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Coordination-related ethical challenges in large-scale earthquake response: a cross-sectional survey of field and institutional personnel involved in the 2023 Kahramanmaraş earthquake response, Türkiye

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Abstract

Background Sustainable disaster response depends not only on technical and logistical capacity but also on coordination arrangements that support human dignity, fairness, accountability, and public trust. The 6 February 2023 Kahramanmaraş earthquakes created a complex multi-actor response environment in which personnel reported both operational and ethical challenges. Aim This study aimed to identify coordination-related ethical challenges self-reported by personnel involved in field operations or institutional support and coordination after the earthquakes and to examine whether reporting of these challenges varied according to demographic, professional, and deployment characteristics.

Methods This descriptive cross-sectional survey incorporating exploratory associational analyses included 417 of 2,309 personnel involved in search-and-rescue, health, support, and institutional coordination roles. Data were collected using a 30-item Ethical Issues Assessment Form developed from national and international disaster-response frameworks and refined through expert review. Descriptive statistics and chi-square or exact procedures, as appropriate, were used for analysis.

Results Among 956 selections for coordination difficulties, information-flow disruption accounted for 28.5%, inefficient resource use for 25.5%, uncertainty in assignments for 24.5%, and overlapping authority for 21.5%. Resource insufficiency was reported by 145 of 344 respondents (42.2%). Inefficient resource use was associated with volunteer-related problem type ($p=0.002$; BH-FDR $q=0.035$). No other comparison remained below $q=0.05$ after adjustment across the 16 exploratory associations.

Conclusions The findings indicate that self-reported coordination difficulties and ethical concerns were interrelated in this large-scale earthquake response. Although the cross-sectional and retrospective design does not permit causal inference, the results point to the importance of clearer role and authority structures, transparent resource governance, reliable information-sharing arrangements, and structured volunteer management in disaster preparedness and response.

Keywords Disaster response · Disaster ethics · Earthquake · Coordination · Resource governance · Türkiye

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Background

Large-scale disasters require simultaneous action by public authorities, emergency medical services, search-and-rescue teams, humanitarian organizations, volunteers, local communities, and international responders. Effective response therefore depends not only on technical capacity but also on advance preparedness, coordinated information flows, clear responsibilities, and mechanisms for mobilizing scarce resources under uncertainty [1]. Humanitarian standards further emphasize that disaster assistance should protect dignity and be delivered according to principles including humanity, impartiality, accountability, and non-discrimination [2–5]. In the present study, these principles provide an ethical frame for interpreting field-reported problems in coordination, prioritization, privacy, resource allocation, and accountability.

Coordination frameworks operate at both international and national levels. International mechanisms such as the United Nations humanitarian coordination architecture and INSARAG guidance provide structures for multi-actor coordination and international search-and-rescue operations [5, 6]. In Türkiye, the Türkiye Disaster Response Plan (TAMP) defines domestic institutional roles, responsibilities, service groups, and coordination arrangements for disaster response [7, 8]. These frameworks share an emphasis on role clarity, coordinated action, information exchange, and accountable use of resources, while differing in their operational scope and institutional setting.

Disaster ethics literature has traditionally examined questions such as ethical decision-making, crisis standards of care, triage, professional responsibilities, and the dilemmas experienced by healthcare and emergency personnel [6, 9–13]. This literature shows that ethical concerns in disasters are shaped by scarcity, urgency, uncertainty, competing duties, and the need to protect vulnerable populations. However, ethical problems may also be embedded in the organization of response itself. From this perspective, disrupted information flow, unclear authority, poorly coordinated resource allocation, or weak integration of volunteers are not assumed to cause ethical harms; rather, they represent operational conditions that may be reported alongside concerns about fairness, privacy, dignity, discrimination, and accountability.

Türkiye has substantial earthquake exposure, making preparedness and inter-institutional coordination continuing national priorities [14–16]. The 6 February 2023 Kahramanmaraş earthquakes affected 11 provinces and required a response involving national and local authorities, health services, search-and-rescue units, civil society organizations, volunteers, and international teams [17]. Studies and assessments conducted after these earthquakes have described ethical concerns among healthcare personnel, coordination difficulties, challenges in aid distribution, and field-level management problems [18–22]. Research from other major earthquakes has likewise emphasized the importance of a common operational picture, information exchange, and command-and-control arrangements [23].

Existing studies of the Kahramanmaraş earthquakes have provided valuable qualitative, professional, organizational, and administrative perspectives [18, 19, 21, 22, 24, 25]. The present study differs by using structured survey data from 417 search-and-rescue, health, support, and institutional coordination personnel and by examining item-level relationships between reported ethical concerns and selected coordination conditions. This approach does not establish causal pathways; instead, it allows exploratory assessment of whether particular ethical concerns and coordination difficulties were reported together across different participant and deployment characteristics.

The study was guided by a conceptual framework linking three analytically distinct levels: coordination mechanisms, operational conditions, and ethical risks. Coordination mechanisms included information sharing, role allocation, authority clarity, resource governance, volunteer integration, and interoperability with international teams. Operational conditions included information disruption, resource scarcity or inefficient use, role ambiguity, communication barriers, and demanding deployment conditions. Ethical risks included perceived inequity in allocation, privacy and confidentiality concerns, discrimination, mistreatment, and accountability problems. The framework treats these domains as conceptually related rather than as a demonstrated causal sequence. This

distinction is important because the cross-sectional, retrospective, self-report design can identify patterns of association but cannot determine temporal or causal direction.

This framework is also relevant to disaster resilience and safety-critical operations. Research on information in dynamic disaster environments, human-resource coordination, ethical challenges in humanitarian response, disaster victim identification, and the relationship between knowledge and authority illustrates that reliable response depends on both formal structures and their practical implementation [26–31]. Accordingly, coordination can be understood as an operational infrastructure through which ethical principles are translated into field practice, while failures or ambiguities in that infrastructure may coincide with ethically consequential situations.

Against this background, the present study examined coordination-related ethical challenges self-reported by search-and-rescue, health, support, and institutional coordination personnel after the 6 February 2023 Kahramanmaraş earthquakes in Türkiye. The study addressed three research questions:

1. Which coordination-related ethical challenges were most frequently reported by personnel involved in the Kahramanmaraş earthquake response?
2. Did the reporting of these challenges vary according to demographic, professional, and deployment-related characteristics?
3. To what extent were volunteer-related ethical problems associated with other reported coordination difficulties, particularly inefficient resource use and disruptions in information flow?

By addressing these questions, the study seeks to contribute empirical evidence on the intersection of disaster coordination and disaster ethics. Its contribution lies in examining ethical concerns as field-reported phenomena situated within coordination and operational conditions, while maintaining the distinction between observed associations and causal mechanisms.

Methods

Study design and setting

This study was designed as a descriptive, cross-sectional survey incorporating exploratory associational analyses. It examined coordination-related ethical challenges self-reported by personnel involved in field operations or institutional support and coordination after the 6 February 2023 Kahramanmaraş earthquakes in Türkiye. The study covered the 11 provinces officially declared disaster-affected areas: Adana, Adıyaman, Diyarbakır, Elazığ, Gaziantep, Hatay, Kahramanmaraş, Kilis, Malatya, Osmaniye, and Şanlıurfa.

The study focused on search-and-rescue, health, and support personnel who participated in response, recovery, and rehabilitation activities. The coordination-related domains examined included information flow, role clarity, authority boundaries, resource allocation, volunteer involvement, international team collaboration, and personnel support conditions. These domains were operationalized through item-level responses in the Ethical Issues Assessment Form described below.

Study population and sample

The study population consisted of 2,309 personnel assigned by AFAD to the response to the 6 February 2023 Kahramanmaraş earthquakes. It included search-and-rescue, health, support, and administrative personnel involved in field operations or institutional coordination.

A non-probability convenience sampling method was used. Eligible participants were reached through authorized institutional channels after institutional permission had been obtained from AFAD. The source population comprised 2,309 officially deployed personnel. The minimum sample size was calculated using the finite-population proportion formula: $n = Nt^2pq / [d^2(N-1) + t^2pq]$, where N is the population size, t is the standard normal

critical value, p is the expected proportion, q = 1 − p, and d is the margin of error. With N = 2,309, a 95% confidence level (t = 1.96), p = q = 0.50, and d = 0.05, the calculated sample size was 329.48, rounded up to 330 participants. Given the non-probability sampling design, meeting this sample-size target does not establish representativeness.

The final analytic sample comprised questionnaires from 417 participants.

The inclusion criteria were:

1. Being assigned to field operations or institutional administrative support and coordination for the response to the 6 February 2023 Kahramanmaraş earthquakes;
2. Having actively served in search-and-rescue, health-related, support, recovery, rehabilitation, or institutional administrative coordination activities;
3. Being 18 years of age or older;
4. Voluntarily agreeing to participate and providing informed consent.

Participants were excluded if they had not participated in field operations or institutional administrative support and coordination for the earthquake response, or if their questionnaire lacked critical information required for the main study variables.

Data collection tool

Data were collected using a structured questionnaire developed by the researchers. The questionnaire consisted of two sections.

The first section was the Personal Information Form. It included demographic, professional, and deployment-related variables such as gender, year of birth, marital status, educational level, professional title, working unit, years of service, working pattern, institution, previous disaster experience, prior in-service disaster training, type of assignment, duration of deployment, transportation to the disaster area, accommodation conditions, and whether personal needs were met during deployment.

The second section was the Ethical Issues Assessment Form. This form was developed to identify ethical and coordination-related problems encountered during disaster response. The item pool was prepared from the disaster-response and ethics literature, the Türkiye Disaster Response Plan, INSARAG guidance, United Nations humanitarian principles, disaster-medicine sources, and expert input. The form consisted of 30 closed-ended items. The first 17 items addressed assignment and deployment processes within the assessment form, whereas the Personal Information Form captured respondent-level demographic, occupational, and deployment characteristics. Items 18–30 focused on field-reported ethical and coordination-related issues, including resource allocation, communication, handling of deceased persons, volunteer involvement, international team collaboration, and related operational conditions.

The instrument included categorical, multiple-choice, and multiple-response items. It was developed as an applied field assessment form rather than a psychometric scale; therefore, no total score or latent construct score was calculated, and analyses were performed at item level. For multiple-response questions, each response option was evaluated separately.

Content validity and expert review

The form was developed through literature review and consultation with a panel of 12 experts. The panel included personnel from provincial disaster and emergency directorates affiliated with AFAD and disaster health services units affiliated with the Ministry of Health who had experience in national and international earthquake response, as well as academics and field professionals with expertise in disaster management, psychology, sociology, and health sciences.

Expert opinions were obtained through face-to-face interviews. The experts evaluated the content relevance and comprehensibility of the questionnaire, including its scope, wording, and applicability to disaster field

conditions. Questionnaire wording was revised directly in response to their feedback. This qualitative review supported content suitability and clarity but did not establish statistical reliability or comprehensive psychometric validity. No quantitative Content Validity Index (CVI) was calculated, and no pilot study was conducted before the main survey.

Because the purpose of the instrument was field assessment rather than development of a psychometric scale, the emphasis was on content relevance, face validity, and interpretability of individual items. The absence of comprehensive psychometric validation limits interpretation of the instrument as a scale; future studies should examine its construct validity, reliability, and applicability across disaster contexts and responder groups.

Data collection procedure

Following ethical approval and institutional research approval from AFAD (22 July 2024; approval no. 1019180), data were collected through a self-administered electronic questionnaire. Timestamped records in the research dataset extend from 25 October 2024 to 18 March 2025. Participation was voluntary, and informed consent was recorded electronically before questionnaire completion. The dataset itself does not document the exact number of persons invited or refusing participation; therefore, a conventional response rate cannot be calculated from the available research data alone.

The survey was self-reported. No directly identifying personal information was included in the analysis dataset. The original study reported eligibility and completeness checks, although the available records do not identify who performed those checks. Analyses used available valid responses at the item level, without imputation. For the 29 institution-based administrative personnel, responses reflected institutional coordination experience and information received from field personnel, rather than direct observation in the disaster area.

Variables and outcome measures

The dependent variables were ethical and coordination-related problems reported by deployed personnel. These included perceived or observed problems related to discrimination in search-and-rescue or aid prioritization, privacy and confidentiality, mistreatment of victims, resource scarcity, inequitable resource allocation, inefficient resource use, disruptions in information flow, ambiguity in task allocation, overlapping authority areas, language barriers with international teams, differences in command and decision-making processes, difficulties in identifying deceased individuals, and ethical or operational problems arising from uncoordinated volunteer involvement.

The explanatory variables comprised demographic characteristics (gender, age, marital status, education), occupational characteristics (professional title, work unit, years of service, work pattern, institution), and deployment-related characteristics (previous earthquake/disaster response experience, prior in-service disaster training, deployment type and duration, transportation, accommodation, and whether personal needs were met). Age was summarized continuously in Table 1; the age groups used for the exploratory association analysis were ≤ 30, 31–40, and ≥ 41 years, as specified in the original manuscript.

Association analyses were exploratory rather than confirmatory and were selected to address the study's three research questions: describing reported coordination-related ethical challenges, examining whether selected reports differed across participant/deployment characteristics, and exploring whether volunteer-related ethical problems were associated with other reported coordination difficulties, particularly inefficient resource use and disruptions in information flow.

Statistical analysis

Data were analyzed using IBM SPSS Statistics version 29.0. Descriptive statistics summarized participant characteristics, deployment conditions, and item responses. Categorical variables were presented as frequencies and percentages, and age was summarized using mean and standard deviation. Inferential analyses reported in the

Table 1 Sociodemographic and occupational characteristics of participants ($N=417$)

Variable	Category / value	*n*	%
Gender	Female	134	32.1
	Male	283	67.9
Age (mean ± SD)	38.72 ± 9.35		
Marital status	Married	318	76.3
	Single	99	23.7
Education	High school	46	11.0
	University	323	77.5
	Master's	44	10.6
	Doctorate	4	1.0
Unit/Work setting	112/UMKE emergency services	104	24.9
	Administrative units	131	31.4
	Field personnel	182	43.6
Years in current job	0–5 years	125	30.0
	6–10 years	35	8.4
	11–15 years	133	31.9
	≥ 16 years	124	29.7
Work pattern	Day shift	232	55.6
	Shift work	23	5.5
	24-hour duty	162	38.8
Institution	Public hospital	17	4.1
	AFAD	306	73.4
	Provincial Health Directorate	8	1.9
	Emergency Medical Services station	86	20.6
Professional title	Nurse	6	1.4
	Paramedic	101	24.2
	Administrative staff (*)	86	20.6
	Support staff (**)	224	53.7

(*): Personnel employed in institutions in the positions of Branch Manager, Specialist, Officer, Training Specialist, Chief, and Driver

(**): Engineers, Technicians, Technologists, Psychologists, Sociologists, and Religious Officials

manuscript concerned categorical associations. The revised categorical analyses were independently recalculated from the individual-level dataset using Python and SciPy 1.17.0.

Pearson chi-square tests without continuity correction were used for categorical associations when all expected frequencies were at least 1 and no more than 20% of cells had expected frequencies below 5. Otherwise, Fisher–Freeman–Halton tests were approximated by Monte Carlo sampling with 300,000 fixed-margin tables. Probability ordering was used to identify tables at least as extreme as the observed table. Reproducible random seeds were 20,261,002 plus the zero-based Table 2 row index. The Pearson χ^2 statistic was retained for calculation of Cramér's V. Each analysis included only respondents with usable responses to both variables. Observed counts, row percentages, expected frequencies, and sparse-cell diagnostics are reported in Supplementary Table S3.

Items 19 and 28 were single-response questions, with 344 and 350 valid responses, respectively. Item 26 was a multiple-response question with 427 selections from 349 respondents. For multiple-response items, descriptive percentages represent proportions of all selections. For association analyses, each option was coded as selected (1) or not selected (0) only when the parent question had a usable response. Blank parent responses were treated as missing for all associated option variables, rather than as non-selection. A lone period without a substantive response was also treated as missing. Thus, Item 18 had 381 usable parent responses, Item 26 had 349, and Item 27 had 342; pairwise denominators are shown in Tables 2 and S3. Explicit 'no problem' responses were retained. Multiple selections, including combinations of a problem option and a 'no problem' option, were retained as recorded and represent option endorsement rather than mutually exclusive prevalence categories.

All association analyses were treated as exploratory. Cramér's V was calculated to quantify the magnitude of categorical associations. Because multiple bivariate tests were examined, Benjamini–Hochberg false discovery rate (BH-FDR) adjusted q-values were additionally calculated as a sensitivity analysis across the 16 associations

Table 2 Exploratory associations between reported ethical challenges and participant/deployment characteristics

Association	Valid *n*	χ^2	df	*p*	Cramér's V	BH-FDR q
Age group × discrimination observed	349	3.906	2	0.142	0.106	0.227
Gender × privacy breach observed	349	0.187	1	0.665	0.023	0.710
Professional title × privacy breach observed	349	7.387	3	0.053*	0.145	0.121
Professional title × mistreatment observed	349	10.418	3	0.025*	0.173	0.121
Professional title × language barrier	342	6.786	3	0.079*	0.141	0.147
Professional title × equipment incompatibility	342	8.921	3	0.038*	0.162	0.121
Years of service × resource-distribution problem type	344	17.848	9	0.037	0.132	0.121
Education × resource-distribution problem type	344	2.097	6	0.911	0.055	0.911
Education × volunteer-related problem type	350	6.686	8	0.571	0.098	0.652
Deployment timeframe (time-limited vs. open-ended) × language barrier	337	3.958	1	0.047	0.108	0.121
Personal needs met × language barrier	340	4.981	2	0.083	0.121	0.147
Obstruction by leader/supervisor × resource-distribution problem type	315	11.304	9	0.194*	0.109	0.258
Inefficient resource use × volunteer-related problem type	343	16.742	4	0.002	0.221	0.035
Information-flow disruption × volunteer-related problem type	343	9.382	4	0.052	0.165	0.121
Assignment uncertainty × volunteer-related problem type	343	5.861	4	0.210	0.131	0.258
Overlapping authority × volunteer-related problem type	343	6.571	4	0.160	0.138	0.233

V = Cramér's V; q = Benjamini–Hochberg FDR-adjusted *p*-value across all 16 comparisons. Pearson χ^2 statistics are reported without continuity correction. * Fisher–Freeman–Halton Monte Carlo exact p-value, using 300,000 fixed-margin samples and probability ordering; seeds are 20,261,002 plus the zero-based row index. Blank or non-substantive multiple-response parent answers were excluded from option-level comparisons. Full observed and expected frequencies and cell diagnostics appear in Supplementary Table S3

reported in Table 2. Both unadjusted p-values and FDR-adjusted q-values are presented; findings close to $p = 0.05$ that did not remain below $q = 0.05$ were interpreted cautiously. No predictive or causal model was fitted.

Ethical considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Lokman Hekim University Scientific Research Ethics Committee on 28 June 2024 with decision number 2024/164. Institutional research approval was obtained from the Disaster and Emergency Management Authority of Türkiye (AFAD) on 22 July 2024 (approval no. 1019180), before data collection. Participation was voluntary, informed consent was obtained from all participants, and confidentiality was maintained throughout the study. The dataset used for analysis did not contain directly identifying information, and access to the data was restricted to the research team.

Results

Participant profile

A total of 417 valid responses were included in the analysis. Most participants were male (67.9%), and the mean age was 38.72 ± 9.35 years. The majority were married (76.3%) and had a university degree (77.5%). In terms of professional role, support personnel constituted the largest group (53.7%), followed by paramedics (24.2%), administrative personnel (20.6%), and nurses (1.4%). Most participants were employed by AFAD (73.4%), while 20.6% worked in emergency health service stations. Regarding working units, 43.6% were field personnel, 31.4% worked in administrative units, and 24.9% worked in 112/UMKE emergency service units. The distribution of years of service was relatively balanced, with 30.0% having 0–5 years, 31.9% having 11–15 years, and 29.7% having 16 years or more of service. Most participants worked during daytime hours (55.6%), while 38.8% worked 24-hour shifts (Table 1). Remaining categories are shown in Table 1. Of the 86 administrative personnel,

57 worked in the disaster area, collecting and relaying field information and supporting coordination, while 29 remained at their institutions and coordinated administrative support using information received from the field.

Deployment and field-operation characteristics

Among participants with valid responses, 53.3% (218/409) were deployed ex officio and 39.6% (162/409) reported voluntary deployment. Another 29 respondents (7.1%) provided administrative support and coordination from their institutions without deployment to the disaster area. Assignment notification was most commonly verbal (42.1%; 163/387), followed by official written notification (38.0%; 147/387). Open-ended deployment was reported by 64.8% (250/386). Among those with valid duration data, 51.2% (200/391) stayed in the disaster area for more than 30 days. Transportation was mainly by road (87.1%; 338/388), and the most frequently selected travel-time category was 6–12 h (55.3%; 215/389). The original response options in the dataset contain 1–2, 6–12, and 12–24 h; no 2–6-hour category is present in the research dataset (Supplementary Table S1). Selected deployment and field-operation characteristics are presented in Table 3.

Among valid responses, institutional accommodation was reported by 54.5% (212/389), while 45.5% (177/389) arranged accommodation independently. Personal needs were fully met for 27.9% (109/390), not met for 28.7% (112/390), and partly met for 43.3% (169/390). Most respondents joined the team with which they arrived (72.4%; 280/387), and 77.4% (302/390) reported knowing the supervising coordination unit. Continuous 24-hour working was reported by 78.4% (304/388). The duty area was most often determined by Disaster Region Coordination (34.6%; 134/387), followed by AFAD Presidency (29.7%; 115/387) and the Provincial Disaster and Emergency Directorate (19.4%; 75/387).

Regarding preparedness, 54.2% (217/400) of participants with valid responses had not previously served in earthquake-related disaster tasks, whereas 45.8% (183/400) had prior experience. Other deployment and field-operation characteristics are presented in Supplementary Table S1.

Coordination-related ethical and operational challenges

Item 26 was a multiple-response question. Among 349 respondents, across 427 selections, 204 (47.8%) indicated no unethical practice, 112 (26.2%) discrimination in search-and-rescue or aid prioritization, 83 (19.4%) privacy/confidentiality breaches, and 28 (6.6%) mistreatment of affected people. Because participants could select more than one option, the selection count exceeded the 349 respondents answering this item (Table 4).

Table 3 Selected deployment and field-operation characteristics of participants (*)

Variable	Distribution, *n*/valid *n* (%)
Deployment mode	Ex officio 218/409 (53.3%); Volunteer 162/409 (39.6%); Institutional administrative support and coordination outside the disaster area 29/409 (7.1%)
Prior earthquake-response experience	Yes 183/400 (45.8%); No 217/400 (54.2%)
Days spent in disaster zone	1–5 days 26/391 (6.6%); 6–10 days 75/391 (19.2%); 11–30 days 90/391 (23.0%); >30 days 200/391 (51.2%)
Personal needs met	Yes 109/390 (27.9%); No 112/390 (28.7%); Partly 169/390 (43.3%)
Team integration upon arrival	Joined arrival team 280/387 (72.4%); Joined an existing on-site team 107/387 (27.6%)
Knowing supervising coordination unit	Yes 302/390 (77.4%); No 40/390 (10.3%); Partly 48/390 (12.3%)
Working hours in disaster zone	08:00–17:00 72/388 (18.6%); 17:00–00:00 12/388 (3.1%); 24 h continuous 304/388 (78.4%)
Authority determining duty area	Disaster Region Coordination 134/387 (34.6%); AFAD Presidency 115/387 (29.7%); Provincial Disaster & Emergency Directorate 75/387 (19.4%); Provincial Health Directorate 44/387 (11.4%); Personal initiative 19/387 (4.9%)

(*). Values are based on valid responses for each variable. Only deployment characteristics most directly relevant to the study questions are shown in the main text. The complete distribution of deployment and field-operation variables is provided in Supplementary Table S1

Table 4 Key coordination-related ethical and operational challenges

Domain / item	Response distribution
18. Coordination-deficiency problems *	Information-flow disruption 272/956 selections (28.5%); Inefficient resource use 244/956 (25.5%); Uncertainty in assignments 234/956 (24.5%); Overlapping authority 206/956 (21.5%)
19. Resource-distribution problem	Resource insufficiency 145/344 (42.2%); Misuse 79/344 (23.0%); Unequal distribution 64/344 (18.6%); Other 56/344 (16.3%)
20. Issues in handling deceased persons *	Identification 229/625 selections (36.6%); Informing families 154/625 (24.6%); Transport/storage 148/625 (23.7%); No issue 71/625 (11.4%); Other 23/625 (3.7%)
26. Observed unethical practices *	No unethical practice 204/427 selections (47.8%); Discrimination 112/427 (26.2%); Privacy breach 83/427 (19.4%); Mistreatment 28/427 (6.6%)
27. Issues with international SAR teams *	No problem 177/435 selections (40.7%); Language barrier 131/435 (30.1%); Command/decision differences 72/435 (16.6%); Equipment mismatch 37/435 (8.5%); Other/no international-team work 18/435 (4.1%)
28. Volunteer/civilian-related ethical problems	Lack of training 128/350 (36.6%); No problem 78/350 (22.3%); Authority conflict/role overlap 76/350 (21.7%); Privacy problem 45/350 (12.9%); Other 23/350 (6.6%)

* Multiple-response item; percentages are based on the total number of selections. For single-response items, percentages are based on the valid participant denominator. The complete distributions for Items 18–30, including Items 21–25 and 29–30, are provided in Supplementary Table S2

For the multiple-response coordination-deficiency item, 956 selections were recorded: information-flow disruption accounted for 28.5% of selections, inefficient resource use for 25.5%, uncertainty in assignments for 24.5%, and overlapping institutional authority for 21.5%. The resource-distribution item was single-response with 344 valid answers: resource insufficiency was reported by 42.2%, misuse of resources by 23.0%, unequal distribution by 18.6%, and other problems by 16.3%.

For the multiple-response item concerning deceased persons, difficulties in identification accounted for 36.6% of the 625 selected responses, difficulties informing families for 24.6%, and transportation/storage problems for 23.7%. For registration of deceased and injured persons ($n=339$ valid responses), 27.1% reported regular record keeping, 43.4% reported records with missing information, 17.1% reported records only in some cases, and 12.4% reported no systematic recording system.

Among 372 valid responses concerning food and water support, 27.7% reported that needs were fully and regularly met, 46.8% reported partial difficulties, 14.5% reported inadequate support, and 11.0% reported serious difficulty. Among 340 valid responses regarding teammates, 53.5% reported no problems, 25.0% situational problems, 18.2% minor disagreements, and 3.2% major problems. Among 336 valid responses regarding team leaders, 64.6% reported no problems, 24.1% occasional problems, 6.2% communication/decision-making problems, and 5.1% could not assess or selected another response. Detailed distributions for Items 21–25 are provided in Supplementary Table S2.

For obstruction by a team leader or area supervisor ($n=341$ valid responses), 62.8% reported no obstruction, 10.9% reported being obstructed a few times, 1.5% reported frequent obstruction, and 24.9% could not clearly assess the issue.

International team coordination and volunteer-related problems

For the multiple-response item concerning international rescue teams, 435 selections were recorded: no problem accounted for 40.7%, language barriers for 30.1%, differences in command chains and decision-making for 16.6%, and equipment incompatibility for 8.5%. These percentages describe selections rather than participant prevalence.

The volunteer/civilian item was single-response with 350 valid answers. Lack of training among civilians or volunteers was reported by 36.6%, authority conflict or role overlap by 21.7%, and privacy-related problems by 12.9%; 22.3% reported no problem and 6.6% selected another response.

Among 370 valid responses concerning preventive measures, 67.8% selected the combined use of standard operating procedures, technological solutions, and international standards; 10.3% selected SOP development,

10.0% international standards, 8.9% technological solutions, and 3.0% another response. Among 367 valid responses, search-and-rescue was most often identified as the most successful activity (45.2%), followed by health services (20.4%), aid distribution (18.0%), and shelter provision (16.3%) (Supplementary Table S2). Full response distributions for Items 29–30 are provided in Supplementary Table S2.

Selected associations between ethical challenges and participant/deployment characteristics

Age group was not associated with discrimination reporting after missing parent responses were excluded ($\chi^2 = 3.906$, df = 2, $p = 0.142$, V = 0.106, q = 0.227). Gender was not associated with privacy/confidentiality breach reporting ($\chi^2 = 0.187$, df = 1, $p = 0.665$, V = 0.023, q = 0.710).

Professional-title comparisons yielded the following results: privacy/confidentiality breaches ($\chi^2 = 7.387$, df = 3, Monte Carlo exact $p = 0.053$, V = 0.145, q = 0.121), mistreatment ($\chi^2 = 10.418$, df = 3, Monte Carlo exact $p = 0.025$, V = 0.173, q = 0.121), language barriers ($\chi^2 = 6.786$, df = 3, Monte Carlo exact $p = 0.079$, V = 0.141, q = 0.147), and equipment incompatibility ($\chi^2 = 8.921$, df = 3, Monte Carlo exact $p = 0.038$, V = 0.162, q = 0.121). None remained below q = 0.05. Sparse expected cells, partly arising from the small nurse subgroup, required Monte Carlo exact inference; these comparisons should be interpreted cautiously.

Years of service showed an unadjusted association with resource-distribution problem type ($\chi^2 = 17.848$, df = 9, $p = 0.037$, V = 0.132, q = 0.121), which did not remain below q = 0.05.

Education was not associated with resource-distribution problem type ($\chi^2 = 2.097$, df = 6, $p = 0.911$, V = 0.055, q = 0.911) or volunteer-related problem type ($\chi^2 = 6.686$, df = 8, $p = 0.571$, V = 0.098, q = 0.652).

Deployment timeframe (time-limited versus open-ended) was associated with language-barrier reporting before adjustment, but did not remain below q = 0.05 ($\chi^2 = 3.958$, df = 1, $p = 0.047$, V = 0.108, q = 0.121). Neither personal-needs status ($\chi^2 = 4.981$, df = 2, $p = 0.083$, V = 0.121, q = 0.147) nor obstruction by a team leader/area supervisor ($\chi^2 = 11.304$, df = 9, Monte Carlo exact $p = 0.194$, V = 0.109, q = 0.258) showed a supported association with their respective outcomes.

Inefficient resource use was associated with volunteer-related problem type ($\chi^2 = 16.742$, df = 4, $p = 0.002$, V = 0.221, q = 0.035) and was the only comparison retained below q = 0.05. The remaining coordination comparisons were not supported: information-flow disruption ($\chi^2 = 9.382$, df = 4, $p = 0.052$, V = 0.165, q = 0.121), assignment uncertainty ($\chi^2 = 5.861$, df = 4, $p = 0.210$, V = 0.131, q = 0.258), and overlapping authority ($\chi^2 = 6.571$, df = 4, $p = 0.160$, V = 0.138, q = 0.233). These exploratory associations do not establish directionality or causation.

Discussion

This study examined coordination-related ethical challenges reported by search-and-rescue, health, and support personnel involved in field operations or institutional coordination after the 6 February 2023 Kahramanmaraş earthquakes in Türkiye. Respondents reported ethical concerns alongside difficulties involving information flow, role clarity, authority boundaries, resource governance, volunteer involvement, and international-team coordination. These co-reported experiences are consistent with the conceptual framework, but do not demonstrate that coordination difficulties caused ethical harms.

Four areas were prominent in the descriptive findings: information-flow disruption; resource scarcity, distribution, and use; volunteer-related training and role concerns; and communication with international teams. These reports identify operational contexts in which respondents perceived ethical challenges. The survey did not independently assess operational performance or safety outcomes.

After correcting the treatment of missing multiple-response answers, inefficient resource use was the only association retained below the BH-FDR threshold. Professional-title comparisons and all other associations did not remain below q = 0.05. These patterns require cautious interpretation because of retrospective self-report, small subgroups, and the exploratory design.

A central finding of this study is that information-flow disruption was the most frequently reported coordination-related problem. In disaster response, information flow is not merely a technical communication issue. It directly influences the speed, safety, fairness, and accountability of operations. When field teams do not receive timely, accurate, and consistent information, rescue activities may be delayed, resources may be duplicated or misdirected, and affected populations may experience unequal access to assistance.

This finding is consistent with previous studies emphasizing the importance of communication, shared operational awareness, and command coordination in disaster response. Studies on the Kahramanmaraş earthquakes and previous earthquake responses have similarly identified communication problems, weak institutional networks, and fragmented information-sharing mechanisms as barriers to effective field response [22, 24–26]. Evidence from the 2011 Tohoku-Oki earthquake also highlights the importance of a common operational picture and balanced information flow between central and local authorities [23]. The present study adds to this literature by showing that information-flow problems also have an ethical dimension: they may contribute to perceived unfairness, delayed intervention, confusion in prioritization, privacy risks, and loss of trust in the response system.

From a safety science perspective, disaster coordination should therefore be treated as a safety-critical function. The ability to maintain a shared operational picture, communicate needs and decisions rapidly, and prevent contradictory instructions is essential not only for operational effectiveness but also for ethically defensible response. In this respect, information governance should be embedded in disaster preparedness plans through standard reporting templates, traceable task records, interoperable communication systems, and clear decision-escalation pathways.

Resource scarcity was the most frequently reported problem in relation to materials, equipment, personnel, and other resources needed for rescue or emergency intervention. Participants also reported inequitable distribution and misuse of resources. These findings are important because resource allocation is one of the areas where operational constraints and ethical principles most clearly intersect. In disaster settings, decisions about the distribution of scarce resources affect not only the efficiency of response but also perceptions of fairness, legitimacy, and public trust.

Humanitarian standards emphasize dignity, impartiality, accountability, and assistance based on need [2, 6, 9]. Similarly, national disaster response structures such as TAMP aim to define roles, responsibilities, and resource coordination mechanisms in advance [7, 8]. However, the present findings suggest that the existence of formal plans does not automatically eliminate field-level allocation problems during large-scale disasters. When the scale of destruction exceeds routine capacity, gaps may emerge between planned resource governance and actual field implementation.

Age group and gender were not associated with discrimination and privacy-breach reporting, respectively, in the revised analyses. None of the professional-title comparisons remained below the BH-FDR threshold. The small nurse subgroup and sparse cells limit the stability of subgroup comparisons.

These results point to the need for transparent and traceable resource governance. Resource allocation in large-scale disasters should not depend solely on ad hoc decisions made under pressure. Instead, preparedness systems should include predefined prioritization criteria, real-time inventory tracking, transparent distribution logs, and field-level accountability mechanisms. Such mechanisms may reduce both inefficient use of resources and perceptions of unfairness.

Another important field-level issue concerned the identification and documentation of deceased persons. Participants frequently reported difficulties in identification, family notification, and the transportation or preservation of bodies. These findings underline the need for standardized disaster victim identification procedures, traceable documentation systems, and coordinated forensic processes. The identification methods used following the Kahramanmaraş earthquakes have also been documented in the national literature [29].

Respondents reported volunteer-related concerns involving lack of training, authority conflict or role overlap, and privacy. Inefficient resource use was associated with volunteer-related problem type after BH-FDR adjustment ($q = 0.035$). The information-flow comparison was not supported ($p = 0.052$; $q = 0.121$). These results

support further investigation of volunteer integration and resource coordination without establishing the direction of the relationship.

Volunteers can provide essential support in large-scale disasters, especially when professional response capacity is overwhelmed. However, without registration, briefing, task zoning, supervision, and integration into the command structure, volunteers may unintentionally increase operational burden. They may enter unsafe areas, duplicate tasks, interfere with professional teams, misuse scarce resources, or compromise the privacy and dignity of affected individuals. Therefore, volunteer participation should not be treated as an informal or spontaneous component of disaster response. It should be planned as part of the response architecture.

These findings are consistent with previous research showing that collaboration with civil society organizations and volunteers can create coordination challenges when roles and responsibilities are not sufficiently defined [21]. They also align with studies emphasizing that disaster personnel need not only technical training but also preparation in humanitarian principles, ethical decision-making, and rights-based disaster response [13, 28]. For future disaster preparedness, volunteer management should include pre-disaster registration systems, minimum training requirements, rapid field briefing, role cards, restricted access zones, supervision protocols, and privacy rules.

The study also identified language barriers and differences in command chains or decision-making processes as important challenges in collaboration with international rescue teams. The reported command- and decision-related difficulties may partly reflect the tension between operational knowledge and formal authority previously described in international disaster relief work [31]. Although many participants reported no problems with international teams, language barriers accounted for 30.1% of selections. In the unadjusted analyses, deployment timeframe was associated with language-barrier reporting ($p = 0.047$), whereas professional title ($p = 0.079$) and personal-needs status ($p = 0.083$) were not. None of these associations remained below the BH-FDR threshold after adjustment. This finding should be interpreted in terms of interoperability. International teams can substantially increase response capacity in major disasters, but their effectiveness depends on shared terminology, compatible operating procedures, liaison structures, translation support, and a clear understanding of command arrangements. In large-scale disasters where time pressure is high and field conditions are unstable, even minor communication gaps can lead to misdirection, duplicated efforts, delayed decisions, or uncertainty about responsibility.

INSARAG guidelines provide an important framework for international search-and-rescue coordination [5]. However, the present findings suggest that the operationalization of international coordination also requires practical field tools, such as interpreter pools, multilingual reporting templates, liaison officers, pre-defined coordination points, and common terminology for rescue, medical, logistics, and safety operations. These tools may strengthen interoperability and reduce preventable coordination failures in future international disaster responses.

The findings also highlight the importance of personnel support conditions. Only about one-quarter of participants reported that their personal needs were fully met, while many reported partial or unmet needs. A large proportion also reported continuous 24-hour work during deployment. These conditions are not only occupational welfare issues; they can affect operational safety, decision quality, communication, and ethical sensitivity.

Personnel who are exposed to prolonged working hours, insufficient rest, unmet basic needs, and high psychological pressure may experience reduced situational awareness, impaired communication, and increased vulnerability to stress-related errors. In this sense, responder welfare should be considered a structural component of disaster resilience. Human resources management in disasters should include rotation plans, rest periods, nutrition and hydration support, safe accommodation, psychosocial support, and mechanisms for reporting fatigue or distress.

Previous studies have emphasized human resources management, training, command structures, and support systems in disaster response [27, 30]. The present descriptive findings identify personnel support as a practical concern. They do not establish that unmet needs caused ethical or operational difficulties; the personal-needs association with language barriers did not remain below the BH-FDR threshold.

One of the strongest practical findings of the study is that most participants supported a combined approach involving standard operating procedures, technological solutions, and alignment with international standards. This suggests that field personnel perceive ethical risk reduction not as a separate moral training issue but as part of operational system design.

Based on the findings, several practical implications can be drawn. First, disaster response plans should include ethics-integrated coordination protocols that translate principles such as fairness, dignity, accountability, and non-discrimination into field-level procedures. Second, information governance should be strengthened through shared operational platforms, standardized reporting formats, and traceable communication channels. Third, resource allocation should be made more transparent through real-time inventory systems, distribution logs, and predefined prioritization rules. Fourth, volunteer participation should be regulated through registration, briefing, task zoning, supervision, and privacy protocols. Fifth, international team coordination should be supported by interpreter systems, liaison officers, and common operational terminology. Finally, personnel welfare should be embedded into preparedness plans as a core component of operational resilience.

These implications are particularly relevant for safety science because they show that ethical preparedness is not limited to awareness of humanitarian principles. Ethical preparedness requires coordination mechanisms that make ethical principles actionable under pressure. In large-scale disasters, fairness, accountability, and dignity must be built into the operational architecture of response.

Strengths and limitations

This study has several limitations. First, it concerns personnel deployed after a single large-scale earthquake event in Türkiye, limiting transferability to other disasters, countries, and response systems. Second, voluntary convenience sampling may have introduced selection and non-response bias and does not support claims of representativeness; the available dataset does not contain the total number invited or refusals, so a conventional response rate cannot be calculated. Third, the retrospective self-report design is susceptible to recall and perceptual bias. Fourth, the Ethical Issues Assessment Form was developed as an applied field-assessment instrument rather than a comprehensively validated psychometric scale. Fifth, numerous exploratory bivariate comparisons increase the risk of Type I error; this was addressed through BH-FDR sensitivity analysis, and several borderline unadjusted findings did not remain below $q = 0.05$. Sixth, some professional subgroups were very small (notably nurses, $n = 6$), producing sparse contingency-table cells; exact procedures were therefore used where appropriate, but subgroup estimates remain potentially unstable. Although the form underwent qualitative review through face-to-face interviews with 12 experts, no quantitative Content Validity Index was calculated and no pilot study was conducted. These limitations constrain the evidence for content validity and comprehensibility before the main survey. The sample included 29 administrative personnel who coordinated the response from their institutions rather than the disaster area. Their reports may reflect indirect information and a different observational perspective from that of field personnel; pooled findings should be interpreted with this heterogeneity in mind.

Despite these limitations, the study has important strengths. It provides empirical evidence from personnel involved in field operations and institutional coordination during a major disaster response and focuses on the underexamined relationship between coordination processes and ethical risks. It also integrates field experience with national and international disaster-response frameworks.

Future research should use mixed-methods designs to combine survey findings with qualitative interviews, institutional after-action reports, and operational records. Comparative studies across different disaster types, regions, and responder groups may help identify which coordination failures are context-specific and which are recurrent across disaster systems. In addition, future intervention studies should evaluate whether ethics-integrated coordination packages—such as transparent resource governance, shared information systems, role-authority clarification, structured volunteer onboarding, and personnel support protocols—improve information flow, resource efficiency, operational safety, and public trust in disaster response.

Conclusions

Among personnel surveyed after the 2023 Kahramanmaraş earthquakes, self-reported coordination difficulties co-occurred with a range of ethical concerns, particularly those involving information flow, resource governance, role and authority clarity, international-team communication, and volunteer involvement. The exploratory associations observed in this cross-sectional study should not be interpreted as evidence of causal relationships.

Within the limitations of convenience sampling, retrospective self-report, item-level measurement, and multiple exploratory comparisons, the findings point to coordination processes as an important context for understanding ethical challenges in large-scale disaster response.

Future research using validated measures, mixed methods, operational records, and prospective or comparative designs is needed to test these relationships and to evaluate whether coordination-focused interventions improve ethically relevant and operational outcomes.

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Data availability All data related to this study are available and can be sent upon request.

Declarations

Ethics approval and consent to participate This study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Lokman Hekim University Scientific Research Ethics Committee (28.06.2024; 2024/164). Informed consent was obtained from the participants; no directly identifying information was collected in the analysis dataset, and the data was stored with restricted access.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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