Arabian Gulf Journal of Humanities and Social Studies

ISSN: 3080-4086

Vol 7 - Issue 20 || Issued Date: 20-11-2026

The Relationship Between Physical Fitness, Occupational Endurance, and Clinical Performance Among Emergency Medical Services Personnel: A Systematic Review

العلاقة بين اللياقة البدنية والتحمّل المهني والأداء السريري لدى العاملين في خدمات الإسعاف والطوارئ: مراجعة منهجية

Nawaf Ali Alanazi[1], Abdulaziz Sulaiman Algosaibi[2], Sattam Zaid Alanazi[3], Nayef Khalid Almansour[4], Mohammed Ibrahim Alsunaidi[5], Meshal Sultan Alanazi[6], Mohammed Faleh Jazi Alotaibi[7], Yasir Salem Mohammed Alharbi[8]

نواف علي العنزي[1]، عبدالعزيز سليمان القصيبي[2]، سطام زيد العنزي[3]، نايف خالد المنصور[4]، محمد إبراهيم السنيدي[5]، مشعل سلطان العنزي[6]، محمد فالح جازي العتيبي[7]، ياسر سالم محمد الحربي[8]

Saudi Red Crescent Authority, Saudi Arabia

DOI: https://doi.org/10.64355/agjhss72066

AGJHSS || This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY-NC-SA)

Abstract

Background: Emergency medical services (EMS) personnel repeatedly undertake physically demanding activities, including patient extraction, stretcher handling, stair climbing, equipment carriage and cardiopulmonary resuscitation (CPR). Their capacity to sustain these tasks may affect occupational readiness and potentially clinical care; however, physical task performance and patient-care quality are distinct outcomes.
Objective: To evaluate how physical fitness and occupational endurance relate to job-specific task performance and measured clinical performance among paramedics, emergency medical technicians and related EMS responders, and to identify implications for workforce preparation and research.
Methods: This manuscript follows the section structure of a PRISMA-oriented systematic review and presents a narrative evidence map of independently identifiable primary publications and contextual reviews. Published reports were checked for study design, participant numbers, measured outcomes and bibliographic identifiers. A complete database export, duplicate-removal log, two-reviewer screening record and completed risk-of-bias assessments were not available; consequently this document does not assert a final PRISMA study count or pooled effect.
Results: Direct evidence indicates associations between several fitness measures and standardized rescue-task performance, including a 20-participant rescue simulation study and a 62-participant specialist-paramedic validation study. A 4-week conditioning intervention improved paramedic occupational test time by approximately 10% among lower-performing candidates. Clinical evidence is less consistent: a randomized crossover pilot involving 11 paramedicine students or graduates found no significant decline in global clinical scores or CPR effectiveness immediately after physical exertion, while a 2024 training pilot with nine completers reported selected improvements in cognitive testing. A 2025 study of 34 EMS employees linked greater physical activity with better manikin-measured chest-compression performance. Direct evidence on real-world patient outcomes remains sparse.
Conclusion: Physical fitness and endurance appear relevant to safe and effective execution of strenuous EMS tasks, whereas a causal influence on broader clinical decision-making and patient outcomes is not yet established. Role-specific assessment, supported fitness programmes and prospective measurement of clinically meaningful outcomes warrant further evaluation.

Keywords: emergency medical services; paramedics; physical fitness; occupational endurance; clinical performance; work capacity; patient handling; cardiopulmonary resuscitation; occupational readiness.

EDITORIAL STATUS — This is a substantial scientific draft based on verified literature, not a completed PRISMA 2020 systematic review. Final study counts, searches, screening decisions, bias judgments and author information require the research team's documented review work. No numbers have been invented to fill those gaps.

الملخص

الخلفية: يؤدي العاملون في خدمات الإسعاف والطوارئ (EMS) بصورة متكررة أنشطة تتطلب مجهوداً بدنياً كبيراً، تشمل انتشال المرضى، والتعامل مع نقالات الإسعاف، وصعود السلالم، وحمل المعدات، وإجراء الإنعاش القلبي الرئوي (CPR). وقد تؤثر قدرتهم على الاستمرار في أداء هذه المهام في مستوى جاهزيتهم المهنية، وربما في جودة الرعاية السريرية المقدمة؛ إلا أن الأداء في المهام البدنية وجودة رعاية المرضى يُعدّان نتيجتين مختلفتين.

الهدف: تقييم العلاقة بين اللياقة البدنية والتحمّل المهني من جهة، والأداء في المهام المرتبطة بطبيعة العمل والأداء السريري المقاس من جهة أخرى، لدى المسعفين وفنيي طب الطوارئ وغيرهم من العاملين في خدمات الإسعاف والطوارئ، وتحديد الآثار المترتبة على إعداد القوى العاملة والبحوث المستقبلية.

المنهجية: تتبع هذه المخطوطة الهيكل التنظيمي لأقسام المراجعة المنهجية الموجّهة وفق بيانPRISMA ، وتقدم خريطة سردية للأدلة المستمدة من الدراسات الأولية المنشورة التي أمكن تحديدها بصورة مستقلة، إلى جانب المراجعات المرجعية ذات الصلة.

وقد جرى التحقق من التقارير المنشورة من حيث تصميم الدراسة، وأعداد المشاركين، والنتائج المقاسة، والمعرّفات الببليوغرافية. ونظراً لعدم توافر تصدير كامل لقواعد البيانات، وسجل إزالة الدراسات المكررة، وسجل فرز الدراسات بواسطة مقيّمين اثنين، والتقييمات المكتملة لخطر التحيّز؛ فإن هذه الوثيقة لا تدّعي تقديم عدد نهائي للدراسات وفق مخططPRISMA ، ولا تقدّم تقديراً موحداً لحجم التأثير.

النتائج:تشير الأدلة المباشرة إلى وجود ارتباطات بين عدد من مقاييس اللياقة البدنية والأداء في مهام الإنقاذ المعيارية، بما في ذلك دراسة لمحاكاة مهام الإنقاذ شملت 20 مشاركاً، ودراسة للتحقق من صلاحية اختبارات الأداء لدى المسعفين المتخصصين شملت 62 مشاركاً. كما أسهم برنامج تدريبي لتحسين اللياقة البدنية استمر أربعة أسابيع في تحسين الزمن اللازم لأداء الاختبار المهني لدى المسعفين بنسبة تقارب 10% بين المرشحين ذوي مستويات الأداء المنخفضة.

أما الأدلة المتعلقة بالأداء السريري فهي أقل اتساقاً؛ إذ لم تجد دراسة استطلاعية عشوائية تبادلية، شملت 11 طالباً أو خريجاً في تخصص الإسعاف، انخفاضاً ذا دلالة إحصائية في الدرجات السريرية الإجمالية أو فعالية الإنعاش القلبي الرئوي مباشرة بعد بذل مجهود بدني. في المقابل، أبلغت دراسة استطلاعية تدريبية أُجريت عام 2024، واكتملت بمشاركة تسعة أفراد، عن تحسن في بعض جوانب الاختبارات المعرفية. كما ربطت دراسة أُجريت عام 2025 وشملت 34 موظفاً في خدمات الإسعاف والطوارئ بين ارتفاع مستوى النشاط البدني وتحسن أداء ضغطات الصدر المقاس باستخدام دمية المحاكاة التدريبية. ومع ذلك، لا تزال الأدلة المباشرة المتعلقة بنتائج المرضى في ظروف العمل الفعلية محدودة.

الخاتمة:يبدو أن اللياقة البدنية والتحمّل يرتبطان بأهمية واضحة في تنفيذ المهام الإسعافية الشاقة بصورة آمنة وفعّالة، في حين لم تثبت بعد علاقة سببية بينهما وبين تحسين عملية اتخاذ القرارات السريرية بصورة أوسع أو تحسين النتائج الصحية للمرضى. وتستدعي الحاجة إجراء مزيد من التقييمات القائمة على متطلبات كل وظيفة، وتوفير برامج مدعومة لتعزيز اللياقة البدنية، وإجراء دراسات مستقبلية تقيس النتائج ذات الأهمية السريرية.

الكلمات المفتاحية:خدمات الإسعاف والطوارئ؛ المسعفون؛ اللياقة البدنية؛ التحمّل المهني؛ الأداء السريري؛ القدرة على العمل؛ التعامل مع المرضى ونقلهم؛ الإنعاش القلبي الرئوي؛ الجاهزية المهنية.

الحالة التحريرية:هذه المسودة تمثل عملاً علمياً موسعاً يستند إلى أدبيات علمية جرى التحقق منها، لكنها لا تُعد مراجعة منهجية مكتملة وفق إصدار .PRISMA 2020 ولا يزال تحديد العدد النهائي للدراسات، وعمليات البحث، وقرارات الفرز، وأحكام التحيّز، وبيانات المؤلفين يتطلب استكمال أعمال المراجعة الموثقة من قبل فريق البحث. ولم يتم اختلاق أي أرقام لسد هذه الثغرات.

[1] Paramedic, Saudi Red Crescent Authority, Saudi Arabia.
[2] Paramedic, Saudi Red Crescent Authority, Saudi Arabia.
[3] Paramedic, Saudi Red Crescent Authority, Saudi Arabia.
[4] Paramedic, Saudi Red Crescent Authority, Saudi Arabia.
[5] Paramedic, Saudi Red Crescent Authority, Saudi Arabia.
[6] Emergency Medical Technician (EMT), Saudi Red Crescent Authority, Saudi Arabia.
[7] Emergency Medical Technician (EMT), Saudi Red Crescent Authority, Saudi Arabia.
[8] Paramedic, Saudi Red Crescent Authority, Saudi Arabia.

Introduction

Emergency medical services personnel operate in uncontrolled, time-sensitive environments where physical demands are inseparable from the delivery of clinical care. A routine call may require transporting equipment, negotiating stairs, moving a patient from a constrained location, transferring a stretcher, and undertaking repeated chest compressions before the patient can be transported. These physical duties occur alongside assessment, prioritization, communication, medication administration, and other cognitive and technical tasks. The possibility that fitness influences both the safe completion of manual work and clinical effectiveness is therefore operationally important (Fischer et al., 2017; Rue et al., 2019).

A direct observational task analysis by Fischer et al. (2017) documented physical demands across more than 90 calls observed during 20 shifts, followed by a survey of 155 frontline paramedics. Patient transfer, stretcher loading and unloading, stretcher height adjustment, and CPR were judged especially important and demanding. Subsequent studies have measured fitness against standardized rescue simulations or specialist response tasks, generating evidence that aerobic capacity, muscular strength and muscular endurance contribute to operational performance (Mthombeni et al., 2021; Siddall et al., 2021).

Nevertheless, physical readiness should not be equated automatically with clinical competence. Successfully lifting a stretcher or completing an extraction circuit is a job-specific outcome; accurately identifying deterioration, delivering correct treatment, performing effective CPR, and achieving improved patient survival represent progressively different levels of clinical evidence. A pilot randomized crossover trial found that acute occupational exertion raised physiological load but did not significantly worsen global clinical scores or CPR efficacy in a small sample of paramedicine students and recent graduates (MacQuarrie et al., 2022). That result tempers assumptions that every bout of physical exertion necessarily harms care.

Occupational endurance additionally extends beyond a single fitness test. EMS crews may work irregular shifts, experience restricted recovery, and undertake repeated high-intensity efforts separated by long periods of low activity. Reviews of emergency first-responder fatigue point to poor sleep and repeated fatigue as threats to alertness, physical health and safe behavior, but these findings should not be conflated with the independent effect of baseline physical conditioning (Marvin et al., 2023). Meanwhile, observational studies have documented variation in paramedic physical capacity by age and occupational context (Hunter et al., 2019; Parpa & Michaelides, 2025). There is a practical need to distinguish three linked questions: whether fitter EMS personnel perform strenuous occupational tasks more effectively; whether higher fitness or better endurance improves the quality of actual clinical interventions; and whether structured training can modify performance without creating inequitable or potentially punitive employment policies. The present review manuscript is organized around these questions.

Literature Review

Physical Demands and Role-Specific Fitness

EMS work requires a combination of aerobic endurance for prolonged work, anaerobic capacity for short intense efforts, muscular strength for loading and lifting, muscular endurance for repetition, and functional mobility for work in restricted environments. Rue et al. (2019) identified eleven demanding specialist response tasks, with different patterns of cardiovascular, thermal and muscular demand. The 2025 scoping review of 33 reports by Marsh et al. highlighted stretcher handling and patient extraction as particularly strenuous components of prehospital work. Such evidence supports multidimensional assessment rather than reliance on a single endurance or strength score.

Fitness, Work Ability and Occupational Endurance

In a Dutch cross-sectional surveillance study of 506 ambulance workers, van Schaaijk et al. (2017) found that job-specific physical abilities and alertness/judgment-related requirements contributed to appraised work ability. This is important but does not establish that physical fitness causes better patient care. Hunter et al. (2019) examined 140 regional Australian paramedics and found reductions in several strength measures with increasing age, while Parpa and Michaelides (2025) identified suboptimal fitness indicators in a local sample of 39 US EMS professionals. Both studies are descriptive and cannot by themselves define universally appropriate fitness thresholds.

Clinical Performance After Exertion

MacQuarrie et al. (2022) directly tested performance in high-fidelity simulated patient care following a physically demanding task versus rest. The lack of a statistically significant difference in global clinical performance or CPR efficacy suggests short-term physiological strain is not synonymous with loss of clinical skill, at least in their young, small sample. In contrast, studies of rescuers delivering repeated chest compressions have found associations between upper-body muscular fitness, anaerobic power or habitual physical activity and selected measures of compression quality (Lancaster et al., 2022; Tomičić et al., 2025). These outcomes are clinically relevant but are generally measured on manikins rather than patients.

The Role of Physical Training and Recovery

Physical fitness may be modifiable. Armstrong et al. (2019) reported improved Ottawa Paramedic Physical Ability Test performance after a four-week strength-and-conditioning programme among

lower-performing candidates; the result is specific to an occupational test. Brandt et al. (2024) assessed a 12-week combined endurance and resistance training programme in a very small paramedic pilot and observed improvements in selected cognitive outcomes, though high attrition and uncontrolled design limit inference. Older interventional ambulance research similarly suggests that targeted training can reduce indicators of exertional fatigue during stretcher carriage (Aasa et al., 2008).

The more recent review by Sheridan et al. (2026) found substantial inconsistency in pre-employment tests across ambulance services and no identified service requiring routine ongoing fitness testing for all paramedics. This gap matters for programme design: any fitness assessment should be demonstrably linked to essential tasks, accompanied by appropriate training and accommodation, and evaluated for effectiveness and fairness.

Methods

Protocol and Reporting

The review question was formulated using a population–exposure–comparator–outcome framework. Population: employed EMS clinicians, paramedics, ambulance personnel and emergency medical technicians (with trainees considered separately where relevant). Exposure: measured physical fitness, physical activity, fatigue resistance or structured conditioning. Comparators: lower versus higher fitness, before versus after training, or exertion versus rest. Outcomes: job-specific operational task performance, clinical skills and decision-making, CPR quality, work ability and, where available, patient safety or patient outcomes. PRISMA 2020 is the intended reporting framework (Page et al., 2021).

For preparation of this draft, targeted bibliographic verification was performed on 8 November 2026 using accessible journal and indexing records for directly relevant studies. This was an evidence-mapping step, not an exhaustive reproducible systematic search of all specified databases. The completed protocol, database-specific export files, dated search logs and registration status are pending research-team documentation. The paper therefore describes the planned systematic workflow separately from evidence already verified.

Eligibility Criteria

Proposed inclusion criteria are: (1) original empirical studies of active EMS personnel, paramedics, EMTs, ambulance clinicians or relevant paramedicine students analysed distinctly; (2) objective or defined measures of aerobic capacity, strength, muscular endurance, physical activity, physiological exertion, training or task-related fatigue; (3) a measured occupational, simulated clinical, cognitive or safety outcome; (4) observational, experimental or quasi-experimental designs; and (5) full text obtainable in English. A primary review window of January 2010 to 8 November 2026 is proposed, with earlier landmark ambulance studies used only as historical context.

Exclusions for the final primary synthesis should include editorials without original data; studies confined to unrelated occupations without EMS subgroup data; studies on mental fatigue alone without physical exposure or an explicit work-endurance link; and reports without usable outcome descriptions. Systematic and scoping reviews should inform citation tracking and background discussion but should not be counted as original participant-level evidence or double-counted in any quantitative synthesis.

Information Sources and Search Strategy

The final systematic search should cover MEDLINE/PubMed, Scopus, Web of Science, CINAHL, Embase and SPORTDiscus, supplemented by reference-list and citation searches. A reproducible example of the conceptual search string is: (paramedic* OR "emergency medical service*" OR "emergency medical technician*" OR "ambulance personnel") AND ("physical fitness" OR "aerobic capacity" OR "muscular endurance" OR strength OR "occupational endurance" OR "physical activity" OR conditioning OR "physical fatigue") AND ("clinical performance" OR "work performance" OR "patient handling" OR "task performance" OR resuscitation OR "patient safety"

OR "work ability"). Syntax should be adapted to each database and preserved exactly with execution dates and record counts.

Study Selection

The proposed workflow is database export, automated and manual de-duplication, independent screening of titles/abstracts by two reviewers, independent full-text assessment against predetermined criteria, and consensus resolution of disagreements with an adjudicator when necessary. Reasons for full-text exclusions and all stage-level counts must be retained for a PRISMA 2020 diagram. Such an auditable selection log was not supplied with the reference document and has not been manufactured for this manuscript.

Data Extraction

A standardized extraction form should include authors, year, setting, workforce role, sample, employment status, design, comparator, measured fitness construct, operational/clinical endpoint, test validity, reported statistics, confounder adjustment, attrition and limitations. Outcomes should be classified in advance as (a) physical task execution, (b) clinical technical performance, (c) cognitive/decision performance, (d) work ability and fatigue, or (e) patient-level outcomes. When the same sample appears in multiple papers, participants must be counted only once in any pooled analysis.

Quality Assessment

Appropriate Joanna Briggs Institute (JBI) critical appraisal instruments are proposed for analytical cross-sectional and quasi-experimental reports; randomized controlled trials should be assessed using a recognized trial risk-of-bias framework such as RoB 2 when applicable. Review-level contextual papers may be examined using AMSTAR 2 if they are critically synthesized. The present draft does not assign low/moderate/high ratings to individual studies because item-level appraisal by independent reviewers and access to complete reports have not been systematically documented. Methodological caveats are instead described transparently as preliminary considerations.

Data Synthesis

Because the available reports assess distinct constructs—rescue-circuit time, simulated clinical scores, compression depth, strength, alertness and perceived work ability—a narrative synthesis is appropriate unless subsets share compatible exposures and outcomes. Direction and size of associations should be reported with confidence intervals where available, with observational associations clearly separated from intervention effects. Meta-analysis would require extraction of comparable effect estimates and formal appraisal of heterogeneity; no pooled estimate is claimed here.

Results

Study Selection

The verified evidence described below was located through targeted citation tracing and journal/index records for this draft. It should not be represented as the final set of included studies from a completed systematic search. A defensible number identified, deduplicated, screened, excluded or included cannot be established without the original search exports and decision log. The PRISMA flow diagram and final study-selection summary are therefore intentionally unpopulated.

Characteristics of the Mapped Evidence

The preliminary evidence map includes work from Canada, Australia, the United Kingdom, South Africa, the Netherlands, Germany, the United States and Croatia. Designs include task observation, analytical cross-sectional assessment, randomized crossover simulation, before–after training and physiological field testing. Participants range from paramedicine students to experienced frontline and specialist responders. The most frequent objective outcomes concern standardized physical tasks; fewer reports directly measure clinical or cognitive performance, and none of the cited primary experiments demonstrates that improved fitness produces better real-world patient survival or morbidity outcomes.

Physical Fitness and Operational Task Performance

In South Africa, Mthombeni et al. (2021) studied 20 emergency care providers and found significant correlations between rescue-simulation performance and several physical fitness tests, including a 250-m shuttle run ($r = 0.83$), flexed-arm hang ($r = -0.59$), Cooper 12-minute run ($r = -0.56$), and push-ups ($r = -0.51$). Different test directions explain why some correlations are negative; taken together, the results favor multidimensional fitness rather than a universal single-test threshold. Small sample size and cross-sectional design limit generalization.

In specialist UK paramedics, Siddall et al. (2021) tested 62 responders against job-task reconstructions and simplified simulations; most criterion and simulation performance times correlated strongly ($r = 0.73–0.90$), while water rescue tasks showed weaker correspondence. These results support role-specific standards, not a standardized pass threshold for every EMS role. Armstrong et al. (2019) found a roughly 10% improvement in physical ability test completion performance after a targeted four-week programme for lower-performing candidates, suggesting physical task capability can be improved through structured support.

Physical Capacity, Fatigue and Work Ability

Hunter et al. (2019) reported that muscular strength indicators declined with age in a sample of 140 Australian paramedics, while van Schaaijk et al. (2017) found that physical abilities and alertness-related job demands contributed to self-rated work ability among 506 Dutch ambulance personnel. Parpa and Michaelides (2025) described unfavorable body composition and several limited fitness measures among 39 EMS professionals; 41% met a BMI-based definition of obesity in that sample. These outcomes identify possible readiness needs, but BMI and self-rated work ability are not substitutes for observed clinical performance.

In a controlled biomechanics analysis, Armstrong et al. (2024) evaluated 72 participants performing stretcher and backboard lifts. Strength and lower-body mobility were associated with normalized low-back loading patterns, supporting investigation of targeted exercise as an ergonomic intervention. Associations were not proof that a particular intervention prevents injury. Relevant earlier research found predictors of exertional fatigue during stretcher carriage and a potential reduction in lactate-related fatigue after a year of individually prescribed exercise (Barnekow-Bergkvist et al., 2004; Aasa et al., 2008).

Physical Fitness and Clinical or Cognitive Performance

The direct experimental evidence is limited and mixed. MacQuarrie et al. (2022) randomized the sequence of exertion and rest in 11 students or recent graduates. After exertion, heart rate and respiratory rate were higher, but global clinical simulation scores and CPR efficacy did not differ significantly. Patient-care record accuracy was higher after exertion (61.8% versus 55.5%; $p = 0.03$). The findings apply to the studied acute scenario and cannot establish the impact of months of shift fatigue.

Brandt et al. (2024) enrolled 16 paramedics in a 12-week concurrent training pilot, with nine completing the programme and post-intervention testing. Reaction time and divided attention improved in some pre-exertion comparisons; working memory improved in a post-exertion comparison. Trends rather than clear statistically established effects were reported for some resuscitation measures, and change in the exertion-related difference was not significant. Small sample, attrition and lack of a separate control group limit causal interpretation.

In a CPR-focused observational study, Tomičić et al. (2025) evaluated 34 prehospital EMS workers performing eight minutes of manikin chest compressions; reported physical activity levels correlated with overall compression quality, depth and rate, though not with recoil. Lancaster et al. (2022) evaluated 42 rescuers and found muscular strength and anaerobic power associated with selected high-quality CPR scores under a protocol that allowed rescuer rotation. CPR studies address a specific clinical skill; their findings should not be interpreted as proof of improved diagnosis, medication safety or patient survival across EMS systems.

Summary of Findings

Table 1 summarizes selected verified original studies directly relevant to the review questions. Study counts in this table are for an evidence map only and are not a PRISMA final-inclusion count.

Study / setting	Design and sample	Selected reported outcome	Interpretive limitation
Fischer et al., 2017 (Canada)	Observation (>90 calls) plus survey (n=155)	Demand ranking: patient transfer, stretcher operations and CPR were critical	Defines role-specific criterion tasks; not a clinical outcome study.
van Schaaijk et al., 2017 (Netherlands)	Cross-sectional surveillance (n=506)	Job-specific physical abilities were associated with appraised physical work ability	Self-report; no patient-care measures.
Rue et al., 2019 (UK)	Specialist job-task analysis (n=34)	Eleven technical-rescue tasks required different components of fitness	Specialist workforce, limited transferability to routine EMS.
Hunter et al., 2019 (Australia)	Fitness assessment (n=140)	Older paramedics showed lower strength across several domains	Descriptive fitness outcome; no causal clinical linkage.
Armstrong et al., 2019 (Canada)	Four-week conditioning programme, candidates	Occupational ability test performance improved by about 10% in trained lower-performing group	Potential intervention benefit; nonrandom allocation.
Mthombeni et al., 2021 (South Africa)	Cross-sectional rescue-simulation pilot (n=20)	Task scores correlated with shuttle run (r=0.83), hang (r=−0.59), aerobic test (r=−0.56)	Strong task-specific signals; very small sample.
Siddall et al., 2021 (UK)	Task reconstruction/fitness validation (n=62)	Most reconstruction–simulation times correlated r=0.73–0.90	Supports specialist task standards, not broad clinical outcomes.
MacQuarrie et al., 2022 (Australia)	Randomized crossover clinical simulation (n=11)	No significant global clinical-score or CPR-efficacy decline after acute physical exertion	Direct clinical simulation; small student/graduate sample.
Lancaster et al., 2022 (USA)	Rescuer fitness and prolonged manikin CPR (n=42)	Strength and anaerobic power predicted selected compression quality measures	CPR-specific proxy; mixed rescuer population.
Armstrong et al., 2024 (Canada)	Lifting biomechanics (n=72)	Strength and hip mobility related to normalized low-back forces	Ergonomic loading, not injury incidence or care quality.
Brandt et al., 2024 (Germany)	12-week concurrent training pilot (9 completers)	Selected reaction time, attention and memory improvements; CPR changes largely trends	High attrition; uncontrolled small pilot.
Parpa & Michaelides, 2025 (USA)	Cross-sectional fitness assessment (n=39)	41% BMI-defined obesity; several suboptimal fitness measures	Local descriptive sample; no care-quality tests.
Tomičić et al., 2025 (Croatia)	Physical activity and manikin CPR (n=34)	Higher activity correlated with compression quality, depth and rate	Self-reported activity; simulation rather than patient endpoints.

Narrative Synthesis

Across studies, the most defensible conclusion is that physical fitness is associated with performance in several physically intensive EMS tasks. Evidence is strongest where job demands have been observed and the criterion performance task has been explicitly linked to a fitness measure. Evidence of benefit for clinical performance is more provisional and outcome-specific: CPR simulation studies suggest muscular capacity may be relevant, whereas an acute exertion crossover trial did not demonstrate a general deterioration in clinical skill. A simple causal chain from greater fitness to improved patient outcomes cannot currently be assumed.

Discussion

The purpose of this review was to examine physical fitness, occupational endurance and clinical performance as related—but methodologically distinct—concepts. The assembled studies support the value of adequate task-specific conditioning for demanding EMS work. Importantly, they also expose an evidence gap between physical job performance and patient-centered measures of care quality. This distinction should guide both scientific interpretation and operational policy.

Interpretation of Physical Fitness and Endurance Associations

Aerobic fitness may reduce relative physiological strain during stair climbs and sustained rescues; muscular strength and endurance may support patient handling, repeated lifting and sustained compressions; and mobility may influence handling mechanics. However, the predictive value of each component depends on the specific duty. Mthombeni et al. (2021) associated multiple fitness domains with rescue-simulation results, while Siddall et al. (2021) derived different tests and thresholds for specialist tasks. Consequently, a single generic fitness score is unlikely to represent all operational roles or the physical intensity of all calls.

Age-related differences in muscular capacity should prompt access to individualized exercise support rather than assumptions about competence based solely on age. Similarly, observed sex differences in fitness-test averages are not justification for unvalidated differential employment criteria. Role requirements should be based on genuine essential-task demands, with clinically appropriate accommodations and evaluation of fairness, reliability and safety (Fischer et al., 2017; Hunter et al., 2019; Sheridan et al., 2026).

Interpretation of Clinical Performance Findings

The clinical-performance evidence should be interpreted narrowly. The MacQuarrie et al. (2022) pilot is informative because it directly measured high-fidelity patient care, not just fitness or physical-task time. It found no clear adverse effect on measured global clinical performance following acute physical exertion. Equally, the pilot was underpowered to exclude smaller adverse effects and did not emulate extended shift work, heavy caseloads or older workforces. Positive CPR findings may reflect a genuine influence of muscular power and endurance on a repetitive manual intervention; they do not establish that fitness improves all clinical reasoning or communication tasks.

Brandt et al. (2024) offers a plausible but preliminary bridge between conditioning and performance of cognitive tasks. That study suggests training-related improvements are worth testing in a larger randomized trial, ideally with objective improvements in measured fitness, standardized clinical scenarios, baseline comparability and complete follow-up. Its high attrition and multiple outcomes preclude definitive claims of clinical effectiveness.

Occupational Fatigue, Recovery and Confounding

Endurance during a shift is shaped not only by cardiorespiratory and musculoskeletal fitness, but also by sleep opportunity, hydration, workload, rest breaks, staffing levels, psychological stress, heat exposure and case complexity. A systematic review by Marvin et al. (2023) linked first-responder fatigue and sleep disturbance with poorer alertness and safety-related outcomes. Because fitter workers may also differ in training, experience, sleep habits and job assignment, observational associations require appropriate control for these factors before an independent fitness effect can be inferred.

Arabian Gulf Journal
Humanities and Social Studies

Theoretical Perspectives

A task-capacity framework offers a useful interpretation: occupational strain depends on task demands relative to an individual's sustainable capacity. Improvements in fitness could reduce the relative load of a fixed physical task, potentially preserving reserve for subsequent activities. A systems approach is also needed because equipment, teamwork and ergonomics can reduce external load, while organizational scheduling determines recovery opportunity. Neither framework replaces direct experimental evidence on clinical quality.

Policy and Clinical Implications

EMS services can operationalize the current evidence by undertaking local job-task analysis, developing reliable tests tied to essential tasks, and offering voluntary or supported aerobic, resistance and mobility training. Policies should avoid using one unvalidated fitness cut-score to judge all staff, and training should not become a substitute for adequate staffing, mechanical lifting aids, safer stretcher systems or fatigue risk management. Clinical skill and patient safety should be assessed independently of fitness through simulation, chart audit and validated operational outcomes.

Strengths and Limitations of the Evidence

Strengths include objective occupational simulations, some physiological measures, task analysis directly linked to job requirements and an emerging but small body of clinical simulation research. Principal limitations include small or nonrepresentative samples, frequent cross-sectional design, measurement heterogeneity, limited adjustment for confounding, scarce real-world clinical endpoints and restricted geographic coverage. Fitness tests, rescue time, perceived work ability and manikin CPR metrics cannot be pooled as though they were interchangeable endpoints.

A major limitation of this manuscript itself is that the systematic search and independent screening workflow have not been completed and audited. The selected verified articles illustrate the evidence base but may not represent every eligible study. No PRISMA diagram, JBI score distribution, meta-analysis, certainty rating or definitive study count should be inferred from the present synthesis.

Future Research Directions

Research priorities are prospective multi-service cohorts connecting objective fitness testing to occupational injury, standardized clinical error rates and patient-centered outcomes; randomized trials of individualized, supported training programmes; validation of role-specific tests in diverse workforces; studies of repeated task exposure over long shifts; and analyses of interactions between fitness, sleep, stress, ergonomic equipment and staffing. Future studies should preregister primary outcomes, report adherence and adverse events, and investigate whether changes in physical capacity translate into clinically meaningful benefits.

Conclusion

The current evidence supports a relationship between physical fitness and the execution of physically demanding EMS tasks, particularly patient extraction, stretcher handling, specialist rescue and standardized occupational simulations. Preliminary intervention studies also indicate that task performance can improve with tailored strength and conditioning. Findings for clinical and cognitive performance remain more limited: some CPR and cognitive measures are associated with activity or improve after training, whereas acute exertion did not consistently reduce global clinical performance in a small crossover trial.

Physical readiness should therefore be viewed as one component of high-quality prehospital care, not a substitute for clinical competence, sound systems or adequate recovery. Stronger research is required to establish whether interventions that improve EMS fitness also enhance patient outcomes. Completion of the prespecified systematic search and bias appraisal remains necessary before this manuscript can be presented as a completed PRISMA systematic review.

Recommendations

1. Base physical readiness requirements on observed essential EMS job tasks, with separate criteria for specialist rescue roles and routine ambulance practice.
2. Provide accessible, individualized aerobic, strength, muscular endurance and mobility programmes with appropriate professional supervision and accommodations.
3. Combine exercise promotion with mechanical lifting aids, ergonomic design, safe crew procedures and workload management rather than shifting all responsibility to the employee.
4. Assess clinical quality separately through validated simulation, CPR feedback, documentation, procedural accuracy and patient-level indicators when feasible.
5. Implement fatigue-risk management addressing shift length, sleep opportunity, rest breaks, staffing and recovery independently of baseline physical fitness.
6. Support longitudinal and randomized evaluations to determine whether improved fitness changes operational, clinical and safety outcomes and whether benefits persist.
7. Complete the database search logs, duplicate removal, PRISMA flow chart, independent JBI/RoB appraisal and certainty assessment before journal submission.

References

1. Barnekow-Bergkvist, M., Aasa, U., Ängquist, K.-A., & Johansson, H. (2004). Prediction of development of fatigue during a simulated ambulance work task from physical performance tests. Ergonomics, 47(11), 1238–1250. https://doi.org/10.1080/00140130410001714751
2. Aasa, U., Ängquist, K.-A., & Barnekow-Bergkvist, M. (2008). The effects of a 1-year physical exercise programme on development of fatigue during a simulated ambulance work task. Ergonomics, 51(8), 1179–1194. https://doi.org/10.1080/00140130802116471
3. Armstrong, D. P., Sinden, K. E., Sendsen, J., MacPhee, R. S., & Fischer, S. L. (2019). Evaluating the effect of a strength and conditioning program to improve paramedic candidates' physical readiness for duty. Work, 63(4), 623–633. https://doi.org/10.3233/WOR-192953
4. Armstrong, D. P., Beach, T. A. C., & Fischer, S. L. (2024). Quantifying how functional and structural personal factors influence biomechanical exposures in paramedic lifting tasks. Ergonomics, 67(7), 925–936. https://doi.org/10.1080/00140139.2023.2270728
5. Brandt, T., Schittenhelm, A., Botelho, D. K., Müller, T., & Schmidt, A. (2024). Effects of concurrent training on resuscitation and cognitive performance in paramedics—A pilot study. Healthcare, 12(16), 1599. https://doi.org/10.3390/healthcare12161599
6. Fischer, S. L., Sinden, K. E., & MacPhee, R. S. (2017). Identifying the critical physical demanding tasks of paramedic work: Towards the development of a physical employment standard. Applied Ergonomics, 65, 233–239. https://doi.org/10.1016/j.apergo.2017.06.021
7. Hunter, J. R., MacQuarrie, A. J., & Sheridan, S. C. (2019). Physical capacity of New South Wales ambulance paramedics. Occupational Medicine, 69(8–9), 534–540. https://doi.org/10.1093/occmed/kqz131
8. Lancaster, G. D., Stilley, J. D., & Franke, W. D. (2022). How does rescuer fitness affect the quality of prolonged cardiopulmonary resuscitation? Prehospital Emergency Care, 26(2), 195–203. https://doi.org/10.1080/10903127.2021.1894275
9. MacQuarrie, A. S., Hunter, J. R., Sheridan, S., Hlushak, A., Sutton, C., & Wickham, J. (2022). Paramedic student clinical performance during high-fidelity simulation after a physically demanding occupational task: A pilot randomized crossover trial. Simulation in Healthcare, 17(4), 234–241. https://doi.org/10.1097/SIH.0000000000000613
10. Marsh, E., Orr, R., Canetti, E. F. D., & Schram, B. (2025). Profiling paramedic job tasks, injuries, and physical fitness: A scoping review. Applied Ergonomics, 125, 104459. https://doi.org/10.1016/j.apergo.2024.104459

11. Marvin, G., Schram, B., Orr, R., & Canetti, E. F. D. (2023). Occupation-induced fatigue and impacts on emergency first responders: A systematic review. International Journal of Environmental Research and Public Health, 20(22), 7055. https://doi.org/10.3390/ijerph20227055
12. Mthombeni, S., Coopoo, Y., & Noorbhai, H. (2021). Correlation between fitness parameters and an occupational rescue simulation among emergency care providers in North West Province, South Africa: A pilot study. Australasian Journal of Paramedicine, 18, 1–7. https://doi.org/10.33151/AJP.18.862
13. Page, M. J., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71
14. Parpa, K., & Michaelides, M. (2025). Anthropometric characteristics and fitness status of Emergency Medical Services (EMS) personnel. Emergency Care and Medicine, 2(4), 50. https://doi.org/10.3390/ecm2040050
15. Rue, C. A., Rayson, M. P., Walker, E. F., Doherty, J., Thompson, J., Myers, S. D., & Blacker, S. D. (2019). A job task analysis to describe the physical demands of specialist paramedic roles in the National Ambulance Resilience Unit (NARU). Work, 63(4), 547–557. https://doi.org/10.3233/WOR-192960
16. Sheridan, S., Pope, R., MacQuarrie, A., MacPhee, R. S., Rayner, R., Stack, H., Rose, L., & Fischer, S. (2026). Paramedic physical fitness requirements, standards and preparation: A scoping review. Safety, 12(5), 137. https://doi.org/10.3390/safety12050137
17. Siddall, A. G., Rayson, M. P., Walker, E. F., Doherty, J., Osofa, J. I., Flood, T. R., Hale, B., Myers, S. D., & Blacker, S. D. (2021). Development of physical employment standards of specialist paramedic roles in the National Ambulance Resilience Unit (NARU). Applied Ergonomics, 95, 103460. https://doi.org/10.1016/j.apergo.2021.103460
18. Tomičić, D., Osmančević, B., & Ivanišević, K. (2025). The relationship between physical activity and the quality of chest compressions during cardiopulmonary resuscitation. Croatian Nursing Journal, 9(2), 223–230. https://doi.org/10.24141/2/9/2/7
19. van Schaaijk, A., Boschman, J. S., Frings-Dresen, M. H. W., & Sluiter, J. K. (2017). Appraisal of work ability in relation to job-specific health requirements in ambulance workers. International Archives of Occupational and Environmental Health, 90(1), 123–131. https://doi.org/10.1007/s00420-016-1181-z

Appendix A. Systematic Search and Study Selection Completion Checklist

Before the manuscript can be described as a completed systematic review, the research team should provide the following auditable materials. These items are deliberately unfilled rather than replaced with assumed counts.

- Full database-specific search strings, date searched, database/platform and each returned record count.
- Combined reference library export and exact number of duplicates identified and removed.
- Title/abstract screening decisions from two reviewers and records excluded at that stage.
- Full-text reports sought, unretrieved reports, reports assessed and reasons for each full-text exclusion.
- Final included-study list, any overlapping samples, and study characteristics and effect estimates.
- Completed independent JBI or RoB 2 worksheets, consensus decisions and risk-of-bias summary.
- Final PRISMA 2020 flow diagram and any registration/protocol deviation disclosure.
- Author names, institutions, corresponding author contact, contributions, funding and conflict-of-interest declarations.

Appendix B. Proposed Extraction Fields and Outcome Hierarchy

Proposed extraction columns: Study ID | Full reference/DOI | Country | EMS role | Design | Sample size | Fitness exposure and testing method | Comparator | Operational outcome | Clinical outcome | Patient outcome | Effect estimate and uncertainty | Adjustments | Follow-up | Attrition | Risk-of-bias items | Reviewer notes.

Hierarchy for interpretation: (1) patient-level outcomes and serious adverse events; (2) validated clinical performance, CPR quality, procedure accuracy and cognitive competence; (3) observed essential-task completion and safety; (4) physiologic performance or work ability; (5) descriptive fitness measurements alone. Lower-level outcomes should not be described as proof of higher-level patient benefits.

EDITORIAL STATUS — Submission checks outstanding: final authorship; independent database search and PRISMA counts; finalized study selection and quality appraisals; full-text verification of all data; journal formatting and declarations.