Safety & Defense 9(1) (2023)
DOI: https://doi.org/10.37105/sd.197

Evaluating approaches to wartime mass evacuation management in eastern NATO territories: a literature review

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Received: 05 June 2023 | Revised: 02 August 2023
Accepted: 17 August 2023 | Available online: 18 September 2023

Abstract

The eastern flank of NATO has been a region of strategic importance due to its proximity to Russia. Moreover, tensions have escalated in recent years following Russia's annexation of Crimea and military intervention in Ukraine. As a result, questions have emerged regarding the preparedness of NATO's eastern flank in the event of a military conflict. One critical aspect of preparedness is the ability of its inhabitants to move and relocate to safer areas during a crisis. This article provides a comprehensive literature review on the mass evacuation of civilians, focusing on the spatial mobility of residents of NATO's eastern flank in the event of a military conflict on their territory. It delves into the availability of transportation infrastructure and the supply of resources for relocation, factors crucial for spatial mobility during military conflict. Additionally, the article explores the potential impact of critical infrastructure destruction and the complex behavioral issues affecting evacuation. The study's findings reveal that both logistical and human factors must be considered in evacuation planning, contributing to

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the state of the art in this field. The implications of this work reach beyond immediate preparedness strategies, suggesting the need for a holistic approach that combines infrastructure development, resource allocation, human behavior understanding, and international coordination. By highlighting these nuances, the article offers valuable insights that may inform policymakers and practitioners in developing more effective, resilient strategies for managing mass evacuations during times of crisis, reflecting broader concerns about regional security and humanitarian response.

Keywords: conflicts; crisis management; mass evacuation; NATO's eastern flank; war

1. Introduction

In today's intricate socio-political landscape, international security is under profound influence. As emphasized in the World Economic Forum Report (2013), it's essential to perceive resource quantity and distribution within the broader context of societal utilization (*Global Agenda. World Economic Forum Annual Meeting*, 2013). Particularly in developing nations such as Ukraine, spatial distribution becomes a paramount concern given the existing adversities, including economic hardship, social strain, and political and economic volatility. This isn't just a domestic matter; security plays a globally significant role, weaving into the fabric of international peace and societal stability. The intersection of societal structures and security dimensions opens up a novel, evolving research area, considering the profound role these complex security elements will play in shaping global peace and stability (*Global Agenda. World Economic Forum Annual Meeting*, 2013). These multifarious pressures could lead to instability, conflict, unrest, and insecurity, thereby severely challenging global security and stability in the early years of the 21st Century (Council, 2012; OSCE, 2003; Simion and Su]. Moreover, they could potentially incite not only economic duress but also societal instability, intensifying existing interstate tensions and disagreements that might serve as ignition points for devastating wars (Simion and Surdu, 2014).

In this context, the eastern flank of NATO has been a region of great strategic importance for many years, given its close proximity to Russia. However, tensions have increased in recent years due to Russia's annexation of Crimea and military intervention in Ukraine, which have raised concerns about the readiness of NATO's eastern flank in the event of a military conflict. One crucial factor in preparedness is the ability of inhabitants to move and relocate to safer areas during a crisis.

The spatial mobility of inhabitants is crucial to ensuring the safety and security of civilians and can play a critical role in determining the outcome of a military conflict (Gotkowska and Szymański, 2017; Sokolsky, 2017). However, limited research has been conducted on the spatial mobility of residents of NATO's eastern flank in the event of a military conflict on their territory (Biziewski, 2019; Gotkowska and Szymański, 2017; Lepik and others, 2009).

The availability of transportation infrastructure is a crucial factor in the spatial mobility of residents during a military conflict. The transportation options available to inhabitants of the region include personal vehicles, public transportation, and rail systems (Tseng et al., 2005). The presence and functionality of transportation infrastructure are essential for enabling residents to move and relocate during a military conflict. However, transportation systems can be disrupted in the event of a military conflict, limiting the ability of inhabitants to move and relocate (Nipa et al., 2023; Rutner et al., 2012). The destruction of critical infrastructure can have a significant impact on the mobility of inhabitants in the region (del Romero Renau, 2018; Drozdzewski et al., 2016; Fuhs, 2008).

In addition to transportation, the availability of resources for relocation is also a critical factor affecting the spatial mobility of residents during a military conflict (Rodriguez et al., 2006). The residents may face challenges in securing essential resources such as food, water, and shelter when relocating to safer areas (Khorram-Manesh et al., 2021). The destruction of critical infrastructure can limit the availability of resources, making it challenging for inhabitants to relocate (Linnenluecke and McKnight, 2017). The presence of resources for relocation is critical to the ability of inhabitants to move and relocate in the event of a military conflict ('Handbook for Emergencies', 2007, 'Natural Disasters: Coping with the Health Impact', 2007, 'UN-CMCoord Field Handbook', 2015). To address these issues, it is essential to develop comprehensive plans for the mass evacuation of civilians in the event of armed conflict and to prepare (educate) the population for the need to evacuate.

This article reviews literature in the field of mass evacuation of civilians and provides recommendations for NATO countries for the management of the evacuation process. The mobility patterns of inhabitants of NATO's eastern flank region have been explored, including their ability to move and relocate to safer areas, access to transportation, and the supply of resources for relocation. Additionally, the potential impact of the destruction of critical infrastructure and the behavioral issues of people taking part in a mass evacuation have been examined.

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2. Materials and Methods

The study employed a rapid evidence review approach, which involved a combination of a systematic literature search and a non-systematic literature review. This method enabled the researchers to provide an overview of the current state-of-the-art research, even in the absence of quantitative outcome data in the reviewed literature (Haby et al., 2016). Additionally, the study utilized content analysis to identify similarities and differences in the findings across all included articles, thereby enhancing the reliability of the results (Stemler, 2000). Initially, the electronic search model was designed to search for relevant literature in English using PubMed, Scopus, and Web of Science databases, with the following search terms: war, conflicts, mass population, evacuation, alone or in combination.

The search was limited to English-language literature, and all original publications and literature reviews were included, while proceedings, editorials, meeting notes, news, abstracts, and irrelevant papers were excluded. The study involved a qualitative analysis of the included literature (Figure 1).

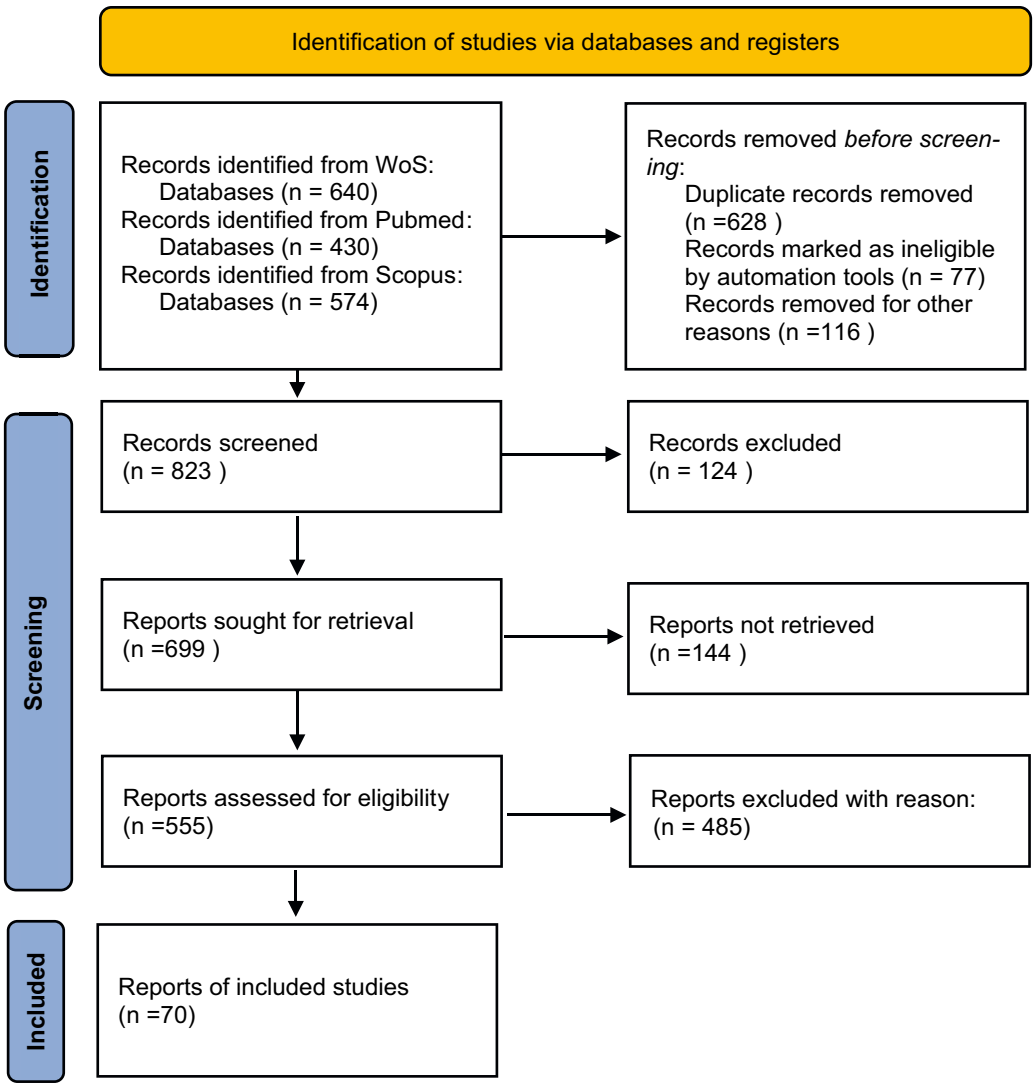

Figure 1. Flow Diagram of Literature Selection Process
Source: Moher et al., 2009.

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3. Results

The results of the search are shown in Figure 1 as a flowchart. A total of 90 studies were included studies. All the information was categorized and qualitatively evaluated. Using content analysis, the following topics were found and described below:

3.1. Mobility patterns of inhabitants of the NATO's eastern flank region

Recent studies have shed light on the mobility patterns of inhabitants of the eastern flank region. One study conducted in Poland found that the most common mode of transportation for daily commuting is the car, with public transportation and cycling being less common. The study also found that commuting patterns are largely influenced by factors such as distance, employment status, and income (Biernat et al., 2018).

Another study conducted in the Baltic states found that mobility patterns are influenced by a range of factors, including urbanization, employment opportunities, and cultural and social norms. The study identified a trend of urbanization and a shift towards private car ownership in the region, which has resulted in increased traffic congestion and air pollution (Antrop, 2000).

These studies highlight the importance of understanding the mobility patterns of the inhabitants of the eastern flank region and the factors that influence their transportation choices. Effective transportation policies and strategies should take into account these factors and aim to promote sustainable and efficient transportation modes, such as public transportation and cycling.

The mobility patterns of inhabitants of the NATO's eastern flank region are complex and influenced by a range of factors. Understanding these patterns is essential for planning and implementing effective transportation policies and strategies to support NATO's defense posture. By promoting sustainable and efficient transportation modes, transport authorities can improve the mobility of individuals in the region and support the economic and social development of these countries.

The occurrence of armed aggression or the signs of it may necessitate the implementation of an evacuation process, which can significantly impact the transportation system's functioning (Chen et al., 2012). The road network may experience heavy traffic due to people moving from risk areas to safe places, while other trips, including individual car transport, may not take place as a result (Church and Cova, 2000). As such, the impact of an evacuation on road transport can be observed in both evacuation journeys and their influence on the overall system's balance.

Regardless of the timing of decisions related to evacuation, it is crucial to consider the population's ability to self-evacuate, which refers to people moving out of areas where a direct or potential threat exists primarily using their means of transport (Dash and Gladwin, 2007). However, the flow of vehicles related to self-evacuation, whether planned or spontaneous, can affect the transport system's balance, particularly when parallel shutdowns of road network sections are in place due to, for example, military relocation.

To develop further on the transportation of vulnerable populations, including individuals with limited mobility or attached to medical equipment such as respirators, it is important to explore transportation alternatives for these groups. For instance, special provisioned vehicles or medical transport units may be requisitioned for moving patients in hospitals. Accessible transportation services are also required for persons with disabilities, keeping in mind the infrastructure accommodations like ramps or low-floor vehicles (Borowska-Stefańska, et al. l 2022). These alternatives ensure that all individuals, irrespective of their physical condition, can be safely and efficiently moved from danger zones when self-evacuation is not an option.

Nevertheless, self-evacuation cannot be the only means of moving people from danger zones to safer areas. It is essential to consider the transportation of vulnerable groups such as the elderly, sick, and those with limited mobility or individuals in penitentiary institutions who cannot undertake self-evacuation. Self-evacuation can pose significant challenges for transport services responsible for organized transport, particularly when local capacity limitations are present (Hsu and Peeta, 2014). The list of potential secondary threats that representatives of local communities may experience while evacuating people in the face of an armed conflict is extensive.

In discussing a regional unit's role in harmonizing all transport routes simultaneously, let's consider the potential strategies for enhancing the regional transportation framework. Regional units play a pivotal role in coordinating and harmonizing transport routes for both daily commutes and emergency situations. By employing technologies such as Geographic Information System and Intelligent Transportation Systems, they can streamline evacuation routes and eliminate bottlenecks (Borowska-Stefańska, et al. 2022). This coordination is essential in emergency situations to minimize evacuation time and maximize the safety of all inhabitants, including vulnerable populations.

Many studies suggest that the mobility and relocation patterns of inhabitants in the eastern flank region are influenced by a range of factors, including infrastructural, economic, social, and political conditions. For example, in some areas, limited economic opportunities and poor infrastructure can hinder mobility, while political instability can make it difficult for individuals to relocate safely ('Infrastructure & Intelligent Transportation Systems', 2022; King et al., 2013).

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International policies and the humanitarian support offered, including medical evacuations across Europe and the provision of adequate care and support for displaced people, are also important here (Roborgh et al., 2022).

However, there have also been efforts to improve the ability of individuals to move and relocate in the region. For example, NATO has implemented a number of initiatives aimed at improving transportation infrastructure and promoting sustainable transportation modes in the region (Deutschmann, 2022; 'NATO Resilience Symposium', 2022). These efforts include the development of regional transportation networks, the promotion of alternative transportation modes such as cycling and public transportation, and the improvement of border crossing procedures to facilitate cross-border mobility ('The situation of Roma in 11 EU Member States – Survey results at a glance', 2015).

Despite these efforts, there are still challenges to ensuring the ability of inhabitants to move and relocate in the time of war. The potential for conflict in the region highlights the need for continued investment in transportation infrastructure and the promotion of sustainable transportation modes to improve mobility and relocation options for individuals in the eastern flank region.

Although some efforts have been made to improve transportation infrastructure and promote sustainable transportation modes in the region, there are still challenges to ensuring the ability of individuals to move and relocate safely and quickly. Continued investment in transportation infrastructure and policies to promote sustainable transportation modes can help to improve the mobility and relocation options for individuals in the region.

The variety of methodological approaches, the diversity of the transport network, the distribution of the population at risk and safe places, and above all, the significant unpredictability of their behavior (e.g. the occurrence of "anarchic evacuation") all make research on the organization of evacuation-related transport in the face of an armed conflict seem justified only if local conditions and the same spatial scale are taken into account (Kongsomsaksakul et al., 2005).Adopting universal assumptions in this respect could significantly distort the obtained results.

It is important to recognize the possible scale of self-evacuation and to identify its potential directions and areas, evacuation routes or to ensure fuel supplies and technical assistance on evacuation routes. When the evacuated population moves with their own means of transport, the management of the evacuation process is limited to indicating the recommended directions, routes (evacuation) and areas (destination places) for the evacuees (Lumbroso, 2008)**.** The evacuation of the population should usually take place within a given administrative unit (depending on the scale of the threat, it may be only a local government but also a regional one). When creating evacuation plans, one should not adopt one universal model for various types of threats. In terms of transport issues, taking into account the range of evacuation, the possibility of using individual transport should be taken into account, and reference should be made to the principles of traffic management and its organization.

In addition to the devastation and humanitarian crisis caused by the war, Russia's military intervention in Ukraine came at the peak of the COVID-19 wave. The calculated predictive incidence of COVID-19 in Ukraine in early March 2022 was about 30,000 new cases per day. Diagnosis and treatment were definitely hampered due to warfare, and self-isolation was virtually impossible. A significant factor increasing the spread of the virus is the high density of the population during evacuations, both on trains and at train stations. At the same time, most of the evacuees were children. In Ukraine, children under the age of 12 were not vaccinated, and children 12 and older began to be vaccinated on January 13, 2022, so vaccination coverage among children was low (Chumachenko and Chumachenko, 2022). The situation related to the Covid outbreak in Europe at the time of the armed conflict, the restrictions in place as a result, as well as the health status of those residing in the areas of Russian military intervention during the evacuation process are also an important theme in considering the ability of residents to move.

3.2. The accessibility of transportation

In the eastern flank region, there have been efforts to improve the availability of transportation infrastructure through investment in new transportation projects, such as the construction of new roads and railways. NATO has implemented initiatives aimed at enhancing transport infrastructure in the region, including the development of regional transportation networks, the promotion of alternative transportation modes such as cycling and public transportation, and the improvement of border crossing procedures to facilitate cross-border mobility (World Bank, 2002). However, transportation infrastructure in some areas of the eastern flank region remains underdeveloped, particularly in rural areas. This can have significant implications for regional economic development, social integration, and security, particularly in the event of a potential conflict (Dumitrescu and others, 2015; 'European Civil Protection and Humanitarian Aid Operations', 2021).

The availability of transportation infrastructure in NATO's eastern flank region is an important factor in ensuring regional connectivity and mobility. Continued investment in transportation infrastructure and policies to promote sustainable transportation modes can help improve the availability and quality of transportation infrastructure in the eastern flank region (Ambler et al., 2021; 'Mobility and Transport', 2022).

Military operations can significantly impact the transport network, including roads and road engineering structures (Murray-Tuite and Wolshon, 2013)**.** These factors can limit the efficiency and availability of the network, resulting in the resistance

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of individual elements being exceeded and affecting their use. The destructive factors can originate from a range of events, such as high temperature, pressure, excessive load, or fire, which can cause burnout of the pavement and deformation of the structure, leading to a decrease in the load-bearing capacity of the structure (Pel et al., 2010).

Exceeding the permissible load of network elements can occur due to the movement of vehicles with excessive weight or unforeseen large flows of vehicles resulting from changes in the organization of traffic during evacuation or relocation of the armed forces. Changes in the foundation conditions of the structure or geological and fatigue effects can also result in a reduction of the load capacity of road structures or the loss of stability of their structures (Richter et al., 2013).

In addition to military operations, weather conditions can significantly impact transportation infrastructure, notably in regions where extreme weather conditions are prevalent (Pel et al., 2010). Adverse weather conditions such as heavy rain, snow, and icy conditions can make roads impassable, disrupt public transportation, and affect air travel. Similarly, seasonal weather patterns can lead to regular disruptions, such as flooding in rainy seasons or impassable roads due to snow in the winter (Pel et al., 2010). These weather-related disruptions can particularly hamper evacuation efforts during emergencies and escalate the existing challenges posed by armed conflicts.

Furthermore, long-term climatic changes can also have profound impacts on transportation infrastructure. Rising temperatures and sea levels, changing precipitation patterns, and increased frequency of severe weather events can all degrade transportation infrastructure and disrupt service availability. For instance, heatwaves can cause road surfaces to soften and railroad tracks to buckle, storms can wash out roads and bridges, and rising sea levels can erode or inundate coastal roads and rail lines (Murray-Tuite and Wolshon, 2013). Therefore, planning for these potential impacts of climate change should be integral to the development and management of transportation infrastructure in NATO's eastern flank region.

In the event of an armed conflict, the use of the road network must be regulated and supervised by infrastructure managers to maintain a minimum level of efficiency acceptable to users. Infrastructure managers should also take care of the removal of direct and indirect damages and designate detours for out-of-service sections of the network, if possible.

The management of the transport network during an armed conflict requires careful planning and execution to minimize disruptions and ensure the safety of users. Infrastructure managers must be prepared to address the challenges posed by destructive factors and develop strategies to mitigate their impact (Shahabi and Wilson, 2014). By doing so, they can ensure that the transport network remains operational and continues to support the movement of people and goods, even in the face of conflict.

Overall, whether it's the impact of military operations, the availability of transportation infrastructure, or the effects of weather and climatic changes, a comprehensive understanding and anticipatory planning are essential. These multi-faceted aspects require strategic and coordinated responses from infrastructure managers, governments, and international agencies alike to ensure the uninterrupted operation of the transport network, even under duress.

3.3. The availability of resources for relocation

The availability of resources for relocation can vary significantly depending on the location and the extent of the conflict. In some cases, resources may be readily available, while in others, they may be scarce or difficult to access. This can have significant implications for the ability of civilians to relocate and for their safety and well-being (Dickman, 2010).

Efforts have been made to improve the availability of resources for relocation in the NATO's eastern flank region (Jankowski, 2022). So far, initiatives have been implemented to enhance regional preparedness for emergencies and crisis situations, including developing contingency plans and providing training and resources for emergency responders (Beaussier and Cabane, 2020).

However, even in peacetime, over 25% of resources, such as vehicles, might not be available due to repair, accidents, and technical issues. This significantly reduces the overall mobility capability, which can have major implications during conflict or emergencies when the need for transport assets can suddenly increase. To mitigate this, regular maintenance and prompt repair of transport resources are essential to minimize downtime. Stockpiling spare parts for vehicles and other necessary equipment can also help to quickly bring them back to operation. In addition, it's vital to have contingency plans that include arrangements for acquiring additional transport resources from alternative sources or through mutual aid agreements during emergencies (Beaussier and Cabane, 2020).

However, challenges remain in ensuring the supply of resources for relocation in the event of a conflict (Urciuoli et al., 2014). This is particularly true in areas where resources are already scarce or where infrastructure has been damaged or destroyed (Balint et al., 2011). It is, therefore important to continue to invest in preparedness efforts and to work towards building more resilient communities that are better able to cope with the challenges of conflict and displacement.

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3.4. Destruction of critical infrastructure

The destruction of critical infrastructure is a major concern in the event of war or conflict in NATO's eastern flank region (Shlapak and Johnson, 2016). Critical infrastructure includes systems and facilities that are essential for the functioning of society, such as transportation networks, communication systems, and power grids. Damage to critical infrastructure can have serious consequences, including disruptions to essential services and the displacement of civilians.

Degradation of critical infrastructure may occur through a variety of means, including direct attacks, sabotage, or collateral damage from military operations. In addition to the immediate impact on civilians and infrastructure, damage to critical infrastructure can also have longer-term economic and social consequences (Urlainis et al., 2014).

NATO has implemented initiatives aimed at enhancing regional resilience and preparedness, including the development of contingency plans and the provision of training and resources for emergency responders. Additionally, international organizations such as the United Nations and the World Bank have provided support for infrastructure reconstruction and recovery efforts.

In situations where ground infrastructure such as roads and bridges are destroyed, air transport becomes a crucial alternative for evacuation, relief aid delivery, and maintaining overall connectivity. The advantage of air transport lies in its ability to bypass terrestrial obstacles and reach areas otherwise inaccessible. Helicopters, in particular, can be instrumental due to their vertical take-off and landing capability, which allows operations even from improvised sites. However, reliance on air transport comes with its own set of challenges. For instance, weather conditions, air defense threats during conflicts, availability of suitable landing zones, and aircraft availability can all limit the effective utilization of air transport. Hence, maintaining a fleet of well-maintained aircraft and training personnel for emergency operations should be part of the contingency planning (Urlainis et al., 2014).

The destruction of critical infrastructure remains a significant concern in the region. Ongoing conflicts and tensions in the area highlight the continued vulnerability of critical infrastructure and the need for continued investment in preparedness and response efforts. This is a major concern in the event of war or conflict in NATO's eastern flank region. While efforts have been made to mitigate the impact of such destruction, challenges remain in ensuring the resilience and recovery of critical infrastructure. Continued investment in preparedness and response efforts can help to build more resilient communities and reduce the impact of future conflicts (Spaans and Waterhout, 2017).

Armed conflicts can have severe consequences on critical transport infrastructure, causing temporary difficulties in movement and the need to evacuate people. The destruction of infrastructure elements, such as roads, bridges, viaducts, tunnels, and culverts, can immobilize or cause difficulties in transport, leading to difficulties in communication and rescue operations (Southworth, 1991). The inability of residents to reach their workplaces and access damaged areas further aggravates the situation.

To prevent such consequences, the minister responsible for transport and the security centers of the flank countries should develop and update detailed criteria to identify critical infrastructure facilities (Sun et al., 2020). They should prepare and update a uniform list of these facilities and carry out analyses and forecasts concerning possible threats relevant to the national critical infrastructure.

In the context of the road network, it is crucial to introduce a risk assessment methodology that takes into account the possibility of an armed conflict, including even low-probability threats with catastrophic consequences (Yuan et al., 2017). The authorities involved in managing critical infrastructure must prepare and implement plans for the protection of critical infrastructure, maintain backup systems, and ensure the security and functioning of the infrastructure until it is fully restored (de Oliveira et al., 2014). Scientific institutions and the scientific community should provide expert support and develop new technologies and analytical methods to assess the risk of destruction or cessation of transport network functioning and assess its vulnerability to threats.

Activities to protect critical infrastructure should guarantee high availability and reliability of road transport infrastructure at all times (Leveson et al., 2017). The network should be as reliable as possible, achieved by ensuring the mutual substitutability of its individual elements, a short repair period for restoring functionality, continuous supervision, and high quality and resistance of individual network elements.

3.5. Behavioral issues

The behavioral issues of people taking part in a mass evacuation associated with war are complex and multifaceted. The literature suggests that the mental state of this population has a significant impact on their decision-making processes related to evacuation. Understanding how people perceive evacuation in terms of threat and risk, and how it affects their decision-making is crucial, especially since evacuee behavior is difficult to predict and control during emergency situations (Borowska-Stefańska and Wiśniewski, 2022). For example, in times of war, individuals may experience fear, anxiety, and uncertainty, which can lead to hesitation or even resistance to evacuate (Laor et al., 2001). Additionally, the experience of trauma and loss can exacerbate pre-existing mental health conditions and lead to behavioral issues that hinder the evacuation process (Norris et al., 2002).

There are several aspects to consider when analyzing the behavior of individuals in conflict situations. For instance, there may be some who do not wish to leave their homes because of emotional attachment, precious belongings, or memories. These

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individuals may require special counseling and persuasion strategies to help them understand the importance of evacuating for their safety (Khorram-Manesh et al., 2022). This aspect also touches on the ethics of evacuation – forcing people to leave their homes without their consent is a delicate matter that must be approached with respect and understanding. There may be situations in which the immediate threat to life outweighs ethical considerations, but efforts should still be made to obtain consent wherever possible (Goniewicz, 2022). To address these issues, it's essential to conduct simulation exercises to educate and prepare people for potential evacuation scenarios. Such exercises can help individuals understand the importance of evacuating in a timely manner and can also assist in identifying and addressing potential barriers to evacuation (Goniewicz et al., 2021). These exercises can also provide valuable feedback for refining evacuation plans and strategies.

The literature highlights the psychological pathologies in the aftermath of warfare, and as in all crises where human rights are often the first casualty, proactive protection of vulnerable groups is crucial. During the current crisis, civilian authorities have understandably focused on protecting the general public. However, care for the mental health and well-being of prisoners of war, detainees and psychiatric patients cannot be neglected (Liebrenz et al., 2022).

Studies on behavioral issues have found that individuals with pre-existing mental health conditions, such as post-traumatic stress disorder (PTSD), may be less likely to evacuate in the event of an emergency. This may be due to factors such as fear of leaving familiar surroundings or a lack of trust in the evacuation process (Makwana, 2019). Conversely, individuals who experience high levels of anxiety or panic may be more likely to evacuate but may not be able to do so in an orderly or efficient manner, which can lead to safety hazards.

Furthermore, the literature suggests that the behavior of individuals during an evacuation is influenced by the behavior of others around them. This can lead to a herd mentality, in which individuals follow the actions of others rather than making decisions based on their own assessment of the situation (Nickerson, 1992). This can result in overcrowding, confusion, and even panic, which can hinder the evacuation process and pose safety risks. Planning for mass evacuations is crucial for ensuring safe departures from a given space, especially during threatening circumstances. Simulation of people's movement and behavior can play a key role in this planning process, as it provides valuable insight into how evacuees are likely to behave and move during an emergency (Mohd Ibrahim et al., 2022).

The behavioral issues of individuals during a mass evacuation associated with war are complex and influenced by a variety of factors, including pre-existing mental health conditions, fear, anxiety, trauma, and the behavior of others. Understanding and addressing these issues is essential for the effective management of mass evacuations during wartime. By incorporating behavioral factors into evacuation planning and implementation, transport authorities can improve the safety and efficiency of mass evacuations and help ensure the well-being of individuals impacted by war (Thoresen et al., 2012). Evacuating people during a war is challenging and unpredictable, but proper training of emergency services can minimize negative incidents. The efficient management of the evacuation process is critical in influencing the behavior of the population (Long et al., 2022). Given the potential scale and urgency of the evacuation, it is crucial to be prepared and capable of executing the process efficiently.

4. Discussion

While this study has primarily focused on wartime mass evacuation management within NATO's eastern flank, it's insightful to recognize the potential cross-applicability with the strategies used in natural hazard preparedness and response. Indeed, principles of effective evacuation planning and execution can transcend the boundaries of specific crisis types, with lessons learned from one context enriching the understanding and practice in another.

Both wartime and disasters such as hurricanes, earthquakes, and tsunamis necessitate the rapid and efficient movement of populations to safety. Strategies focusing on robust transportation infrastructure, clear communication, and coordination between authorities can be equally valuable across these different scenarios (Borowska-Stefańska et al., 2023). The behavioral issues identified in wartime evacuations, such as reluctance to leave home or following herd mentality, can similarly manifest in evacuations due to disasters. Insights into managing these behavioral complexities can, therefore, have broader applications (Dulebenets et al., 2019).

The importance of infrastructure resilience in wartime to mitigate the destruction of critical infrastructure like roads and bridges parallels the need for natural hazard management. Techniques used to enhance infrastructure resistance to earthquakes or floods may inform strategies for enhancing resilience to military attacks (Abdulhalim et al., 2021). Both contexts necessitate special considerations for vulnerable and sick populations, which may require additional assistance and resources. Strategies developed for assisting these groups during disasters, such as improved preparedness for deaf and hard-of-hearing children, could be adapted for use in conflict settings (Dulebenets et al., 2019).

Technological tools and methodologies used for modeling evacuations during disasters, such as soft computing applications (Liang et al., 2023), GIS mapping, and simulation exercises, could be adopted and customized for wartime scenarios. These tools

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enable authorities to plan and respond more effectively to dynamic and unpredictable situations. International collaboration and alignment with legal and humanitarian frameworks are valuable across disaster and wartime evacuation planning. Lessons learned from cross-border coordination in disasters may guide the development of protocols for multinational cooperation during military conflicts.

Educational initiatives targeting public preparedness for natural hazards, such as tsunami awareness in New Zealand (Dhellemmes et al., 2021), can be adapted to enhance awareness and readiness for wartime evacuations. These may include drills, awareness campaigns, and community engagement strategies.

While the specificities of wartime and disaster evacuations may differ, the underlying principles and practices offer rich opportunities for cross-learning and integration. Considering both contexts in tandem may lead to the development of more versatile, resilient, and humane approaches to mass evacuation management. These insights not only contribute to the scholarly understanding of evacuation dynamics but also provide practical guidance for policymakers, emergency managers, and other stakeholders across various domains of crisis response. As it applies across different types of emergencies, the multifaceted nature of evacuation offers a promising avenue for further interdisciplinary research and collaboration.

5. Recommendations

The findings of the literature review suggest that the spatial mobility of inhabitants of NATO's eastern flank in the event of a military conflict is dependent on various factors, including the availability of transportation and resources for relocation, and the potential impact of a military conflict on critical infrastructure.

One crucial aspect that significantly impacts the successful evacuation of people is public preparedness. The general public needs to be well-educated about the potential risks and the necessary actions during a military conflict (Goniewicz et al., 2023). An uninformed or unwilling public may hinder or delay transportation processes and create additional issues. Therefore, raising public awareness and increasing preparedness through various means, such as information campaigns, drills, and simulations, is essential.

Considering the diverse needs of the population, it is also crucial to have specific strategies in place for different civilian groups.

a. For healthy civilians who can use their own vehicles or other recommended transportation methods, ensuring the availability of clear evacuation routes and providing real-time information about the conflict situation can aid in a smooth evacuation. Efforts should also be made to increase the capacity and efficiency of public transportation systems to cater to those without personal vehicles.
b. The vulnerable and sick populations require special attention during evacuation. It is vital to have trained personnel who can provide assistance and suitable transportation options to this group. Detailed databases should be created and maintained to quickly identify and reach out to vulnerable individuals during a crisis.

To better prepare for a potential military conflict, policymakers and emergency management officials should focus on enhancing the existence of transportation and resources for relocation, as well as developing contingency plans for the potential disruption of critical infrastructure. To ensure effective management of mass evacuations during times of war, it is important to provide adequate training to emergency services on how to handle such situations, especially with regards to the psychosocial aspects. Additionally, it is important to prioritize education among the civilian population to reduce their vulnerability and increase their ability to respond appropriately in emergency situations.

6. Limitations

The analysis presented herein is not without its limitations. The primary constraint of this study is its exclusive concentration on English-language literature, potentially resulting in the exclusion of pertinent information available in other languages. The selection criteria utilized to limit the included publications allowed the authors to obtain accessible data and a manageable quantity of publications to analyze and review. Nevertheless, the selection criteria employed may have been too stringent, leading to the omission of relevant information. These limitations may be remedied in subsequent research.

7. Conclusions

The safety and security of inhabitants in NATO's eastern flank during potential military conflicts largely depend on their spatial mobility. A comprehensive understanding of the population's mobility patterns, the preparedness of transportation

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infrastructure, the availability of relocation resources, the potential impact of critical infrastructure destruction, and behavioral considerations is crucial.

This review provides insights into these factors, emphasizing that enhanced preparedness is not only about infrastructure and resources but also involves understanding human behavior during evacuations. It further underlines the importance of public awareness and preparedness, outlining specific recommendations for different civilian groups.

A holistic approach to preparedness, combining infrastructure development, resource allocation, and understanding human behavior, is essential for effectively managing conflict-related risks. Moreover, international coordination and collaboration play a crucial role in handling mass displacements resulting from armed conflicts. The findings and recommendations from this review can inform policymaking, enhancing preparedness in the region and contributing to improved safety and security outcomes for its inhabitants.

Acknowledgements
This article has been supported by the Polish National Agency for Academic Exchange under the NAWA Urgency Grant programme", entitled: Spatial Mobility of the Inhabitants of the Countries of NATO's Eastern Flank in the Event of a Military Conflict on their Territory.

Declaration of interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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