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A qualitative study of health problems, risk factors, and prevention among Emergency Medical Service workers

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Abstract.
BACKGROUND: Risk factors among Emergency Medical Service (EMS) workers are difficult to characterize and inconsistencies remain about their main health problems.
OBJECTIVES: To identify main work-related health problems among EMS workers in the United States; identify risk factors at the organizational, task, and exposure level; identify prevention strategies; examine these issues between participants (EMS workers and supervisors).
METHODS: Two types of qualitative research methods based on grounded theory were used: in-depth interviews with emergency medical technicians/paramedics (EMS workers) and focus groups (EMS workers and supervisors).
RESULTS: Most participants reported similar health problems (musculoskeletal injuries) and the task related to these injuries, patient handling. Participants also reported similar physical exposures (ascending stairs with patients and patient weight). For organization/psychosocial factors, participants agreed that fitness, wages, breaks, and shift scheduling were linked with injuries, but overall, perceptions about these issues differed more than physical exposures. Lack of trust between EMS workers and supervisors were recurrent concerns among workers. However, not all organizational/psychosocial factors differed. EMS workers and supervisors agreed pre-employment screening could reduce injuries. Participants identified micro- and macro-level prevention opportunities.
CONCLUSIONS: The grounded theory approach identified workers' main health problems, and the organizational factors and exposures linked with them. Perceptions about work organization/psychosocial exposures appeared more diverse than physical exposures. Prevention among all participants focused on mechanized equipment, but EMS workers also wanted more organizational support.

Keywords: Interviews, focus groups, low back pain, exposures, organizational factors, primary prevention

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1. Introduction

Emergency medical service (EMS) workers provide pre-hospital emergency care and are integral to disaster response [1]. Because of the changing nature of health care, EMS workers also routinely transfer in-patients from Community Hospitals to tertiary care Medical Centers. While accurate numbers of EMS workers are difficult to obtain, there are an estimated 700,000 EMS workers (emergency medical technicians/EMT and paramedics) in the United States (US) who treat approximately twenty-two million patients per year [1]. Paradoxically, EMS work involves occupational exposures associated with ill health.

A National Institute for Occupational Safety and Health (NIOSH) report recently highlighted two of their most hazardous exposures, exertion and "bodily reaction," and their most common health problem, low back pain [2]. One study found relative risks (RR) for patient handling injuries among EMS workers were slightly higher than for all other types of health care workers (RR = 1.1, 95% CI 1.0–1.2) [3]. Maguire et al. [4] found that RRs for patient handling injuries among EMS workers were higher than for firefighters (RR = 1.5, 95% CI 1.4–1.7). Recent Bureau of Labor Statistics reported that EMS workers were ranked the top occupation with injuries from overexertion and patient handling [5].

Conversely, a report from the National Highway Traffic Safety Administration (NHTSA) reported EMS workers were at risk from six hazardous exposures, leading to diverse health problems: 1) patient handling resulting in low back pain, 2) traumatic events (for example, earthquakes) resulting in post-traumatic stress disorder, 3) job stress associated with trouble sleeping and cardiovascular disease, 4) traumatic injuries or violence leading to acute trauma, and 5) needle stick injuries related to infectious disease, while 6) transportation was associated with fatalities [1].

Additional research has corroborated the NHTSA report. EMS workers are at an elevated risk of low back pain [6]. EMS workers are also at risk for developing sequelae from exposure to traumatic events [7] and have a high prevalence (46%) of job stress [8]. The Longitudinal Emergency Medical Technician Attribute and Demographic Study (LEADS) found the leading complaint for EMTs was trouble sleeping, often associated with job stress [9]. Another study found that early retirement was most associated with cardiovascular disease in the EMS [10]. Several authors found that EMS workers have high rates of traumatic injuries (e.g., 35 per 100 workers) [11]. Mock et al. [12] found that 5% of EMS runs were classified as involving aggression. Maguire et al. [13] found the occupational fatality rate among EMS workers was 13 per 100,000.

The literature on infectious disease is more uncertain. While a past review reported contact with body fluids involving needle stick injuries accounted for 15% of exposures [14], current studies found these injuries have declined [1]. Conversely, a recent NIOSH publication reported the third most hazardous exposure to EMS workers was harmful substances, such as potentially infectious bodily fluids [2].

1.1. Research gaps and needs

Work-related tasks among EMS workers are difficult to characterize because their work environment is unfixed and autonomous. Inconsistencies in the literature remain about their main health problems and which exposures are associated with them. Moreover, limited research exists on prevention [15–17]. Little information also exists about perceptual differences within EMS workers and between EMS workers and supervisors about these issues.

Examining EMS workers now is particularly germane. The NHTSA recently reported the need for EMS is increasing because the nation is challenged with an older and increasingly diverse population, overall workforce shortages, and the increasing potential for national traumatic events [1].

One method to explore these topics is to listen to workers and supervisors and, from their stories, develop a conceptual framework in order to reduce hazards through prevention strategies. A qualitative research approach was chosen to explore these issues as the first step in a series of epidemiologic studies that aim to longitudinally characterize risk factors associated with EMS workers' health problems and identify interventions using prospective and experimental methods.

1.2. Objectives

We sought to 1) identify main work-related health problems among EMS workers, 2) identify their risk factors at the organizational, task, and exposure level, 3) identify prevention strategies, and 4) examine responses within EMS workers and between EMS workers and supervisors.

2. Methods

Two types of qualitative research methods, based on grounded theory, were used: in-depth interviews with key informants (EMS workers) and focus groups (EMS workers and supervisors). One goal of grounded theory is to discover the participants' main problems and how they attempt to control them. Another goal is to formulate hypotheses based on conceptual ideas related to the main problems and the control of these problems [18–20]. Grounded theory is most commonly used with qualitative data [21]. Thus, a qualitative approach was used to characterize perceptual and cognitive processes related to these conceptual ideas [22, 23]. The study protocol, consent forms, and surveys were approved by our institution's Internal Review Board.

2.1. Participants

Participants (EMS workers and supervisors) were drawn from an Emergency Medical Services Operations Unit (EMSOU), which is the largest hospital-based ambulance service in the North Eastern US. It provides emergency ambulance service and inter-facility transfer services throughout their catchment area. While it employs over 500 EMS workers and supervisors who operate and manage 110 available response units and respond to more than 120,000 requests a year, this study focused on approximately 319 participants, based on their assigned catchment area.

Interviews were based on a sample of convenience. Times for in-depth interviews were arranged in coordination with EMS management. Management initially identified ambulances at "waiting emergency call time." The researchers then travelled to the on-duty waiting emergency call site. The researchers approached the team (one EMT and one paramedic) in the ambulance, described the purpose and procedures of the project, and asked them if they would be interested in participating. If they agreed, following study consent, the researchers contacted management, who then ensured that interviewees were assigned as on-duty for a call. Interviews lasted approximately 45 minutes and took place in the patient compartment of the ambulance. A total of ten teams were interviewed ($n = 20$).

For focus groups, an email was sent to all workers and supervisors, describing the purpose and procedures of the project and asking potential volunteers to contact the researchers if they were interested in participating. Workers ($n = 68$) and supervisors ($n = 22$) who volunteered were assigned an integer in chronological order, based on the date they volunteered.

Based on the literature from grounded theory [21, 22], we required approximately twenty to forty participants (for example, four focus groups, with ten participants per group). To achieve this value in light of the number of volunteers ($n = 90$), potential participants were randomly assigned (allocated) to either participate or not participate by an epidemiologist, blind to study objectives to avoid predictable sequences. The epidemiologist recorded the assignment at the same time he performed the randomization procedure to avoid manipulation of assignment.

A simple individual randomization scheme was used. Stata 11 (StataCorp, College Station, TX, USA) generated a dichotomous (0, 1) randomization sequence analogous to a repeated fair coin tossing for each participant. Potential participants could be randomly assigned to participate based on a pre-defined 50% event probability, where 0 = non-participant and 1 = participant. The randomization sequence was reiterated until the predetermined number of participants was obtained: two focus groups of EMS workers ($n = 10$ per focus group) and two focus groups of supervisors ($n = 9$ per focus group).

Allocation concealment and implementation of assignments followed sequence generation and were kept secret from the authors and volunteers until after they were assigned to their groups (that is, participant or non-participant) by the epidemiologist. Each volunteer was given an identical sealed envelope by an author, which contained their assignment. Study consent was then obtained among participants.

Focus groups lasted 1.5 hours and took place at the EMSOU on agency time. Times for the focus groups were arranged in coordination with management. Schedules were coordinated to ensure participation did not interfere with job duties. Supervisors did not participate in the same focus groups as workers.

To provide supplemental and contextual information, individual and work environment characteristics among participants were obtained just prior to interviews and focus groups. These items were based on the LEADS Core Survey [24] and the EMS workforce for the 21st Century [25]. A list of organizational/psychosocial factors and physical exposures/individual characteristics obtained from one health and safety workshop conducted two years previously with participants ($n = 27$) helped guide the development of open-ended questions; employees and supervisors who took part in the workshop were ineligible to participate in the study.

Response characteristics (age, gender, and history of lower back or shoulder injury) between volunteers ($n = 110$) and non-responders ($n = 209$) within the EMSOU were collected from an administrative data base to examine potential selection bias.

2.2. Data collection

Initially, three open-ended pilot questions were presented to two interviewees and five focus group participants (workers and supervisors) who were not included in the study [22]. The questions were: 1) Which work-related health problem was EMS workers' main concern? 2) Which work-related risk factors were EMS workers' main concerns? 3) What prevention strategies existed to reduce EMS workers' main work-related health problems? A fourth item, not used in interviews or focus groups, but rather used by researchers to determine whether responses differed by participants was: 4) Do perceptual differences exist within EMS workers and between EMS workers and supervisors?

Pilot questions for the interviews and focus group were led by the most experienced focus group researcher, with the less experienced focus group researcher operating the audio-recorder, participating in discussions, and taking supplementary notes. The more experienced researcher had twenty years of experience conducting interviews and focus groups, while the less experienced researcher had eighteen years conducting qualitative research.

While we used a discussion guide for interviews and focus groups [26, 27], the guide was modified based on participants' responses during pilot sessions. The pilots informed the researchers as to whether modifications, additions, or deletions were required to questions or the guide.

The four questions were modified and expanded into six opened-ended questions for interviews and focus groups to provide a richer, more in-depth story among participants. The researchers assumed the same roles as they did in the pilot survey, noted above. The expanded questions were: 1) What was the participant's main work-related health problem? 2) Which tasks were related to the workers' main work-related health problem? 3) Which physical exposures were related to the workers' main work-related health problem? 4) Which organizational factors and psychosocial exposures were related to the workers' main work-related health problem? 5) What prevention strategies existed to reduce the main work-related health problem? 6) Do differences exist within EMS workers and between EMS workers and supervisors on these issues?

To ensure that an assertive participant did not dominate interviews or focus groups, or to reduce the possibility that a participant might be more responsive or deferential to another participant, the moderators employed two iterations of a round robin algorithm [28], in which each participant took, in turn, an equal share of the discussion. The second iteration used probing questions to further elicit responses from each participant. These were: 1) Were there any other severe or frequent health problems the participants' would like to discuss? 2) Were there any other hazardous tasks related to the workers' main health problem? 3) What were the most hazardous physical exposures related to the workers' main health problem? 4) What were the most hazardous organizational factors and psychosocial exposures related to the workers' main health problem? 5) What types of prevention strategies were most cost effective and simple to implement?

Both interviews and focus groups followed an identical format to ensure standardized data extraction methods. Interviews and focus groups were transcribed verbatim from the audio-recordings. Transcriptions were then used for data management and analysis.

Data collection for interviews and focus groups occurred as "rounds" [22]. Twenty workers (ten paired interviews) consisted of two rounds; each round consisted of five pairs of workers ($n = 10$). Four rounds of focus groups consisted of two rounds of twenty workers ($n = 10$ workers per round) and two rounds of eighteen supervisors ($n = 9$ per round). After each round, data management was performed to organize data collection. Data were then analyzed to define potential themes [22, 29].

2.3. Data management and analysis

A general summary of interviews and focus groups was written. A researcher reviewed each participant's interview and focus group to check for measurement error when transcribing recordings, to assess precision of transcriptions, and to ensure the participants' important points were captured [22]. Once validity was established, the same researcher completed a contact summary sheet to reflect each interview and focus group [22, 31]. This sheet consisted of three items: 1) Main issues that were revealed in interviews and focus groups; 2) Information obtained from these discussions; 3) Salient, interesting, illuminating, and important factors.

Following completion of the contact summary sheet, a theoretical framework was developed based on the following general procedure: Key points within transcripts were systematically marked from data collected with a series of codes (anchors that allowed key points of data to be gathered) extracted from text [29]. The codes were grouped into similar concepts (a collection of codes of similar content that allowed data to be grouped). From these concepts, themes (broad groups of similar concepts) were developed. The themes that were identified were based on participants' statements and interrelated [22, 29], and helped to explain participants' perceptions [22, 30], such as the link between a work-related physical or psychosocial exposure and health problem [22, 30]. Themes also generated hypotheses (a collection of explanations explaining the research subject) [19, 22, 29].

Specific procedures for the development of the theoretical framework involved a step-by-step approach, using three coding procedures (open, axial, and selective) [22, 30]. Initially, an open coding process was reiterated four times [22] to analyze each interview and focus group transcript. To further ensure standardization of data extraction, the process followed this procedure [22]: 1) scan text to capture the essence of interviews and focus groups; 2) perform line-by-line analysis to identify code words; 3) write memos and draw diagrams for each interview and focus group; 4) write a detailed summary of each interview and focus group. After each round (six rounds in total) data were compared to identify similarities and differences and develop concepts, themes, and subthemes. The contact summary sheet helped corroborate these findings. After the last round, additional interviews and focus groups stopped because both methods yielded no new information; data saturation was reached.

Axial coding was conducted concurrently with open coding. Data were reconstructed to show relations among themes and link themes and subthemes with other themes and subthemes. To organize data, a model was developed to show relations between various themes based on the study's grounded theory framework [22, 29]. The overarching context was: EMS workers' main work-related health problem and work organization; task, and physical and psychosocial exposures related to these conditions; strategies and barriers for primary prevention. Specific themes linked with this model were lower back and shoulder injuries, which were related to work organization, including management policies and workers' perceptions about these policies. Several subthemes surfaced, including patient handing (task), partners, environmental factors, financial constraints, and worker-supervisor relationships. Opportunities (consequences) also emerged, including the potential for improved patient care, workforce safety, and performance, as did organizational challenges (additional consequences).

Finally, a selective coding process was performed. A story line was written producing one central theme [22]: Musculoskeletal injuries were related to the work environment and work organization (consisting of physical and psychosocial exposures) [32]. Additional but similar themes and subthemes then emerged: organizational structure, management style, and policies (themes), weight, force, posture, number of calls, weather and house or apartment layout, funding for on-going training, inadequate medical care for EMS workers, job control, updated equipment, choosing partners, poor social support, breaks, low pay, second jobs, and trust (subthemes) were linked with lower back and shoulder injuries.

3. Results

Table 1 presents individual characteristics of participants ($n = 58$). The majority of workers were 35 years old or under, while all supervisors were older than 35 years. All participants were male and the majority were white and had at least an associate's degree or two years of education and training in EMS. Most workers reported their health status (for example, back problems) had worsened over the past year and the majority of workers in the focus groups reported trouble sleeping. Conversely, less than 50% of supervisors reported that any health problems had worsened; those reporting problems stated lower back conditions were the main issue. Although most workers reported that back problems had worsened, the majority rated their overall health status and physical fitness as good to excellent. While fewer than 50% of interviewees earned less than $60,000.00 per year, EMS focus group participants and supervisors reported earnings of more than $60,000.00 per year, although this may have involved working two or more jobs. EMS focus group participants and supervisors had at least eight years of EMS experience, while most interviewees had the opposite. All participants had over nineteen calls per week. When asked what was the most severe and frequently occurring injury or illness over their working life in EMS, the majority reported musculoskeletal conditions.

Tables 2 and 3 present data from a health and safety workshop obtained two years before the study

Table 1
Individual characteristics and work environment from interviewees and focus group participants

Individual characteristics	Interviews EMS workers ($n=20$) n (%)	Focus Group EMS workers ($n=20$) n (%)	Focus Group Supervisors ($n=18$) n (%)
Date of birth			
<than 35 years old*	13 (65%)	17 (85%)	0 (0%)
Gender: male	20 (100%)	18 (90%)	18 (100%)
Which of the following categories describes you			
Asian		1 (5%)	
Hispanic or Latino		2 (10%)	
White	20 (100%)	17 (85%)	18 (100%)
Highest level of education			
Associates degree or greater	12 (60%)	13 (65%)	15 (83%)
Health status has gotten worse over the past year			
Hearing problems	0 (0%)	1 (5%)	0 (0%)
Sleeping problems	7 (35%)	11 (55%)	0 (0%)
Back problems	17 (85%)	15 (75%)	7 (39%)
TB turned+	0 (0%)	0 (0%)	0 (0%)
Overall health status			
Good to Excellent	11 (55%)	14 (70%)	15 (83%)
Overall physical fitness			
Good to Excellent	13 (65%)	11 (55%)	13 (72%)
Work environment			
Money earned from EMS related jobs in past year			
$20,000–$59,999	12 (60%)	6 (30%)	
>$60,000*	8 (40%)	14 (70%)	18 (100%)
Different organizations you work for			
2 or more	14 (70%)	17 (85%)	16 (89%)
Number of calls in typical week			
>19	20 (100%)	20 (100%)	16 (89%)
Years worked in EMS			
<1 year to 3–7 years	12 (60%)	8 (40%)	
>8 years	8 (40%)	12 (60%)	18 (100%)
If injured, what was the most severe injury over your working life in EMS?			
Musculoskeletal	20 (100%)	20 (100%)	18 (100%)
Non-musculoskeletal			
If injured, what was the most frequent injury over your working life in EMS?			
Musculoskeletal	20 (100%)	20 (100%)	18 (100%)
Non-musculoskeletal			

Interviews of paired teams of emergency medical service (EMS) workers comprised 50% emergency medical technicians (EMTs) and 50% paramedics. Focus groups of EMS workers comprised both EMTs and paramedics. *< = less than.> = greater than.

[24, 25]. Both workers and supervisors ($n=27$) were asked about organizational factors and psychosocial exposures (Table 2) and physical exposures and individual factors (Table 3) related to work-related injuries and illnesses. Ambulance design, tours greater than twelve hours, inexperienced new hires, lack of choice when choosing a partner, lack of pre-employment screening, no batteries for power stretchers, poor social support, lack of scheduled breaks, referral sources to physicians once injured, and ineffective policies for reporting injuries were main organizational/psychosocial concerns (Table 2). The majority of workshop participants reported the patient's weight, lifting patients, negotiating stairs, weight and number of pieces of equipment, long sitting time in the ambulance between calls, weather, and poor physical fitness of their partner were main physical exposures and individual factors related to injuries and illnesses (Table 3).

Table 4 shows response characteristics between volunteers and non-responders, which were collected from an administrative database. While marked differences in distributions existed for age and gender (more non-responders were less than 35 years old and female), distributions of lower back or shoulder injuries were similar between groups.

Table 2
Emergency medical service workers and supervisors perceptions on importance of organizational and psychosocial factors related to incident injuries or illnesses

Importance each of the following is in relation to developing injuries or illnesses?	Very important or moderately important ($n=27$)* (%)
Lack of choice in choosing partner	100%
Pre-employment screening and agility testing	100%
Provide referral sources to medical doctors	97%
New, inexperienced hires	93%
Provide an effective policy for reporting EMS injuries	89%
Ambulance design	88%
Scheduled meal and restroom breaks	73%
No batteries for power stretchers	70%
Poor organizational social support	69%
Tours>12 hours	62%
Daily or weekly maintenance checks on all equipment	48%
Training on waiting for proper resources and assistance in the field	41%
Second job	35%
No control over work environment due to unexpected events	33%
Lack of third crew	27%
Lack of good equipment at the EMSOU	17%

*Includes both EMS workers and supervisors in one health and safety workshop obtained two years prior to the study. EMSOU = Emergency Medical Services Operations Unit.

Table 3
Emergency medical service workers workers and supervisors perceptions on importance of physical exposures and individual factors related to incident injuries or illnesses

Importance each of the following is in relation to developing injuries or illnesses?	Very important or moderately important ($n=27$)* (%)
Weight of the patient	100%
Negotiating stairs with patients	100%
Lifting a patient (may involve one or two EMS workers)	100%
Poor physical fitness of partner	100%
Weather	92%
Carrying a patient (with two EMS workers)	91%
Long sitting time between calls	86%
Weight and number of pieces of equipment	77%
My own poor physical fitness	44%
Motor vehicle accidents	33%
Exposure to body fluids	7%
Exposure to noise	3%

*Includes both EMS workers and supervisors in one health and safety workshop obtained two years prior to the study.

Table 4
Response characteristics between volunteers and non-responders

	Volunteers ($n=110$) (%)	Non-responders ($n=209$) (%)
Age (<35 years old)*	68%	83%
Gender (female)	8%	20%
History of low back or shoulder injury	89%	85%

*< = less than.

3.1. Qualitative findings

Findings from coding procedures showed themes and subthemes that explained participants' stories about health problems, organizational factors, tasks, exposures, and prevention. While each participant had a unique story, common patterns emerged, which were enriched with descriptive details from each story. The study's central theme was that lower back and shoulder musculoskeletal conditions were linked with patient handling (task), organizational factors, and exposures. The following sections present conditions, themes, and subthemes based on a model from which consequences emerged (Fig. 1). Participants' distinct quotes were documented.

3.2. Conditions: Health problems and related tasks

Most participants reported the same main health problems (lower back and shoulder injuries) and the task (patient handling) related to these problems. An EMS interviewee noted that "*all I have to do is injure my low back once. Once I have an injury, just one wrong move with a patient or when carrying equipment will flare me up. I can lose three months of work.*" A supervisor reported that a "*big, heavy set worker hurt his right shoulder when laterally transferring a patient and now he's out for over six months. He came back too soon, hurt the same shoulder, and left work again for another three months.*" On allowing injured workers back on the job too soon, an EMS interviewee said "*a partner with a low back injury can't do his job because he's afraid of re-injury. That places extra stress and strain on me and increases my chance of injury. He can reinjure his low back any time on this job.*"

A few other health problems were reported. Some new hire interviewees said that blood borne pathogens, needle sticks in particular, were frequently encountered. Workers reporting this exposure had less than three years of experience, and this exposure was not corroborated by the majority of participants. Rather, they stated this exposure was "*engineered out.*"

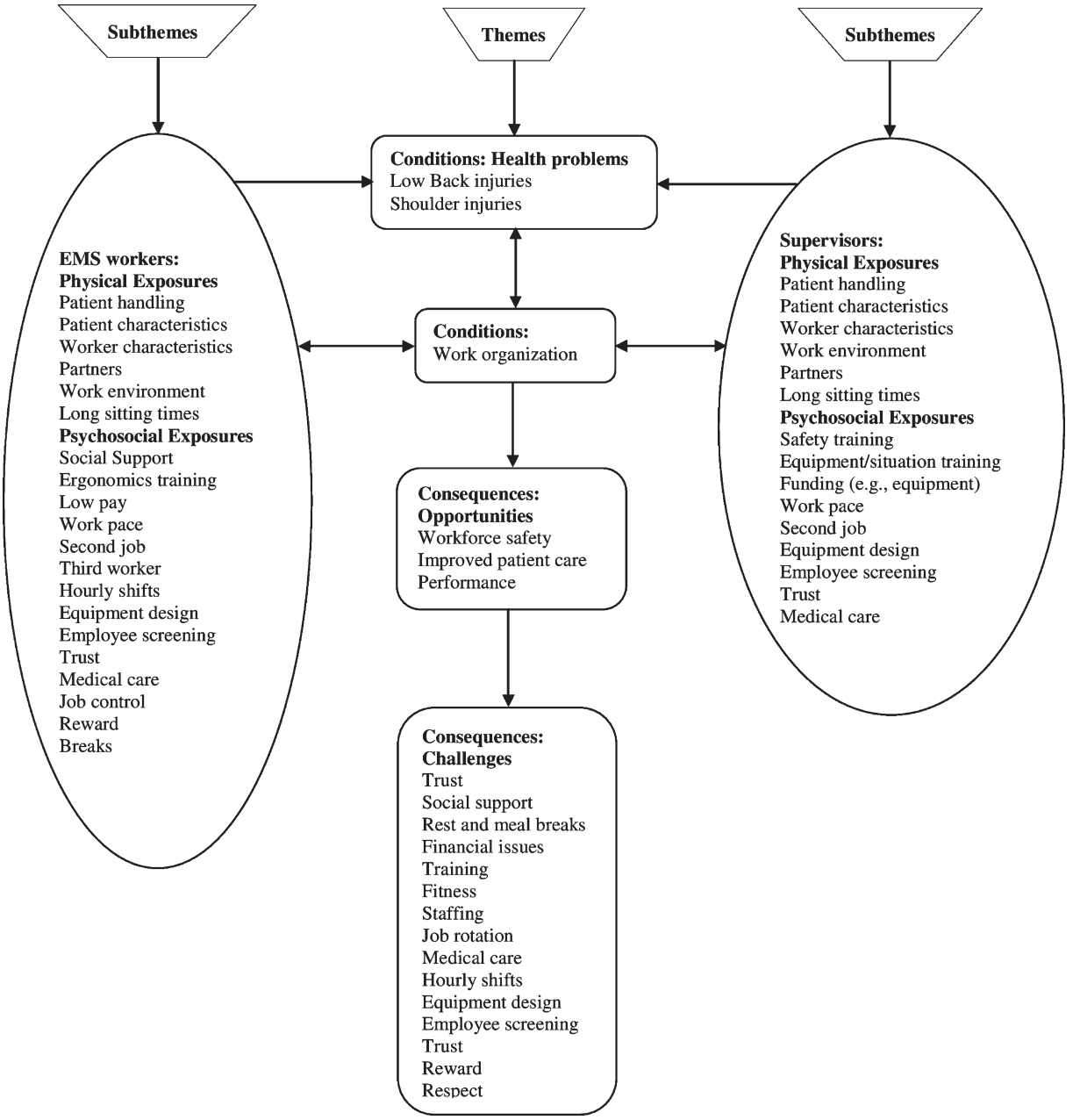

Fig. 1. Model showing the relation among themes, subthemes, conditions, and consequences based on a grounded theory framework.

A few supervisors reported that cardiovascular disease and metabolic problems, such as obesity, were concerns, but these problems were neither nearly as common nor led to more lost workdays as lower back or shoulder injuries. The majority of supervisors also linked obesity with musculoskeletal injuries. Likewise, certain supervisors reported that assaults may occur, with one supervisor citing an incident in which a patient assaulted several EMS workers; the assault on one of the workers led to a "*career ending incident.*"

3.3. Themes and subthemes: Exposures and work organization

Participants, in general, reported similar physical exposures (for example, weight of either patients,

workers, or both). One previously injured EMS focus group participant said "*a patient over 250–300 pounds is going to be difficult and dangerous to handle. Usually a third person is required.*" Another EMS focus group participant stated "*an overweight partner puts more pressure on me. He's out of shape and I have to do most of the lifting and carrying. I end up getting hurt.*"

The danger when handling patients on stairs was nearly unanimous (a large majority of both EMS staff and supervisors agreed) for two reasons: body dimensions and strength. Participants agreed that carrying a patient on a stair chair was more hazardous for tall workers. Tall workers often had to flex their hips and low backs into awkward postures to accommodate their smaller partners; patients trying to help, such as when reaching for stair rails, compounded the hazard. Workers also reported that stairs were often narrow and curved. They had a saying, "*the heavier the patient, the more flights of stairs.*" Supervisors reported that workers must be vigilant about toys or household devices when negotiating stairs.

Most supervisors reported that weight and number of pieces of equipment that EMS staff and their partners carried and handled, combined with icy, wet weather were "*headaches.*" The majority of workers agreed with supervisors about wet conditions, although supervisors emphasized they "*constantly worry about weather. Slips, trips and falls are factors related to rain, sleet and snow. It's a big problem related to low back issues while handling patients.*"

Most participants agreed that long sitting times between calls was a main problem. One supervisor noted that "*patients and families think these workers are super athletes. That they can sit for hours in the front of their vehicles with the engines running, being stiff, not flexible, not moving, and then – without any warm up – become strong and work at super fast speeds.*"

Upstream organizational factors seemed more disparate between EMS staff and supervisors, most notably for meal and rest room breaks and work shifts. Participants' perceptions about breaks were marked. Interviewees noted there were "*no scheduled bathroom or meal breaks.*" An EMS interviewee said: "*I always end up eating junk food because there's never scheduled meal breaks. I gain so much weight because of eating fast food. I can't eat healthy food on this job. There's no time.*" Conversely, supervisors were almost unanimous that every worker gets scheduled bathroom and meal breaks in the field. As one noted, "*workers already receive breaks.*"

Most participants agreed the change from 13–16 hour tours to 8–12 hour tours reduced fatigue and injuries; however, an EMS interviewee stated it "*doesn't matter that they changed work shifts to 8 or 12. We still end of working 16 hour tours.*" Moreover, workers were reluctant to reduce tour hours as it reduced their ability to work second jobs at other organizations because of the complexity of daily scheduling and partnering at any EMS facility ("*EMS staffers cannot just show up at another facility on any day and begin to work*"). Low pay, work shifts, and second jobs were related according to workers. Low wages led to second jobs, but most had no choice because of their salaries. Conversely, supervisors wanted 8–12 hours per shift to reduce musculoskeletal injuries. Although supervisors acknowledged pay was low, this appeared to be the norm at state and national levels and they had little control over this issue.

Likewise, the majority of participants agreed low salary was a problem related to musculoskeletal injuries because most had to work second jobs, but reasons differed. Workers were resentful about the low pay and having to work another job. Supervisors assumed all EMS workers, including themselves, had to work at least one other part-time job to "*maintain their standard of living.*"

An EMS interviewee stated "*I'm always rushing, not just to get the patient to the emergency department (ED), but with paperwork and to get home from the last call.*" Supervisors appeared to be aware of this issue. Although they advised against rushing at work, as supervisors believed this led to injuries and poor performance, they said workers didn't listen to their advice. Supervisors also noted that workers needed more training on waiting for help (either from another EMS team or a supervisor) and not rushing on the last call in order to go home. However, they noted there was no scheduled time for additional training on appropriate and safe work practices.

Scheduling time and available funding for work practice training and equipment workshops were difficult to secure, as reported by supervisors. Although the majority of workers did not discuss the need for work practice workshops, EMS focus group participants agreed that ongoing ergonomics training was important to prevent injuries. Currently, only new personnel receive ergonomics training, but only at the time of employment. The EMS worker who conducts most ergonomics training said that "*other workers in the health system get ongoing, yearly ergonomics training, like nursing. I only train new hires once. The old timers*

didn't even get ergonomics training before I came here."

The limited chance to choose a partner and new employees were acknowledged as problems by nearly all participants. One supervisor reported that "*we all have our favorites. The workers want someone who they know will carry their own weight and have experience.*" An EMS interviewee said "*I never get to choose who to work with. As soon as I get familiar with someone and have a rhythm going, they change our partners.*" An EMS focus group worker said "*I'd do anything not to work with a new hire.*"

Most workers reported that a third worker could help during patient calls. They noted if the third worker was unable to help with patient handling because of the layout of the house, s/he could carry equipment and medically stabilize the patient. While placement of the third person was a safety issue in the ambulance, the majority of workers said better ambulance design can reduce this concern. One experienced EMS focus group worker who disagreed reported that EMS teams don't use a third member. If they do, the team was "*weak and inexperienced. It's our culture.*"A large number of supervisors also did not agree about the third worker concept, but for safety and performance reasons, not cultural factors. They noted it was too dangerous for a third worker to sit in the patient compartment of the ambulance and that limited room in the ambulance and home reduced the worker's effectiveness. They also reported additional help was always available if workers waited for help to arrive.

An EMS interviewee noted the new ambulance design was hurting his back and that he was injured when sitting in the patient compartment during transport. Workers were frustrated that management did not ask them for input about ambulance design. Most workers said the new ambulances limited leg room, constrained posture, had limited seat adjustability, and patient compartments were hazardous while medically stabilizing a patient.

However, workers appeared satisfied with most other aspects of the organization's equipment or, through informal networks, were aware that the technology didn't exist or funds were unavailable to purchase newer, lighter, mechanized equipment. Supervisors noted that good equipment is not always available. This meant that batteries for power stretchers were unavailable because they were "*stockpiled*" by certain crews or "*dead.*" They also reported that improved patient handling equipment design, such as designing with lightweight materials, can improve worker compliance with equipment and reduce the possibility of slips, trips, and falls due to poor weather or constrained home environments.

"*Respect*" appeared throughout discussions with workers, but not supervisors. Paramedics are highly trained groups of workers; it was frustrating for them when hospital employees, their "*colleagues,*" did not give them the respect they felt they deserved. "*Nurses think we're mules and ambulance drivers. They're usually unwilling to help transfer patients.*" An interviewee said "*they're always too busy to assist in transfers.*" Aware of this, workers often made backup plans while transferring patients out of medical facilities: they brought extra equipment or asked physical therapy for help.

When leaving a hospital, an EMS focus group worker reported "*I have no predictability or control over the work environment when transferring a patient to home. It's impossible to carry a bariatric patient up four flights of stairs. We need additional support.*" They disagreed with supervisors that additional help was "*always available.*"

Trust was a main and recurring issue between workers and supervisors, but in particular, on reporting lower back or shoulder injuries and sick leave. Workers wanted a day off in the middle of the workweek to reduce fatigue and recover from pain. Supervisors noted that when a worker wants a long weekend or vacation, s/he reports an injury, goes to the emergency department (ED), and a doctor gives the worker the number of sick days s/he requests. Conversely, supervisors wanted to provide referral sources to "*their own*" physicians so that they can determine if an injury really exists and prescribe the "*accurate*" number of sick days. An EMS focus group participant reported "*every worker works with pain. If they don't trust us, management should have referral sources in place so we know exactly where to go.*" The majority of participants seemed aware of the ED scenario. This same participant said some of us "*don't always go to the ED for treatment. The referral locations should also be close to our Center.*"

3.4. Consequences: Opportunities for healthy work and improved quality of care

Participants identified macro- and micro-level opportunities to improve patient care, workplace safety, and performance. Macro-level changes primarily consisted of improving adverse organizational factors and psychosocial exposures by addressing subthemes: training, fitness, job control, adequate staffing for assistance

during calls, financial issues, social support from supervisors, trust between workers and supervisors, and breaks. However, changes also included engineering (equipment) controls, such as newer designs in ambulances.

The majority of participants agreed that micro-level prevention included weekly maintenance on all equipment and ensuring adequate numbers of batteries were available for power stretchers. Supervisors also wanted newer, state-of-the-art equipment, while workers wanted input on ambulance design.

Macro-level changes appeared more difficult to implement, as these involved top-tier managerial decisions within the health system (and usually outside of the EMSOU's directive). Mechanisms and policies for the implementation of most solutions also varied substantially among participants. The majority of workers wanted a mechanism for choosing work hour shifts, the "*right*" partner and a third worker, and wanted formal breaks; most supervisors wanted a budget for additional training and a policy for workers to walk between calls.

For example, supervisors were nearly unanimous that workers should be mandated to walk while waiting for a call. One supervisor said "*I always encourage my staff to walk around to get the blood flowing and ease back tension from sitting all day.*" While workers said they walked around their vehicles, supervisors were doubtful. Therefore, supervisors wanted to have the ability to authorize walking near the ambulance while waiting for a call.

Some workers wanted 8–12 hour shifts (12 hour shifts were most desirable if shorter shifts were implemented), but the majority preferred 13–16 hour shifts. Supervisors wanted their staff to work twelve hour shifts or less to limit injuries and lost workdays. Eight to twelve hour work shifts were recently instituted at the EMSOU and system-wide data are being prospectively compiled to determine whether this organizational shift reduces injury rates, workers' compensation, and lost work days.

Workers were emphatic about wanting the ability to choose their partners. Supervisors said this was impossible because of complex scheduling and operational issues during shifts; however, they were aware of the workers' frustration over this issue.

Most workers reported using a third crew member could enhance prevention and patient care. They were also adamant about not getting lunch and rest breaks. As noted above, supervisors perceived this subtheme differently: all workers receive breaks "*most of the time.*" They also reported that workers' needed yearly ongoing EMS training on potential emergency situations, how to use state of the art equipment, training on waiting for proper resources and assistance in the field, and standardization on which equipment to use based on the situation. Supervisors were cognizant of the stressful nature of the unpredictability of the job. They said "*We can't train these guys on every possible situation. You only get this by experience. Unfortunately, these guys have to learn while they're working. Sometimes it's terrifying.*"

Job rotation was broached by workers, although supervisors said this was "*too difficult*" to implement. The division of labor was apparent with respect to this work practice solution. EMS workers believed that job rotation would reduce physical and psychological fatigue in the field. Indeed, EMS staff mostly worked in the field, often performing stressful clinical care under time constraints; supervisors usually worked in an office performing administrative duties, at a digital event monitoring board, or monitored phones. Coupled with their years of experience, supervisors may have been somewhat removed from the job stress associated with field work, and the urgency of finding a "work around" for job rotation.

Not all opinions among participants differed. Most participants agreed on improving overall fitness and decreasing obesity among workers. The majority wanted to initiate agility tests, and pre-employment and return-to-work screening to "*weed-out*" those who were "*unable to carry their own weight.*" However, methods for achieving this were divergent. Workers wanted to change their diet from fast foods to regular meals through scheduled breaks, while supervisors wanted scheduled times for workers to exercise at gyms. The subtheme, *screening*, seemed to be related to choosing partners. EMS workers wanted healthy, strong, fit workers as their partners to reduce injury risk and speed "*production.*" Similarly, the majority of participants agreed that allowing injured workers back on the job too soon should be changed. However, pre-employment and return to work screenings had to be changed at the highest managerial levels of the health system. There was much debate among human resource management about the utility of work hardening or functional capacity examinations; further, past organizational and work practices were impediments to implementing either.

Providing an "*effective policy*" for reporting injuries and providing referral sources for medical management once an injury occurs were also agreed on by nearly all participants, but for different reasons, revolving around trust and supervisor support. Workers wanted more

social support from supervisors on injury validation; supervisors often disbelieved their staff regarding the severity of work-related incident injuries. Workers also reported difficulty in taking days off after an injury and the lack of effective rehabilitation once an injured developed.

While numerous opportunities for prevention emerged involving work organization, organizational structure, including a military culture in this profession, may make prevention difficult. Moreover, because participants' views were divergent and involved many stakeholders, prevention may be even more difficult to achieve.

In general, there was more variability in responses between EMS workers and supervisors then within EMS workers. One EMS interviewee described prevention using two subthemes: trust and organizational support. Conversely, in linking prevention and musculoskeletal injures, one of the most experienced supervisors used a different set of subthemes: financial resources, fitness, and certain organizational changes (such as screening potential employees).

4. Discussion

The conceptual ideas related to the main problem and its control generated several hypotheses. Two hypotheses were: 1) lower back and shoulder injuries are the main health problems among EMS workers; 2) the main task related to these injuries is patient handling, while lifting a patient is the main physical exposure and low supervisor support is the main organizational factor/psychosocial exposure.

Lower back injury studies supported Hypothesis 1 [14, 33], but shoulder conditions among EMS workers were not well characterized in the literature. However, it is biologically plausible that patient handling tasks, coupled with different anthropometric properties between EMS teams and a fast work pace might affect multiple anatomical regions.

Hypothesis 2 was also supported in the literature [3, 34, 35]. Several studies examined the burden of patient handling injuries in health care workers and reported the highest lower back injury rates were experienced by emergency medical technicians, who are usually the most inexperienced among EMS workers [15, 34]. Kim et al. reported that patient handling involves numerous activities, including lifting, lowering, carrying, and transferring a patient, all of which may increase compression and shearing forces on the lower back [3]. While workers reported lifting a patient was a main hazard, we were unable to tease apart whether this was the most hazardous activity or whether other aspects of patient handling, such as lateral transfers or negotiating stairs, were more hazardous. In addition to lifting a patient out of a bathtub, negotiating up stairs was also reported as a main exposure among participants.

One study found that low supervisor support was associated with lower back pain and, prospectively, disability; authors' concluded that an unsupportive environment may create feelings of dependence, incompetence, and high work effort [35]. However, direct links between low supervisor social support and lower back pain are not well established. Authors have suggested that individuals working in dysfunctional environments, such as working with low social support, may be more susceptible to experiencing job stress than supportive environments [36, 37]. Job stress might then create psychological distress. This can adversely affect the central nervous systems (CNS) [38], leading to somatic symptoms, with the CNS modulating pain. Job stress may also increase sensitization of painful stimuli within the CNS [38]. Similarly, job stress may trigger sustained autonomic stress responses leading to physiological changes involving neurotransmitters, which can excite nociceptors and enhance their response to painful stimuli [38].

A third hypothesis that was generated was mechanized equipment and improved work organization will improve prevention efforts; conversely, poor work organization will present a structural challenge to implementing change and inhibit prevention. While challenges were marked, several subthemes for prevention emerged: new lightweight, mechanized equipment and improved social support. Opportunities and challenges can be conceptually regarded as intermediate factors on the same causal pathway between poor work organization, exposures, and lower back pain [6, 39–42].

Prevention involves management commitment at the highest levels of the organization. If work organization restructuring and subsequent controls are not implemented to promote primary prevention, incident lower back and shoulder injuries might develop. Thus, work organization drives prevention, beginning at the macro-level [43]. Indeed, from a macro-occupational health and safety perspective, management commitment may be the most important factor in determining whether hazard reduction will be successful [44].

Management commitment should be integrated system wide by issuing policy statements (for example,

treat control efforts as furthering the agency's goals); holding meetings between workers and supervisors to discuss new policies; setting goals that address specific issues and priorities; providing resources (for example, training the workforce on ergonomics, including safe work practices and state of the art equipment); providing release time or other compensatory measures during the work shift for training; providing information to all stakeholders (for example, management should provide open communication about the possible impacts of policy changes on job tasks, and information should be made available to those affected by policy changes) [45].

A fourth hypothesis that was generated involved differences in perceptions between workers and supervisors; specifically, EMS workers and supervisors report different risk factors and control strategies, while a fifth hypothesis that was generated was responses in interviews and focus groups within EMS workers are different.

The literature seemed to support Hypotheses 4 and 5 [46–49]. Perceptions about organizational factors differed between workers and supervisors. For example, workers and supervisors agreed that long sitting times between calls made "backs stiff." While EMS workers agreed on a micro-level solution involving encouraging and training workers to walk between calls, a macro-level, policy mandated solution to walk between calls was favored by supervisors but not staff. Likewise, many workers were reluctant to change work hours from 13–16 to 8–12 (another macro-level control). However, this issue was so important to supervisors that they advocated (and were eventually successful) for a top level health system policy change.

Similarly, there was more variability in participants' responses about organizational factors than physical exposures. Since supervisors began their careers as EMS workers, both workers and supervisors would most likely have similar experiences about physical exposures, such as long sitting times and patient handling. However, supervisors would likely be equally concerned about organizational structure in order to provide a highly functional, flexible, and effective operation.

Different perceptions among EMS workers and supervisors might also be attributed to "role theory," in which an individual's attitude will be influenced by the role s/he occupies in an organization [46]. Moreover, workers may not be aware of higher level organizational policies. For example, EMS workers reported that hiring practices were a main concern. While supervisors agreed that pre-employment screening was needed, they cited health system liability issues that may have precluded this option. Interestingly, the health system recently implemented pre-employment screening for potential applicants. It appears when given system-wide priority from top management [47], a change in organizational structure might be achieved.

Other possible reasons for diverse viewpoints may include job duties: supervisors may need to establish best practices and national or state EMS regulatory issues; conversely, EMS workers were primarily concerned with clinical care [48]. Organizational leadership among supervisors is associated with work pace, time schedules, and deadlines [48]. If supervisors were unaware of employees' physical and mental capabilities, they may be less attuned to organizational factors and job exposures, possibly resulting in conflicting perspectives between participants about job expectations. Further, since supervisors have more experience than workers, they most likely had different outlooks about job expectations. Leadership styles that use a militaristic culture may also place higher priorities on productivity and performance than safety [48].

There were also diverse perspectives between interviewees and focus groups among EMS workers. Considerable differences between these methodologies can exist [49]. For example, "memory work effects," which are shared experiences among workers, are advantages in focus groups. In fact, only focus group participants noted the need for ongoing ergonomics training, which was initially highlighted by the ergonomics trainer in one focus group. Likewise, when someone initiates a controversial or novel subject, others may participate in the conversation [50]. The issue of a third worker in the crew was initially broached by an experienced, respected EMS worker in a focus group (different from the experienced worker cited above who disagreed with this solution). Other focus group members, initially skeptical of or hesitant to discuss this because they thought supervisors would "*kill this idea before it got off the ground,*" agreed with this approach after probing by moderators. Another EMS focus group participant said a third crew member is often "*looked down on*" because of "*our culture.*" Thus, in addition to differences between interviewees and focus groups within workers, views also differed within focus groups among workers. This moderately experienced worker continued: "*the team is weak and inexperienced if they want a third EMT.*" The more experienced worker may have allowed other workers to feel comfortable to acknowledge this might be a way

to improve safety and patient care. While this issue was also reported by interviewees, the operational and safety considerations and the debate were not as well developed as those of focus groups.

Focus groups can also be a valuable and productive method of highlighting social exchange, reinforced by peer group structure and hierarchies. Similarly, focus groups may give moderators the chance to observe how individuals within groups react to views [49]. This was observed during discussions about fitness and weight of their partners. While most workers reported poor fitness and overweight or obese workers increased their own risk of injury, there was dynamic debate in focus groups (but not explored by interviewees) about mechanisms to achieve physical fitness and reduce obesity among workers.

Nevertheless, some aspects of the participants' experiences can be excluded from focus groups. Interviews that allow in-depth exploration of sensitive experiences may help identify underlying contributory factors [51]. One sensitive issue was "high workload," reported only by a few interviewees. Likewise, the majority of interviewees noted that problems getting assistance in the field and no breaks were "*directly*" related to lower back and shoulder injuries, while the responses in the focus groups were mixed. However, implicit to a greater extent in interviews are concerns affecting their usefulness: performances of those being interviewed, the level of commitment of the interviewee, truthfulness, reality, suspicion, and hidden agendas [49].

Other methodological differences include the increased pressure on focus group participants, whose views are different from the majority; those who leak knowledge may risk job security; and a participant can play the radical outsider with exaggerated opinions.

4.1. Qualitative research on the EMS

Other researchers have examined health and exposures among EMS workers using qualitative methods [15]. When measuring patient handling exposures, Conrad and colleagues [15] reported that handling patients down stairs was one of the most frequently performed and strenuous exposures. Conversely, while the majority of participants reported negotiating stairs was one of the main exposures associated with lower back and shoulder injuries, both groups cited that negotiating patients upstairs, such as in a "*deep subway station,*" was more hazardous. We were unable to find any qualitative studies that examined both micro-level exposures and organizational (macro-level) factors. However, original research and reviews indicated the most effective exposure reduction strategies involved a multifaceted approach, addressing both micro- and macro-level factors [52–54].

4.2. Strengths and limitations

This appeared to be one of the few systematic approaches to use a qualitative framework to characterize work-related topics among EMS workers. Employing a qualitative methodology helped to organize and catalogue data in workers who were not employed in conventional environments. It can be particularly helpful when workers are autonomous, scattered in small groups, have no fixed workplace, and lack historical exposure measurements. For workers who spend much of their time outdoors, such as EMS workers, additional challenges are unpredictable activities and uncontrolled work environments. For example, they often have long work cycles and are affected by weather and other natural phenomena. Qualitative methods can provide information about health effects, exposures, and work processes in workers where traditional exposure and health assessment methods are difficult to obtain. They can also provide data to help guide more precise, future quantitative studies [55].

Moreover, using in-depth interviews and focus groups, and workers and supervisors may have provided more balanced results. For example, while agreement existed between participants on low salaries, reasons differed. Likewise, most workers eventually agreed a third worker would be useful in reducing lower back and shoulder injuries. Conversely, supervisors were reluctant to implement this strategy for safety and operational reasons.

While the study expands the existing literature on the EMS, the sample size was small ($n = 58$), which may limit the accuracy of responses. All responses were self-reported. Misclassification of health problems with respect to exposures, or vice versa, may have occurred. For example, low supervisor support may have led to an over-reporting of injuries, although the direction of misclassification is difficult to determine in this qualitative study. Likewise, while participants provided detailed perceptions, measurement error (information bias due to selective reporting) about what they wanted to share may have occurred, despite pilot testing and probing questions. However, the analysis showed participants' perceptions had common themes and subthemes.

Only one EMS organization was used. The organization was the largest and active in the Northeast

and one of the largest in the US. Its structure and level of control from management and supervisors to workers may have been unique and unrepresentative compared with smaller or idle EMS operations. There may also have been potential for selection bias. As Table 4 demonstrates, a substantially greater proportion of volunteers were older and male compared with non-responders, which may indicate potential selection bias. However, distributions of past injuries were similar between volunteers and non-responders, which might provide evidence that selection bias was not considerable. In addition, selection bias can only occur when differences in distributions are related to both determinants (for example, age) and health outcomes [56].

With only one organization, we may also have experienced cross-over effects, where one team member may have been more responsive or deferred to another team member, which might have happened despite methodological strategies to reduce this from occurring (for example, two iterations of a round robin algorithm [28], where each participant takes, in turn, an equal share of the discussion).

5. Conclusions

Grounded theory was used to develop themes and subthemes of main health problems (lower back and shoulder injuries), and organizational factors and exposures linked with them. Physical exposures included patient handling (task), work environment, patient's weight, and negotiating stairs. Organizational factors and psychosocial exposures included low social support from supervisors, trust between workers and supervisors, lack of predictability and control of the work environment, and respect. Prevention focused around improved organizational support (macro-level controls) and mechanized equipment (micro-level controls). It appeared that while physical exposures were main concerns (as were organizational factors), controls involving organizational factors and psychosocial exposures appeared more diverse and difficult to implement. Ironically, they may also be more important, as upstream factors affect downstream exposures.

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