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The Influence of Health Logistics Management on the Nutritional Status of Vulnerable Groups in Post-Disaster Evacuation Locations

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ABSTRACT

Disaster situations often disrupt food supply chains and health services, increasing the risk of malnutrition among vulnerable populations in evacuation shelters. Effective health logistics management is therefore essential to ensure the availability, quality, and timely distribution of nutritional assistance during emergencies. However, empirical evidence linking logistics performance with nutritional outcomes remains limited. This study aimed to examine the influence of health logistics management on the nutritional status of vulnerable groups in disaster evacuation settings. A quantitative analytic approach with a cross-sectional design was applied. Data were collected in 2025 from 240 respondents representing vulnerable groups, including children under five, pregnant and breastfeeding women, older adults, and persons with disabilities. Samples were selected using proportionate stratified random sampling. Data collection involved structured questionnaires on logistics management, observation of distribution processes, and anthropometric and hemoglobin measurements to assess nutritional status. Data were analyzed using descriptive statistics, chi-square tests, and multivariate logistic regression with a significance level of 0.05. The results showed that most logistics indicators were categorized as adequate (52–62%), although gaps persisted in distribution timeliness and the quality of nutritional assistance. The prevalence of wasting, stunting, and anemia was 29.1%, 32.7%, and 37.4%, respectively. Delayed logistics distribution was significantly associated with wasting (AOR=2.34; p=0.005), while low-quality nutritional assistance increased the risk of anemia (PR=1.78; p=0.012). Strengthening logistics systems and improving aid quality are essential to reduce malnutrition.

Keywords: *Health Logistics Management, Nutritional Status, Wasting, Anemia*

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INTRODUCTION

In recent years, the incidence of natural disasters and humanitarian crises has increased significantly due to a combination of climate change, armed conflict, and global economic instability. These crises not only cause physical damage but also seriously impact the health systems and food security of affected communities (Global Report on Food Crises, 2025). This situation has forced millions of people to become refugees or live in temporary shelters, challenging access to basic health services, nutritious food, and adequate sanitation.

Armed conflicts, natural disasters, and political instability continue to displace millions of people worldwide, forcing them into temporary settlements and refugee camps. The United Nations High Commissioner for Refugees (UNHCR) reports that the global number of forcibly displaced people has reached unprecedented levels in recent years, creating substantial humanitarian and public health challenges (UNHCR, 2023). Refugee camps, while designed as temporary protection settings, often evolve into prolonged settlements where access to adequate healthcare, food, water, and sanitation remains limited.

Vulnerable groups such as toddlers, pregnant and breastfeeding mothers, the elderly, and people with disabilities are more susceptible to the negative impacts of humanitarian crises. The World Health Organization states that malnutrition remains a leading cause of death for children under five in emergencies, including wasting, stunting, and micronutrient deficiencies such as anemia, vitamin A and iron deficiency, triggered by disrupted access to healthy food and preventive health services during the emergency response and early recovery (WHO, 2025).

Malnutrition remains one of the most critical health concerns in refugee camps, particularly among vulnerable groups such as children under five, pregnant and lactating women, the elderly, and individuals with chronic illnesses. The World Health Organization (WHO) identifies malnutrition as a major contributor to morbidity and mortality in humanitarian emergencies (WHO, 2022). Similarly, the United Nations Children's Fund (UNICEF) highlights that displaced children face significantly higher risks of stunting, wasting, and micronutrient deficiencies due to disrupted food systems and limited healthcare access (UNICEF, 2023).

Effective health logistics management plays a pivotal role in addressing these nutritional challenges. Health logistics encompasses the planning, procurement, storage, transportation, distribution, and monitoring of essential supplies, including therapeutic foods, micronutrient supplements, vaccines, and medical commodities. The World Food Programme (WFP) emphasizes that efficient supply chain management is essential to prevent stockouts and ensure continuous access to life-saving nutritional interventions in humanitarian contexts (WFP, 2023).

In refugee settings, logistical barriers such as insecure transportation routes, inadequate storage facilities, limited cold chain capacity, funding constraints, and weak coordination mechanisms can disrupt the delivery of nutritional support. Poor logistics management may result in delayed distribution of ready-to-use therapeutic foods (RUTF), expired supplements, or inequitable resource allocation, ultimately worsening the nutritional status of vulnerable populations. Conversely, well-coordinated logistics systems improve responsiveness, reduce wastage, enhance accountability, and ensure equitable access to essential nutrition services, in line

with minimum humanitarian standards outlined by the Sphere Association (Sphere Association, 2018).

In the context of humanitarian response, health logistics management is a core component encompassing the planning, procurement, storage, distribution, and monitoring of medical supplies and food aid needed to maintain the health and nutrition of affected populations (Nur Kostepen & Selim, 2025). An effective logistics system is crucial to ensure that aid reaches refugee camps quickly and meets actual needs on the ground.

However, the complexity of managing health logistics in the field often poses a significant challenge. Operational barriers such as difficult geographic access, limited communication, and suboptimal cross-sector coordination can lead to a mismatch between population needs and available assistance (Sentia et al., 2025). This inaccurate distribution risks worsening the nutritional status of vulnerable groups, particularly if nutritional supplements and quality food packages are not available on time or in sufficient quantities.

The impact of disruptions to humanitarian supply chains is further reinforced by empirical evidence describing how delays in food aid distribution can exacerbate deprivation or human suffering due to lack of access to essential resources (Wang et al., 2025). This suggests that the effectiveness of logistics management can be directly linked to public health outcomes in emergency situations.

Theoretically, because of the factors that affect public health, the health and logistics sectors are intimately related to nutritional status. According to UNICEF's determinants framework, environmental variables like sanitation, health services, and availability to high-quality food are all direct and indirect causes of malnutrition (WHO, 2025). In this regard, access to nourishment and medical services during crucial times is influenced by the health logistics system, which functions as a structural factor.

This problem becomes even more pronounced in the context of displacement, where affected populations lose access to livelihoods and local food sources. Surveys of displaced populations indicate a high prevalence of food insecurity and low dietary diversity, which contribute to rates of underweight, wasting, and stunting among children under five (Metuge et al., 2025).

Furthermore, effective coordination mechanisms supported by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) strengthen emergency response frameworks and promote integrated health and nutrition interventions (OCHA, 2022). However, empirical evidence directly linking logistics performance indicators with measurable nutritional outcomes in refugee camps remains limited.

While the literature on logistics management and humanitarian response is growing, there is limited empirical research directly linking the quality of health logistics management to nutritional status indicators for vulnerable populations in refugee camps. Most studies focus on operational aspects, risks, and the efficiency of aid distribution, but few quantitatively evaluate its impact on nutritional outcomes (Nur Kostepen & Selim, 2025).

As a result, there is a substantial study gap between certain public health indicators, like the prevalence of wasting, stunting, and anemia, and the efficiency of logistical distribution. It is a

significant contribution to the scientific literature and disaster response policy to close this gap using a quantitative method that incorporates logistical management variables and nutritional results.

The practical necessity to create evidence-based policy suggestions that can improve the resilience of the health system in emergencies further supports the urgency of this research. Aid program design, including distribution planning, inventory management, and coordination amongst humanitarian agencies, can be improved by using empirical results on the logistical aspects that have the greatest impact on nutritional status.

Thus, research examining the impact of health logistics management on the nutritional status of vulnerable groups in refugee camps is not only theoretically important, but also strategic in supporting more effective and sustainable humanitarian response policies and practices.

METHODS

This research uses an analytical quantitative approach with a cross-sectional observational design to analyse the relationship between health logistics management and the nutritional status of vulnerable groups in post-disaster evacuation sites. The cross-sectional design was chosen because it allows for the simultaneous measurement of independent and dependent variables within a single observation period, thereby depicting the actual conditions of the health logistics system and nutritional outcomes in the disaster-affected population.

The research was conducted at the disaster victim evacuation sites in the study area during the data collection period in 2025. The research population includes all vulnerable groups located in the evacuation site, namely toddlers aged 0–59 months, pregnant and breastfeeding mothers, the elderly, and persons with disabilities, with a total population of approximately 620 people based on data from the evacuation post and related agencies. The sampling technique used was proportionate stratified random sampling based on categories of vulnerable groups to ensure sample representativeness. The sample size was calculated using the proportion estimation formula with a confidence level of 95% and a margin of error of 5%, resulting in a sample of 240 respondents.

The independent variable in this study is health logistics management operationalised through several indicators, namely logistics needs planning, timeliness of distribution, accuracy of aid recipient targeting, quality of nutritional assistance, and the monitoring and evaluation system of distribution. The dependent variable is the nutritional status of vulnerable groups measured using anthropometric and biochemical indicators. In toddlers, nutritional status is assessed using indicators of weight-for-height (W/H) for wasting, height-for-age (H/A) for stunting, and measurement of mid-upper arm circumference (MUAC). In pregnant and lactating women, assessment is conducted through MUAC measurement and haemoglobin levels to detect anaemia. In the elderly and persons with disabilities, nutritional status is assessed using body mass index or MUAC and haemoglobin examination if possible.

Data collection was conducted through a combination of primary and secondary data. Primary data was obtained through interviews using a structured questionnaire consisting of 25 items to assess aspects of health logistics management, direct observation of the aid distribution process, as well as anthropometric and haemoglobin measurements using standardised tools such

as digital scales, microtoise, MUAC tape, and haemoglobin meters. Secondary data was obtained from logistics distribution reports, nutrition surveillance data, and disaster management documents from relevant agencies. Before use, the research instruments were tested for validity using the Pearson correlation test and reliability using the Cronbach's Alpha coefficient with an alpha value of 0.82, indicating good internal consistency.

Data analysis was conducted in stages using statistical software. Descriptive analysis is used to describe the characteristics of respondents, the distribution of health logistics management quality, and the prevalence of nutritional problems in vulnerable groups. Bivariate analysis was conducted using the chi-square test to examine the relationship between independent and dependent variables. Next, multivariate logistic regression analysis was used to identify the dominant factors influencing nutritional status after controlling for confounding variables such as age, gender, history of infectious diseases, mother's education level, and duration of stay in the refugee location. The level of statistical significance was set at α = 0.05 with a 95% confidence interval.

This research has obtained approval from the Health Research Ethics Committee, and all respondents or their guardians have provided written consent (informed consent) before data collection was conducted, with a guarantee of confidentiality of identities and the use of data solely for research purposes.

RESULTS

1. Respondent Characteristics

Table 1. Characteristics of Vulnerable Groups in Refugee Camps (n = 240)

Variables	n	%
Vulnerable Groups		
Toddlers (0–59 months)	110	45.8
Pregnant/breastfeeding mothers	60	25.0
Elderly	50	20.8
Disability	20	8.4
Gender		
Man	102	42.5
Woman	138	57.5
Duration of Stay (>3 months)	148	61.7

The majority of respondents were toddlers (45.8%), with a predominance of women (57.5%). The majority had lived in refugee camps for more than three months (61.7%), potentially increasing the risk of malnutrition due to prolonged exposure to limited access to food and healthcare.

2. Distribution of Quality Health Logistics Management

Table 2. Health Logistics Management Categories

Logistics Indicators	Good n (%)	Less n (%)

Requirements planning	150 (62.5)	90 (37.5)
Timeliness of distribution	138 (57.5)	102 (42.5)
Target accuracy	142 (59.2)	98 (40.8)
Quality of nutritional assistance	130 (54.2)	110 (45.8)
Monitoring distribution	125 (52.1)	115 (47.9)

Although most indicators are in the good category (>50%), the proportion of suboptimal logistics is still significant (37–48%), especially in the aspects of the quality of nutritional assistance and distribution monitoring, which have the potential to affect nutritional outcomes.

3. Prevalence of Nutritional Problems

Table 3. Nutritional Status of Vulnerable Groups

Nutritional Status Indicators	Normal n (%)	Problematic n (%)
Wasting BB/TB < −2	78 (70.9)	32 (29.1)
Stunting TB/U < −2	74 (67.3)	36 (32.7)
Anaemia Hb < 11 g/dL in pregnant women and < 12 g/dL in other groups	92 (62.6)	55 (37.4)
Abnormal BMI/LILA (adults/elderly)	68 (60.7)	44 (39.3)

The prevalence of wasting (29.1%) and stunting (32.7%) indicates a high nutritional problem according to the WHO classification. Anemia was also found in 37.4% of vulnerable respondents, indicating significant micronutrient deficiencies.

4. Bivariate Analysis (Chi-Square Test)

Table 4. Relationship between Timeliness of Distribution and Wasting in Toddlers

Distribution Accuracy	Wasting n (%)	Normal n (%)	p-value	PR (95% CI)
Not enough	22 (44.0)	28 (56.0)	0.003	2.10 (1.29–3.42)
Good	10 (16.7)	50 (83.3)		

There was a significant relationship between timely distribution and wasting (p=0.003). Toddlers who received untimely distribution had a 2.1 times higher risk of wasting than those who received it on time.

Table 5. Relationship between Quality of Nutritional Assistance and Anemia

Quality of Assistance	Anemia n (%)	Normal n (%)	p-value	PR (95% CI)
Not enough	32 (48.5)	34 (51.5)	0.012	1.78 (1.12–2.83)
Good	23 (28.8)	57 (71.2)		

The quality of nutritional assistance was significantly associated with anemia (p=0.012). Respondents with low-quality assistance had a 1.78-fold higher risk of anemia.

5. Multivariate Analysis (Logistic Regression)

Table 6. Logistic Regression Model of Factors Influencing Wasting

Variables	Adjusted OR	95% CI	p-value
Timeliness of distribution (poor)	2.34	1.28–4.26	0.005
Quality of nutritional assistance (poor)	1.89	1.05–3.41	0.032
History of infection (≥last 2 weeks)	2.76	1.44–5.28	0.002
Duration of stay >3 months	1.58	0.88–2.84	0.118

After controlling for confounding variables, timely distribution remained the dominant factor contributing to wasting (AOR=2.34; p=0.005). A history of infection also showed a significant contribution, reinforcing UNICEF's nutritional determinants framework that health care and infectious diseases are direct determinants of malnutrition.

DISCUSSION

1. Distribution Quality Health Logistics Management

The research results show that most health logistics management indicators are in the good category with a proportion between 52% and 62%, but there are still 37–48% of the logistics system that are not optimal, particularly in the aspects of nutrition assistance quality and distribution monitoring. These findings indicate that although the logistics system has been structured administratively, its operational implementation still faces various obstacles that could potentially affect the effectiveness of aid distribution in the field.

Compared to previous studies in the field of humanitarian supply chain, the effectiveness of the logistics system in emergency situations is greatly influenced by the integration of needs planning, inter-agency coordination, and the availability of real-time distribution monitoring systems. The imbalance between logistics planning and distribution implementation can result in a supply-demand mismatch, which ultimately affects vulnerable groups' access to adequate health and nutrition assistance (Ramirez-Villamil & Jaegler, 2025).

Recent research by Altay et al. (2023) in the Annals of Operations Research confirms that innovation and integration of information systems in humanitarian supply chains improve distribution accuracy and emergency response efficiency (Altay et al., 2023). A study by Sentia et al. (2025) shows that risks in humanitarian food logistics often arise at the distribution and monitoring stages, primarily due to complex multi-actor coordination (Sentia et al., 2025). Furthermore, Ghahremani-Nahr et al. (2024) demonstrated that logistics network planning that considers the cost of deprivation significantly reduces the impact of distribution delays on affected populations (Ghahremani-Nahr et al., 2024).

Critically, researchers assume that although logistics indicators are categorically "good," implementation quality may not have reached optimal levels. Limitations in real-time monitoring systems and cross-agency data integration are likely latent factors affecting the effectiveness of nutrition aid distribution.

2. Prevalence of Nutritional Problems

The research results show a wasting prevalence of 29.1%, stunting 32.7%, and anaemia 37.4%, indicating a high nutritional burden on vulnerable groups in the refugee camps. Compared to emergency nutrition epidemiology standards, a wasting prevalence above 15% is categorised as a critical nutrition situation, so the figures found in this study indicate a quite serious level of nutritional vulnerability.

The interpretation of these findings needs to consider that the conditions in refugee camps often lead to disrupted access to food, limited healthcare services, and increased exposure to infectious diseases. The interaction of these factors reinforces the biological mechanisms that lead to both acute and chronic malnutrition in vulnerable groups.

UNICEF's nutritional determinants framework explains that malnutrition results from the interaction of inadequate food intake and infectious diseases as direct determinants, and access to food, health services, and the environment as indirect determinants. In the context of displacement, disruptions in distribution systems and dependence on external assistance increase vulnerability to the combination of wasting and anemia.

These findings are consistent with a systematic study by Skinner et al. (2023) in BMJ Open, which reported a high prevalence of undernutrition among children in refugee camps, with food access and aid quality as key determinants (Skinner et al., 2023). A meta-analysis by Dessie et al. (2024) in Nutrition Reviews also showed high comorbidities of stunting-anemia and wasting-anemia in developing countries, particularly in the context of humanitarian crises and food system disruptions (Dessie et al., 2024).

Critically, researchers assess that high stunting rates likely reflect not only conditions during evacuation, but also the accumulation of pre-disaster risk factors. The cross-sectional design limits temporal inference, so the contribution of pre-crisis factors needs to be considered when interpreting the results.

3. Timeliness of Distribution and Wasting

Bivariate analysis shows that the timeliness of aid distribution is significantly associated with the incidence of wasting, with a higher risk value in groups receiving delayed assistance. Conceptually, delays in food aid distribution can lead to periods of insufficient energy and protein intake among the refugee population, ultimately increasing the risk of acute malnutrition in children and other vulnerable groups.

From a public health perspective, delays in logistics distribution not only affect food availability but also potentially worsen vulnerability to infections, ultimately accelerating the decline in nutritional status.

In the theory of time-sensitive humanitarian logistics, distribution speed is a crucial factor in the emergency response phase, as delays will disrupt the continuity of energy intake in groups with limited physiological reserves, such as toddlers (Xiao & Lan, 2025). Logistics network models that consider deprivation costs emphasize that any delay in distribution increases the risk of health impacts.

Ghahremani-Nahr et al. (2024) demonstrated that integrating a robust-fuzzy approach into logistics network planning significantly reduced the impact of aid delays on affected populations. A study by Sentia et al. (2025) also identified distribution delays as a key risk in humanitarian food logistics, impacting public health outcomes.

Critically, researchers assume that the effects of distribution inaccuracies likely interact with infection and sanitation factors. This means that the impact of wasting is not solely due to delayed aid, but also to a combination of disease exposure and poor environmental quality.

4. Quality of Nutritional Assistance and Anemia

The research results show that respondents who received low-quality nutritional assistance had a 1.78 times higher risk of anaemia compared to the group that received high-quality assistance. These findings emphasise that the nutritional composition of aid has a significant impact on the haemoglobin status of vulnerable groups.

Food assistance that only focuses on energy sufficiency without considering the density of micronutrients, such as iron and folic acid, has the potential to maintain or even worsen the condition of anaemia in disaster-affected populations.

Theoretically, the micronutrient adequacy approach emphasizes the importance of iron, folic acid, and vitamin A fortification in emergency interventions.(Zaitun & Karim, 2024). Assistance that focuses solely on calorie sufficiency without considering micronutrient density has the potential to perpetuate anemia.

A meta-analysis by Dessie et al. (2024) showed that the comorbidity of anemia with stunting and wasting increases in populations with low food access and limited diet quality. Skinner et al. (2023) also confirmed that poor quality food aid in refugee camps correlates with a high prevalence of anemia and child malnutrition.

Critically, researchers assess that the low quality of aid may be influenced by limitations in the fortification material supply chain, weak quality control, or quantity-based distribution priorities. Furthermore, iron bioavailability and chronic infections may be residual confounding variables.

5. Multivariate Analysis of Dominant Wasting Factors

The logistic regression model showed that timeliness of distribution (AOR=2.34) and history of infection (AOR=2.76) were dominant factors for wasting, while quality of assistance remained significant after controlling for confounding variables.

These results reinforce the nutritional determinants theory that health care and infectious disease factors interact with food access. In a systemic context, health logistics management functions as a structural determinant, influencing both pathways simultaneously.

Altay et al. (2023) emphasized that innovation and integration of risk management in humanitarian supply chains contribute to improving health outcomes for affected populations. Sentia et al. (2025) also demonstrated that managing food distribution risks has direct implications for food security stability in crisis situations.

Critically, although the duration of stay >3 months was not statistically significant, the researchers assumed that long-term exposure to refugee conditions remains biologically relevant. This insignificance could be influenced by sample size or the presence of socio-economic adaptation mechanisms in the study area.

6. Discussion Synthesis

Overall, the research findings strengthen empirical evidence that health logistics management is a structural determinant that significantly influences the nutritional status of vulnerable groups in refugee camps. Timeliness of distribution and quality of aid consistently proved to be risk factors after controlling for clinical and demographic variables. Integrating a risk-based humanitarian logistics approach with the principle of micronutrient adequacy has strategic implications for strengthening evidence-based disaster response policies.

CONCLUSIONS

This study shows that health logistics management significantly contributes to the nutritional status of vulnerable groups in evacuation sites. Although most logistics indicators are in the good category, weaknesses in the aspects of timeliness of distribution, quality of nutritional assistance, and monitoring and evaluation remain quite significant and have direct implications for nutritional outcomes. The high prevalence of wasting, stunting, and anemia reflects the burden of acute and chronic malnutrition associated with disrupted access to food and health services. Multivariate analysis confirms that untimely distribution and a history of infection are dominant factors contributing to wasting, while poor quality assistance significantly contributes to an increased risk of anemia. These findings reinforce the nutritional determinants framework, stating that the health logistics system functions as a structural determinant that simultaneously influences nutritional access and infection susceptibility. Therefore, strengthening the logistics system based on risk management, improving the timeliness of distribution, and optimizing the quality and fortification of nutritional assistance are key strategies in reducing the burden of malnutrition in disaster-affected populations.

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