

Early crisis warning system using community engagement through social network sites in times of disaster

Study case of the Dead Sea flash floods

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Summary

Throughout history humanity has always faced different kinds of hazards endangering human lives and their properties. Therefore, humans started to develop methods to help them reduce risks. Disaster management mostly depends on geographical information system (GIS) and disaster communication. One element of disaster communication is early warning systems (EWSs). EWSs one time used to use hazard bells, but they have developed over time. Our age is characterized by new ways of digitized communication. Social network sites (SNS) have brought advantages and challenges not only for the authorities involved in disaster communication but for the whole community. In this study we investigate the credibility and reliability of using SNS in EWSs through the case of the Dead Sea flashing floods of 2018. Results reflect which is more credible and we provide recommendations aimed at civil protection in Jordan.

Keywords: disaster communication, early crisis warning system, disaster management, social network sites, flashing floods, Jordan

Korai krízisjelző rendszerek alkalmazása a közösség bevonásával katasztrófák idején a közösségi oldalakon keresztül

A 2018-as holt-tengeri villámárvizek példája

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Absztrakt

A történelem során az emberiség mindig is szembesült különböző katasztrófákkal, amelyek nemcsak az emberi életet, hanem az anyagi javakat is veszélyeztették. Éppen ezért szükség volt olyan módszerek kidolgozására, amelyek csökkentik a kockázatokat. A katasztrófa elleni védelem hatékonysága számottevően függ a földrajzi információs rendszertől (GIS) és a kommunikációtól, amelyek az elmúlt évtizedekben gyors ütemben fejlődtek. A katasztrófavédelem fontos eleme a korai figyelmeztető rendszer, amely előre jelzi a veszélyeket az adott földrajzi területen. Régen a korai figyelmeztetést szolgálták bizonyos fokig a vészharangok is.

Napjainkban már a katasztrófa-kommunikációs módszerek egyre hatékonyabbak, az emberek időbeni figyelmeztetése pedig egyre fontosabb. Ez utóbbira számos módszer létezik a katasztrófa típusától, illetve a veszélyek jellegétől függően, amelyekkel külön-külön felelős szolgálatok foglalkoznak. A villámárvizek esetében ismert az internetnek és azoknak az érzékelőknek a jelentősége, amelyek a talajnedvesség mérését végzik, szükség szerint riasztva a felelős katasztrófavédelmi vagy polgári védelmi csapatokat. Szintén elengedhetetlen az adott területen élő közösségeknek az első közötti értesítése, amiben a közösségi hálózati helyek technológiája nagy előrelépést hozott. Az emberek ugyanis elkezdtek fontos, veszélyt jelző tartalmakat megosztani a közösségi hálózati helyeken [Social Network Site (SNS)] élő közvetítéssel, vagy videók, fényképek küldésével rokonoknak, barátoknak és ismerősöknek. Ezeknek a

platformoknak a használata sok esetben hasznos volt a katasztrófavédők számára is, mivel minden érintett figyelmét felkeltették.

Ez a tanulmány a 2018-as holt-tengeri villámárvizek példáján mutatja be az SNS alkalmazásának a hitelességét és megbízhatóságát a korai krízis figyelmeztető rendszerekben. Rávilágít arra, hogy a jordán kormány által kiadott előző napi figyelmeztetés nem volt olyan hatékony, mint az, amikor a figyelmeztetést közösségi hálózati helyeken osztották meg. A súlyos áradások következtében ugyanis az előbbi alkalommal voltak halálos áldozatok is, míg az utóbbi figyelmeztető módszer használata révén nem történt sérülés és haláleset sem. A tanulmány bemutatja a helyi híroldalak és az SNS összehasonlításának és tesztelésének eredményeit a jordán használható korai figyelmeztető rendszer módszere. A kérdőíves felmérésre 650 válasz érkezett, amelyeket különféle statisztikai módszerekkel elemeztünk. A tanulmány a főbb megállapításokat összehasonlítja hasonló témájú, korábbi tanulmányokkal is. Ehhez az egyik legnagyobb bibliometriai adatbázisban, a Scopusban kulcsszavak alapján folytatott keresések szolgáltak alapul, összehasonlítva a tanulmány eredményeit a tíz legjobban idézett dokumentummal. A tanulmány megállapításai, ajánlásai a jordániai polgári védelem, valamint a katasztrófaelhárító szolgálatok számára lehetnek hasznosak a villámárvizek esetén. Továbbá, ösztönzést adhatnak arra, hogy több SNS-csatornát hozzanak létre a közösségekben, hogy időben tudjanak riasztásokat adni, és hogy fokozzák a tudatosságot az ilyen veszélyekkel összefüggésben. A jordán példa más országok számára is tanulságokkal szolgálhat a korai krízis figyelmeztető rendszerek terén.

Kulcsszavak: katasztrófa kommunikáció, korai krízis figyelmeztető rendszer, katasztrófavédelem, közösségi hálózati helyek, villámárvíz, Jordánia

1 Introduction

Floods killed nearly 400,000 people in the last decade and dislocated more than a million according to the disaster reports 2020 (Eshghi–Larson 2008). The same reports claimed that by 2050 it is expected that more than 200 million people will live in poverty in the aftermath of both man-made and natural disasters. One fact about natural disasters every disaster response professional is aware of is that “We can’t stop a disaster, but we can stop the panic”. Thus, disaster prevention and disaster preparedness are the key to reduce the risk of a disaster (de Guttery–Gestri–Venturini 2012). Disaster response is mainly the responsibility of disaster response teams in charge, but still people who live in the affected area of an extreme event and/or a disaster are the first respondents to that event. Citizens involved in the disaster response are considered as “bystanders”; other researchers have named this phenomenon society engagement or community participation in disaster management (de Guttery–Gestri–Venturini 2012; Eshghi–Larson 2008). Society engagement in disaster management helps in saving lives, because community engagement is the real first response to the scene. As it is known that disasters usually are the results of fear and panic, this can be a challenge for the front lines of Civil Protection and Emergency Medical Technicians (EMT) responding to the scene. At the time, it helps creating alert in the community itself (Middleton–Middleton–Modafferi 2014; Seeger 2006). Moreover, disaster response is the main responsibility of the states following the international disaster response laws (IDRL) that have been adopted by the European Union (EU), The Federal Emergency Management Agency (FEMA) and many other emergency and disaster management authorities around the globe (de Guttery–Gestri–Venturini 2012). Disaster management laws result mainly from international laws of environment pro-

tection. These laws have defined whose responsibility it is to warn people using the early warning systems (EWS). Thus, it is the responsibility of the state, yet communities had many ways to alert and warn other community members using lights, fire, ringing a bell, phone calls and more (Yates–Paquette 2011). However, in our digital world, we use smartphones and other digital ways of reaching each other, and social network sites is one example for that. In the context of Disaster communication, studies named this phenomenon Community Engagement in Early Warning Systems (EWSs). The most important element in the disaster management process is Disaster communication or Crisis communication. EWS is one of the parts of crisis communication and the fact that community engagement is a part of EWS is important. Crisis communication depends on the reliability and credibility of information at the time of a disaster because it can make a big difference in the risk reduction operations (Kryvasheya et al. 2016). Moreover, communities have different channels of information, genuine information, and media information. Genuine information is what a human hears, sees and analyzes. Media information can be what the government and press media together are trying to spread over many channels online and offline to the community (Johnson–Kaye 2014). Both types of information (genuine and media) are considered raw data that the community members are circulating among each other. In times of disasters communities share both types of information, and that can be a direct engagement in the early crisis warning system by the community. In some cases there are transboundary effects, which means that the disaster can be in one state and the neighboring state is affected as well (Alexander 2014). This itself can have a direct effect on the international relations between countries in some cases – as we could see through the case of the earthquake in the Turkish Greek area. This situation can be an example of

transboundary effect in the case of natural disasters. Also, in that case we could see how that affected the relationship between the two countries (*Ker-Lindsay 2000*) Previous studies confirmed whose responsibility it is to alert and manage a disaster and we can agree that the communities are always involved in this matter. Also, social network sites are a main player in the case of response and recovery reports (*Gladfelter 2018*). It is relevant, as mentioned, that there are some factors that play a major role in disaster management and the early crisis warning system, which is a part of disaster communication and disaster management. It follows that EWSs can be started by both authorities and citizens of the affected spatial area, and we can conclude that rumors and many factors can affect the credibility and reliability of the information used to feed EWSs. In this study the main focus is on the following questions:

- What is more likely to be more credible and reliable to the community in times of disasters – local news sites or social network sites?
- How the news circulating in the social network sites can affect the early crisis warning system in terms of the community engagement?

Those questions arose because of the study motivation which is to help risk reduction of disasters in the world through a case study of Jordan. What triggered it was the death of 23 children in a school trip to the Dead Sea in Jordan during the November 2018 flash floods. The government had announced the day before how gravely the storm would affect the area of the Dead Sea and its surroundings. However, most of the country were not informed. A week after this crisis, another flash flood struck the area of south Jordan (Petra and Wadi Mousa) and it was even more dangerous but with no casualties and no injuries.

This led to the theory that there was more awareness about the conditions in Petra and the southern area in

general, and even though there were more tourists in the city of Petra, nothing happened. What was the reason? And then I noticed that there were live broadcasts going on in the south area of Jordan on Facebook most of the time, promoting merchandise for sale. In addition, this broadcast happened to share the warning of the flash floods in the south of Jordan.

Therefore, people of Jordan were more interactive with the live broadcasts of the people they knew. This led to more community engagement at the time of disaster. And here was the study problem: how can we improve community engagement and to what degree SNS can improve and affect this engagement? Which is more credible to the community: news sites or SNS?

The aim of the study was to create a channel in the early warning system through the SNS in the Jordanian community. To be able to reach this aim a set of hypotheses had to be developed and they were the following:

1.1 Study hypotheses

H₁ It is more likely that people of Jordan rely on SNS more than local news sites in times of disasters.

H₂ People of Jordan find SNS more credible than news sites in times of disasters.

H₃ SNS have a direct effect on early warning system in the Jordanian community.

1.2 Study model

The study model is one tool to help explain the relationship between the independent and the dependent variables as well as to fully understand the study hypotheses. Therefore, here are the study hypotheses again.

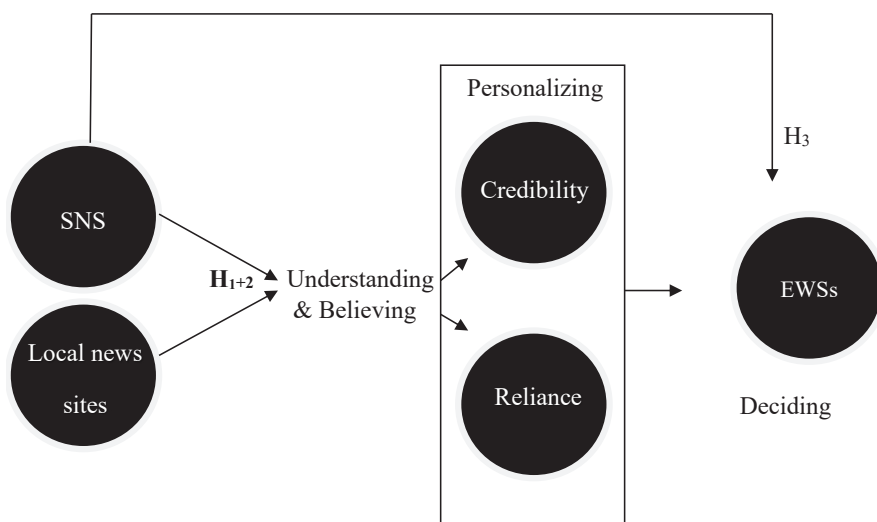


Figure 1 | The study model source
Source: own contribution

2 Literature review

2.1 Disaster, concept, management, disaster communication, EWSs

Disaster: There are quite a lot of expressions for crisis, such as emergency, disaster, or catastrophe (Hiltz *et al.* 2011). According to the United Nations Office for Disaster Risk Reduction (UNISDR 2009) a disaster is a disorder of the operative system of a community or a society at any scale because of a hazardous event that interacts with an exposure probability, leading to one or more of human, material, economic and environmental losses, and impacts. Another definition, that most of the articles involved in disaster management took as more comprehensive, and this definition took into consideration both man-made and natural disasters as well, determines disasters as “events, observable in time and space, in which societies or their larger subunits (e.g., communities, regions) incur physical damages and losses and/or disruption of their routine functioning” (Eshghi–Larson 2008). A disaster can be of several types as follows: small-scale disaster, frequent and infrequent disasters, slow-onset disaster, and sudden-onset disaster. All these kinds of disasters have one general frame of management. The frame is a time-based definition, which has been set according to a review by Lettieri *et al.* 2009. It has been divided into three stages and/or periods: preparedness and mitigation, then response, and recovery (Fig. 2) (Lettieri *et al.* 2009; Henriksen *et al.* 2018; Fischer *et al.* 2016).

Though the definition of disaster management would be the process of organization, planning and implementing of measures preparing (mitigation and preparedness) for, responding to and recovering from disasters, the focus of disaster and crisis management is to create and implement a plan to decrease the impacts of disasters and “build back better”. Failure to create and apply a plan could lead to damage to life, assets, and lost revenue.

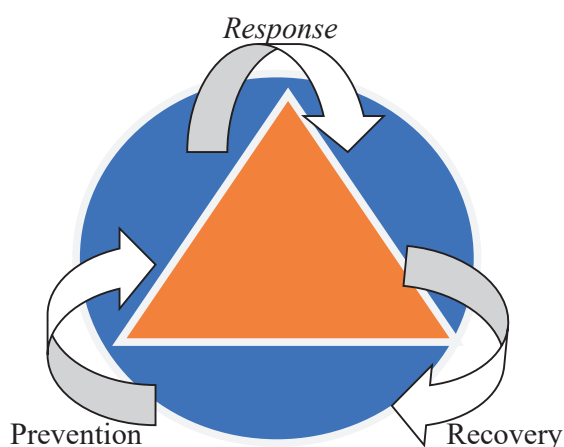


Figure 2 | Disaster management cycle
Source: Eshghi–Larson, 2008

2.2 Mitigation

In terms of disaster management mitigation means reduction or limitation of the adverse impacts of disasters (Kryvasheyen *et al.* 2016). The real aim of mitigation is to draw good risk assessment and prevention plans which can protect the environmental and the social system in times of a disaster and post disaster as well (Fischer *et al.* 2016).

2.3 Preparedness or prevention

It is the plan that ensures how to deal with the unforeseen, through knowing what is needed, to act in times of crisis or disasters. Preparedness requires knowledge and infrastructure, i.e., the responsible authorities must be equipped with the right tools and information to act effectively, to reduce the effects of hazards through effective protective procedures that ensure a timely, appropriate, and efficient establishment and delivery of response and relief actions to achieve the goal, to know how to deal with the aftermath of a disaster, by carrying out thorough investigations. This is a very difficult plan containing long procedures that can take years before reaching a pleasing level, which cannot be done without drills and training too, in a continuous effort all the time (Coppola 2015). Actions and activities are needed in preparedness, the same way as any management element. These actions can be organized into a group depending on the recipient, with governments, professional response and recovery organizations in the first group, and other service agencies, communities, individuals and businesses in the second group. The first group must have the so-called emergency operation plan (EOP); in some countries, it is called crisis special operation, or in Jordan, it is called the higher board of disaster management – this group is known as the creator of the response plan, bolstered through training and exercise. The second group is usually controlled and managed through cooperation with the first group (Coppola 2015; Fischer *et al.* 2016).

2.4 Early warning system (EWSs)

It is a set of capacities which are needed to create, disseminate meaningful, effective and timely warning information and announcements to make to individuals, communities and organizations in a certain geolocation threatened by a hazard; so they will be able to prepare and to act appropriately and in a sufficient time to reduce the possibility of harm or loss of human life and/or property (Gladfelter 2018). This system is considered as one of the disaster management communication methods delivering information to ordinary people. Communication is the main core of the disaster and crisis management during all its elements: planning (mitigation and preparedness), response (act) and recovery, where

this system is one of the key elements of the preparedness, where everything aims to make effective communication which may prevent a disaster or lessen its impact, where ineffective disaster communication may cause a disaster or make its effects worse (Houston et al. 2015). More than ever social network sites are being used in most of our daily life, governments, organizations, individuals, and businesses are using it and it turns out to be a must. Where using SNS in crisis and disaster management also turns out to be more popular in the last few years, one of the important reasons for that is that it did exploit to enhance situational awareness among the community. SNS started campaigns that aimed to describe what to expect from SNS data across a variety of crises (natural disasters, terrorist attacks, etc.) in terms of information levels, types, and sources (Olteanu et al. 2015). This information which is provided by ordinary people on SNS is very useful, timely and relevant during highly forceful and uncertain crises situations. This is how many authors adapted this information to be trustworthy in times of crisis and it can be a basis for decision makers as well not only to inform people affected by the crisis (Li et al., 2015; Olteanu et al., 2015; Saleh-Omoush, 2017; Ellison et al., 2018). Hence, individuals more often tend to find that the distributed content is more accurate and well-timed, which leads to more reliance on SNS for information pursuing, sharing, and commenting in the outcomes of a crisis. In addition, past research has emphasized the importance of relational networks for information transmission during crisis events (Ellison et al., 2018). Also, Jonas, Greenberg, and Frey (2003) proved that most people during terror attacks are provided with information from their personal networks; all this indicates that information flow in times of disasters cannot only come from the governments, people and community have their own channels to exchange information, in which the social network sites have a very major role. Now I will review one of the most important sites that took the crisis as an event that must be shared during a crisis. It is Facebook. And it turns out, this study is focusing more on people's interactions between each other about the ongoing event. Thus, the authorities that act in times of disasters have their own ways to use SNS, extracting geoinformation about the victims or potential victims (Ito et al. 2010), where a number of studies were done by authorities on how to use this information to create an early crisis warning system, which focuses on informing people. Here in this study the focus is on raising the awareness of people. However, this can be addressed by the theories of disaster sociology which confirm that community engagement in the event of disaster is within a four-step evaluation process when they receive alert and warning messages: understanding, believing, personalizing, and deciding (determining appropriate action) (Mileti-Sorensen 1990).

3 Methodology

This study is considered as an analytical descriptive study, exploring and clarifying which is more credible to the Jordanian community in times of disasters: local news sites or social network sites content?

This study relies on the method of social survey. Within this approach, the methodology is surveying the public internet users to collect data and analyze it by using a questionnaire; it was used electronically through Google forums on a random sample of internet users from the Jordanian society, a small amount of money was offered as an award to five randomly selected questionnaires to encourage more people to fill it in, the prize was 10 JOD for 5 (in case of providing contact information), with the help also from one local newspaper. A similar procedure was used in other published articles concerned about election campaigns (Johnson-Kaye 2014; Sutton et al. 2014) where these articles had also tested the credibility of SNS for political attitudes. The data were collected and then they were analyzed using descriptive and indicative statistical methods with the software SPSS v.24, to answer the study questions and to test their hypotheses. After finding the results of the study a bibliometric analysis was conducted using the Scopus database to discuss the results of the study with related studies, using the study keywords as the search keywords to find the top ten cited documents.

3.1 Study population

The targeted population of this study is the SNS users among the Jordanian society. The number of Internet users in Jordan in 2018 reached about 6.6 million among the population according to the Jordanian telecommunication regulatory commission 2019. To reach this sample an online survey had to be posted and shared on SNS for 4 weeks. Most of it was posted in the groups that most of the Jordanians use like the market place for Jordan, Ask Jordan, Jordanian universities Facebook groups, it was also sent via WhatsApp to more people, where the author believes that the people above 45 years of age use WhatsApp more than other SNS. The second survey was distributed in the public sector and some companies of the private sector. That survey was posted on 1 November 2018 five days after the Dead Sea flush floods crisis / Jordan. A similar procedure was used in other published articles concerned about election campaigns (Johnson and Kaye, 2014) where these articles had also tested the credibility of SNS for political attitudes.

3.2 Study sample

The final sample of the study consisted of 651 respondents, who answered the questions of the questionnaire that were applied electronically via Google forums and through hard copy ones, sent to the targeted sample,

after implementing several methodological steps as the following:

First: a random sample was assigned out of the core study sample; 50 people were chosen to identify if there is any problem in implementing the study tool electronically, in order to avoid and solve these problems in the final implementation. A statistical analysis was conducted to verify the psychometric properties to ensure the validity and reliability of the tool. The control sample of 50 respondents were excluded from the study results and analysis and it was used only for control.

Second: after making sure of the validity of the study tool, the author distributed the study tool for four weeks. After collecting the responses, a review, and a check was done and 18 samples were excluded for lack of some answers. *Table 1* shows the personal breakdown of the study sample.

3.3 Study tool objectives

Part I: Personal characteristics of study sample (Gender, Education level, Age).

Part II: Contains 6 questions to measure to which extent the community members rely on SNS or news site at the time of a disaster.

Part III: Contains 6 questions to measure the credibility of SNS and news sites as a local news source at the time of a disaster.

Part IV: Contains 6 paragraphs to measure the effect of SNS on early crisis warning system.

3.4 Study tool stability

The study tool stability was verified calculating the coefficient of Cronbach's alpha by relying on the results of the 50-people control sample. The stability coefficients are shown in *Table 2*.

As shown in *Table 2* the study tool has a high degree of consistency, using Cronbach's alpha; where the coefficient for the overall of the tool was 0.937 and for the test fields the range was between the values of 0.882–0.913. After applying the tests, the tool paragraphs were reliable to be 18 paragraphs: covering the mentioned three main fields.

3.5 Statistical methods

This study processed the data which were extracted from the study tool using SPSS v.24, where the variables and paragraphs were coded. To answer the study questions in order to achieve the study objectives the following statistical methods were used:

1. Descriptive Statistic Measures to determine the study sample's estimates level in the study fields and paragraphs, standard deviations were calculated to clarify the dispersion of estimates.

Table 1 | Study sample personal breakdown

Variable	Categories	Number	Ratio (%)
Gender	Male	369	56.68
	Female	282	43.32
	Total	651	100
Education level	Secondary school or below	70	10.75
	Diploma	102	15.67
	BA	378	58.06
	Master or PhD	101	15.51
	Total	651	100
Age	Under 18	65	9.98
	18–25	165	25.35
	26–35	180	27.65
	36–45	143	21.97
	Above 45	98	15.05
	Total	651	100

Source: own calculations

Table 2 | Stability coefficients of the study tool

Field	Number of paragraphs	Cronbach's alpha
Reliance on SNS and news sites as local news sources	6	0.913
The credibility of SNS and news sites as a local news source	6	0.882
The effect and role of SNS in the community early crisis warning system	6	0.898
Overall	18	0.937

Source: own calculations

2. Pearson correlation coefficient.

3. Cronbach's Alpha.

4. (One-way ANOVA).

5. Multiple regression analysis.

What is more likely to be more credible and reliable to the community: local news sites or social network sites at the time of a disaster?

How the news circulating in the social network sites can affect the early crisis warning system in terms of the community engagement?

4 Study Results

In this section we can find the results of the statistical analysis which led to answering the study question and testing the study hypotheses. Here we can also find how the statements of the study tool were related to each factor of the study model presented earlier.

Table 3 | Arithmetic averages, standard deviation, and the level of the arrangement of the study sample estimates the extent of the reliance on SNS and news sites as a local news source

Paragraph No.	Paragraph	Mean	Standard deviation	Ranking	Level
2	I Browse local news on news sites to see the latest news and updates	4.006	1.08	1	High
6	I believe that the news sites are the most widely used for local news compared to other media	3.868	1.15	2	High
4	I believe it's possible to get local news from SNS only without going back to the news sites	3.359	1.22	3	Medium
3	I browse local news on SNS to learn about the latest events in the community	3.320	1.34	4	Medium
5	I believe that it's possible to get local news only from news sites	3.258	1.25	5	Medium
1	I use SNS to follow up with the daily news and events in the community	3.031	1.05	6	Medium

Source: own calculations

4.1 Results in accordance with RQ1 in terms of reliability

RQ1 – What is more likely to be more credible and reliable to the community? Local news sites or social network sites in times of disaster?

In this regard people in the study sample were asked to respond to these statements by using the Likert scale – in *Table 3* we can see those statements that were translated from Arabic. The statements in *Table 3* are meant to discuss the reliability of SNS and local news as an information channel to the community.

Table 3 shows the average mean and the standard deviation of the study sample estimation towards relying on SNS or local news. Therefore, if we compare the means of the statements that support the SNS, and the ones that support the local news in terms of reliance we can find that the sample relies more on the local news sites. However, this is only in terms of reliance but when

we take a look at the study model in *Figure 1*, we can see that there are 4 factors the study adopted from the four terms of disaster psychology cycle that shows how people believe and trust, then personalize and decide, but more importantly, what to share and what not to share as this study suggests. In this regard indeed, the people rely more on local news but still the differences between the estimations to local news and SNS are relatively close to each other. Therefore, the study sample estimates indicated that the reliance is more on the local news websites.

4.2 Results in accordance with RQ1 in terms of credibility

In *Table 4* we can see the statements that were asked to agree with or not in the study sample, using the Likert scale to measure the credibility of each SNS and local news sites.

Table 4 | Arithmetic averages, standard deviation and the level of the arrangement of the study sample estimates for the credibility of SNS and news sites as a local news source

Paragraph No.	Paragraphs	Mean	Standard deviation	Ranking	Level
1	I believe that local news on social media sites is comprehensive in media coverage of events and facts.	3.868	0.93	1	High
5	Broadcasting live on Facebook and/or Instagram provides the real situation about the event scene.	3.830	1.15	2	High
3	People's interaction with local news of news sites contribute to giving confirmation or denial of news.	3.821	1.26	3	High
4	I follow the local news published by the known and influential persons in the community on their SNS accounts and I find it more credible than others.	3.685	1.32	4	Medium
2	SNS Local news is objective and neutral.	3.419	1.11	5	Medium
6	I believe that the live broadcast of my friends on SNS about the ongoing event is more credible and I rely on it more than the news sites ones.	3.130	1.31	6	Medium

Source: own calculations

The results of analysis that *Table 4* is showing are related to the credibility of SNS and local news. Moreover, the paragraphs as you can see above *Table 4* are either medium or highly related according to the importance of relevance. And if we read the statements number 4, 2 and 6, we can conclude that the credibility ratio is more into SNS compared with local news sites. We can define the reason behind it that the engagement with the news in SNS is possible and can affect the choice of believing the news or not, after the understanding of the news. However, this led us to the second element of disaster psychology “believing”, and then, if we look at statements number 1, 3, 5 and 4, we can see that the interaction provided by people can increase the degree of credibility. It also can confirm or reject that information. Moreover, we can see that the live broadcast of news on SNS like Facebook live is informative and can give instant feedback to the publisher and the viewer as well. This can illustrate the process of believing then personalizing which came after the understanding and believing.

4.3 Results in accordance with RQ2: the relation of SNS in EWSs

RQ2 – How the news circulating in the social network sites can affect the early crisis warning system in terms of the community engagement?

Again, defining this stage based on the disaster psychology is based on the deciding which means determining the proper action in regard to the information. In this study the discussion is about how much this deciding can affect the EWS. We can see in *Table 5* the statements aimed at the EWS and the effects of SNS on that.

Table 5 shows the results of the estimates of the participants in the sample about the overall level of SNS role in the community early warning system, with a 3.789

mean and a standard deviation of 0.67. Moreover, the correlation between the paragraphs in the table reflects the importance of relevance between each paragraph (study tool) and the variable those paragraphs are associated with. The results showed that the standard deviations of the estimates of the study sample values on the paragraphs of this area ranged from 1.39 to 0.86 indicating a convergence in the study sample’s answers to the paragraphs of this area.

4.4 Hypotheses testing

This section is a demonstration of the study results and hypotheses testing.

H₁ It is more likely that people of Jordan rely on SNS more than news sites at the time of disasters.

H₂ The people of Jordan find SNS more credible than news sites at the time of disasters.

H₃ SNS have a direct effect on the early warning system in the Jordanian community.

4.4.1 Testing *H₁* that states: It is more likely that people of Jordan rely on SNS more than news sites at the time of disasters This hypothesis has been tested using one-way ANOVA as shown in *Table 6*.

Table 6 shows the results of the regression analysis testing the first hypothesis of the study. The calculated *F* value was 28.33 at freedom degrees of (1), which is a statistically significant value at significance level $\alpha \leq 0.05$; the results in the table show that the independent variable – Reliance on the SNS and news sites as sources for local news – explained 31.6% of the variation in variable of ‘The role of SNS in the early crisis warning system’, moreover, this is showing the impact of the reliance on SNS and news sites as local news sources in the early crisis warning system.

Table 5 | Arithmetic averages, standard deviation, and the level of the arrangement of the study sample estimates for the role of SNS in community early warning system in the Jordanian society

Paragraph No.	Paragraphs	Mean	Standard deviation	Ranking	Level
1	I believe that posting warnings on SNS regarding crisis and disasters help create ways in risk reduction	4.030	0.86	1	High
2	Posting news about crises and disasters on SNS to increase the awareness of the individuals to take appropriate precaution to ensure their safety and the safety of their properties	3.983	1.17	2	High
6	Posting on SNS about ongoing and/or upcoming crisis or hazard helps reducing the time of warning	3.834	1.17	3	High
3	Posting on SNS helps to deliver the message of “how dangerous the crisis is” for a huge group of the society	3.749	1.26	4	High
4	I believe that posting news about the crisis and disasters on SNS helps to communicate with the responsible decision makers and crisis management	3.722	1.39	5	High
5	Posting related issues to crisis and disasters help measuring the society opinion regarding crisis management	3.413	1.12	6	Average
-	The overall level of the role of SNS in the community early crisis warning system	3.789	0.67	-	High

Source: own calculations

Table 6 | Testing H₁ using ANOVA

Sample	Sum of groups	Df	Mean square	F value	F sig
Regression	18.640	1	18.640	28.33*	0.00
Residual	428.3	649	0.66	–	–
Total	466.9	650	–	–	–
(R ²) R Square	0.316				
(R ²) Adjusted R Square	0.322				

* Statistical significance level ($\alpha \leq 0.05$)

Source: own calculations

Table 7 | Testing H₂ using ANOVA

Sample	Sum of groups	Df	Mean square	F value	F sig
Regression	21.15	1	21.15	32.2*	0.00
Residual	425.7	649	0.65	–	–
Total	446.9	650	–	–	–
(R ²) R Square	0.366				
(R ²) Adjusted R Square	0.361				

* Statistical significance level ($\alpha \leq 0.05$)

Source: own calculations

4.4.2 Testing H₂ –The people of Jordan find SNS more credible than news sites in time of disasters.

Table 7 shows the results of regression analysis testing the first hypothesis of the study. The value of the calculated *F* was 32.2 at freedom degrees of (1), which is a statistically significant value at significance level $\alpha \leq 0.05$. The results in the table show that the independent variable – Credibility of the SNS and news sites as local news sources – explained 36.6% of the variation in variable ‘The role of SNS in the early crisis warning system’, moreover, this shows the impact of the credibility of SNS and news sites as a local news source in the early crisis warning system.

4.4.3 Testing H₃ SNS have a direct effect on early warning system in the Jordanian community.

Accepting the first two hypotheses of the study can drive to the conclusion that people who use SNS to spread the news to warn people can be classified according to their personal characteristics (age, education, and gender). In this regard, without the necessity to conduct any test, it is approved by the previous studies that the younger generations intend to use SNS more in their lives but when it comes to the variables of education and gender it might be different from one community to another. Therefore, to test this theory another theory was set that there is a relationship between the SNS news and the early warning system but it also depends on the per-

sonal characteristics of the study sample and the extent it represents the Jordanian community. Answering the third hypothesis of this study, at first the mean has been calculated for the answers of the study sample regarding the level of only reliance on the SNS and news sites as sources for local news according to the difference in personal characteristics of the study sample in Table 1, and then one way ANOVA statistical test was carried out, which is shown in Table 7. There we can see that accepting the first two alternative hypotheses of the study we can confirm that SNS has a direct effect on early warning system in the Jordanian community, knowing that personal characteristics affect this as younger people tend to use SNS more than the rest in the community.

5 Discussion

In this part the study is going to compare the former studies which have discussed the issue of community engagement during a disaster and especially at the time of warning when a disaster hits. For these studies the information on the internet and disaster response laws are very wide and much more extensive than can be discussed in one study. Therefore, this study has followed the method of bibliometric analysis to identify the most important studies in this regard which are mostly cited on the topic areas.

In this regard it means all studies related to this study’s variables have to be discussed, yet this study will take only two databases and only the top twenty documents. At the beginning I have set a different keyword to express the study variables, which are community engagement at the time of a disaster, SNS, SNS use at the time of a disaster, disaster management in the context of social media, reliability of SNS, and credibility of SNS. Then I used the advance search query in both the Web of Science and the Scopus databases, using the related keywords mentioned above. The time span of the search was 1960–2018. And the result of the search was more than 3,000 documents on both sides. Then the excel file with the documents was analyzed using the software Vos viewer to create mapping and to find the top cited documents related to the study variables.

After reviewing the database findings, a systematic literature review was carried out to reach for the core information to answer the study questions and test the hypotheses during the discussion relying only on the top twenty documents comprised of both top ten in Scopus and top ten from WOS.

Using this method was popular among authors to identify the core information and in Table 8 we can see the top ten documents (book, book chapter, journal article, conference article, etc.)

In Table 8 we can see the top cited articles in the database of Scopus. Those articles have discussed the early warning system, community engagement in the crisis response and using SNS by the authorities to act during a

Table 8 | Top ten cited documents on Scopus database

Ref In cite	Document title	Number of citations	Links
(Imran et al. 2015)	Processing social media messages in mass emergency: A survey	493	22
(Houston et al. 2015)	Social media and disasters: A functional framework for social media use in disaster planning, response, and research	441	24
(Oh et al. 2013)	Community intelligence and social media services: A rumor theoretic analysis of tweets during social crises	427	19
(Kryvasheyev et al. 2016)	Rapid assessment of disaster damage using social media activity	345	4
(Kim-Hastak 2018)	Social network analysis: Characteristics of online social networks after a disaster	326	4
(Alexander 2014)	Social media in disaster risk reduction and crisis management	309	21
(de Albuquerque et al. 2015)	A geographic approach for combining social media and authoritative data towards identifying useful information for disaster management	254	14
(Simon et al. 2015)	Socializing in emergencies - A review of the use of social media in emergency situations	241	13
(Charles-Smith et al., 2015)	Using social media for actionable disease surveillance and outbreak management: A systematic literature review	212	2
(Reuter et al. 2018)	Social media in crisis management: An evaluation and analysis of crisis informatics research	184	8

Source: Own contribution using Scopus database

disaster. In those studies, we can see that the majority of it were conducted using Twitter. Also, we can see that the first official use of SNS at the time of a disaster response was by the Americans during the Haiti earthquake. In this regard the software which was used is related to Microsoft office applications. This application is not considered as a SNS in some studies. Therefore, the study about the Haiti earthquake is not considered as a good example, however, this software was used to share the information between the authorities to help in responding to the crisis (Middleton et al.; Yates-Paquette 2011). Other studies were discussing the credibility of the information shared on SNS during a crisis by the authorities who were responding.

What is expected to be found here is the findings of the study that used three hypotheses which were already mentioned in the statistical results part of the study. The findings of this study cannot be generalized, either related to the Jordanian or any other society, for certain reasons that had been already mentioned and referenced earlier in the study. Thus, these results came according to the estimates of the study sample which included 651 people from the SNS users in Jordan from different geographic areas among the kingdom, where – according to TRC in Jordan – more than 60% of the population are using SNS through smartphones, etc. Following the results, the author is going through a discussion with a former study that went through a review of one and/or more variables of the study, explaining how the variables are differing from one another. Here is each one and a quick review of the findings without the numbers that could be found in the statistical results earlier.

The hypothesis which was discussed was testing the credibility of the local news from both news sites and SNS. Credibility term in this study meant to explain how the study sample believe and react to one topic, where the element of credibility that has been taken into consideration was the believability and depth of the information, unlike in other studies that went through fairness and other criteria (Johnson-Kaye 2014). Then after the local news from both SNS and news sites, the study went through the effects of SNS on the crisis early warning system. This was discussed by using the differences of the personal characteristics. The study also found out that the SNS users in Jordan are more likely to use Facebook, WhatsApp, Instagram for social networking and the following graph shows in detail which Apps are being used and to what percentage (Fig. 3).

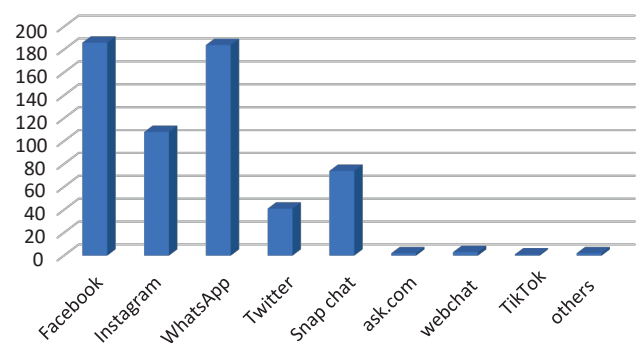


Figure 3 | SNS used by the study sample representing the Jordanian society.

Source: own contribution

In the study tool there was a question “which one of the SNS Apps are you using?”, with choices left to be filled in and empty fields also provided for others. The answers show that 88.10% of the participants in the study sample said that they are using Facebook more than any SNS App, to keep them posted about everyday life events and feeds, for Twitter the percentage was 18.60% in the Jordan community but in other studies in Canada and US 43% are using Twitter (Sutton *et al.* 2014; Maier *et al.* 2015).

This study also shows that WhatsApp is highly used by the Jordanian community and in most cases links from YouTube and Facebook are being shared through it. This application actually belongs to WhatsApp Inc. (www.whatsapp.com) and this firm is one of the Facebook companies’ chain. The percentage of the users was high, with 87.10% of the study sample.

One important issue that the study is discussing is interaction. People started to interact with the news more than ever on SNS. This can deliver the message of “how much the hazard can harm you?” In this study the question “Posting news about crises and disasters on SNS to increase the awareness of the individuals to take an appropriate precaution to ensure their safety and the safety of their properties” had a mean of 3.983 and standard division of 1.17, which is high and can be explained as interaction can result in awareness as also shown by former studies. SNS platforms are being used by consumers such as sites of content sharing, wikis, social networking, and blogs to discuss, share, modify and create the content of the Internet. In a research study (Kietzmann *et al.* 2011) it is shown that SNS can allow people to interact with posts, news or other, and it can raise awareness. This can make a big difference at the time of a crisis where a huge number of people underestimate the hazard and do not leave their homes and/or take with them their properties that can result in losing lives.

5.1 Credibility and reliance

One important thing that this study also found out and aimed to discuss when the study tool was used is how much the new live broadcasting option that Facebook, Instagram, and Snap chat are offering made everyone nowadays a reporter using a smartphone. Participants of the sample addressed with the following statement: “I believe that the live broadcast of my friends on SNS about an ongoing event is more credible and I rely on it more than the news sites ones” had a mean of 3.130 and standard division of 1.31, which is still medium. Also, the author assumes that at the time of a man-made crisis and/or terror attacks this can make a big difference. More and more consequences can occur which can provide information for the attackers, sometimes people are broadcasting live through their phones, while police and/or responsible authorities operations are ongoing. Broadcasting live, on the one hand, can cause harm or

leaking of information, but on the other hand, people trust live sharing from those they know as “real life friend” more than they believe news channels. Other studies showed that more than 20% of SNS depend and rely on friend’s feeds for news more than news sites. Among students and within the age category of 18–25 people are more likely to find their known friends’ feeds more credible (Laranjo *et al.* 2015).

5.2 The role of SNS in early crisis warning system

The study found out that among the sample of the study population, 651 respondents think that SNS plays a major role in the crisis early warning system. The personal characteristics were taken into consideration to relate which group could be more interested in sharing disaster risk reduction related topics on SNS. In this way we aim at that specific group to share with if any scenario occurs. Thus, many studies found that the SNS has very deep effects on the disaster and crisis management (Sweetser–Metzgar 2007; Latonero–Shklovski 2011; Wu–Cui 2018) as using social media information is faster and more effective than using satellite images and maps (Annamalai 2014) to decide whom to be warned. This huge amount of information is very useful and the best thing about it is that you are aware of who there is, so they can be your first contact to make decision. Hence, as already mentioned, the study found that males, bachelors and post-graduates aged 45 and older were more likely to depend on both SNS and news sites as a credible local news source.

6 Conclusion, recommendations, and limitations

To conclude, the study examined the reliability and credibility of SNS comparing it with the local news agencies from the point view of the community in Jordan. According to the TRC and the number of SNS users in Jordan we cannot generalize the results of the study on the Jordanian community in regard to the geographic sample that the it covers. We cannot confirm the online sample which is about 200 respondents. Still, we can conclude the degree of reliability and credibility of news. This study used the disaster psychology accepted of EWS or the reaction of the community at the time of a disaster in regard to the information. This model of four factors was distributed on the stages of disaster management process and/or cycle, as we can see in the study model. According to the facts of disaster sociology it appears that there is a process of processing news in the study sample. The study sample estimations suggested that there is an effect from the SNS on the EWS and we can also find out that the reliance on local news sites had a higher mean according to the statistical analysis of the

primary results of the study, knowing that the difference between the means is not high. Thus, the estimates of the study sample approved the study hypothesis Number 2. In this study the effect of SNS on EWS was the main question but the study variable was directed at testing the reality and credibility of the information. There are different studies on the topic of effects of SNS on the EWS but all those studies in 2005–2018 discussed the EWS and SNS yet only few studies discussed the fact that there is a degree of reliance and credibility on SNS in times of disasters, comparing it with local news agencies. Also, some other studies discussed the effect of rumors and the false info on the credibility of the SNS. *Table 8* was extracted from other studies using both databases of Web of Science and Scopus. The study relied on an online survey and hard copy survey as well, for the social network sites users in Jordan to examine how people in Jordan rely on social network sites for local news, where at the beginning of the study the author explained the relationship between that and the circulation of news among the society, which leads to the impact of creating an early crisis warning system. Choosing the online method of collecting data was helpful, since it became a popular way to gather information (*Johnson–Kaye, 2009*). This study followed the same authors who had been followed in previous studies (*Johnson–Kaye, 2009, 2015; Johnson et al. 2014*). After the literature review, which focused on going through the studies that discussed the use of the social network sites in the news industry, and the context of the social network sites in crisis and disaster management, preparedness pre-crisis and disaster management, where the author took one part of the preparedness, which is the early warning system, and where this system can take many different forms. The form that this study tackled was the community warning system, to alert people who are in the circle of hazard impacts to be aware of the ongoing event, so prevention can be achieved in a maximum way to assure risk reduction for lives and also property. The study asked three main questions to be answered. After that, I went to test three hypotheses which were generated from these questions. The questions were the following:

RQ₁: What is more likely to be more credible and reliable to the community? Local news sites or social network sites in times of disaster?

RQ₂: How the news circulating in the social network sites can affect the early crisis warning system in terms of the community engagement?

After using the study tool (questionnaire) with a process that had been explained in the methodology and analysis chapter earlier, this tool consisted of three main parts and every part had 6 paragraphs and/or questions. The results of the statistical analysis were that all the paragraphs showed either medium or high mean according to the relevance of importance; the results showed that the standard deviations of the estimates of the study sample values on the paragraphs of this area ranged from

1.05–1.41 for the first research question, while the second was 0.93–1.31 and the third was 1.26–0.86, showing that all the paragraphs were homogeneously related to the importance of the field itself. In other words, the paragraphs were related to the questions expressing the logic of the author's ideas that it can fill the gap which has been brought up from the former studies.

The hypotheses were tested using statistical methods which were explained in the methodology section earlier, where it resulted as accepting all the study hypotheses which were applied on the study sample of 651 respondents representing the social network sites users in the Jordanian community. After testing the hypotheses, the author went through a review of the findings and discussion and down below is the study recommendations, limitations, and suggestions for further studies.

6.1 Recommendations

After answering and explaining the questions, testing the hypotheses, the study recommends the following:

- In the discussion of former studies on using the SNS to create EWSs it could be noticed that SNS was first used in the disaster response field by the Americans during a Haiti earthquake to manage the teams and giving the ability to produce the information between the team and other rescue teams also involving the community. The software used is related to the Microsoft office applications. Other cases we can see in the former studies dealing also with the USA disasters and crises where FEMA have used Twitter to share imagery that could play a role in spreading the awareness between the community of one area of a disaster and other areas that could be risked by hazards, for example in the case of the Katrina hurricane. But in this study using the live broadcast on Facebook can be a good tool to achieve more interaction within the community, using the live broadcast by a community member in collaboration with the civil defense can help the community spreading the awareness. The use of the live broadcast by a community member is required because people in the sample have confirmed that they tend more to believe the news of a person known to them. A similar case was in the USA when FEMA started to use Twitter, they noticed that the people had interacted with the news more than what could be seen in the case of local TV or local newspaper. In this regard I recommend that the civil protection teams in Jordan should focus on appointing a disaster management community member who can share live videos or imagery that can spread awareness.
- In the other matter of the reliability and credibility of the information that is being spread it can be approved with the study results that people are more likely to find the info shared by a known community member more credible, but is it actually more reliable? Therefore, the study recommends that there are assigned

community members of the civil protection teams to the graphic data as well as to all the data that can be effective in the disaster management. And more importantly that those members are announced by the civil protection and it is ensured that they have the information they need from the right authority, which can be reflected in the reliability of the information. As we can see, the results of the study highlighted how the local news is more reliable but less credible compared with SNS in the Jordanian community according to the sample estimation.

- One thing that can always be successful in risk reduction is training, where it is proved that a trained person can act in a systematic way to assure the smooth and successful operations in the disaster management cycle. Therefore, it is recommended that the assigned community members have training on how to spread the information within the civil protection teams. The community members training also should focus on the quality of the content which they will share in a way to help EWSs and to minimize the panic in the community caused by a disaster. As we can see in the answers of the second study question and testing the hypotheses of the study it is noticeable that people tend to believe what others they know personally are sharing online. This can lead to more awareness if those people were recognized by the civil protection as well as the social media by the certified badges we can see on Twitter and other social networking.

6.2 Limitations

This study relied on an online survey of the SNS users in Jordan and a hard copy survey. The hard copy was distributed among public sector and private sector employees as well as users to examine the degree to which SNS were judged as credible. Using an online survey became an increasingly popular and effective way of data collection, however, it cannot be said that such online polling results in a random sample. This study used two ways to promote the survey. The first one, which was offering a small award of 10 JOD to five randomly selected respondents in case they provided optional contact information. With the second one, the author contacted two electronic newspapers to help to post the survey, and the number of online respondents was expected to be higher, but it was only 208 people in four weeks and the rest of the 651 used the hard copy questionnaire. The number was low because

- Facebook prevents the users from sharing the survey considering it as against their advertisement policy, and they took it as spam and everyone who was sharing it was blocked for 24 hours; the author contacted Facebook but received no helpful response.
- People were not cooperative in filling in the survey for reasons and replies were sent to the author that everyone thought if they filled in the answers to the ques-

tions they would be punished as they mentioned and thought that “this survey contains hidden agenda”.

- Some people did not agree to fill it in for an emotional reason relating to the victims.

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