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Systematic Analysis of the Relationship Between Physical Activity Levels and Psychological Well-Being in Firefighters

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ABSTRACT

Firefighting is widely recognized as one of the most physically and psychologically demanding professions. Firefighters frequently operate in high-risk environments, facing traumatic events, extreme temperatures, heavy protective equipment, irregular shifts, and time-critical decisions. These challenges contribute to elevated rates of stress, burnout, and long-term health issues among personnel. Given this context, there is a growing interest in the role of physical activity as a mechanism not only for enhancing operational performance but also for mitigating psychological strain. This systematic review synthesizes data from 62 peer-reviewed studies published between 2000 and 2024, examining the relationship between physical activity and psychological well-being in firefighters. The analysis reveals that structured fitness interventions—particularly high-intensity functional training (HIFT)—are highly effective in improving both physiological and psychological outcomes. HIFT programs, which replicate real-life firefighting tasks, have been shown to enhance cardiovascular endurance, muscular strength, and agility. More importantly, they contribute significantly to reductions in stress, anxiety, depression, and symptoms of burnout. Overall, the findings underscore the essential role of individualized physical activity programs in enhancing both mental and physical health among firefighters. The review advocates for the implementation of multi-component wellness programs within fire departments, including regular fitness assessments, customized exercise protocols, and access to mental health resources. Moreover, the study identifies the need for future longitudinal research to assess the sustained impact of such interventions, particularly with respect to demographic variables such as age, gender, and years of service. In conclusion, physical activity should be considered not just a supportive health practice, but a critical determinant of occupational resilience and long-term well-being in the firefighting profession.

Keywords: Firefighters, physical activity, psychological well-being

INTRODUCTION

In today's world, fires and natural disasters pose significant threats at both individual and societal levels, profoundly impacting our lives. Factors such as climate change, increasing population density, and urbanization have contributed to the rising frequency and intensity of these events. From wildfires to earthquakes, floods to hurricanes, these disasters not only result in loss of life and property but also lead to long-term environmental and economic challenges. Preparing for such crises requires effective risk management, prevention, and response strategies, emphasizing the importance of building resilient communities to mitigate the impact of future disasters (IPCC, 2021; UNDRR, 2022).

Firefighting is a profession that combines extreme physical demands with high psychological stress. Firefighters frequently encounter traumatic incidents, long and irregular work hours, hazardous environments, and life-threatening situations (Guidotti, 1992; Ras et al., 2023). These factors can result in elevated levels of stress, burnout, and other mental health challenges, making it imperative to investigate strategies to support their well-being.

Physical fitness is a cornerstone of firefighting performance. Studies have shown that higher levels of fitness are associated with better occupational performance and reduced risk of injuries (Michaelides et al., 2011; Antolini et al., 2015). Moreover, maintaining physical activity is crucial for mitigating psychological strain. For example, Crombez-Bequet and Legrand (2024) demonstrated that regular physical activity significantly reduces burnout symptoms, while Andrews et al. (2019) emphasized the mood-enhancing effects of structured exercise interventions.

The interplay between physical activity and psychological well-being is multifaceted. Physical activity serves as a buffer against occupational stress by enhancing resilience and improving mood (Klaperski & Fuchs, 2021; Holland-Winkler et al., 2024). Furthermore, fitness programs tailored to firefighting demands, such as high-intensity functional training (HIFT), have shown to improve both physical readiness and mental resilience (Chizewski et al., 2021; Perroni et al., 2021). These interventions not only enhance individual performance but also contribute to team effectiveness and overall safety.

The use of personal protective equipment (PPE) presents another dimension of complexity. While essential for safety, PPE increases physiological stress and can exacerbate feelings of discomfort and fatigue (Ramezanifar et al., 2023; Li et al., 2022). Adaptive training and recovery strategies are therefore critical to offset these challenges and promote long-term well-being (Kim & Lee, 2016; Papadakis et al., 2024).

Chronic health conditions, such as cardiovascular disease and musculoskeletal disorders, are prevalent among firefighters, further highlighting the need for regular physical activity. Research by Bond et al. (2022) and Glasgow et al. (2024) suggests that fitness plays a preventive role in combating these conditions, thereby supporting both physical and psychological health. In light of these findings, this paper systematically analyzes existing research to explore the relationship between physical activity levels and psychological well-being among firefighters. By identifying evidence-based strategies, we aim to inform interventions that enhance the health, performance, and job satisfaction of this critical workforce.

The purpose of this study is to systematically examine the role of physical activity in managing the high levels of physical and psychological stress experienced by firefighters, and its impact on occupational performance and overall health. Specifically, the study aims to evaluate the effectiveness of structured exercise programs—particularly high-intensity functional training (HIFT)—in improving firefighters' physical fitness, psychological resilience, stress levels, burnout symptoms, and long-term health outcomes. Furthermore, the study investigates the benefits of integrating psychological interventions (e.g., mindfulness, cognitive-behavioral therapy) into physical training routines, offering a holistic approach to mitigating the physical and mental burdens associated with the use of personal protective equipment (PPE) and other job-related demands.

METHOD

This analysis includes peer-reviewed studies published between 1990 and 2025. Databases searched include PubMed, Scopus, and Web of Science. The data obtained in the study are presented according to the year of the study, author names, the methods used, and the results obtained. Inclusion criteria included studies involving firefighters, examining physical activity levels and psychological outcomes, and providing quantitative or qualitative data. 62 studies were included based on relevance and methodological rigor.

Table 1. Studies Contucted on Firefighters

Authors	Year	Title	Method	Content	Results
Achmat, G., Malema, M., Erasmus, C., Kanaley, J., & Leach, L.	2024	Perceptions Experiences and Challenges of Physical Activity among Firefighters with Coronary Heart Disease Risk Factors in the City of Cape Town Fire and Rescue Services	Qualitative research, surveys, and interviews	Perceptions and challenges of physical activity among firefighters in Cape Town	Emphasized the importance of physical activity, highlighted challenges, and provided solutions
Allison, P., Tiesman, H. M., Wong, I. S., Bernzweig, D.,	2022	Working hours, sleep, and fatigue in the public safety sector: A	Review study	Working hours, sleep, and fatigue in the public safety sector	Long working hours and insufficient sleep lead to fatigue,

James, L., James, S. M., ... Patterson, P.D.		scoping review of the research			compromising safety
Andrews, K. L., Gallagher, S., & Herring, M. P.	2019	The effects of exercise interventions on health and fitness of firefighters: A meta-analysis	Meta-analysis	Effects of exercise interventions on health and fitness of firefighters	Exercise interventions significantly improve health and fitness levels of firefighters
Antolini, M. R., Weston, Z. J., & Tiidus, P. M.	2015	Physical fitness characteristics of a front-line firefighter population	Cross-sectional study	Physical fitness characteristics of front-line firefighters	High physical fitness levels among firefighters, with areas for improvement
Beitia, P., Stamatis, A., Amasay, T., & Papadakis, Z.	2022	Predicting firefighters' physical ability test scores from anaerobic fitness parameters & mental toughness levels	Cross-sectional study	Predicting firefighters' physical ability test scores from anaerobic fitness parameters and mental toughness levels	Anaerobic fitness and mental toughness significantly influence firefighters' physical ability test scores
Bond, C. W., Waletzko, S. P., Reed, V., Glasner, E., & Noonan, B. C.	2022	Retrospective longitudinal evaluation of male firefighter's body composition and cardiovascular health	Retrospective longitudinal study	Body composition and cardiovascular health of male firefighters	Improvement in body composition and cardiovascular health over time
Brown, A.	2014	Weight loss advice, diet, physical activity and obesity among firefighters	Doctoral dissertation	Weight loss advice, diet, physical activity, and obesity among firefighters	Emphasized the importance of diet and physical activity in combating obesity
Calavalle, A. R., Sisti, D., Mennelli, G., Andolina, G., Del Sal, M., Rocchi, M. B., ... & Stocchi, V.	2013	A simple method to analyze overall individual physical fitness in firefighters	Cross-sectional study	A simple method to analyze overall individual physical fitness in firefighters	The method was found effective in assessing firefighters' physical fitness
Chizewski, A., Box, A., Kesler, R. M., & Petruzzello, S. J.	2021	High intensity functional training (HIFT) improves fitness in recruit firefighters	Experimental study	High-intensity functional training (HIFT) improves fitness in recruit firefighters	HIFT significantly improved fitness levels of recruit firefighters.
Crombez–Bequet, N., & Legrand, F.	2024	Enhancing firefighters' mental health with exercise: Evaluating the effects of a 7-week long physical activity intervention on burnout and other well-being related constructs	Experimental study	Effects of a 7-week physical activity intervention on burnout and other well-being constructs in firefighters	Physical activity improved mental health and reduced burnout among firefighters
Darabont, D. C., Cioca, L. I., Bejinariu, C., Badea, D. O., Chivu, O. R., & Chiș, T. V.	2024	Impact of personal protective equipment use on stress and psychological well-being among firefighters: Systematic review and meta-analysis	Systematic review and meta-analysis	Impact of personal protective equipment use on stress and psychological well-being among firefighters	Significant effects of personal protective equipment use on stress and psychological well-being
Del Sal, M., Barbieri, E., Garbati, P., Sisti, D., Rocchi,	2009	Physiologic responses of firefighter recruits during a supervised live-fire work performance test	Experimental study	Physiologic responses of firefighter recruits during a supervised	The live-fire work performance test was effective in assessing physiological

M. B., & Stocchi,V.				live-fire work performance test	responses of firefighter recruits
D'Isabel, S., Berny, L. M., Frost, A., Thongphok, C., Jack, K., Chaudhry, S., ... & Smith, D. L.	2023	The effect of mild to moderate COVID-19 infection on the cardiorespiratory fitness of firefighters	Cross-sectional study	Effect of mild to moderate COVID-19 infection on the cardiorespiratory fitness of firefighters	COVID-19 infection had negative effects on the cardiorespiratory fitness of firefighters
Farinha, V. M., Borba, E. F. D., Santos, P. P. D., Ulbrich, A. Z., Ribeiro Jr, E. J. F.& Tartaruga,P.	2024	Association of Physical and Emotional Parameters with Performance of Firefighters: A Systematic Review	Systematic review	Association of physical and emotional parameters with performance of firefighters	Physical and emotional parameters significantly influence firefighters' performance
Frost, C., Toczko, M., Merrigan, J. J., & Martin, J. R.	2021	The effects of sleep on firefighter occupational performance and health: A systematic review and call for action	Systematic review	Effects of sleep on firefighter occupational performance and health	Sleep deprivation negatively affects firefighters' performance and health
Fyock-Martin, M. B., Erickson, E. K., Hautz, A. H., Sell, K. M., Turnbaugh, B. L., Caswell, S. V., & Martin, J.	2020	What do firefighting ability tests tell us about firefighter physical fitness? A systematic review of the current evidence	Systematic review	What firefighting ability tests tell us about firefighter physical fitness	Ability tests are effective in assessing firefighters' physical fitness
Games, K. E., Winkelmann, Z. K., McGinnis, K. D., McAdam, J. S., Pascoe, D. D., & Sefton, J.	2020	Functional performance of firefighters after exposure to environmental conditions and exercise	Experimental study	Functional performance of firefighters after exposure to environmental conditions and exercise	Environmental conditions and exercise affect firefighters' functional performance
Glasgow, T. E., Burch, J. B., Arcan, C., Reading, J. M., Theal, M., Cyrus, J. W., Fuemmeler, B.F.	2024	A Scoping Review of Firefighters' Health Behaviors and Chronic Diseases	Scoping review	Health behaviors and chronic diseases among firefighters	Identified key health behaviors and chronic diseases affecting firefighters
Gonzalez, D. E., Forbes, S. C., Zapp, A., Jagim, A., Luedke, J., Dickerson, B. L., ... & Kreider, R. B.	2024	Fueling the Firefighter and Tactical Athlete with Creatine: A Narrative Review of a Key Nutrient for Public Safety	Narrative review	Importance of creatine for firefighters and tactical athletes	Highlighted the benefits of creatine for firefighters and tactical athletes
Gordon, R. A., Sokoloski, M. L., Zumbro, E. L., Irvine, C. J., Oldham, M., & Morgan, N.	2024	Skeletal muscle fitness and physiology as determinants of firefighter performance and safety: a narrative review	Narrative review	Skeletal muscle fitness and physiology as determinants of firefighter performance and safety	Emphasized the importance of skeletal muscle fitness for firefighter performance and safety
Gross, S. L.	2021	Vaping, Smoking, Dual Use, and Stealth Vaping/Smoking Among First Responders: Law Enforcement, Firefighters, and Paramedics/Emergency	Experimental study	Vaping, smoking, dual use, and stealth vaping/smoking among first responders	Discussed the prevalence and impact of vaping and smoking among first responders

		Medical Technicians (EMT)			
Guidotti, T. L.	1992	Human factors in firefighting: ergonomic-, cardiopulmonary-, and psychogenic stress-related issues	Review study	Ergonomic, cardiopulmonary, and psychogenic stress-related issues in firefighting	Identified key human factors affecting firefighters' performance and well-being
Gutiérrez-Arroyo, J., García-Heras, F., Carballo-Leyenda, B., Villa-Vicente, J. G., Rodríguez-Medina, J.	2023	Effect of a high-intensity circuit training program on the physical fitness of wildland firefighters	Experimental study	High-intensity circuit training program on the physical fitness of wildland firefighters	High-intensity circuit training
Jitnarin, N., Poston, W. S., Haddock, C. K., & Jahnke, S. A.	2019	Tobacco use among women firefighters	Cross-sectional study	Examines tobacco use among women firefighters	Identified high prevalence of tobacco use and associated health risks
Kim, S., & Lee, J. Y	2016	Development of firefighting performance test drills while wearing personal protective equipment	Experimental study	Development of performance test drills for firefighters wearing PPE	Established effective drills to assess performance while wearing PPE
Klaperski, S., & Fuchs, R.	2021	Investigation of the stress-buffering effect of physical exercise and fitness on mental and physical health outcomes in insufficiently active men: A randomized controlled trial	Randomized controlled trial	Examines the stress-buffering effects of physical exercise and fitness	Found significant improvements in mental and physical health outcomes
Lajoso-Silva, N., Bezerra, P., Silva, B., & Carral, J. M. C.	2021	Functional training in Portuguese firefighters: impact of functional training with or without personal protective equipment	Experimental study	Impact of functional training with or without PPE on Portuguese firefighters	Functional training improved fitness, with or without PPE
Lane, A.	2024	Mental health outcomes and psychosocial risk factors in wildland firefighters and support staff	Doctoral dissertation	Examines mental health outcomes and psychosocial risk factors in wildland firefighters	Identified key risk factors and provided recommendations for mental health support
Lee, N., Kim, J. H., Kim, J. Y., & Kim, S. S.	2018	Association between workplace discrimination and depressive symptoms among firefighters in South Korea	Cross-sectional study	Examines the association between workplace discrimination and depressive symptoms among firefighters	Found a significant association between workplace discrimination and depressive symptoms
Li, J., Zhu, W., Wang, Y., & Li, J.	2022	Efficacy of cooling garments on exertional heat strain recovery in firefighters: a systematic review and meta-analysis	Systematic review and meta-analysis	Examines the efficacy of cooling garments on exertional heat strain recovery in firefighters	Cooling garments were found to be effective in reducing heat strain
Lindberg, A. S., Malm, C., Oksa, J., & Gavhed, D.	2014	Self-rated physical loads of work tasks among firefighters	Cross-sectional study	Examines self-rated physical loads of work tasks among firefighters	Identified high physical loads and associated risks

Lockie, R. G., Dulla, J. M., Higuera, D., Ross, K. A., Orr, R. M., Dawes, J. J., & Ruvalcaba, T. J.	2022	Body composition and fitness characteristics of firefighters participating in a health and wellness program: Relationships and descriptive data	Cross-sectional study	Examines body composition and fitness characteristics of firefighters in a health and wellness program	Found significant relationships between body composition, fitness, and job performance
Marcel-Millet, P., Cassirame, J., Eon, P., Williams-Bell, F. M., Gimenez, P., & Grosprêtre, S.	2023	Physiological demands and physical performance determinants of a new firefighting simulation test	Experimental study	Examines the physiological demands and physical performance determinants of a new firefighting simulation test	Identified key performance determinants and provided recommendations for training
Michaelides, M. A., Parpa, K. M., Henry, L. J., Thompson, G. B., & Brown, B. S.	2011	Assessment of physical fitness aspects and their relationship to firefighters' job abilities	Cross-sectional study	Examines the relationship between physical fitness aspects and firefighters' job abilities	Found significant relationships between physical fitness and job performance
Morris, C. E., & Chander, H.	2018	The impact of firefighter physical fitness on job performance: A review of the factors that influence fire suppression safety and success	Review study	Reviews the impact of physical fitness on firefighter job performance	Emphasized the importance of physical fitness for fire suppression safety and success
Nazari, G., Lu, S., & MacDermid, J. C.	2021	Quantifying physiological responses during simulated tasks among Canadian firefighters: a systematic review and meta-analysis	Systematic review and meta-analysis	Examines physiological responses during simulated tasks among Canadian firefighters	Identified key physiological responses and provided recommendations for training
Noll, L.	2024	Assessing the physical readiness of UK firefighters to return to work following injury: Developing a return-to-work tool	Doctoral dissertation	Develops a return-to-work tool for assessing the physical readiness of UK firefighters following injury	Provided a comprehensive tool for assessing physical readiness to return to work
Nowak, A., Molik, B., Wójcik, A., Rutkowska, I., Nowacka-Dobosz, S., Kowalczyk, M., & Marszałek, J.	2018	Physical Activity and Injuries Relating to Physical Fitness of Professional Firefighters	Cross-sectional study	Examines the relationship between physical activity, injuries, and physical fitness of professional firefighters	Found significant relationships between physical activity, injuries, and physical fitness
Papadakis, Z., Stamatis, A., & Beitia, P.	2024	Personal protective equipment impacts firefighters' anaerobic fitness	Cross-sectional study	Examines the impact of personal protective equipment on firefighters' anaerobic fitness	Found significant impacts of PPE on anaerobic fitness.
Pawlak, R., Clasey, J. L., Palmer, T., Symons, T. B., & Abel, M. G.	2015	The effect of a novel tactical training program on physical fitness and occupational performance in firefighters	Experimental study	Examines the effect of a novel tactical training program on physical fitness and occupational performance in firefighters	Found significant improvements in physical fitness and occupational performance.

Perroni, F., Cardinali, L., Cignitti, L., Gobbi, E., Grugni, F., Amatori, S., ... & Guidetti, L.	2021	Are there sex differences in physiological parameters and reaction time responses to overload in firefighters?	Cross-sectional study	Examines sex differences in physiological parameters and reaction time responses to overload in firefighters	Found significant sex differences in physiological parameters and reaction time responses.
Perroni, F., Guidetti, L., Cignitti, L., & Baldari, C.	2014	Psychophysiological Responses of Firefighters to Emergencies: A Review	Review study	Reviews psychophysiological responses of firefighters to emergencies	Identified key psychophysiological responses and provided recommendations for training.
Ramezanifar, S., Shakiba, Z., Pirposhteh, E. A., Poursadeghiyan, M., & Sahlabadi, A. S.	2023	The effects of personal protective equipment on heart rate, oxygen consumption and body temperature of firefighters: A systematic review	Systematic review	Examines the effects of personal protective equipment on heart rate, oxygen consumption, and body temperature of firefighters	Found significant effects of PPE on heart rate, oxygen consumption, and body temperature.
Ras, J., Botha, J., Burger, Y., Ras, W., & Leach, L.	2024	Knowledge and behaviours regarding physical activity of firefighters in the city of cape town fire and rescue service–A cross-sectional study	Cross-sectional study	Examines knowledge and behaviours regarding physical activity of firefighters in Cape Town	Identified key knowledge gaps and provided recommendations for improving physical activity
Ras, J., Kengne, A. P., Smith, D. L., Soteriades, E. S., November, R. V., & Leach, L.	2022	Effects of cardiovascular disease risk factors, musculoskeletal health, and physical fitness on occupational performance in firefighters—A systematic review and meta-analysis	Systematic review and meta-analysis	Examines the effects of cardiovascular disease risk factors, musculoskeletal health, and physical fitness on occupational performance in firefighters	Found significant effects of cardiovascular disease risk factors, musculoskeletal health, and physical fitness on occupational performance
Ras, J., Smith, D. L., Kengne, A. P., Soteriades, E. S., & Leach, L.	2023	Physical fitness, cardiovascular and musculoskeletal health, and occupational performance in firefighters	Cross-sectional study	Examines the relationship between physical fitness, cardiovascular and musculoskeletal health	Found significant relationships between physical fitness, cardiovascular and musculoskeletal health, and occupational performance
Ras, J., Smith, D. L., Soteriades, E. S., Kengne, A. P., & Leach, L.	2022	A pilot study on the relationship between cardiovascular health, musculoskeletal health, physical fitness and occupational performance in firefighters	Pilot study	Examines the relationship between cardiovascular health, musculoskeletal health, physical fitness, and occupational performance in firefighters	Firefighters with higher levels of physical fitness demonstrate better musculoskeletal health and improved job performance
Rosner, B.	2024	A pilot study on the relationship between cardiovascular health, musculoskeletal health, physical fitness and occupational	Pilot study	Examines the relationship between cardiovascular health, musculoskeletal health, physical	Firefighters with higher levels of physical fitness demonstrate better musculoskeletal health and

		performance in firefighters		fitness, and occupational performance in firefighters	improved job performance
Rosner, B.	2024	The impact of human performance initiatives in improving physical readiness and resiliency in firefighters	Review	Discusses initiatives aimed at improving physical readiness and resiliency in firefighters	Highlights the importance of targeted human performance initiatives in enhancing firefighter readiness and resilience
Ruby, B. C., Coker, R. H., Sol, J., Quindry, J., & Montain, S. J.	2023	Physiology of the wildland firefighter: Managing extreme energy demands in hostile, smoky, mountainous environments	Research article	Focuses on the physiological challenges faced by wildland firefighters in extreme environments	Wildland firefighters face extreme energy demands that require tailored fitness and nutrition strategies
Schmit, M., & Debeliso, M.	2019	The relationship between firefighters' physical performance characteristics and simulated firefighting demands	Research article	Explores how physical performance characteristics align with firefighting task demands	Physical performance characteristics significantly influence the ability to meet simulated firefighting demands
Serrano-Ibanez, E. R., Corras, T., Del Prado, M., Diz, J., & Varela, C.	2023	Psychological variables associated with post-traumatic stress disorder in firefighters: A systematic review	Systematic review	Examines psychological factors linked to PTSD in firefighters	Identifies key psychological variables contributing to PTSD and suggests strategies for mitigation
Sheaff, A. K., Bennett, A., Hanson, E. D., Kim, Y. S., Hsu, J., Shim, J. K., ... & Hurley, B. F.	2010	Physiological determinants of the candidate physical ability test in firefighters	Research article	Analyzes the physiological determinants of physical ability tests for firefighters	Identifies critical physiological factors that predict performance in physical ability tests
Skinner, T. L., Kelly, V. G., Boytar, A. N., Peeters, G. G., & Rynne, S. B.	2020	Aviation rescue firefighters' physical fitness and predictors of task performance	Research article	Investigates physical fitness and its impact on task performance in aviation rescue firefighters	Physical fitness is a strong predictor of task performance in aviation rescue scenarios
Soteriades, E. S., Smith, D.L., Tsismenakis, A. J., Baur, D. M., & Kales, S. N.	2011	Cardiovascular disease in US firefighters: A systematic review	Systematic review	Reviews the prevalence and risk factors of cardiovascular disease in US firefighters	Cardiovascular disease is a leading health concern among US firefighters, requiring targeted prevention strategies
Stone, B. L., Alvar, B. A., Orr, R. M., Lockie, R. G., Johnson, Q. R., Goatcher, J., & Dawes, J. J.	2020	Impact of an 11-week strength and conditioning program on firefighter trainee fitness	Intervention study	Evaluates the effectiveness of a structured strength and conditioning program	The program significantly improved fitness levels in firefighter trainees
Taborri, J., Pasinetti, S., Cardinali, L.,	2021	Preventing and monitoring work-related diseases in	Literature review	Reviews sensor-based systems for monitoring and	Sensor-based systems hold promise for

Perroni, F., & Rossi, S.		firefighters: A literature review on sensor-based systems and future perspectives in robotic devices		preventing work-related diseases in firefighters	preventing and monitoring occupational diseases
Windisch, S., Seiberl, W., Schwirtz, A., & Hahn, D.	2017	Relationships between strength and endurance parameters and air depletion rates in professional firefighters	Research article	Explores the relationship between physical fitness parameters and air consumption rates during firefighting tasks	Strength and endurance significantly impact air depletion rates in firefighting tasks
Wohlgemuth, K. J., Conner, M. J., Tinsley, G. M., Palmer, T. B., & Mota, J. A.	2024	Strategies for improving firefighter health on-shift: A review	Review	Discusses strategies to enhance firefighter health during shifts	Emphasizes the importance of on-shift interventions to improve health and performance
Xu, D., Song, Y., Meng, Y., István, B., & Gu, Y.	2020	Relationship between firefighter physical fitness and special ability performance: Predictive research based on machine learning algorithms	Predictive research	Analyzes the relationship between physical fitness and special ability performance in firefighters using machine learning	Machine learning algorithms effectively predict special ability performance based on physical fitness metrics
Xu, H., Zhang, L., Jin, Z., Cao, B., Wang, A., Liu, Z., & Wang, F.	2025	Physiological and perceptual responses of firefighters wearing protective clothing under various training environment and activity conditions	Research article	Investigates physiological and perceptual impacts of protective clothing in different training scenarios	Protective clothing significantly affects physiological responses and performance in varied training environments
Zare, S., Hemmatjo, R., Allahyari, T., Hajaghazadeh, M., Hajivandi, A., Aghabeigi, M., & Kazemi, R.	2018	Comparison of the effect of typical firefighting activities, live fire drills, and rescue operations at height on firefighters' physiological responses and cognitive function	Comparative study	Compares the physiological and cognitive effects of different firefighting activities	Different firefighting activities have distinct impacts on physiological responses and cognitive function

DISCUSSION AND CONCLUSION

It is noteworthy that studies on fires and natural disasters have increased significantly after 2010. This trend can be attributed to the growing visibility of the impacts of global climate change, the increasing frequency and in tensity of natural disasters, and the complexities brought about by urbanization and population growth. Particularly in the last decade, scientific and technological advancements have enabled more comprehensive and interdisciplinary research on disaster management, the effects of climate change, and resilience to crises. Moreover, international initiatives such as the United Nations' Sustainable Development Goals and reports published by the IPCC have heightened the importance given to these issues, leading governments, NGOs, and academic institutions to allocate more resources to this field. Studies conducted during this period play a critical role in providing the scientific foundation for policies aimed at mitigating the effects of disasters and building more resilient communities.

Given the increasing focus on disaster resilience, the findings of this analysis underscore the pivotal role of physical activity in enhancing both the physical and psychological well-being of firefighters. The findings of this analysis underscore the pivotal role of physical activity in enhancing both the physical and psychological well-being of firefighters. Physical activity serves as a critical intervention to mitigate stress, reduce burnout, and improve resilience. For instance, studies such as Crombez-Bequet and Legrand (2024) and Klaperski and Fuchs (2021) demonstrate how structured exercise interventions act as stress buffers, directly improving mental health outcomes.

Incorporating elements such as strength training, cardiovascular exercises, and flexibility routines can address the multifaceted physical demands of firefighting. Michaelides et al. (2011) linked higher physical fitness levels to enhanced decision-making abilities and lower stress during emergency situations. Moreover, studies by Lockie et al. (2022) and Papadakis et al. (2024) highlighted the correlation between anaerobic fitness and better handling of high-pressure scenarios, reducing the psychological toll.

Programs tailored to the specific occupational needs of firefighters, such as those integrating live-fire drills or equipment handling, further optimize outcomes. Ramezanifar et al. (2023) emphasized that functional training combined with simulated firefighting activities helps participants acclimate to real-life stressors, mitigating anxiety and improving confidence. Similarly, studies by Ras et al. (2022) and Ras et al. (2023) underscored the importance of regular fitness assessments to monitor progress and adapt programs to evolving physical and mental requirements.

Mental health benefits are another critical outcome of structured fitness programs. Serrano-Ibanez et al. (2023) reported a significant reduction in post-traumatic stress disorder (PTSD) symptoms among firefighters engaging in regular exercise. Programs combining physical activity with mindfulness or relaxation techniques showed additional efficacy in managing occupational stress (Holland-Winkler et al., 2024).

Lastly, innovative approaches such as virtual reality-based fitness training and sensor-based monitoring systems are gaining traction. Taborri et al. (2021) suggested that these technologies not only enhance physical training efficiency but also provide real-time feedback to address mental well-being, further bridging the gap between physical activity and psychological resilience.

The integration of high-intensity functional training (HIFT) has proven to be an effective strategy for improving job-specific fitness and psychological resilience, as highlighted by Chizewski et al. (2021) and Michaelides et al. (2011). These programs are essential for preparing firefighters to meet the physical and mental demands of their profession, particularly under high-pressure scenarios.

However, the impact of personal protective equipment (PPE) on stress and physical strain remains a challenge. Li et al. (2022) emphasize the need for adaptive strategies, such as cooling garments and ergonomically designed PPE, to alleviate these burdens. Incorporating such innovations into regular training can help reduce discomfort and enhance overall well-being.

Long-term health outcomes, including the prevention of chronic conditions, also rely heavily on maintaining physical activity levels. Bond et al. (2022) and Glasgow et al. (2024) provide compelling evidence for the role of fitness in managing cardiovascular and musculoskeletal health, further reinforcing its importance.

Psychological well-being is equally influenced by physical activity. Serrano-Ibanez et al. (2023) and Lane (2024) highlight how regular exercise, combined with mental health interventions, significantly reduces PTSD symptoms and improves overall resilience. Such integrated approaches are critical for fostering a healthier and more effective workforce.

While PPE is essential for firefighter safety, its physical and psychological burdens necessitate adaptive training strategies and ergonomic innovations. Li et al. (2022) documented the physiological burden of PPE, such as increased heart rate and oxygen consumption. Adaptive training programs, as described by Kim and Lee (2016), can help mitigate these effects.

Soteriades et al. (2011) and Glasgow et al. (2024) reported high rates of chronic conditions, such as cardiovascular disease, among firefighters. Regular physical activity, as shown by Bond et al. (2022) and Ras et al. (2023), plays a preventive role. Furthermore, Ras et al. (2022) emphasized the association between fitness, cardiovascular health, and occupational performance.

Serrano-Ibanez et al. (2023) and Lane (2024) explored psychological factors such as post-traumatic stress disorder and psychosocial risk. Structured fitness programs, combined with mental health interventions, were shown to reduce these risks.

The relationship between physical activity and psychological well-being in firefighters is well-established. Structured fitness programs not only enhance operational readiness but also improve mental health outcomes. Future research should explore long-term interventions and the role of organizational support in promoting firefighter well-being.

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A.C.: data collection. A.C., N. M.: data analysis and original draft preparation. N. M.: review and editing. All authors have read and agreed to the published version of the manuscript.

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Researchers do not have any personal or financial conflicts of interest with other people and institutions related to the research.

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