in the thinking of emotional factors, and lacks quantitative research between emotion and behavior. There is also a lack of quantitative research on herd mentality.

Based on this, this paper uses the method of system dynamics to analyze the formation and dissemination process of panic buying behavior by introducing internal factors such as panic and individual needs, and external factors such as the influence of surrounding individuals and the change of external information. Combined with the SIR epidemic model, the whole process of panic buying behavior formation, disappearance, and recurrence is simulated, and the transmission model of panic buying behavior under the sudden epidemic situation is constructed. Then, with the help of computer simulation technology to simulate the whole process of the problem, we can understand the internal evolution mechanism of panic buying behavior, and analyze the impact of changes in real conditions.

METHODS

This paper is based on Monte Carlo's multi-agent method for modeling, using Agent to represent individual nodes in the network, and assuming that the network scale is N, that is, there are N netizen nodes in the network. The BA network is used as the basic network and the build panic buying propagation model is based on SIR model. The research framework of the paper is shown in **Figure 1**.

(1) BA model

BA model (28) refers to a scale-free network model, which was proposed by Albert-László Barabási and Réka Albert to explain the generation mechanism of the power law. BA model has two characteristics: the first is growth, which means that the network scale is increasing; the second is priority connection mechanism, which means that the new nodes in the network tend to connect with those nodes with a higher degree of connection. BA model can explain many phenomena, such as graduate students' choice of tutors. In this network, both graduate students and tutors are increasing, and graduate students always tend to choose tutors who have brought many graduate students.

(2) SIR Model

In the 1860's, Daley and Kendal found the similarities between infectious diseases and information transmission by comparing them. They first proposed the classic DK model (29), that is, the SIR model, which is the most widely used. In this model, the population is abstractly divided into three categories, susceptible, infected, and recovered individuals, corresponding to the individuals who do not know the information, the individuals who transmit the information, and the individuals who no longer participate in the information transmission. When individuals contact each other, there is a certain probability that they will transform each other. After that, scholars have carried out extended research on the basis of the SIR model, such as improving the crowd classification method, improving the propagation rules, and so on. For example, Chen et al. (26) added an individual category of exposed state and constructed the SEIR model. Exposed refers to the person who has been in contact with an infected person but has no ability to infect others.

Based on the SIR epidemic model, this paper constructs a panic buying propagation model, as shown in **Figure 2**. Under COVID-19, people learn about epidemic information through news and other methods. On the one hand, information such as shortages of supplies and the reappearance of the epidemic will cause people to panic. Under this influence, the individual transforms from a susceptible person (S) who never participates in panic buying into an infected person (I) who is a panic buyer with the probability α. On the other hand, the buying behavior of surrounding individuals will also cause panic among the people. The number of infected people (I) around the individual is used as an indicator to measure the influence of surrounding individuals, which further affects them. As the time goes by, the individual gradually forgets about it, and transforms from an

FIGURE 1 | Research framework.
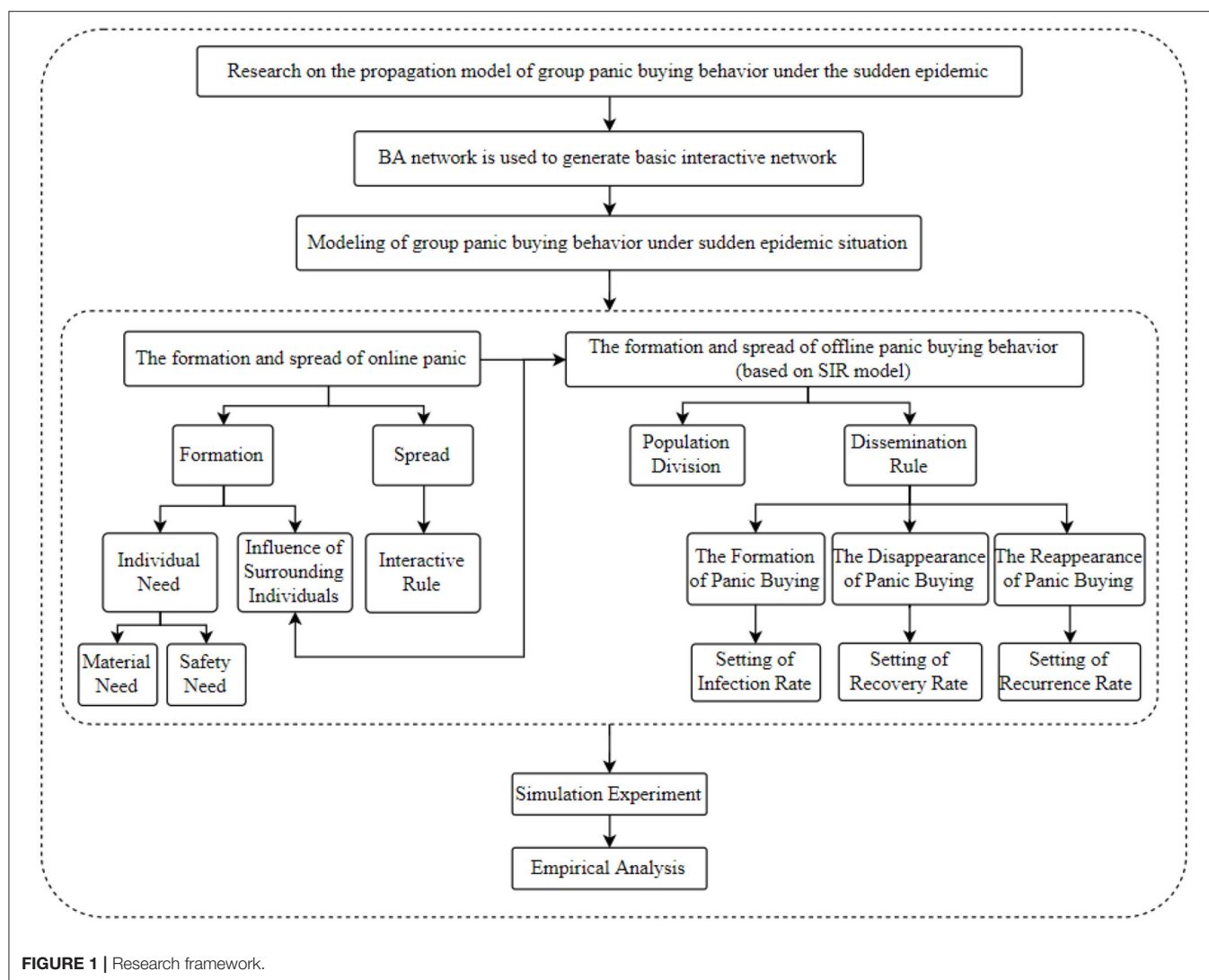
infected person (I) into a recovered person (R) who is insensitive to the panic buying with probability β. Finally, when the relevant epidemic information is brought up again, the memory of the people is awakened again, and the recovered people (R) will transform into susceptible people (S) with probability γ, becoming panic buyers again. The parameters and variables involved in the model are shown in **Table 1**.

The Formation and Spread of Online Panic

Emotions are people's psychological feelings. In the process of behavior decision-making, various emotions will interfere with individual behavior judgments from a psychological level. Under the COVID-19 epidemic, panic is the most common emotion that interferes with individual behavior. It refers to a kind of depressive emotion that people may have while facing a certain dangerous situation. Under its effect, the individual's cognitive imbalance and the ability to make rational judgments are reduced, so they may perform various irrational behaviors.

For example, during the period of COVID-19, facing the unpredictable future, people all over the world spontaneously panicked, triggering various panic buying events, such as the panic buying of hand sanitizer, toilet paper, and beverages in Canada and the United States, as well as rice in China. Under the influence of panic, people are more likely to be irrational and tend to conduct group behavior. At the same time, the predicament of forbidding going out has prompted people to confide their emotions more through online social networks, and the characteristics of no spatio-temporal limit, anonymity, and wide audiences of online social networks undoubtedly further promote the formation and spread of panic.

The Formation of Panic
The formation of online panic is affected by the individual's needs from the internal influence and from the external influence of surrounding individuals. All kinds of news related to the epidemic on the Internet can stimulate the actual needs of

FIGURE 2 | Model explanation.
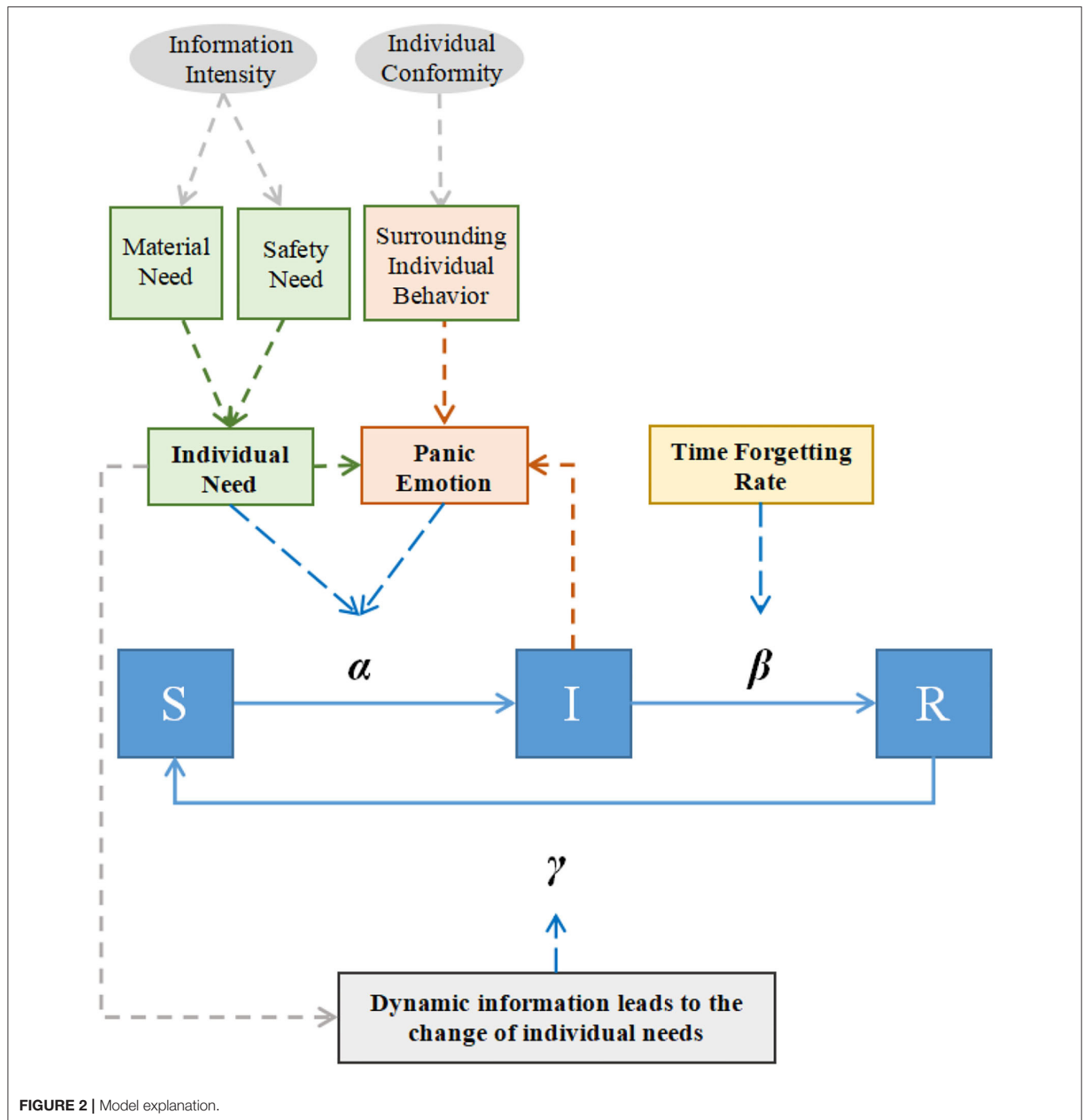
people. For example, seeing the news of other infected people enables individuals to perceive that they are in a dangerous environment and generate safety needs. The news of supply shortages will make individuals think about whether one's future life is guaranteed; in turn, there will be a need for supplies. If these actual needs are not met, the individual will panic. In addition, people will browse and publish information related to their lives on the Internet. Once they find their neighbors participate in panic buying, they will also have a buying desire due to group psychology. In reality, the unsafety of panic buying behavior increases their panic.

Based on the above analysis, $E_i(t)$ is used to represent the panic value of individual i at time t and $E_i(t) \in [0, 1]$. The higher the value is, the higher the panic degree is. Its calculation formula is as follows:

$$E_i(t) = a^* M_i(t) + b^* S_i(t) + F_i(t) \tag{1}$$

TABLE 1 | Related parameters and variables.

a	The weight of material need (physiological need) in individual need
b	The weight of safety need in individual need
$Con(i)$	Conformity of individual i
μ_1	Assimilation parameter
μ_2	Exclusive parameter
d_1	Assimilation threshold
d_2	Exclusive threshold
c_1	Parameter that affects the forgetting rate function for deciding the attraction of panic buying on the infected people
c_2	Parameter that affects the forgetting rate function for deciding the shape of forgetting curve
$E_i(t)$	Panic value of individual i at time t
$M_i(t)$	Material need of individual i at time t
$S_i(t)$	Safety need of individual i at time t
$F_i(t)$	Influence of surrounding individuals on individual i at time t
$I_{M+}(t)$	Intensity of positive information about material need
$I_{M-}(t)$	Intensity of negative information about material need
$I_{S+}(t)$	Intensity of positive information about safety need
$I_{S-}(t)$	Intensity of negative information about safety need
$N_i(t)$	Number of neighbor nodes around individual i at time t
$NI_i(t)$	Number of neighbor nodes that take panic buying behavior around individual i at time t
$NS(t)$	Number of susceptible individuals S at time t
$NI(t)$	Number of infected individuals I at time t
$NR(t)$	Number of recovered individuals R at time t
$PS(t)$	Proportion of susceptible individuals S to all individuals at time t
$PI(t)$	Proportion of infected individuals I to all individuals at time t
$PR(t)$	Proportion of recovered individuals R to all individuals at time t
α	Infection rate
β	Recovery rate
γ	Recurrence rate
θ_1	Influence weights of individual need on the buying behavior
θ_2	Influence weights of panic on the buying behavior
t_1	Duration of an individual becoming infected

where a and b are the weights of material need (physiological need) and safety need from an individual level, respectively ($a + b = 1$). Since physiological need is higher than safety need in Maslow's hierarchy of needs, set $a>b$; $M_i(t)$ and $S_i(t)$ are the material needs and safety needs of an individual i at time t respectively. $F_i(t)$ means the influence of surrounding individuals on individual i at time t.

Individual Need

Needs are the rational needs of social people, which also affect individual behavior. At present, the most typical need theory is Maslow's Hierarchy of Needs. The lowest and most prioritized need to be met is physiological need, which includes people's needs for food, water, air, and other basic materials. Only when people meet their physiological needs can they have a chance of survival. Secondly, safety needs correspond to people's uncertainty of the surrounding environment, natural uncertainty, and natural contradictions between people. During

the period of COVID-19, people avoided going out as much as possible for the sake of safety. However, people had to find ways to purchase materials for the need of survival materials, so it might be necessary to go out. Therefore, from the perspective of individual needs, safety needs and physiological needs play a game with each other, which has an important influence on people's behavioral decisions, such as whether to go out or purchase goods during the epidemic period.

People's needs for supplies and safety will be affected by external information. During the epidemic, this information is mainly spread through online channels. After the information about materials and safety is received by people, everyone will synthesize the information they receive to form their own judgments on whether the external materials are sufficient and whether the external environment is safe, which are represented by material need $M_i(t)$ and safety need $S_i(t)$, respectively. The more abundant external materials are, the lower the material need is. The safer the external environment is, the lower the safety need is.

Material need $M_i(t)$. Material need $M_i(t)$ refers to the material need of individual i at time t, $M_i(t) \in (0, 1)$. The larger the value is, the higher the need for materials is, and the more people are prone to purchasing behavior. The calculation formula of the material need $M_i(t)$ is as follows:

$$M_i(t) = \frac{1 - (I_{M+}(t) - I_{M-}(t))}{2} \quad (2)$$

where $I_{M+}(t)$ is the intensity of positive information about material need, and $I_{M-}(t)$ is the intensity of negative information about material need. If the intensity of positive information is stronger and the intensity of negative information is weaker, it means that the material is sufficient and the need for material is lower. In actuality, the intensity of information can be measured by the number of readings, page views, and likes of the information on platforms such as Twitter, Facebook, and Sina Weibo. Generally speaking, $I_{M+}(t) \in (0, 1)$, $I_{M-}(t) \in (0, 1)$.

Safety need $S_i(t)$. Similarly, with regard to the safety needs $S_i(t) \in (0, 1)$, the higher the value is, the higher the vigilance of the individual to the external environment is, and the more insecure the external environment is, the less easy it is to go out. The calculation formula of safety need $S_i(t)$ is as follows:

$$S_i(t) = \frac{1 - (I_{S+}(t) - I_{S-}(t))}{2} \quad (3)$$

where $I_{S+}(t)$ is the intensity of positive information about safety need, and $I_{S-}(t)$ is the intensity of negative information about safety need. If the intensity of positive information is stronger and the intensity of negative information is weaker, it means that the safety is higher and the safety need is lower. In general, $I_{S+}(t) \in (0, 1)$, $I_{S-}(t) \in (0, 1)$.

Influence of Surrounding Individuals

People, as part of a social group, are influenced by the individuals around them. During the period of COVID-19, when relatives and friends released pictures of buying goods or netizens

published tips for buying goods on social media, these buying behaviors would cause uneasiness and anxiety, making people more uncertain about whether to go out to purchase goods in such a dangerous environment, and further stimulating the formation of people panic.

The influence of the surrounding individuals is defined as $F_i(t)$, which is related to the number of people around the individuals who take panic buying behavior and the conformity of the individuals. The calculation formula is as follows:

$$F_i(t) = \frac{NI_i(t)}{N_i(t)} * Con(i) \qquad (4)$$

where $N_i(t)$ represents the number of neighbor nodes around individual i at time t, and $NI_i(t)$ represents the number of neighbor nodes that take panic buying behavior around individual i at time t. The more neighbor nodes are around the individual that take panic buying behavior, the easier it is to trigger panic. $Con(i)$ represents the conformity of individual i, which is related to social factors such as the growth environment and educational background of the individual.

The Spread of Panic

Panicked people usually feel uneasy and anxious. Many people choose to vent their negative emotions on online social networks, such as Twitter, Facebook, and Sina Weibo, while others who follow their accounts see this may be affected, which affects more people. As a result, panic is further spread in online social networks.

The J-A model proposed by Jager and Amblard (30) is an important model of opinion interaction, which considers assimilation, repulsion, and neutrality in social evaluation theory. Based on this, a panic spread model is established. Assuming that individuals i and j interact, the interaction rules are as follows:

(1) If the emotion values of individuals i and j are similar, the psychology of convergence will occur, and the emotion value will be closer.
(2) If the emotion value differences between individuals i and j are large, rebellious psychology will occur, and the difference will increase.
(3) In other cases, the emotions of the two individuals remain unchanged.

According to the interaction rules, the emotion values of the individuals i and j after the interaction are updated. The calculation formula is as follows:

$$
\begin{aligned}
E_i(t) &= \begin{cases} E_i(t) - \mu_1 * (E_i(t) - E_j(t)) &, \text{if } |E_i(t) - E_j(t)| < d_1 \\ E_i(t) + \mu_2 * (E_i(t) - E_j(t)) &, \text{if } |E_i(t) - E_j(t)| > d_2 \\ E_i(t) &, \text{others} \end{cases} \\
E_j(t) &= \begin{cases} E_j(t) - \mu_1 * (E_j(t) - E_i(t)) &, \text{if } |E_i(t) - E_j(t)| < d_1 \\ E_j(t) + \mu_2 * (E_j(t) - E_i(t)) &, \text{if } |E_i(t) - E_j(t)| > d_2 \\ E_j(t) &, \text{others} \end{cases}
\end{aligned} \qquad (5)
$$

where μ_1 is the assimilation parameter, μ_2 is the exclusive parameter, d_1 is the assimilation threshold, and d_2 is the exclusive threshold.

The Formation and Spread of Offline Buying Behavior

From a micro perspective, the behavior of individuals participating in offline panic buying is comprehensively affected by factors such as panic and individual needs. The higher the individual material need is, the lower the safety need is and the higher the panic is, the easier it is to promote individual participation in panic buying. From a macro perspective, probability is adopted to measure the occurrence of individual panic buying behavior, and the SIR model is used to build the spread process of offline panic buying behavior.

Group Division

According to the principle of the SIR infectious disease model, the group is divided into three categories - S(Susceptible people), I(Infected people), and R(Recovered people) - with panic buying behavior as the content of spread. Susceptible people refers to people who are not panic buying but are easily affected. Infected people refers to people who are currently engaged in panic buying. Recovered people refers to people who have participated in the panic buying but are not involved now.

At time t, the number of susceptible, infected, and recovered individuals are recorded as $NS(t)$, $NI(t)$, $NR(t)$, and their proportions to all individuals are $PS(t)$, $PI(t)$, $PR(t)$, obviously $PS(t)+PI(t)+PR(t) = 1$. Supposing $PS(t)$, $PI(t)$, and $PR(t)$ are continuous and differentiable function about time t, the initial proportions of three kinds are defined as $NS(0)$, $NI(0)$, and $NR(0)$. The transformation of the relationship among S, I, and R is shown in **Figure 3**.

Spread Rules

As shown in **Figure 3**, the spread rules for panic buying are as follows:

① The formation of panic buying behavior: Under the comprehensive influence of individual needs and panic, the susceptible people (S) are transformed into infected people (I) at the infection rate α.
② The disappearance of panic buying behavior: As time goes by, individuals will gradually forget about this. The infected people (I) are transformed to the recovered people (R) at the recovered rate β.
③ Reappearance of panic buying behavior: When the relevant epidemic information is brought up again, the people's memory is awakened again, and the people who are recovered people (R) are transformed into susceptible people (S) at the recurrence rate γ.
④ Repeat the above steps.

The differential equation of SIR model is shown in Equation (6) as follows:

$$
\begin{cases}
\frac{dS}{dt} = \gamma RS - \alpha SI \\
\frac{dI}{dt} = \alpha SI - \beta IR \\
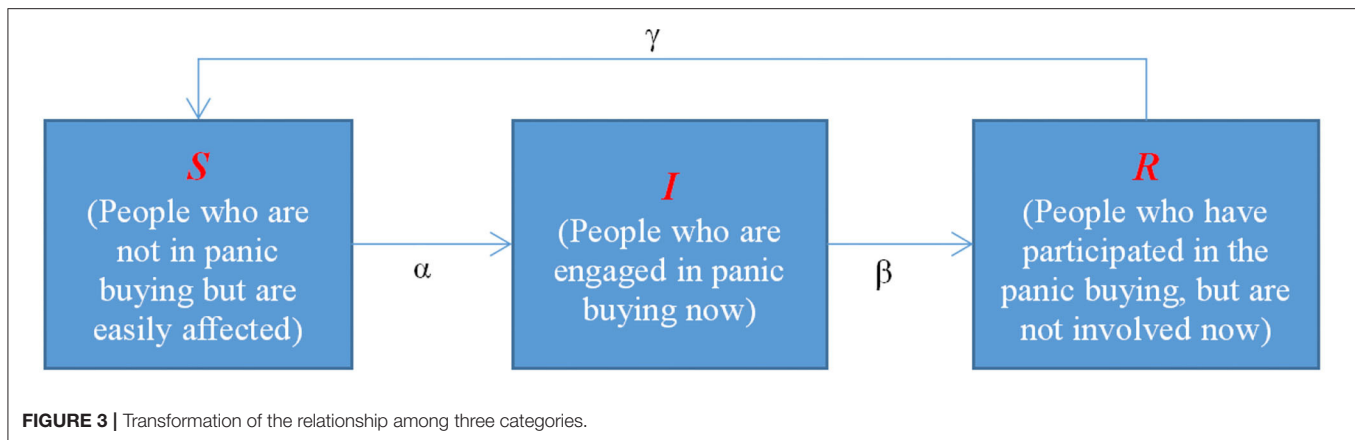\frac{dR}{dt} = \beta IR - \gamma RS \\
N = S + I + R
\end{cases} \qquad (6)
$$

FIGURE 3 | Transformation of the relationship among three categories.

where α is the infection rate, and the individual infection process is expressed as SI. β is the recovered rate, and the process from the infected to the recovered is expressed as IR. γ is the recurrence rate, and the process of recovered people to susceptible people is expressed as RS.

Setting of Infection Rate α

The infection rate α is related with individual needs and panic. The higher the material need $M_i(t)$ is, the more individuals have the desire to buy. The lower the $S_i(t)$ is, the more confident individuals are to go out. The higher the panic value of $E_i(t)$ is, the easier it is for individuals to abandon rational thinking and adopt panic buying behavior. Therefore, the calculation formula of infection rate α can be expressed as follows:

$$\alpha = \theta_1 * \big(a * M_i(t) + b * (1 - S_i(t)) \big) + \theta_2 * E_i(t) \quad (7)$$

where θ_1 and θ_2 are the influence weights of individual need and panic on the buying behavior. a and b are the weights of the physiological need $M_i(t)$ and safety need $S_i(t)$ in individual needs, $a + b = 1$ and $a > b$.

The higher the value of panic is, the more irrational the individual is, the stronger the effect of emotion is on individual buying behavior, and the weaker the effect of individual need is on buying behavior. Therefore, the value of panic can be used to measure the influence weight, as follows:

$$\begin{cases} \theta_1 = |1 - E_i(t)| \\ \theta_2 = |E_i(t)| \end{cases} \quad (8)$$

Since the formation of panic is related to the surrounding individuals, as time goes by, when the panic continues to spread or there are more and more surrounding individuals to buy things, the infection rate of individuals will further increase, thus forming the spread of buying behaviors.

Setting of Recovery Rate β

When an individual becomes susceptible S and is in a state of panic buying behavior, if there is no new and dynamic epidemic information, the longer the time passes, the more the individual will forget this and no longer participate in the panic buying.

Nekovee et al. (31) introduced the forgetting mechanism when studying the rumor propagation model. Therefore, the recovery rate β is related to time. Referring to Nekovee's literature, the specific calculation formula is as follows:

$$\beta = c_1 - e^{-c_2 \cdot t_1} \quad (9)$$

where c_1 and c_2 are the parameters of the forgetting probability function, and t_1 represents the duration of an individual becoming infected. When $t = 0$, $\beta = c_1 - 1$, that is, the forgetting rate at the initial moment is $c_1 - 1$, representing the initial attraction of the buying behavior to the infected people. The parameter c_2 determines the shape of the forgetting curve. The larger the value is, the faster the forgetting rate changes and the easier it is to forget.

Setting of Recurrence Rate γ

When there is a new outbreak, all kinds of epidemic information reappear in the public, stimulating recovered people (R) to be panic buyers again and transform to susceptible people (S), starting the next round of panic buying. For example, when the epidemic reached the United Kingdom in March 2020, many places witnessed panic buying; hand sanitizer, toilet paper, and other daily supplies were out of stock. After the release of the new epidemic blockade measures in the UK in December, people feared that there were not enough Christmas supplies. Supermarkets in London, Cardiff, Newcastle, and other places witnessed "frantic panic buying." Therefore, the calculation formula of recurrence rate γ is as follows:

$$\gamma = \begin{cases} \frac{M_i(t) + (1 - S_i(t))}{2}, & \text{if } M_i(t) > M_i(t-1) \text{ or } S_i(t) < S_i(t-1) \\ 0, & \text{others} \end{cases} \quad (10)$$

When $M_i(t)$ increases or $S_i(t)$ decreases, it means that the negative information about materials increases, and the positive information about safety increases, which will stimulate the individual to purchase outside. In other cases, the recurrence rate is 0.

Based on the above analysis, the evolution process of panic buying behavior under the sudden epidemic is shown in **Figure 4**.
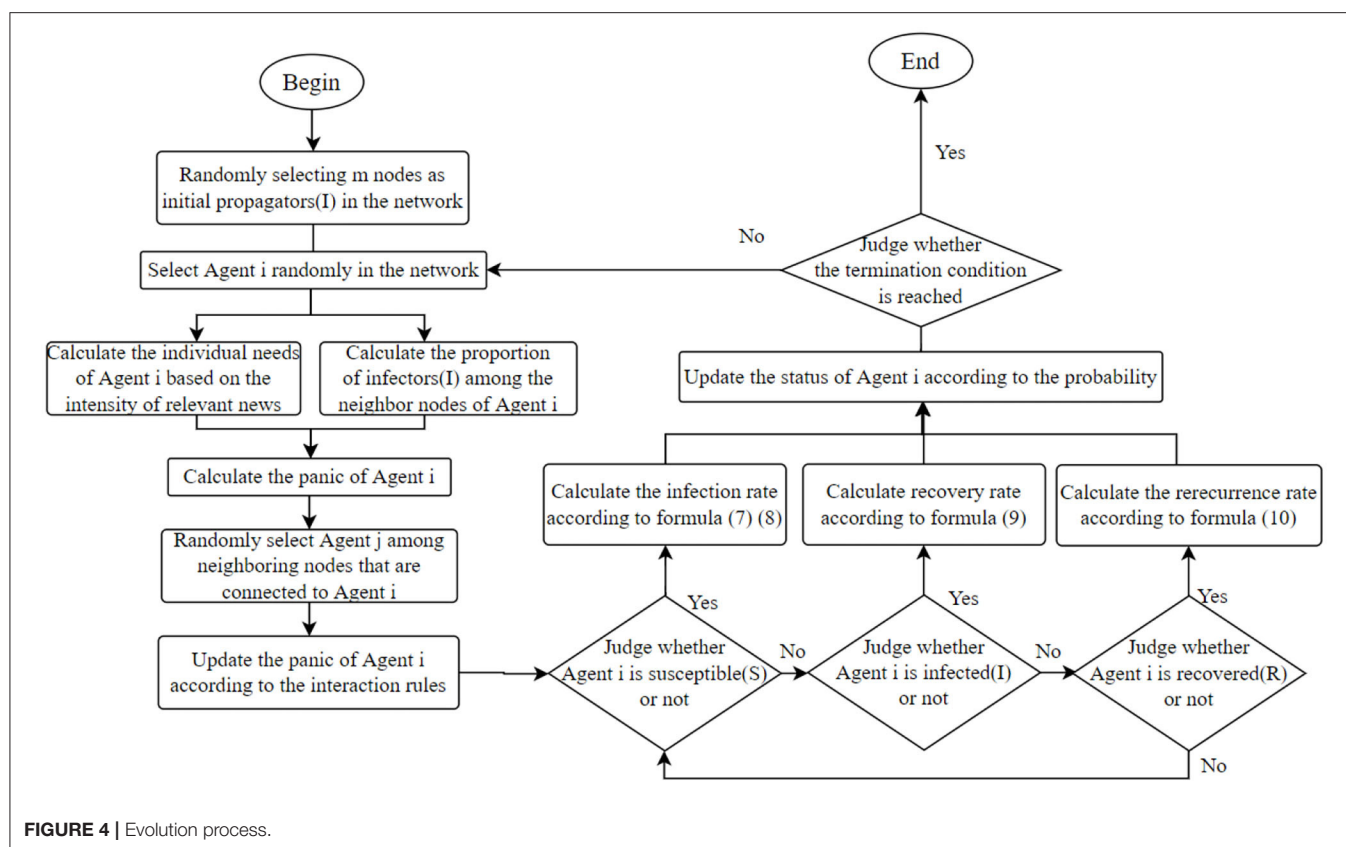
FIGURE 4 | Evolution process.

RESULTS

In this section, MATLAB is used to simulate the model constructed above, analyzing the influence of individual needs, panic, individual conformity, interaction times, and the released time of external information on panic buying behavior to reveal its internal evolution mechanism.

BA scale-free network is selected as the initial network for the simulation experiment, and the node size is 1,000. According to Maslow's hierarchy theory of needs, physiological needs are more basic and more important than safety needs. Therefore, set $a = 0.6$ and $b = 0.4$. According to the central limit theorem, people's height, shoe size, surrounding environment, and so on are subject to normal distribution. Therefore, the individual conformity degree $Con(i)$ is set to follow the normal distribution of $N\sim(0.5, 0.15)$, the value >1 is set as 1, and the value <0 is set as 0, so that the parameter is mapped within the interval of [0, 1]. The mean value of 0.5 indicates that most individuals in the group are in the middle of conformity, and the variance of 0.15 is to make all the numbers within the range of [0, 1] reach the probability value. Comprehensive visualization consideration, the proportion of individuals (i.e., infected people I) who participate in panic buying at the initial moment is set to be 6%, and the remaining individuals are susceptible people. The parameters of J-A model are set as $\mu_1 = 0.2$, $\mu_2 = 0.2$, $d_1 = 0.2$, $d_2 = 0.6$. The parameters of forgetting probability function in immunity rate are set as $c_1 = 1$, $c_2 = 0.01$.

The Influence of Individual Needs and Panic on the Spread of Panic Buying

Individual needs and panic are the direct factors affecting buying behavior. Due to the long-term inability to go out during the epidemic, in order to prevent shortage of supplies and meet their own physiological needs, people may rush to buy, hoarding a large amount of supplies at once. In addition, under the influence of panic, people with sufficient supplies may follow others and participate in panic buying. At the same time, there is a certain correlation between individual needs and panic. Individual needs are the internal factors causing panic. In order to analyze the influence of individual needs (material need, safety need) and the panic on the spread of panic buying behavior, different individual needs are set by random distribution. One hundred simulation experiments were carried out and the following information was recorded: the initial average material need, the initial average safety need, the initial panic value, maximum number of panic buyers, the moment to reach the maximum scale, and the moment when panic buying disappears completely. The demonstration of the maximum number of panic buyers, the moment to reach the maximum scale, and the moment when panic buying disappears completely is shown as **Figure 5A**.

Figure 5 shows the comprehensive influence of individual demand and panic on panic buying. As can be seen from **Figure 5B**, the lower the safety need is, the higher the material need is, the higher the panic is, the more the maximum number of panic buyers is, and the larger the scale of panic buying is. As can

be seen from **Figure 5C**, the higher the safety need is, the lower the material need is and the lower the panic is, so the shorter the time to reach the maximum scale of panic buying is. Moreover, the change brought by material need is greater than the change brought by safety need, indicating that the moment to reach the maximum scale of buying is more affected by the change of material need. As can be seen from **Figure 5D**, the moment when panic buying disappears completely has little correlation with individual needs and panic. Therefore, material need and panic have a positive impact on the scale and moment of panic buying, which has a negative impact on the scale of panic buying and the moment to reach the maximum scale. Individual need and panic have no obvious correlation with the disappearance of panic buying.

The Influence of Individual Conformity on the Spread of Panic Buying

People are always influenced by the information around them. Conformity measures the degree to which individuals are influenced by those around them. In general, the greater the conformity is, the greater the influence will be. The following three different conformity degrees are set to compare the influence of individual conformity on the spread of panic buying behavior.

Figure 6 shows the changes of panic buyers over time under different conformity degrees. **Figures 6A–C** shows the situations where the conformity degree $Con(i)$ obeys N∼(0.2, 0.15), N∼(0.5, 0.15), and N∼(0.8,0.15) respectively, simulating the situation that the individual conformity degree in the network is generally low, medium, and high. As can be seen from the figure, the higher individual conformity indicates more panic buyers and larger buying scale. It may be affected by the effect of conformity on panic. With a higher degree of panic among people, more people will participate in panic buying. Through communication with people, individuals will also feel panic and want to participate in the panic buying. To verify this idea, the influence of individual conformity on panic emotion is further analyzed below.

We take all individuals in the group as the unit to observe the change of group panic through the polarization rate of panic. Assuming that the panic emotion value of 0.9 and above is extreme panic, the proportion of individuals with extreme panic in the whole is recorded as panic polarizability, and the polarizability under different conformity degrees is recorded. The results are shown in **Figure 7**.

As can be seen from **Figure 7**, the polarization of panic emotion first rises and then falls. The rise of the curve represents the increase of group panic. The initial panic buying occurs and is influenced by other individuals. The individual panic spreads continuously, leading to the rise of polarization. In the
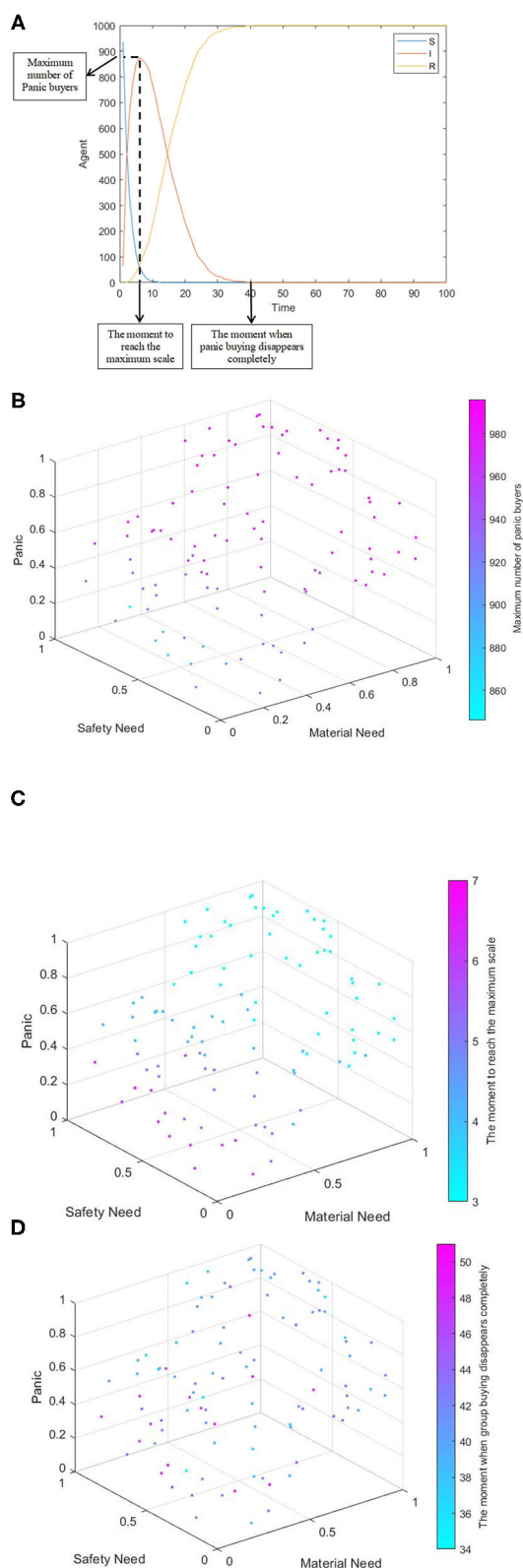
FIGURE 5 | The comprehensive influence of individual need and panic on the spread of panic buying. **(A)** Indications demonstration. **(B)** Four-dimensional scatter diagram of safety need, material need, panic, and maximum number of
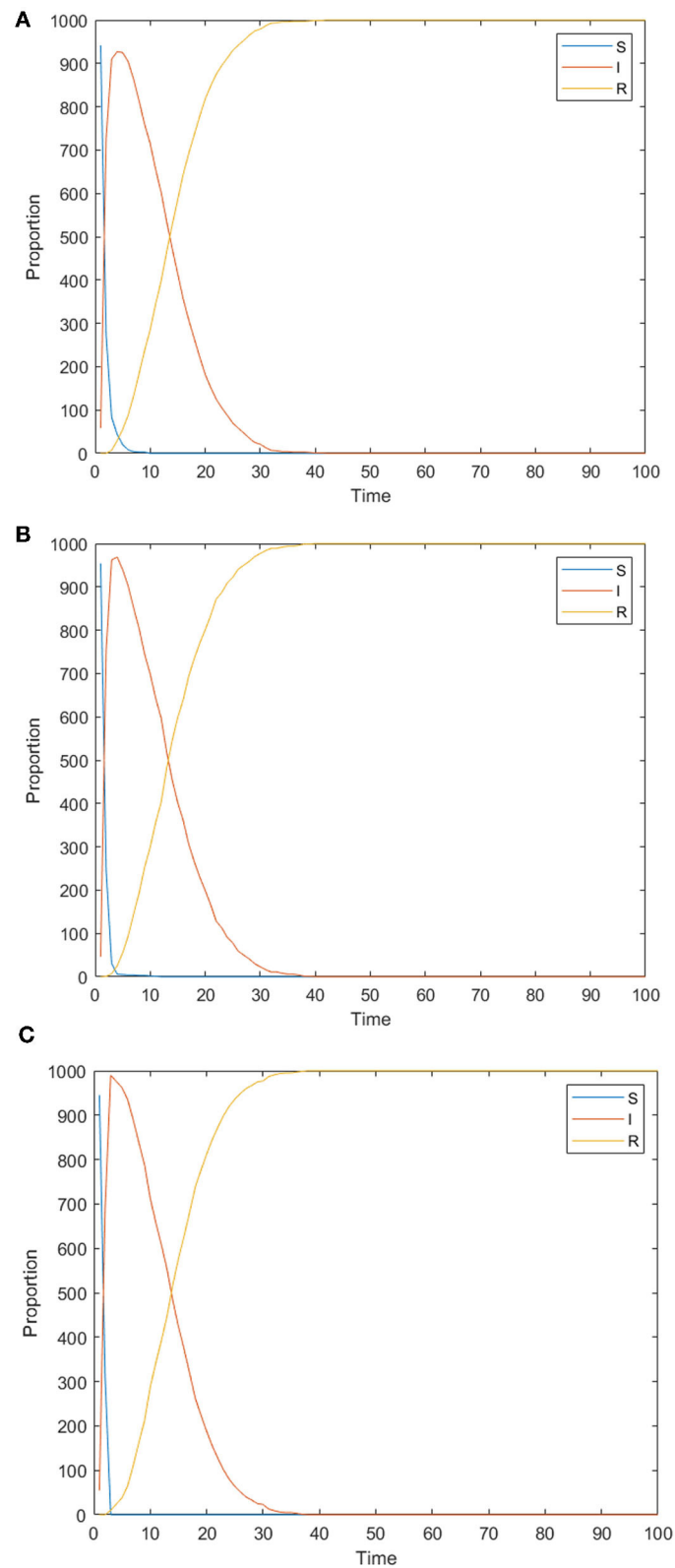*(Continued)*

FIGURE 6 | changes of panic buyers over time under different conformity degrees. **(A)** *Con(i)* obeys N~(0.2, 0.15). **(B)** *Con(i)* obeys N~(0.5, 0.15). **(C)** *Con(i)* obeys N~(0.8, 0.15).
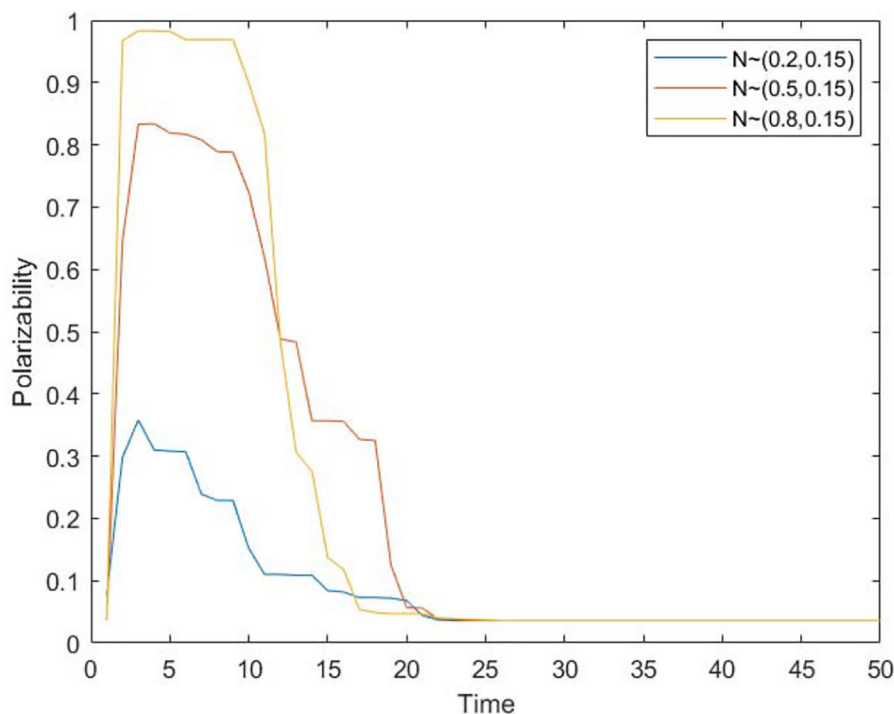
FIGURE 7 | The change of panic polarizability over time under different conformity degrees.

latter stages, the panic buying has dissipated and the panic has abated. This is because in the early stage of spreading, the higher the individual conformity is, the higher the polarization rate of panic (the wider spreading range) and the shorter the time to reach the highest polarization rate (the faster spreading speed) will be, which is consistent with the conclusion in **Figure 6**. In addition, in the later stage of spreading, the higher the individual conformity is, the faster the rate of panic polarization decreases. Higher conformity means listening to the opinions of others is easier, and the panic will dissipate faster. Therefore, although the increase of conformity makes the panic spread more widely and spread faster, it also makes the panic dissipate faster. In real life, in order to alleviate people's panic, relevant departments can guide people not to follow blindly and maintain independent thinking ability in the early stage of the event. In the later stages of the event, people can be guided to listen to others.

The Influence of Different Connection Numbers on the Spread of Panic Buying

In the analysis in the previous section, individual conformity will affect the spread of panic and then panic buying behavior. However, if the individual has a smaller social circle and fewer people to communicate with, will the spread of panic and panic buying behavior be affected? Therefore, BA scale-free networks with different connection numbers are set up. BA scale-free network is a network generated according to the adoption of growth mechanism and priority connection mechanism. It

changes the number of edges m increased each time, so as to understand the influence of interaction number on the spread of panic buying behavior. The simulation results are shown in **Figure 8**.

Figure 8 shows the influence of interaction number on the spread of panic buying. **Figure 8A** shows the change of panic polarizability over time under different numbers of connections, which show different effects at different stages. Time∈(1, 6) is the formation stage of panic emotion. At this time, the number of connections has no obvious effect on panic. Time∈(6, 20) is the main stage of panic remission. At this time, the panic polarizability is the highest when $m = 3$, followed by $m = 6$, and finally $m = 1$. This shows that the number of communicators does not faster reduce panic emotion. Instead, there is a threshold. When the number of nodes in the network reaches this threshold, the panic will reduce the fastest; over or under this threshold, the rate will slow down. In real life, if there are too many communicators, the individual may need to consider more and be more cautious. If there are too few communicators, they may be more self-centered and opinionated. Time∈[20, 50] is the final stage of the panic reduction. At this time, the reducing speed of the panic is proportional to the number of node edges. In the case of $m = 1$, the equilibrium is reached at Time = 20. In the case of $m = 3$, a balance is reached at Time = 22. In the case of $m = 6$, a balance is reached at Time = 26. Therefore, in order to alleviate the panic among the people, the relevant departments must distinguish the stages. In the initial stage of panic reduction, their best strategy is to properly grasp the
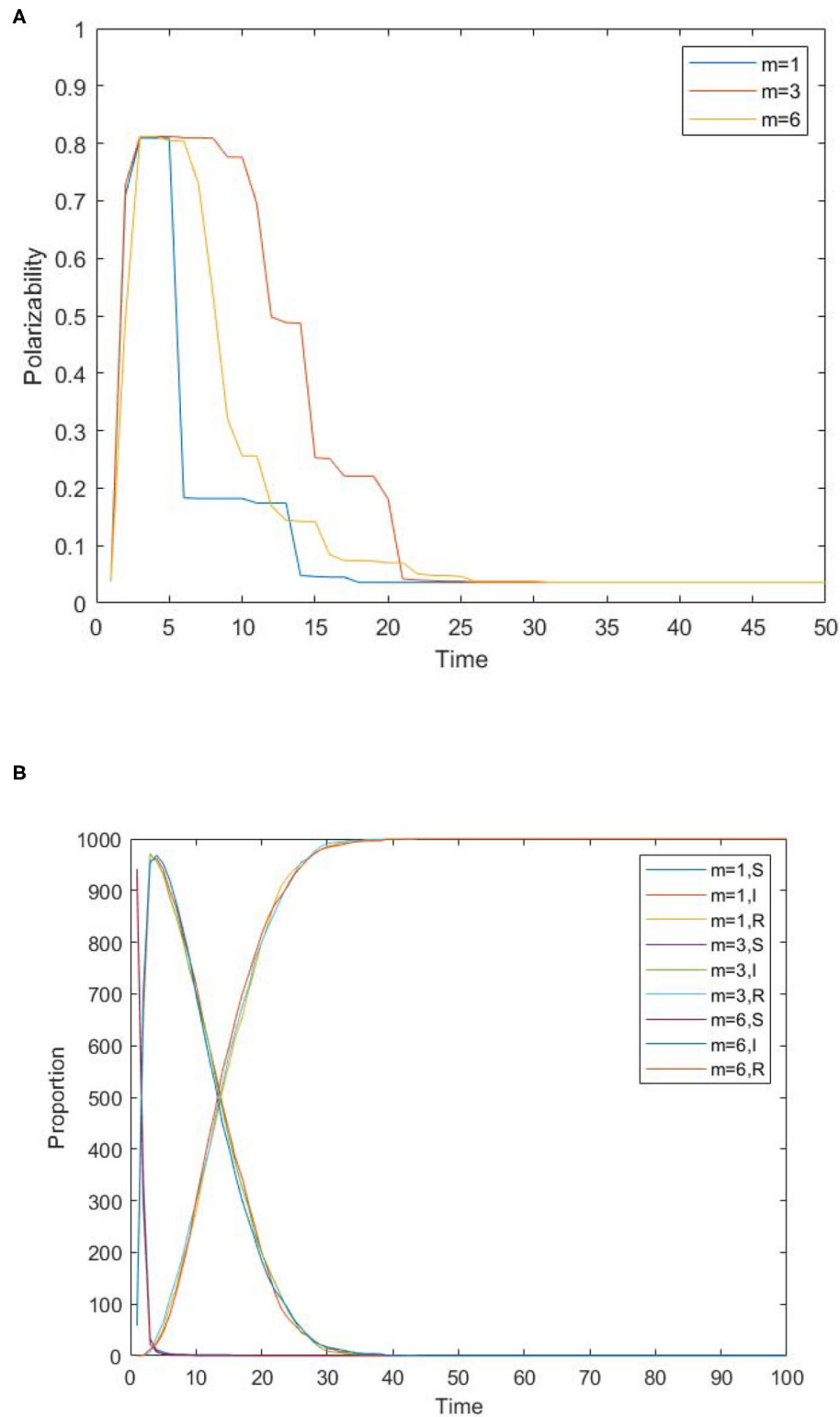
FIGURE 8 | The influence of interaction number on the spread of panic buying. **(A)** The change of panic polarizability over time under different numbers of connections. **(B)** The distribution of panic buyers over time under different numbers of connected edges.

connection between people, and not to deliberately block or guide people communicate. When the panic has dropped to a certain level, the communication among members of the society should be reduced as much as possible, and the channels of information spread should be reduced.

Figure 8B shows the distribution of panic buyers over time under different numbers of connected edges. It can be seen from the figure that the number of edges has no influence on the spread of panic buying behavior, so the number of people interacting has little influence on the spread of panic buying behavior. On the one hand, it may be that the influence of interaction number on panic emotion is mainly in the withdrawal period of emotion, and has no influence on the formation of panic emotion in the early stage, so there is little correlation on the spread of panic buying behavior. On the other hand, it may be because there are fewer isolated nodes in the network. Although there are differences in the number of individuals interacting with each other, it is still a closely connected network in general, and there is no isolated small group, therefore, it is easy to interact with each other, resulting in a chain reaction and forming panic buying.

The Influence of the Released Time of External Information on the Spread of Panic Buying

Changes in external information will lead to changes in people's needs, which will affect people's desire to buy. For example, Chen et al. (32) studied the polarization of multi-dimensional public opinion and they found that the intervention of external information in different times and dimensions will affect the spread of public opinion. Keane and Neal (33) constructed a daily consumer panic index for 54 countries from January to April 2020. Research shows that the announcement of movement restrictions at the beginning of a pandemic can cause more panic than later announcements. Thus, this section will analyze the impact of the released time of external information on the spread of panic buying behavior, which will help relevant departments to explore the best time to release information, so as to better grasp the opportunity for intervening. The situation where the epidemic information about safety and supplies is negative and unchanged is studied first. The simulation results are shown in **Figure 9A**. It can be found that the number of infected people (I) reaches the maximum at $t = 3$, and the curves of infected people (I) and recovered people (R) intersect at $t = 15$. At $t = 32$, the number of infected people (I) drops to 0, and no individuals are participating in panic buying. Later, the influence of changes in external information on the spread of panic buying is observed, and the general direction of the change of epidemic information is that the material-related information changes from negative to positive, and the safety-related information changes from negative to positive, that is, material need and safety need are gradually reduced. Taking the time $t = 3$, 15, and 32 as anchor points, through the adjustment of the time points of the epidemic information change, the changes in the spread of panic buying are discussed. The change time points of the epidemic information are set to $t = 2$, 10, 15, 20, 30, and 40, respectively. The results are shown in **Figures 9B–G**.

Figures 9B–G shows the changes at $t = 2$, 10, 15, 20, 30, and 40. Comparing **Figures 9B,C** and **Figure 9A**, we can see that if the epidemic information changes before the first panic buying reaches a maximized scale, it will not cause a second wave of panic buying, otherwise there will be. Comparing **Figures 9A,C–E**, it can be seen that if the epidemic information changes occur before the I and R curves intersect, the impact on panic buying will fluctuate less, and vice versa. When $t = 30$, the first panic buying is about to end, and when $t = 40$, the first panic buying has completely ended. Comparing **Figures 9A,F,G**, it can be seen that the maximum size of the second panic buying at $t = 30$ is about 450 people, and the maximum size of the second panic buying at $t = 40$ is about 400 people. This shows that when the first panic buying is about to end, if the scale of the second wave of panic buying is to be controlled, the effect of releasing positive information after the first panic buying is better than before the end.

DISCUSSION

This paper selected panic buying cases in China and the United Kingdom, and verified the panic buying model through text analysis and simulation modeling based on real data.

Case Analysis
Case 1: Panic Buying in Shijiazhuang, China

Since December 2019, some hospitals in Wuhan, Hubei Province, China initially discovered multiple cases of pneumonia of unknown cause. Subsequently, this virus spread rapidly around the world. In February 2020, Tedros Adhanom Ghebreyesus, the Director-General of the World Health Organization, announced that the pneumonia caused by the new coronavirus was named "COVID-19." In China, as a result of positive public health intervention measures, various provinces have resumed work and production from March 2020, and universities have begun to organize resumption of school from April 2020, and social life has basically returned to normal (34).

However, on January 4, 2021, 127 COVID-19 infected people reappeared in Shijiazhuang, Hebei Province, China. Shijiazhuang government urgently declared the need to enter a state of war (35). On January 6, 2021, citizens of Shijiazhuang rushed to the supermarket to buy daily necessities such as rice, noodles, grains, and oil (36). From January 7th to January 10th, in order to avoid another panic buying boom, the Shijiazhuang government released news about the guaranteed basic living materials when releasing information about the epidemic. For example, 70 supermarkets in Shijiazhuang promised not to increase the price of storage-resistant vegetables (37). These topics are widely discussed by netizens on Sina Weibo.

Sina Weibo is China's leading social media Weibo company. It has interactive functions such as follow, like, comment, and forward. Currently, Sina Weibo has more than 511 million monthly active users, and a large number of netizens' comments on various events have been accumulated on the platform. Therefore, this paper takes Sina Weibo as the case data source.

Figure 10 is a Sina Weibo topic index trend with regard to #Shijiazhuang residents rush to buy rice, flour, grain, and oil#.
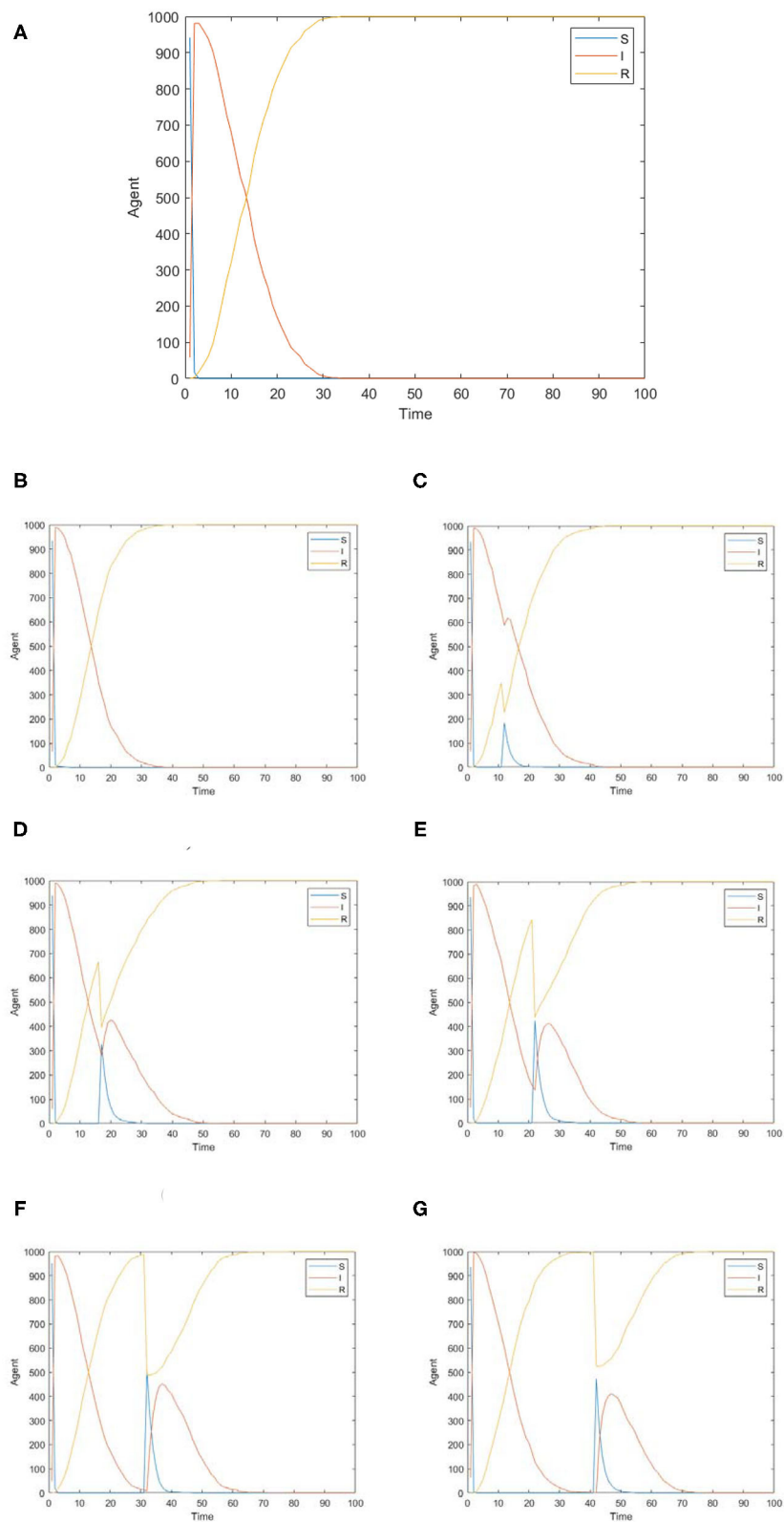
FIGURE 9 | The distribution of panic buyers over time under different release times of external information. **(A)** The epidemic information unchanged. **(B)** $t = 2$. **(C)** $t = 10$. **(D)** $t = 15$. **(E)** $t = 20$. **(F)** $t = 30$. **(G)** $t = 40$.

FIGURE 10 | Sina weibo topic index trend of #Shijiazhuang residents rush to buy rice, flour, grain, and oil# (data from Sina Weibo). **(A)** Discuss trend. **(B)** Original trend.

The trend represents the change in the number of netizens who publish related Weibo content by themselves, as well as comments, likes, and reposts related to others' Weibo content. The original trend represents the change in the number of related Weibo content that netizens publish by themselves, which can reflect the enthusiasm of Shijiazhuang panic buyers to a certain extent. There are two crests in the two trend graphs (indicated by red dots in the figure), the big crest on January 6 and the small crest on January 9, which shows that the panic buyers have shown a two-stage change in panic buying. The enthusiasm of netizens for panic buying in the first stage is very high, while the enthusiasm of netizens for panic buying in the second stage is very low.

In order to study the panic buying behavior of "Shijiazhuang residents rush to buy rice, flour, grain, and oil," this section cites the data analysis method of Chen et al. (38) to analyze the comments of Sina Weibo topic of #Shijiazhuang residents rush to buy rice, flour, grain, and oil#. We divided the event into two stages, focusing on the time when the topic first appeared: the first stage is the first panic buying period, that is, from January 4, 2021 to January 6, 2021, and the second stage is the period when the positive information about the materials is released after the first panic buying, that is, from January 7, 2021 to January 10th, 2021. On Sina Weibo, news topics related to the safety and supplies of the Shijiazhuang epidemic were crawled in two time periods. A total of 11 Weibo topics and 17,856 Weibo

comment data under the topics are crawled. The topic division is shown in **Table 2**. Although the amount of data obtained here is limited, according to the six-degree separation theory in interpersonal relationships, the statistical results of these user data can reflect the general applicability of Weibo user behavior to a large extent.

Data Preprocessing

With regard to the selected Weibo topics and comments, data preprocessing is conducted first. The first step is to clean up the emojis in the comments. We keep the emojis that can be converted into text like "[heart]" and "[tears]," and delete the emojis that cannot be converted into text. The second step is to eliminate invalid and bot comments. Invalid comments that only contained numbers, punctuation marks, or empty words are deleted. Referring to the representative features of robot accounts pointed out by Loyola et al. (39) suspected bot comments are removed. Finally, 14,449 comment data is selected.

Emotion Analysis of Comments

Emotion analysis is carried out on comment data. Emotion dictionary to perform emotion analysis based on Python is used. The dictionary is divided into three parts: emotion dictionary, degree word dictionary, and emoji dictionary.

The specific emotion analysis steps are as follows:

① Perform text preprocessing on a single Weibo sentence, and use punctuation as a segmentation mark to divide a single Weibo into *n* sentences, and extract the emotional word in each sentence.
② Use clauses as the processing unit, look for positive or negative emotional words in the emotional vocabulary, and use each emotional word as a benchmark to look for the degree words in turn, and calculate the corresponding score. Sum up the scores of each emotional word in the clause.
③ Determine whether there are emoticons in the sentence. If so, the clause adds or subtracts the corresponding weight on the basis of the original score.
④ Accumulate the scores of all the clauses of this Weibo to get the final score of this Weibo.

Finally, the emoticon score of each comment is obtained, which is statistically sorted and summarized as shown in **Table 3**.

People's panic is measured by their negative emotions. It can be seen from the line of "proportion of negative emotions." From the first stage to the second stage, the proportion of negative comments on Safety News decreased from 0.39 to 0.36, and the proportion of negative comments on material news decreased from 0.48 to 0.34, representing a decline in people's panic. It can be seen from the line of "Average score of negative emotion" that, although the public's concern about safety has increased in the second stage, the average score of negative emotion of safety news has decreased from −2 to −2.2, but the negative emotion of material news has been alleviated, and the average score of negative emotion of material news has increased from −2.2 to −1.9, which also shows the decline of public panic.

Measure the Strength of Epidemic Information

In order to simulate the impact of changes in external epidemic information on public panic and panic buying behavior, it is necessary to quantify the intensity of the epidemic information in the case. Topic reading times are the times that netizens read the topic, which can represent the spreading range of the topic. Generally speaking, the higher number of topic readings means the more netizens they see, the more netizens pay attention to this issue. Therefore, the number of topic readings can be used as a measure of topic information intensity. In addition, the number of total comments crawled represents the degree of discussion of the topic by netizens, and can also be used as a measure of the strength of topic information. These two measurement indicators are used to comprehensively quantify the intensity of epidemic information, and the quantitative results are shown in **Table 4**.

After statistical analysis, it is found that the highest reading times for material and safety topics in different periods is about 330 million. According to the latest financial report released by Sina Weibo, as of September 2020, the monthly active users of Weibo were 511 million, and the average daily active users were 224 million. Therefore, the range of users affected by 330 million topic readings has been very high. As such, the analysis sets the news information intensity of 330 million or more topics to be read as 1. In turn, the information intensity of other topics is calculated based on 330 million. The calculated information intensity is shown in **Table 4** "Information intensity 1" Line. The maximum number of comments on material and safety topics in different periods is about 5,000. Therefore, the information intensity of the epidemic information for the total number of crawled comments of 5,000 and above is set as 1, and the information intensity of other topics is calculated based on 5,000. The calculated information intensity is shown in **Table 4** "Information intensity 2" Line.

Finally, the average value of information intensity under the two indicators (i.e., information intensity 1 and 2) is taken as the final value of information intensity of different categories in different periods by combining reading times and number of total comments crawled. The calculated results are shown in the line "Average Information Intensity" in **Table 4**.

Case 2: Panic Buying in UK

In March 2020, affected by the spread of COVID-19, the British experienced a trend of hoarding goods. Many supermarkets in London witnessed panic buying. Toilet paper, hand sanitizer, and canned food were all swept away (40). In December 2020, due to the emergence of new coronavirus variants, the UK announced the implementation of the highest level of "level 4" blockade restrictions on London and the southeast of the UK. As it turned out, some people were worried about the shortage of goods and hoarded goods in supermarkets, which evolved into a panic buying frenzy (41).

In order to study the differences of two panic buying events in the UK in March and December 2020, we took #UK panic buying# and #London panic buying# as keywords to obtain relevant tweets and the comments under the tweets from March

TABLE 2 | Topic division.

Time	News category	Positive or negative news	Topic	Number of comments
2021.1.4–2020.1.6	Safe	Negative	#Shijiazhuang entered a state of war#	3,725
	Material	Negative	#Shijiazhuang residents rush to buy rice, flour, grain, and oil#	431
2021.1.7–2020.1.10	Safe	Negative	#259 positive cases were detected in Gaocheng District of Shijiazhuang#	2,843
			#Shijiazhuang residents stay at home for 7 days#	2,476
	Material	Positive	#70 supermarkets in Shijiazhuang promise not to increase the price of storable vegetables#	1,139
			#Shijiazhuang is offering a maximum reward of 5,000 Yuan for reporting price gouging#	1,385
			#Buying food in Shijiazhuang#	1,537
			#All stores in Shijiazhuang have suspended offline business#	866
			#Shijiazhuang food deliverymen speed up to work#	17
			#Shijiazhuang food deliverymen start work one after another#	87
			#Vegetable Supply in Shijiazhuang#	86

TABLE 3 | Overall statistic of emotion analysis.

Statistical items	The first stage		The second stage	
	Safe topic	Material topic	Safe topic	Material topic
Number of positive comments	1,135	102	2,002	1,752
Number of negative comments	1,429	199	1,893	1,709
Number of neutral comments	1,118	110	1,364	1,636
Proportion of negative emotions	0.39	0.48	0.36	0.34
Ratio of positive and negative comments	0.8	0.5	1.1	1
Average score of positive emotion	1.9	1.8	2.2	1.9
Average score of negative emotion	−2	−2.2	−2.2	−1.9
Total emotional average score	−0.2	−0.6	0.1	0
Average score of positive/negative emotion	1	0.8	1	1
Positive score variance	2.7	2.2	3.6	2.6
Negative score variance	2.6	2.7	2.9	2.3
Total emotion score variance	4.6	4.6	6	4.2
Positive/negative score variance	1.1	0.8	1.3	1.2

TABLE 4 | Information intensity.

Time	2021.1.4–2020.1.6		2021.1.7–2020.1.10	
News category Positive or negative news	Safe Negative	Material Negative	Safe Negative	Material Positive
Reading times	330 million	5.063 million	340 million	330 million
Information intensity 1	1	0.015	1	1
Number of total comments crawled	3,725	431	5,319	5,117
Information intensity 2	0.745	0.086	1	1
Average information intensity	0.873	0.051	1	1

2020 to April 2020 and from December 2020 to January 2021. Finally, we crawled 247 posts and 15,656 comments.

Follow the method in Case 1 for data analysis:

(1) Clear the posts irrelevant to panic buying, and further divide all data into two categories, positive material information and negative material information, and then preprocess the data. Finally, we obtain a total of 157 posts and 8,543 comments.

(2) Through the calculation of sentiment analysis, the proportion of negative emotions rises from 0.178 in the first stage to 0.183 in the second stage, which means that the people's panic has increased.

(3) As for information intensity, because of the long duration of COVID-19, people are gradually numb to the changes in the number of cumulative confirmed cases. Therefore, we use

more serious daily deaths to measure the intensity of safety information. According to COVID-19 data released by the WHO website (42), in March 25, 2020, the number of daily deaths increased by 148 in Britain, and in December 22, 2020, the number of daily deaths increased by 215. The highest daily death in the UK in 2020 was 1,105. Taking 1,105 as the benchmark, the negative information intensity of safety in the first stage is 0.13, and in the second stage is 0.19. Next, we measured material information intensity by the number of comments crawled. The highest total number of comments is about 3,500. Therefore, the information intensity of materials with a comment number of 3,500 or above is set as 1, and other information intensity is calculated on the basis of 3,500. After calculation, in the first stage, the positive information intensity of material is 0.34 and the negative information intensity of material is 0.67. In the second stage, the positive information intensity of material is 0.36 and the negative information intensity of material is 1.

Case Simulation

Due to the large amount of data, considering comprehensive visualization, the simulated network scale is set to 1,000. Since panic buying behavior was originally caused by external information, based on the above analysis of information intensity, the information intensity in the experiment is set as follows: For the first case (in China), in the first stage, the information intensity of negative and positive safety news is set as $I_{S-}(t) = 0.873$, $I_{S+}(t) = 0$, and the intensity of negative and positive material news is $I_{M-}(t) = 0.051$, $I_{M+}(t) = 0$. In the second stage, the intensity of negative and positive safety news is $I_{S-}(t) = 1$, $I_{S+}(t) = 0$, and the intensity of negative and positive material news is $I_{M-}(t) = 0$, $I_{M+}(t) = 1$. For the second case (in the UK), in the first stage, $I_{S-}(t) = 0.13$, $I_{S+}(t) = 0$, $I_{M-}(t) = 0.67$, $I_{M+}(t) = 0.34$. In the second stage, $I_{S-}(t) = 0.19$, $I_{S+}(t) = 0$, $I_{M-}(t) = 1$, $I_{M+}(t) = 0.36$. In both cases, the other parameter settings are the same: the individual conformity degree $Con(i)$
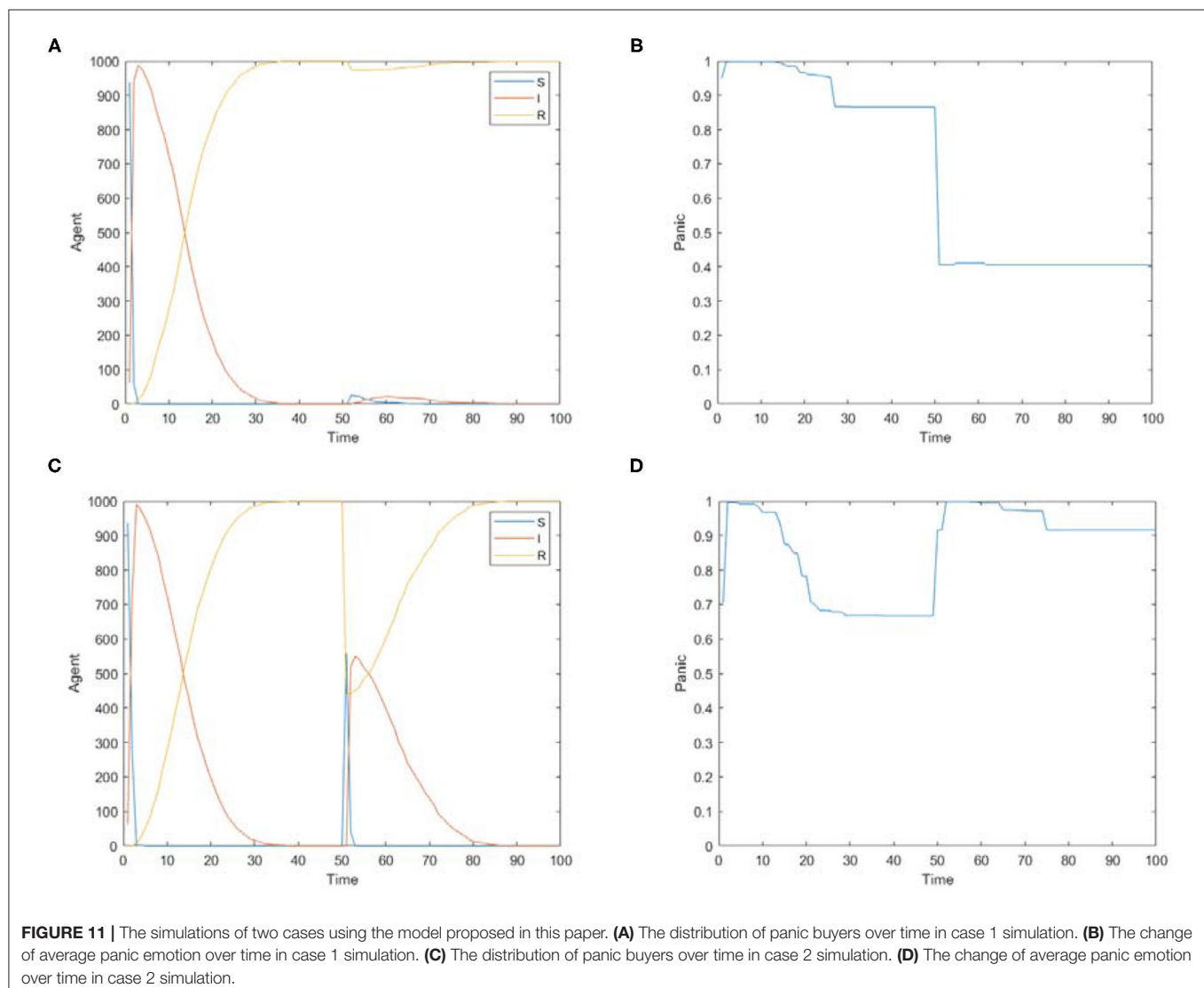

FIGURE 11 | The simulations of two cases using the model proposed in this paper. **(A)** The distribution of panic buyers over time in case 1 simulation. **(B)** The change of average panic emotion over time in case 1 simulation. **(C)** The distribution of panic buyers over time in case 2 simulation. **(D)** The change of average panic emotion over time in case 2 simulation.

obeys the normal distribution of N~(0.5, 0.15), and is mapped to [0, 1], indicating that the conformity degree of most individuals is general; parameter a of the material needs (physiological needs) is 0.6 and parameter b of safety need is 0.4. Setting the proportion of individuals (i.e., infected people I) is 6%, and the remaining individuals are all susceptible S; $\mu_1 = 0.2$, $\mu_2 = 0.2$, $d_1 = 0.2$, $d_2 = 0.6$, $c_1 = 1$, $c_2 = 0.01$. The simulation results are shown in **Figure 11**.

Figure 11 is the simulation figures of two cases using the model proposed in this paper, in which **Figures 11A,C** simulates the distribution of panic buyers over time in case 1 and case 2, respectively, and **Figures 11B,D** simulates the change of average panic emotion over time in in case 1 and case 2, respectively.

It can be seen from **Figure 11A** that there have been two-stage changes in panic buyers in case 1. In the first stage when Time∈[0, 50], the number of panic buyers rises rapidly with most individuals participating in the panic buying, and then the number of panic buyers declines. In the second stage when Time∈[50, 100], the number of panic buyers increases slightly with only a few individuals participating in the material panic buying, and then the number of panic buyers declines. The change curve of infected people I (people who participated in the panic buying) in **Figure 11A** is basically the same as the data change trend of the real case in **Figure 10**.

It can be seen from **Figure 11B**, in case 1, when Time∈[0, 50], the average value of panic first rises and then drops to about 0.87 and remains stable. With the continuous reports of positive news related to materials, when Time∈[50, 100], the average value of panic drops. However, due to the severe COVID-19 situation, the average value of panic does not drop to 0, but stabilizes at about 0.4. The declining trend of the panic emotion in the second stage in **Figure 11B** is the same as the emotion trend of the real case in **Table 3**.

It can be seen from **Figure 11C**, in case 2, there are also two-stage changes in panic buyers. In the first stage, the number of panic buyers increased rapidly—almost everyone participated in the panic buying—and then the number of panic buyers decreased. In the second stage, half of the individuals participated in the panic buying, and then the number of panic buyers decreased. According to the relevant retail data of the British Bureau of statistics (43), in March 2020, the Relative Strength Index (RIS) of food stores in March 2020 increased by 9.3% year-on-year, while medical and toilet goods increased by 3.4% year-on-year. In December 2020, the RSI of food stores increased by 4.5% year-on-year, and medical and toilet goods decreased by 0.4% year-on-year. This shows that the quantity of materials purchased in March was higher than that in December, which reflects that the panic buying situation in March was more serious than that in December. Therefore, the real data situation is similar to the simulation results in the figure.

It can be seen from **Figure 11D**, in case 2, when Time∈[0, 50], the average value of panic first rises and then drops to about 0.67. With the upgrading of blocking measures, when Time [50, 100], the average value of panic rises again, and then drops to about 0.9. The comparison shows that

people's panic emotion is higher in the second panic buying, which is similar to the trend of real emotion score in case 2.

It can be found from these two cases that although the environments of the cases are not the same, the simulation results of the cases are relatively close to the real situation, which shows that the panic buying model proposed in this paper can simulate panic buying events in different situations. This model has good applicability and effectiveness and it has important guiding significance for analyzing the causes of panic buying and predicting the changing trend of panic buying.

CONCLUSION

This study aims to quantitatively explore the formation and propagation mechanism of panic buying under a sudden epidemic. Therefore, this paper constructs a panic buying propagation model based on SIR model and discuss the influence of individual needs, panic, individual conformity, interaction number, and released time of external information, and verifies feasibility and effectiveness of model by two empirical cases.

The following conclusions are obtained through simulation experiments:

(1) The dissipation rate of individual panic is related to the number of people interacting with it, but it is not that the more or less people interacting with, the faster the individual panic will dissipate. There is a threshold. When the number of individuals interacting with each other reaches this threshold, the panic will dissipate the fastest.

(2) The released time of the external information will have an impact on the occurrence of a second wave of panic buying. Releasing information of sufficient supplies at the same time as the information of epidemic escalation can help avoid second panic buying. When the first wave of panic buying is coming to an end, it is better to curb the size of the second rush by sending out positive messages after the first panic buying than ahead of the end.

(3) Higher conformity among people escalates panic, resulting in panic buying.

However, this paper still has the following shortcomings, which need further study:

(1) Although the impact of relevant epidemic information on individual needs is mentioned in the model, it does not identify the publisher of external information sources, that is, it does not consider the difference between information released by government agencies or mass media or netizens. In follow-up research, it can be further refined and improved.

(2) The model does not take into account the degree of individual trust in external information sources. In different countries and regions, people's trust in government officials may be different, which will also lead to different perceptions of materials and safety news. In the follow-up research,

it is necessary to consider the individual's trust in the information source.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

PF designed the study and conceived the manuscript. BJ implemented the simulation experiments. TC and CX drafted the manuscript. JY and GC were involved in revising the manuscript.

All authors were involved in writing the manuscript and approve of its final version.

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Perceived Impact of Social Media on Panic Buying: An Online Cross-Sectional Survey in Iraqi Kurdistan

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Background: Social media has an impact on panic buying by creating fear, disseminating pictures, and videos of people purchasing extra goods in a state of panic during the COVID-19 pandemic.

Aim: We aimed to evaluate the perceived impact of social media on panic buying behaviors in the Iraqi Kurdistan region.

Methods: This cross-sectional survey was conducted from October 10 to November 25, 2020. A self-reported instrument was designed in English and then translated to the Kurdish Language to conduct the study. It was disseminated through social media platforms (Facebook, Viber, and WhatsApp) and e-mail, *via* a link, and 466 responses were collected from social media users. The statistical computations were performed using SPSS version 21.

Results: The majority of respondents were male (62.2%), were <25 years old (43.9%), and had completed their bachelor's degree (53.9%), and most of the respondents (86.3%) used Facebook. Among the respondents, 42.1% were involved in panic buying, 32.8% of the respondents thought that social media platforms had an influence on panic buying, 86.1% of the respondents thought that social media should be sensible while reporting it, 88.4% thought that the reporting should be controlled, and 78.5% thought that photos of empty shelves should be avoided. There was a significant positive statistical correlation ($r = 0.84$) between social media use and panic buying among consumers during the COVID-19 pandemic in Iraqi Kurdistan ($p = <0.001$).

Conclusion: This research assessed how social media affects buying behavior, particularly in Iraq. Collective measures, such as sensible use and adequate media literacy, are needed to prevent such behaviors at least during public health emergencies.

Keywords: panic buying, social media, COVID-19, stockpiling, Iraq

INTRODUCTION

The COVID-19 pandemic has disrupted the world economy and medical services, generating fear, panic, and vulnerability among billions of individuals. During the initial phase of COVID-19 spreading and mandatory lockdowns in numerous locations, panic buying (PB) has arisen as a common component of the COVID-19 outbreak (1). Store racks have been stripped bare across countries. Toiletries, frozen food, rice, beans, eggs, and bread are some basic goods that were regularly sold out as customers made hasty purchases and bought extra amounts (2). There are some logical explanations behind this behavior, such as the purchase of many tissues, which might be identified with the critical and pointless requirement of washing hands, or as an intelligent response to watching pictures of frenzy purchases in different nations (3–5). One study has proposed the causative model of PB, suggesting that there is usually an adverse stimulus such as disaster, war, or a pandemic (4). Subsequently, other factors such as media shape the initial response (4).

The panic behavior of buying toilet paper was one of the predominant, appalling, and stunning recordings that was viewed by people across the world on social media platforms. Numerous individuals have shared stories, pictures, and encounters on Twitter and Facebook which additionally furthered frenzy purchasing among different shoppers (6, 7). Mao (7) explains that social media has encouraged the utilization of some hashtags, for instance "#toilet-paper-gate" and "#toilet-paper-crisis," which demonstrate shoppers' frenzied behavior during the COVID-19 pandemic. Scientists have reported that business exercises and buyer purchasing behaviors have been altered due to the COVID-19 pandemic and its controlling measures (8).

The Iraqi people have for the most part been in crisis since 1921, after the creation of Iraq. The political instability and economic situation have always been in turmoil (9). Therefore, Iraqis usually buy more goods and store them. However, since the emergence of COVID-19, the episodes of PB have been reported, particularly for some protective equipment such as gloves, masks, protective materials, food, and toilet paper. Along with the enduring conflict, the COVID-19 pandemic acts as a precipitating event for initiating PB as previous studies reported that crises, conflict, pandemics, health-care emergencies precipitate it (2–4).

Media has an important causative as well as the preventive role in PB (4, 10, 11). There are various forms of media: digital media platforms have connected all users through their phones, and computer networks connect users through computerized markets, internet banking, and shopping. Diverse web-based media platforms have emerged providing worldwide availability to clients (12). Ahmad & Murad (13) claim that posts on social media platforms in Iraq have had a significant impact on the psychological aspects of society, creating panic among people, particularly during the first months of the emergence and spread of COVID-19. Other studies have found that that there is a lack of comprehension of how online media can shape fear and customer reactions, triggering PB during the COVID-19 outbreak across the world (14, 15). However, the impact of social media on PB, particularly in influencing the consumers to buy more, has not

been assessed in many countries including Iraq. As a conflict-prone region, the findings of this study would help to examine the prevention of PB during other crises like war. In this study, we aimed to evaluate the perceived impact of social media on PB behaviors in the Iraqi Kurdistan region.

MATERIALS AND METHODS

Data Collection

We applied a cross-sectional quantitative survey method to gather data from social media users in Iraqi Kurdistan, using Google forms. The survey was conducted from October 10 to November 25, 2020, and was disseminated through social media platforms (Facebook, Viber, and WhatsApp) and e-mail with a link. The survey was created in the Kurdish language, and 466 responses were collected from the social media users. The random online questionnaire was aimed to determine the perceived impact of social media on PB among consumers in Iraqi Kurdistan. The scope of the survey and objectives of the research were made available to all the respondents. The link to the questionnaire was circulated to the respondents, and they were requested to respond. A summary containing the objectives and the procedures was displayed by clicking on the questionnaire link, followed by the mandatory consent form. Respondents who provided consent were able to complete the survey.

Instrument

The instrument was designed by the authors, and the scale was made following a previous study on social media and panic in Iraq (13). The survey was designed in English and then translated to the Kurdish Language which is the formal language in Iraq. We prepared it in a clear and simple way with examples which was easy to understand the terms and concepts as panic buying is common among Iraqi people because of enduring crises. The questionnaire was composed of seven questions regarding the sociodemographic profile of the respondents (age, marital status, gender, education, number of people in a household, and monthly salary): three questions were regarding respondents' social media, and the remainder of the questions were regarding the impact of social media platforms on customers' fear of empty shelves. Cronbach's alpha was 0.92. We did not assess the mode of panic buying, frequency, and the name of the commodities.

Statistical Analysis

All statistical computations were performed using SPSS version 21. Data were coded, tabulated, and presented in a descriptive form. The statistical procedure used to determine the results of the present study included Cronbach's alpha to test the reliability of the questionnaire, descriptive statistical data analysis (frequency, percentage, mean, standard deviation, coefficient of variance, and relative importance), and inferential data analysis: Pearson bivariate correlation and simple regression model.

Ethical Statement

The study was conducted in compliance with the Helsinki declaration (1964). Permission was obtained from the University

TABLE 1 | Demography of the respondents (*n* = 466).

Variables	*n* (%)
Sex	
Male	290 (62.2)
Female	170 (36.5)
Prefer not to say	6 (1.3)
Age in years	
<25	204 (43.9)
25–35	150 (32.2)
36–45	77 (16.5)
46–55	26 (5.6)
More than 55	9 (1.9)
Mean ± SD	29.63 ± 9.85
Highest level of education	
High school	94 (20.2)
Bachelor	251 (53.9)
Masters	52 (11.2)
Ph.D. or higher	26 (5.6)
Prefer not to say	43 (9.2)
Current employment status	
Employed full-time	130 (27.9)
Employed part-time	90 (19.3)
Seeking opportunities	52 (11.2)
Retired	6 (1.3)
Prefer not to say	188 (40.3)
Marital status	
Single	244 (52.4)
Married	209 (44.8)
Prefer not to say	13 (2.8)
Children	
None	270 (57.9)
1	41 (8.8)
2–4	123 (26.4)
More than 4	14 (3)
Prefer not to say	18 (3.9)
Monthly income	
<$100	82 (17.6)
$100–$300	69 (14.8)
$300–$600	72 (15.5)
$600–$900	39 (8.4)
$900–$1200	78 (16.7)
more than $1200	126 (27)
Total	**466**

TABLE 2 | Social media use profile of the respondents (*n* = 466).

Variables	*n* (%)
Skills of using social media platforms (subjective assessment)	
Very good	9 (1.9)
Good	15 (3.2)
Medium	127 (27.3)
Bad	168 (36.1)
Very bad	147 (31.5)
Social media platform	
Facebook	402 (86.3)
Instagram	210 (45.1)
Snapchat	157 (33.7)
YouTube	182 (39.1)
Twitter	53 (11.4)
Viber	170 (36.5)
Line	5 (1.1)
WhatsApp	126 (27)
Telegram	118 (25.3)
Duration of use of social media platforms in a day	
Less than hour	10 (2.1)
1–2 h	118 (25.3)
2–4 h	179 (38.4)
4–6 h	92 (19.7)
More than 6 h	67 (14.4)
Total	**100.0**

employed full time (27.9%), and were single (52.4%) (**Table 1**). Most of the respondents (86.3%) used Facebook; 38.4% used social media for 2–4 h per day (**Table 2**). Among the respondents, 42.1% (*n* = 196) were involved in PB. Among the panic buyers, 35.2% (*n* = 69) were involved in the activity during the COVID-19 pandemic while 64.8% (*n* = 127) bought extra amounts during usual times.

Perceived Impact of Social Media on PB

The perceived influence of social media on PB is displayed in **Table 3**. Only one-third (32.8%) of the respondents thought that social media platforms had an influence on creating PB, and one-sixth (16.1%) thought that the fear shown on social media can create PB (**Table 3**). The assessment of overall perceived influence revealed that less than one-third of the respondents were supposed to be influenced (**Table 3**). The majority (86.1%) of the respondents thought that social media should be sensible while reporting PB, 88.4% thought that the reporting should be controlled, and 78.5% thought that photos of empty shelves should be avoided (**Table 4**). There was a significant positive statistical correlation ($r = 0.84$) between usage of social media platforms and PB among consumers in Iraqi Kurdistan ($p = <0.001$) (**Table 5**). **Table 6** indicates that the regression model predicted the dependent variable significantly. Here, the *p*-value (<0.001) was <0.05, which indicates that the regression model statistically predicts the outcome variable significantly (i.e., it is a good fit for the data). The R^2 value indicates how much of the

of Raparin, Iraq (ID Number: 7-29-319). Informed consent was obtained electronically while initiating the survey.

RESULTS

Demography of the Respondents

The mean (±SD) age of the respondents was 29.63 (± 9.85) years. The majority of respondents were male (62.2%), were <25 years old (43.9%), had completed their bachelor's degree (53.9%), were

TABLE 3 | Perceived influence of social media on panic buying.

Item	Totally disagree (*n*, %)	Disagree (*n*, %)	Neutral (*n*, %)	Agree (*n*, %)	Totally agree (*n*, %)	Mean ± S.D
Social media platforms have influence on creating panic buying.	18 (3.9)	244 (52.4)	51 (10.9)	119 (25.5)	34 (7.3)	2.8 ± 1.08
Fear on social media drives to panic buying.	151 (32.4)	208 (44.6)	32 (6.9)	55 (11.8)	20 (4.3)	2.11 ± 1.11
Spreading the fear of not having the products on social media leads to buying more things.	142 (30.5)	188 (40.3)	51 (10.9)	49 (10.5)	36 (7.7)	2.25 ± 1.21
I panic when I saw the photos and video of empty shelves of essential products on social media.	186 (39.9)	128 (27.5)	44 (9.4)	39 (8.4)	69 (14.8)	2.3 ± 1.44
The feeling of uncertainty during emergency influences my buying habits.	118 (25.3)	199 (42.7)	31 (6.7)	73 (15.7)	45 (9.7)	2.42 ± 1.28

TABLE 4 | Preventive aspects of panic buying on social media.

Questions	No (*n*, %)	Don't know (*n*, %)	Yes (*n*, %)	Mean ± S.D
Do you think that social media reports should be sensible while reporting panic buying?	25 (5.4)	40 (8.6)	401 (86.1)	2.8 ± 0.54
Do you think that social media reports should be controlled while reporting panic buying?	33 (7.1)	21 (4.5)	412 (88.4)	2.81 ± 0.51
Do you think that photos of empty shelves should be avoided while social media reporting panic buying?	39 (8.4)	61 (13.1)	266 (78.5)	2.7 ± 0.61
Sum	97 (6.94)	122 (8.7)	1179 (84.3)	2.77 ± 0.55

TABLE 5 | Association between social media and panic buying.

		Social media platforms	Panic buying
Social media platforms	Correlation	1	0.838
	Sig.		0.000
Panic buying	Correlation	0.838	1
	Sig.	0.000	

total variation in the dependent variable (PB) can be explained by the independent variable (social media). The R^2 for this study was 0.7, indicating that 70% of the variance (of PB) is explained by the usage of social media.

DISCUSSION

Panic buying received the focus of researchers during the COVID-19 pandemic (16). Newer studies exploring its aspects are being published (16, 17). Media plays a bidirectional role in the case of PB. Hypothetically, it can increase fear by disseminating pictures of the empty shelves and rumors of a shortage of supply (4, 10, 11, 15). Previous studies revealed that mass media and social media have a role in disseminating fear and rumors, which in turn increases erratic behavior like PB (10, 12, 18, 19). Furthermore, it has been reported that fake news on social media demonstrated a strong positive impact on impulse buying (18–20). In contrast, mass media and social media can minimize PB by reducing public tension and threat and assuring the public that there is a sufficient supply of good. However, the role of social media in PB is yet to be established by empirical studies. We aimed to assess whether social media has a role on PB behavior in Iraqi Kurdistan.

Main Findings of the Study

The study revealed that Facebook was the most commonly used platform, with more than one-third of the respondents spending 2–4 h per day on social media (**Table 2**). Further, 42.1% (*n* = 196) were involved in PB and 35.2% (*n* = 69) of the respondents exhibited this behavior during the COVID-19 pandemic.

The perceived influence of social media as measured by the responses was identified in less than one-third of the respondents (**Table 3**). However, the respondents thought that social media should be monitored as a controlling measure. Furthermore, we found a significant positive statistical correlation between usage of social media platforms and panic buying among consumers (**Table 5**). A previous study following similar methods had similar findings regarding social media platforms. The study measured the impact of social media on panic and reported that the spread of panic and anxiety was significantly related to self-reported social media use (13). It was revealed that social media can help promote social exchange, resulting in proactive activities in the form of consumer PB (14). Additionally, other studies reported that PB was more common among people who were more worried about the COVID-19 pandemic and that social media possibly played a role in disseminating the worry, fear, and anxiety by showing images of empty shelves, which in turn produced a sense of scarcity and short supply (19–21). Studies from different settings have also reported that rumors regarding the shortage of supplies increased PB (22–24).

Owing to the development of new technology and the progress of new forms of media, people spend more time on social media than before. Within seconds, new information, news, pictures, and videos can be posted to millions of people. The study shows that social media has an impact in creating PB during the COVID-19 pandemic and that social media posts spread panic which caused people to buy more products than needed.

TABLE 6 | The effects of social media platforms on panic buying among consumers during the COVID-19 pandemic in Iraqi Kurdistan.

Model	Coefficients		T-test	Sig.	Model summary			ANOVA	
	Unstandardized coefficients				R	R^2	Adjust R^2	F Test	Sig.
	B	Std. error							
Constant	0.522	0.042	8.376	0.00	0.838	0.702	0.701	1093.15	0.00
Social media	0.832	0.025	33.06	0.00					

Implications of the Study Results

During any public health emergency, people get anxious because of uncertainly and look for information. For this purpose, social media is an easily available option. However, it is difficult to distinguish between real and false information on social media. False information and rumors can increase consumer anxiety. As a result, it is possible that social media could exacerbate feelings of helplessness leading to emotional distress. To avoid information contamination, it might be appropriate to prohibit people from sharing pictures of empty shelves. Facebook has the ability to block posts based on their content. It is critical to establish an enduring collaboration between the region's health practitioners and for media experts to ensure that only helpful characteristics of reporting of PB are disseminated (1, 10, 11).

Challenges of Assessing the Relationship of Social Media and Panic Buying

Estimation of a precise relationship between several aspects of social media and PB is challenging for several reasons. Firstly, social media is supposed to have a mediating effect while other major factors (4, 17). Secondly, PB appears suddenly during crises, occurs in irregular bouts, and is difficult to predict (25). Thirdly, as an emerging topic with fundamental challenges to study, there is an extreme dearth of empirical studies to ascertain such associations (25). Fortunately, newer studies are coming out even though further studies are warranted (14, 15, 19). Fourthly, there are numerous confounding variables such as socio-demography, economic construct, previous experience, and the public health crisis itself. Fifthly, there is no established guideline for social media use and controlling the misuse. Finally, social media gets the poor attention of the public health agency during a pandemic in comparison to the pandemic itself.

Strengths of the Study

This is the first study assessing the impact of social media on PB in a conflict-prone area. As responses were collected through online platforms and a self-reporting instrument, the chances of having conformity biases are lower.

Limitations

This study has some limitations related to data collection, reading comments, and obtaining feedback from respondents on social media reports about empty shelves in shops and markets.

Quantification of the PB was not performed. The instrument was self-reporting, and responses were collected via online platforms, which may produce recall biases. There is a potential chance of biases in understanding the meaning and terminology as the PB phenomenon was not explained explicitly to all the respondents. The instrument was not psychometrically tested before the study. Collecting data during the pandemic was not an easy process, particularly with people who had been affected by the panic of COVID-19. Participants were not assessed or screened for any psychological disorders and other confounding variables affecting social media use have not been considered.

Conclusion

This research assessed how social media affects buying behavior particularly in Iraq. Collective measures such as sensible use and adequate media literacy are needed to prevent the behaviors, at least during public health emergencies. The regulatory bodies and social media companies could implement new regulations on social media platforms during crises and pandemics to controlling PB. It could be used as the universal and primary prevention strategies while considering the prevention of PB during the forthcoming disasters. Culturally appropriate interventions should be developed and tested as PB has been noticed during crises and public health emergencies.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be provided on request to the corresponding author.

ETHICS STATEMENT

The study was conducted complying with the Helsinki declaration (1964). Ethical clearance was obtained from University of Raparin, Iraq (ID Number: 7-29-319).

AUTHOR CONTRIBUTIONS

SA contributed to the concept, design, and writing. AA, HM, and HK contributed to data collection and writing. All the authors contributed to manuscript writing, revision, reading, and approval of the submitted version.

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