The Open Public Health Journal
DOI: 10.2174/0118749445327343240821051143, 2024, 17, e18749445327343
ISSN: 1874-9445

RESEARCH ARTICLE **OPEN ACCESS**

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

Ghaleelullah Achmat[1,*], Makhaya Malema[1], Charlene Erasmus[2], Jill Kanaley[3] and Lloyd Leach[4]

[1]*Department of Sport, Faculty of Community and Health Science, University of the Western Cape, Recreation and Exercise Science Private Bag X17 (Robert Sobukwe Rd) Bellville, 7535, South Africa*
[2]*Child and Family studies Unit, Department of Social Work, University of the Western Cape, South Africa*
[3]*Department of Nutrition and Exercise Physiology, University of Missouri, United States*
[4]*Department of Sport Recreation and Exercise Science, University of the Western Cape, South Africa*

Abstract:

Background: The development of atherosclerosis in firefighters is affected by various cardiovascular risk factors, such as smoking, poor dietary choices, and lack of physical activity. Together, these elements lead to obesity, high blood pressure, unhealthy cholesterol, and increased blood sugar levels. Continuous exposure to these risks raises the chances of worsening atherosclerosis, which can impede blood circulation to essential organs like the heart and brain. As a result, sudden cardiac death is the leading cause of fatalities while on duty in the fire service.

Aim: This study aimed to explore and describe the perceptions, experiences, and challenges associated with physical activity among firefighters with risk factors for coronary heart disease in the City of Cape Town Fire and Rescue Services.

Methods: A purposive sample of nine full-time active career firefighters from the City of Cape Town Fire and Rescue Services, representing three different ranks, was employed, using a descriptive qualitative study design. The semi-structured interview responses were recorded and transcribed verbatim. The participants were free to leave the study at any time and without penalty, and their rights to confidentiality were protected. The thematic analysis was then used to examine the transcripts.

Results: The results revealed that firefighters were not physically active enough to meet the suggested minimum levels of physical activity and were physically inactive. Sedentary lifestyles have numerous detrimental effects on the human body, such as elevated rates of dyslipidemia, hypertension, diabetes mellitus, cardiovascular disease mortality, and all-cause death. Therefore, it is essential to reduce sedentary behavior and increase physical exercise to improve the health and well-being of firefighters.

Conclusion: Policy strategies should be designed to introduce physical activities at low-moderate intensity levels and accommodate firefighters with coronary heart disease risk factors. Implementing team-based physical activity interventions has demonstrated positive impacts on individual behavior changes within the fire service.

Keywords: Physical activity, Firefighters, Coronary heart disease, Sedentary behaviour, Dyslipidemia, Type 2 diabetes, High blood pressure, Cigarette smoking.

*Address correspondence to this author at the Department of Sport, Faculty of Community and Health Science, University of the Western Cape, Recreation and Exercise Science, Private Bag X17 (Robert Sobukwe Rd), Bellville 7535 South Africa; E-mail: gachmat@uwc.ac.za

Cite as: Achmat G, Malema M, Erasmus C, Kanaley J, Leach L. 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. Open Public Health J, 2024; 17: e18749445327343.
http://dx.doi.org/10.2174/0118749445327343240821051143

Received: May 16, 2024
Revised: July 30, 2024
Accepted: August 06, 2024
Published: October 07, 2024

1. INTRODUCTION

The progression of atherosclerosis among firefighters is influenced by cardiovascular risk factors, which include tobacco use, an unhealthy diet, and physical inactivity. These factors collectively contribute to obesity, elevated blood pressure (hypertension), abnormal blood lipids (dyslipidemia), and elevated blood glucose (diabetes) [1, 2]. Persistent exposure to these risk factors increases the likelihood of further atherosclerosis progression, resulting in the obstruction of blood flow to vital organs such as the heart and the brain [1-3]. Consequently, the primary cause of on-duty fatalities in the fire service is sudden cardiac death [4, 5]. Previous investigations indicate that deaths attributed to cardiovascular disease (CVD) account for 30 to 49% of the total on-duty deaths occurring annually [1, 4-6, 7]. CVD stands as the leading cause of morbidity and mortality globally, characterized by key risk factors known as coronary heart disease risk factors (CHDRFs) [7-10]. These factors encompass a sedentary lifestyle, type 2 diabetes (T2D), obesity, high blood pressure, high cholesterol, cigarette smoking, advancing age, and a family history of heart disease [11, 12]. The spectrum of CVD includes various conditions, such as arrhythmias, dilated, hypertrophic, or idiopathic cardiomyopathies, heart failure, and atherosclerosis [13, 14]. These conditions, if left unchecked, can lead to potentially fatal cardiac events such as stroke, myocardial infarction (heart attack), and cardiac arrest [15, 16].

Extensive research on the prevention of cardiovascular risk factors reveals that firefighters with coronary heart disease (CHD) often lack awareness of their own personal risks and understanding of appropriate lifestyle changes [16-19]. Understanding the factors influencing behavioral modification is crucial for firefighters with health risks [20-22]. Ensuring employee well-being is a fundamental responsibility of employers, and legislation in South Africa mandates a conducive work environment for the health and safety of employees [23-27]. Work guidelines serve as measures implemented by employers to enhance productivity, performance, and output. The National Institute for Occupational Safety and Health (NIOSH) Policy underscores the importance of addressing cardio- vascular health issues among firefighters [28-31].

Some incumbent firefighters lack the minimum exercise tolerance considered necessary to safely perform the demanding tasks within their line of duty [1, 32, 33]. A significant factor contributing to the high risk of heart attacks among firefighters could be insufficient on-duty exercise or neglect of physical activity (PA) at home [34-38]. Failing to meet the recommended 150 minutes of PA in a week increases the health risk behavior of firefighters and contributes to the development of CHDs [1, 32, 33, 38-40]. These health risk behaviors jeopardize public safety, emphasizing the importance of assisting firefighters in adopting behavioral lifestyle modifications [1, 4, 5]. This effort aims to prevent loss of life, protect public assets, and limit property damage [41-45]. Conflict between managing work and engaging in PA can often lead to stress and may further elevate the risk of CHD [1, 46-49].

Firefighters operate in extreme conditions, facing environmental heat exposure, including high ambient temperatures, while wearing protective clothing, which is a significant concern in firefighting [1, 50, 51]. Heat stress not only poses hazards to the cardiovascular system but can also accentuate muscle fatigue and overexertion [1, 50-53]. Engaging in PAs offers benefits in the fire service by stimulating the production of endorphins, enhancing mood, serving as a natural pain reliever, and reducing stress hormone levels such as adrenaline and cortisol [1, 54-56]. Regular participation in PA induces physiological adaptations, impacting areas such as stroke volume, resting heart rate, blood pressure, and cardiac output. These adaptations lead to improvements in cardio-respiratory and musculoskeletal performance, ultimately enhancing individuals' health-related quality of life (HRQoL) [9, 57-59].

The Fire Brigade Services Act: White Paper on Fire Services (2020) makes it obligatory for fire services to implement and maintain employee wellness programs that will address the physical fitness and mental health needs of fire services staff in a professional manner. As legislation is open to interpretation by individuals in the fire services, comparisons across management levels are beneficial for identifying common problems and successes that could be implemented nationally [60]. The current research, therefore, draws on perspectives of firefighters from lower, middle, and top management to evaluate current perceptions, experiences, and challenges and examples of best practices for developing their physical activities for firefighters with coronary heart diseases

1.1. Problem Statement

Firefighters encounter hazardous occupational conditions at high levels of strenuous exertion and are expected to have good physical fitness [1]. The prevalence of coronary heart disease continues to increase due to an easily accessible Western lifestyle adopted in developing countries [1, 2]. Western diet and sedentary living have caused a significant adverse impact on the health status of the population from which firefighters are recruited [1-3]. The extreme physical, environmental, emotional, and mental stress of firefighting places on human physiology, particularly the cardiovascular system, thus increasing the medical costs in the fire service [1]. Many firefighters have one or more modifiable CHD risk factors for cardiovascular disease and only modest aerobic capacity [4, 5]. The leading cause of line-of-duty death among US firefighters, a sudden cardiac event accounts for almost half of all fatalities, with 90% of these caused by coronary heart disease [1-3]. Furthermore, to counteract these mortalities and morbidities, the WHO recommends at least 150 minutes of moderate-intensity aerobic physical activity throughout the week. [1-6] However, many firefighters do not meet the recommended fitness levels based on cardiovascular and metabolic demands, and it remains unclear why a substantial portion of firefighters do not meet the World Health Organization's physical activity (PA) recommendations [7, 8]. Therefore, this study

will contribute to a better understanding of the perceptions, experiences, and challenges of physical activity for firefighters with coronary heart disease risk factors in the City of Cape Town Fire and Rescue Services.

1.2. Aim

This study aimed to explore and describe the perceptions, experiences, and challenges of physical activity for firefighters with coronary heart disease risk factors in the City of Cape Town Fire and Rescue Services

2. LITERATURE REVIEW

2.1. Benefits of Physical Activity for Firefighters Living with Coronary Heart Disease

Firefighting is a demanding profession that requires both physical fitness and mental resilience [60]. A pivotal approach to enhancing physical fitness among firefighters involves engaging in regular PA, offering numerous health benefits, including the mitigation of chronic conditions associated with CHD [1, 4, 5]. This includes reducing inflammation indicators, enhancing metabolic well-being, decreasing the chances of heart failure, and contributing to better overall longevity [1, 4, 5, 7, 61]. Engaging in PAs induces adaptations in the heart and vascular system, ultimately resulting in enhanced cardiovascular function [1, 4, 61, 62]. Consistent physical exercise results in a reduction in resting heart rate, blood pressure, and markers of atherosclerosis [62-64]. Simultaneously, it promotes physiological cardiac hypertrophy by influencing skeletal muscle, liver, and adipose tissue [65, 66]. Additionally, it improves overall metabolic health, thereby reducing the incidence of T2D by enhancing glucose tolerance and insulin sensitivity and decreasing circulating lipid concentrations [67-69].

PA increases the amount of blood circulating, thereby enhancing the health and function of blood vessels [67-70]. Firefighters who exercise regularly have more flexible blood vessels and improved blood flow [67-70]. Therefore, during periods of high stress (like fire operations), those with healthier blood vessels and lower blood pressure will respond better and are less likely to have a cardiac incident [67-73]. Consistent engagement in PAs promotes physical exercise, leading to a decrease in resting heart rate, blood pressure, and detrimental markers linked to CVD [68-70]. Moreover, it fosters beneficial cardiac muscle growth, enhances myocardial perfusion, and elevates levels of high-density lipoprotein (HDL) cholesterol [69-71]. Collectively, these effects alleviate the burden on the heart, resulting in improved overall cardiovascular health for individuals regardless of whether they are healthy or affected by underlying conditions [68-73].

Additionally, PA contributes to the reduction and management of risk factors associated with heart disease, including high blood pressure, elevated cholesterol levels, and obesity [69-73]. Furthermore, PA has been shown to improve cardiac risk factors such as blood pressure, cardiovascular fitness, flexibility, and body fat percentage, as indicated by multiple research studies [73-78]. This is particularly crucial for firefighters who regularly face sleep deprivation and high-stress situations, as regular PA plays a significant role in mitigating stress levels [73-78].

2.2. Physical Activity for Firefighters Living with Coronary Heart Disease

For firefighters with CHD, engaging in PAs that are safe and tailored to their health conditions is crucial [49, 64, 79]. Before initiating any exercise program, individuals need to consult with their medical doctor to obtain medical clearance [79-81]. Pre-exercise screening serves to identify firefighters with medical conditions that may pose a higher risk of experiencing health problems during PAs [79-81]. Biokineticists, sports scientists, and health-care providers can play a vital role in assisting firefighters by promoting healthy lifestyle modifications through education and prescribing appropriate PAs [82-84]. The WHO encompasses physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. The movements include three different activity expenditure levels [85-90], *i.e.*, low, moderate, and vigorous intensity. Light activity+ is less than 3.0 METs and less than 3.5 calories per minute. The examples of light PAs includes walking slowly (for example, shopping or walking around the fire station), sitting at a computer, making the bed, eating, preparing food, and washing dishes [85-90]. The moderate activity+ is less than 3.0 - 6.0 METS between 3.5 - 7.0 calories per minute. The examples of moderate physical activities include sweeping the floor, walking briskly, slow dancing, vacuuming, washing windows, and shooting a basketball [85-90]. The vigorous activity+ is greater than 6.0 METS and more than 7.0 calories per minute. The examples of vigorous physical activities include running (faster than 5 mph/8.04 kph), swimming, shoveling, soccer, jumping rope, and carrying heavy loads (such as bricks) [85-90].

2.3. Firefighters' Experiences and Challenges of Physical Activity

The physical health of firefighters is an essential part of the firefighting function and often needs to be improved. However, physical stressors lead to a physiological response that can result in either a positive or negative adaptation. Several sources of stress, such as physical strain, physical exhaustion, and altered circadian cycle, have been identified as impacting the physical health of firefighters [91, 92]. Further studies suggest the biggest obstacle cited by firefighters was the risk of being in the middle of training or just finishing a workout when a call comes in and being too tired to perform occupational tasks to one's full potential [91, 92].

Firefighters indicated that hands-on training is an important factor because it helps them improve their stamina [92, 93]. Resources available in the workplace, such as a gym, nutritional advice for weight control, and fitness programs, were also cited as beneficial. Firefighters who experienced CVD and had sedentary lifestyles were uncertain about the types of physical

activities to do and how best to target coronary heart diseases with health promotion interventions [94-97]. The lack of self-motivation and ambivalence was highly influenced by the firehouse culture and are frequently reported deterrents to exercise among firefighters [98, 99]. Ras *et al*. (2023) reported that firefighters with a positive attitude toward physical activity were motivated to increase their overall health [38]. In addition, firefighters experienced negative food cultures such as fatty foods increasing levels of adiposity, hypertension, and dyslipidemia with high sugar diets further negatively impacting nutrition and obesity in the fire service [99-102]. One prominent challenge at the departmental level is the lack of funding and wellness program partnerships with healthcare facilities and universities [103, 104]. The perception of certain fire and rescue department training policy guidelines varied greatly as some firefighters thought they were clear, others thought they were unclear, however, some firefighters thought they did not exist at all [103-106]. Firefighters may be exposed to and experience workplace stress as a result of additional perceived challenges or threats at work. They may also be at a higher risk of developing certain diseases, which, if left undiagnosed, can result in devastating consequences like heart attacks or strokes that can negatively impact their physical and mental health. [1-6] According to Smith *et al*., acute myocardial infarction (AMI) or stroke accounts for approximately 17 nonfatal events for each duty-related sudden cardiac death (SCD). Thirty percent of the firefighters in their study had hypertension, and thirty percent had prehypertension. [1-6, 1]

3. METHOD

3.1. Research Design

This study employed a qualitative approach to explore the perceptions, experiences, and challenges of PA among firefighters with CHD in the City of Cape Town. The exploratory design was selected to (a) identify factors that have not yet been addressed in the peer-reviewed literature, and (b) allow the voice of firefighters to be heard to gather in-depth insights into problems and generate new ideas for research [107, 108].

3.2. Sample Size and Sampling Technique

Permission to conduct the research study was obtained from the Human and Social Sciences Research Ethics Committee of the University of the Western Cape as well as from the Chief Fire Officer of the Department of the City of Cape Town Fire and Rescue Services. Purposive sampling was used to seek a sample comprising municipal firefighters (operations level), Captains/Platoon Station /Commanders (middle management), and the Chief fire officer/District Commander (high-level management) with experiences of low levels of PA and CHDRF.

The Cape Town Fire and Rescue Services consist of 32 fire stations in four districts, serving a population of 4,618 million people and covering an area of 2,455 square kilometers or 948 square miles. The sample for the nine voluntary interviews with full-time career firefighters discussions consisted of three municipal firefighters (operations level), three Divisional/Station/Platoon Commanders/ Captains (middle management), and three Chief firefighter/District Commander firefighters (high-level management) ranging between 18-65 years of age. Data collection continued until saturation was achieved, which is when sufficient data has been collected to draw the necessary conclusions, and further data collection is unlikely to yield additional valuable insights. The transcripts returned to participants for comment and/or correction.

3.3. Inclusion and Exclusion Criteria

The participants were eligible for inclusion if they met the following criteria: (1) served as a municipal firefighter (operations level), Captain/Station/ Platoon Commander (middle management), and/or Chief fire officer/District Commander (high-level management); (2) were full-time career firefighters; (3) had one or more coronary heart disease risk factors (CHDRF); (4) were 18 years or older; and (5) were actively working in the City of Cape Town Fire and Rescue Services. Conversely, the participants were excluded if they did not have any CHDRFs.

3.4. Data Collection and Procedures

The COVID-19 pandemic disrupted daily routines, imposing lockdowns and social distancing measures that hindered face-to-face data collection. The online interviews were conducted with nine participants from three fire departments in the City of Cape Town for firefighters with CHDRF, lasting 45-60min. The data collection period was between December 2021 – February 2022. A scripted interview was prepared for the interviews with validated questions after the pilot study [109-111].

3.5. Piloting

A face-to-face pilot study was undertaken before the larger research initiative. This smaller-scale exploration served as a preliminary step in the complete research methodology, aiding in planning and modification [112, 113]. It is crucial to assess feasibility before embarking on the primary investigation, also referred to as the complete study or large-scale main trial. The participants were recruited from 32 different fire stations within the City of Cape Town. The recruitment process utilized a variety of methods, including electronic and face-to-face meetings with firefighters, platoon commanders, and the chief fire officer. In addition, the City of Cape Town Fire and Rescue Service circulated an electronic recruitment letter to different fire stations across the City of Cape Town. A total of three career firefighters who work full-time and are actively involved took part. Conducting the pilot study provided the researcher with valuable insights and experience in interviewing participants, enabling a better understanding of the participants' body language [114, 115].

3.6. Data Analysis

All interviews were conducted online by G.A. and

recorded. The google Meet program transcribed the recording, and the researcher read up and confirmed the notes taken during the sessions. The thematic analysis steps of Braun and Clarke (2006) were used to analyze the data. The data were coded into segments of text before bringing meaning to the information [116, 117]. After coding the data, themes, sub-themes were developed and presented in narrative form for further data interpretation [118].

3.7. Trustworthiness /Rigour

Trustworthiness is determined by the trust in the data, interpretation, and methods used in a study to ensure credibility, dependability, transferability, and confirmability.

3.7.1. Credibility

Credibility pertains to the alignment between a respondent's perspective and the researcher's representation of it [119]. In this study, credibility was established by delving into and describing the perceptions of PA among firefighters with CHD in the City of Cape Town. The researcher enhanced credibility by describing their experiences and verifying the research findings with the participants.

3.7.2. Transferability

Transferability is demonstrated by offering readers proof that the results of the research study could be relevant to different contexts, circumstances, time periods, and groups of people. This study employed thick descriptions, a crucial technique for improving the transferability and analytical generalization of qualitative research findings. This enables researchers to evaluate the applicability of the findings in diverse contexts.

3.7.3. Dependability

The dependability of the qualitative data is demonstrated through assurances that the findings were established despite any changes within the research setting or participants during data collection. An external audit was employed in this study, where researchers, not part of the research process, scrutinized both its methodology and outcomes. Their role was to confirm the accuracy and assess whether the findings, interpretations, and conclusions were substantiated by the data.

3.7.4. Confirmability

The confirmability of qualitative data is ensured when data are checked and rechecked throughout data collection and analysis to ensure results that are likely to be repeatable by others [120]. This practice enables others to comprehend the manner and rationale behind the decisions made.

4. RESULTS

4.1. Demographic Information

All firefighters have been living with one or more coronary heart disease (age, family history of CVD, history of smoking, sedentary lifestyle, obesity, hypertension, dyslipidemia, and prediabetes) for 5+ years. All the participants worked in the City of Cape Town Fire and Rescue Service for 5+ years

All nine participants were over the age of 45 years and had a family history of heart disease. Five of the nine participants were obese based on the annual medical screenings, and six out of the nine participants were diagnosed with type 2 diabetes. Additionally, three of the nine participants were diagnosed with high cholesterol levels, and seven out of the nine had hypertension and were on anti-hypertensive medication. Moreover, four out of the nine were smoking cigarettes, and seven of the nine lived a sedentary lifestyle and did not meet the minimum 150 minutes of physical activity as prescribed by ACSM.

4.1.1. Theme 1: Perceptions of Physical Activity and Coronary Heart Disease

Physical inactivity is an important risk factor for chronic physical health and mental health conditions in firefighters118. Firefighters also face an increased risk of poor physical health due to several modifiable risk factors. Physical inactivity, coupled with increasing CHD, in firefighters plays a key role in aggregated cardiovascular events. Firefighters may not be meeting the recommended fitness levels based on the cardiovascular and metabolic demands of the occupation [117-120]. This current theme explores the perceptions of physical activity in the fire service.

4.1.1.1. Subtheme 4.1.1.1: Perceptions of Physical Activity

In this subtheme, the participants perceived physical activity in different ways. The responses from the participants in this study are mentioned below:

"Physical activity for me is anything you can do that involves movement of your body. I've always liked sports, and I've always liked being active". P1

Furthermore, participant Six stated that:

"The only physical activity is gardening and making sure that the house is maintained. I do spend some time I enjoy woodwork, any kind of woodworking so that's something that I do. And that also involves a bit of physical activity. But yeah, that's about the extent of my physical activities. I try to do as little as possible, which is quite wrong, I know but that's just where I am in my life at the moment." P6

Adding to this, another participant said:

"At work, I'm forced to keep fit, to avoid burnout during a fire. It keeps me up with the young guys. so then decided to join Muay Thai" P4

Participant Three had the following to say:

"The whole circuit of TFA also keeps me fit. I enjoy it so much that I compete for the firefighters." P3

"Previously in the fire service we had fire departments, police, all competing against each other in different sports like soccer, cricket, rugby, netball and others." P3

Adding to this, another participant said:

"It was something we used to look forward to and train and prepare together as firefighters. But then all that stopped, even the food, now we prepare our own meals." P4

Furthermore, one more participant stated that:

"If we can have a fitness camp or something that we can attend, maybe if we work on a weekend, maybe the Saturday morning or the Sunday morning where everyone participates in fitness camp. I think that will inspire everyone much more because you're doing it as a team effort and not at the station we need to go out because here it is almost like we are bound to do it. So, if we go out to other places it's going to be like, it's an outing, let's do it." P3

One of the participants specified that:

"We can look up to our Station Commander. He is physically fit and will advise me on the gym. In addition, he listens to your needs and gives you advice. He is a solid role model." P3

Firefighters understood the need for physical activity and the importance of physical activity for job-related task performance. [1-6] These findings are consistent with literature indicating that firefighters who engage in physical activity develop longevity in the fire service by maintaining a healthy weight, building strength, and improving mobility with appropriate exercise [1, 14, 26, 38]. Additional benefits include combating obesity, diabetes and the management of heart diseases. [1, 6-8] Furthermore, physical activity lowers the risk of injury, boosts immune response, lowers the risk of illness, and reduces inflammation, especially due to the high risk of COVID-19 [109-111].

4.1.1.2. Subtheme 4.1.1.2: Perceptions of Coronary Heart Disease

The World Health Organization states that heart disease (CHD) is still the leading cause of death and a major cause of morbidity in both developed and developing nations despite increased attention being paid to its prevention and treatment. More than 7.2 million deaths in both men and women are attributed to CHD annually. Furthermore, every year, at least 20 million people survive strokes and heart attacks [121]. The demanding nature of their work and the high incidence of coronary heart disease (CHD) in the fire service may contribute to firefighters' heightened vulnerability to cardiovascular events or injuries [1, 5]. In this subtheme, the participants perceived CHD in different ways. The responses from the participants in this study are mentioned below:

"My idea of coronary heart disease is that it is related to chest pains and heart attacks" P1

"...For myself, it's a scary thing. Especially because of the family history of it. I expect something to happen or not, but I know that that is affecting me already with age as I get older. And it's only going to get worse as time goes on." P2

"To me, having CHD is a sickness that causes long-term illness." P3

To conclude, another participant believed that:

"...due to my age of 48 years, I am aware that I can get more illness and heart sickness so I usually try to keep my heart healthy by playing club sports and cycling. But the other stuff like smoking, I don't smoke a lot but maybe stress a bit more" P5

Based on the responses reported in this subtheme, the study found that participants have varying perceptions of CHD. These results support previous findings that show participants have a common understanding of the concept of CHD and how it affects both their personal and professional lives [6, 9, 13].

4.2. Theme 2: Experiences of Physical Activity and Coronary Heart Disease

In Sub-Saharan Africa, one of the primary risk factors for the occurrence of coronary heart disease is physical inactivity. A recent WHO study found that approximately 40% of South Africans do not engage in physical activity [122, 123]. In South Africa, the process of urbanization and related socioeconomic transformation is largely responsible for the trend toward lifestyle diseases and physical inactivity [124]. The current subthemes report on the experiences of physical activities.

4.2.1. Subtheme: Experiences of Physical Activity

The participants' responses are mentioned below:

"I used to cycle and walk. The physical activities I enjoy doing at home are the household chores such as sweeping, mopping and doing the laundry. Outside activities, I thoroughly enjoy gardening and woodwork." P1

"I go to the gym where I do some weight training and I also run. I tend to go and run up the tower four or five times. I walk the dog in the park so that keeps me very active running after him. I miss swimming and I wish I could still do gymnastics, but at this age, my body is not built for doing gymnastics anymore." P2

Furthermore, the participants responded as follows:

"I stay alone, I do my washing and then I hang up the washing. Now recently I've been busy with maintenance around the house, cleaning the roof with a high-pressure gun and hose, when I come home from work I start doing a bit of paintwork." P2

One more participant added:

"I engage in physical activities at work, we do the entire circuit of situational drills just throwing out hoses, pulling tires, wasting water drums, carrying ladders, in preparation for the toughest firefighter alive. In my personal capacity, I do Muay Thai, weightlifting, cardio, and hitting the sledgehammer." P4

Another participant reported:

"Spending less time in front of the television and just doing activities like laundry, the garden, walking the dog I also try to eat a bit healthy, it's a bit difficult." P2

Participant 1 had the following to say:

"The fire service provided different types of sporting codes for firefighters in the municipal games. The social competition took place in the Limpopo province where firefighters from Zambia and Botswana joined and we played soccer against each other but it's more like social wasn't that competitive, because afterwards, we all had a good time." P1

"I've recently started gardening and am beginning to enjoy it!" P1

4.2.2. Subtheme: Experiences of Coronary Heart Disease

In the firefighting profession, coronary heart disease is estimated to have higher rates of death from CHD as most on-duty fatalities are work-precipitated and occur in firefighters with underlying CHD [1, 11, 46, 69].

Participants in this study reported that:

"For myself, it's a scary thing because I have a family history of heart disease. I know that that is affecting my health already. And it's only going to get worse as time goes on. My father died because of heart complications. He also has diabetic issues, cholesterol, and hypertension, which are all diseases that I currently have. I lead a very sedentary life, I'm already overweight and my eating habits are not the best." P6

"I also have a family history of CHD as my mother passed away from an angina, before the age of 55 years. Currently, I am in good physical health. I don't have any issues with hypertension but rather cholesterol. The problem is I'm sedentary, I sit and watch sports, and tend to eat fried chips on my own. I think, physically I'm in good health and I hope to be able to maintain the health level which I'm at currently." P5

Another participant stated that:

"I can feel now smoking is affecting me because as I'm getting older and tired more quickly during my physical activity. At the moment I eat whatever, I buy meals and put them in the oven. So, I won't say I'm eating healthy, I'm not unhealthy also" P3

Furthermore, the participants responded as mentioned below:

"Living with hypertension, cholesterol and stress. It is a transportation and economic cost for medical treatment." P3

The *participants also reported:*

"Before lockdown, I was social and participated in recreational sports, then I got COVID-19 and became tired during work activities. I will come home and just feel tired and fatigued and lay and watch TV all the time" P1

The study also showed that many firefighters who reported Coronary Heart Disease (CHD) were not engaging in sufficient physical activity. Despite this, as firefighters age, they are more likely to experience CHDRF and may not be meeting the necessary physical activity guidelines. This puts them at a higher risk of on-duty injury and fatality, even though they may perceive themselves as healthy.

4.3. Theme 3: Challenges of Physical Activity and Coronary Heart Disease

Cardiovascular disease also often leads to disability, premature retirement, and absenteeism, which can result in reduced productivity and economic output. Despite the demanding physical nature of firefighting, a significant number of firefighters do not adequately maintain their physical fitness levels. Although firefighters possess the skills required for the job to ensure their safety and effectiveness during duty, insufficient physical fitness could potentially result in coronary heart disease over some time [124-127]. Coronary heart disease impacts the circulation of blood flow to the heart, and insufficient blood flow can lead to a heart attack and stroke. Heart disease costs the United States $3.70 to $11.73 billion each year. This total includes the cost of healthcare services, medications, and premature death [124-127].

4.3.1. Subtheme: Challenges of Physical Activity

The Participants' responses are mentioned below:

"I don't use the gym a lot because I don't know what to do... but I know I need I the strength for my work" P2

"I got long-term COVID-19 and it impacted my health and since then I don't exercise much" P2

Another participant responded:

"Not much physical activity for me lately due to medical reasons, but I'm worried now that I can't exercise much and I'm getting older". P1

This participant added:

"There are no replacement workers for me while I attend the gym in case the fire alarm bell rings" P5

Another participant:

"Also, if I can add.. If we run or train in the gym too hard and strenuously, I'm afraid I will get hungry and tired when fighting fire... So, I rather save my energy and don't exercise at all" P6

Another participant reported:

"When we come back from a fire or rescue we want to eat and recover from the rescue trauma or the intensity of the fire but then the alarm bell rings and we have to go again for our next duty and by the time we get back we sometimes too tired and hungry" P8

Another participant:

"We have a very small gym and the equipment is old and outdated. I used to do the stairs but that became boring after a while. I also want big muscles" P3

"We don't have a proper gym fitness program for every day or every shift, we just do what we see on the internet or what we can do by ourselves" P3

Another participant added:

"Some of the senior firefighters played sports for the fire service back in the day. Now there's no more sports and they don't exercise but they are getting older and taking more tablets" P7

These results are consistent with research that shows that mandatory fitness programs for firefighters must be implemented to increase firefighter fitness and enhance their general health. The studies show that firefighters who engage in physical fitness and training become more resilient to traumatic and systemic stress [1-6].

4.3.2. Subtheme: Challenges of Coronary Heart Disease

A participant reported that:

"*Obviously our job exposures us to dangerous chemical and physical hazards, so if we have CHD it increases our risk of developing chronic illnesses and cancer" P3*

Participants reported:

"*Yes, he is right, we get exposed to asbestos and other pollutants in the air sometimes in fires, and at rescues, we see a lot of legs and arms laying around and dead people and get emotional stress and makes my heart beat faster, but it's part of the job so we learn to cope" P8*

Another participant reported:

"*Because I have high blood pressure, I don't want to get a heart attack. So, I work slowly and rely on my experience in fire service because I want to avoid tripping, slipping and falling." P5*

This participant so added:

"*I smoke cigarettes and I do a little physical activity, that is my CHD challenge. Perhaps if I do more physical activity I'll smoke less" P1*

Another participant reported:

"*I once got sick while on-duty. Ever since then I always keep sweets and my diabetic medication with me in the truck and the fire house because you never know how long we will be" P8*

These findings concur with literature indicating CHD remains prevalent in the fire and rescue service and is expected to grow in complexity due to the growing prevalence of comorbidities, including obesity, type two diabetes, and increasing age [1-5].

5. ETHICAL APPROVAL AND CONSENT

The study received ethics clearance from the Biomedical Research Ethics Committee (BMREC) at the University of the Western Cape to conduct this study (BM21/02/07). The permission to conduct the data collection was obtained from the Chief Fire Officer who is the head of the department for the City of Cape Town Fire and Rescue Services. Informed consent was obtained from the participants for voluntary participation. All the collected data was kept confidential and stored with password-protected access. The participants were assured that participation in the study was voluntary and that they could withdraw at any time without question or penalty [128, 129].

6. DISCUSSION

Globally, patients with congestive heart failure perceive physical activity as a major obstacle, even though it is frequently mentioned as a primary factor in enhancing health. This study found that seven of the nine (77%) firefighters were living a predominantly sedentary life. Perceptions, experiences, and challenges of physical activity in firefighters with coronary heart disease risk factors are vital elements influencing PA participation in this study. This finding is supported by research that indicates two of the nine (23%) physically active participants perceive more benefits of and fewer barriers to PA than non-physically participants [130-134]. The prevention and treatment of coronary heart disease (CHD) depends heavily on the recommendation of ≥150 minutes of moderate-intensity PA per week in patients with CHD [130-136]. Physical activity is described as any voluntary bodily movement produced by skeletal muscles that requires energy expenditure, encompasses all activities, at any intensity, performed during any time of day or night, and includes both exercise and incidental activity integrated into the daily routine [130-137].

All participants in this study reported substantial perceived benefits of PA, and these findings demonstrate consistency with reported studies of firefighters that better understand the parameters related to firefighting task performance and encourage the employment of on-duty physical training programs for firefighters throughout the employee wellness programs [134-138]. The belief that they were "too unfit," "feeling anxiety," "not enough time," "lack of interest," "bad weather," and "feeling of being uncomfortable" and their experiences with cardiovascular disease contributed to the feelings of inactivity among firefighters [136-139]. Compared to someone active, more effort would be required to initiate physical activity [136-140]. The findings illustrated that participants of this study reported different perceptions, experiences, and challenges regarding physical activity and coronary heart disease [137-143]. Therefore, physical activity is recommended to limit the amount of sedentary time and replace the sedentary time with low, moderate, or high-intensity physical activities [138-141]. Specifically for this study, low or light-intensity physical activities are advised to implement behavioural change and provide CHD health benefits. Furthermore, to grasp the current physical activity guidelines, targeting 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity activity per week is recommended. Brown *et al*. created a low-intensity exercise program lasting three months for participants who were older adults and slightly frail [139-142, 143]. Before and after the program, the participants finished a modified physical performance test covering the following domains: flexibility, balance, body-handling skills, reaction time, and coordination [139-144]. The results showed that low-intensity exercise produced significant improvements in every physical domain. After low-intensity exercise, the participants also reported improvements in their self-rated physical performance and an increase in their sense of enjoyment [139-145].

Policy changes related to physical fitness in the fire and rescue service are required to keep firefighters healthy and safe [2, 7, 15]. Initial medical screening by the

doctors should be followed up with physical activity programs designed for firefighters with CHDRF. This study further reveals that intervention strategies and potential collaborations with policymakers, key stakeholders, and universities could facilitate lifestyle modifications for firefighters, incorporating specific physical activities geared towards addressing coronary heart disease within the fire service.

6.1. Limitations and Strengths of the Study

As researchers desiring to conduct good research, it is important to identify and report the limitations of our study [146]. The findings of this study have to be observed with some limitations. This study had nine active full-time career firefighters, eight males and one female, from 240 firefighters. The small number of female representatives in this study is generally consistent with the City of Cape Town firefighter population, which consists of a majority of males. Furthermore, firefighters at the three different ranks comprise operational level 800 – 900 firefighters, middle-level management 8 – 36 firefighters, andhigh-level management 4 – 8 firefighter/ fire officers. The timing of the study coincided with the peak season (September – April) for firefighters' response to duty. Therefore, research opportunities should be considered during the off-peak season. The COVID-19 pandemic further contributed to few participants as many firefighters prioritized work commitments and safety concerns due to the pandemic. No study has yet been conducted on all the firefighters in the City of Cape Town to assess CHD, however, of the nine participants included, all nine had CHD as part of the inclusion criteria. Additionally, future researchers should study firefighters from different locations across the Western Cape and South Africa since our participants were from the City of Cape Town only. Since our findings cannot be generalized to other ethnic backgrounds, it would be beneficial to expand this study to include various parts of the country with varying ethnicities as well.

This study could be expanded by looking at constructs such as motivation to physical activities, commitment to managing chronic diseases, desire to enhance the quality of firefighters' lives, and altruistic perceptions of selflessness to enhance public safety. The qualitative research approach is particularly effective for exploring a concept with smaller sample sizes inductively [147]. In contrast, quantitative studies should involve larger sample sizes to enhance the understanding of full-time firefighters, which will broaden the insights gained from the current study. While qualitative research offers a deeper comprehension of the subject, quantitative research is essential for expanding the overall research framework [128]. Additionally, by sharing the results of this study, we offer quantitative researchers a foundational basis to develop a more comprehensive understanding of the motivations and affiliations of full-time firefighters, as well as valuable data to inform their studies.

CONCLUSION

The critical incidents described by the firefighters were cardiovascular incidents, CHDRF, and sedentary lifestyles. Physical inactivity was associated with total cholesterol, type 2 diabetes, and obesity. These negative experiences of cardiovascular disease could, however, be alleviated by physical activity efforts directed toward reducing the risks of CHDRF. All firefighters expressed a need for better training with health professionals, such as dietitians for meal preparations and exercise specialists for physical activity prescription. Consequently, increasing physical activity levels by reducing sedentary behavior is essential to enhancing the health, wellbeing, fitness, and performance of firefighters.

AUTHOR'S CONTRIBUTIONS

It is hereby acknowledged that all authors have accepted responsibility for the manuscript's content and consented to its submission. They have meticulously reviewed all results and unanimously approved the final version of the manuscript.

LIST OF ABBREVIATIONS

T2D	=	Type 2 Diabetes
CVD	=	Cardiovascular Disease
CHDRFs	=	Coronary Heart Disease Risk Factors
NIOSH	=	National Institute for Occupational Safety and Health
PA	=	Physical Activity

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study received ethics clearance from the Biomedical Research Ethics Committee (BMREC) at the University of the Western Cape, South Africa to conduct this study (BM21/02/07).

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent with voluntary participation was obtained from the participants.

STANDARDS OF REPORTING

COREQ guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the Zenodo Repository at https://zenodo.org/records/13590648, [10.5281/zenodo.13590647].

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

REFERENCES

[1] Soteriades ES, Smith DL, Tsismenakis AJ, Baur DM, Kales SN. Cardiovascular disease in US firefighters: A systematic review. Cardiology 2011; 19(4): 202-15. PMID: 21646874

[2] Saxton SN, Clark BJ, Withers SB, Eringa EC, Heagerty AM. Mechanistic links between obesity, diabetes, and blood pressure: Role of perivascular adipose tissue. Physiol Rev 2019; 99(4): 1701-63. http://dx.doi.org/10.1152/physrev.00034.2018 PMID: 31339053

[3] Flora GD, Nayak MK. A brief review of cardiovascular diseases, associated risk factors and current treatment regimes. Curr Pharm Des 2019; 25(38): 4063-84. http://dx.doi.org/10.2174/1381612825666190925163827 PMID: 31553287

[4] Smith DL, Barr DA, Kales SN. Extreme sacrifice: Sudden cardiac death in the US fire service. Extrem Physiol Med 2013; 2(1): 6. http://dx.doi.org/10.1186/2046-7648-2-6 PMID: 23849605

[5] Kales SN, Smith DL. Sudden cardiac death in the fire service. Occup Med (Lond) 2014; 64(4): 228-30. http://dx.doi.org/10.1093/occmed/kqu057 PMID: 24850812

[6] Kales SN, Soteriades ES, Christoudias SG, Christiani DC. Firefighters and on-duty deaths from coronary heart disease: A case control study. Environ Health 2003; 2(1): 14. http://dx.doi.org/10.1186/1476-069X-2-14 PMID: 14613487

[7] Jeung DY, Hyun DS, Kim I, Chang SJ. Effects of emergency duties on cardiovascular diseases in firefighters: A 13-year retrospective cohort study. J Occup Environ Med 2022; 64(6): 510-4. http://dx.doi.org/10.1097/JOM.0000000000002490 PMID: 35081586

[8] Balakumar P, Maung-U K, Jagadeesh G. Prevalence and prevention of cardiovascular disease and diabetes mellitus. Pharmacol Res 2016; 113(Pt A): 600-9. http://dx.doi.org/10.1016/j.phrs.2016.09.040 PMID: 27697647

[9] Gaziano TA, Bitton A, Anand S, Abrahams-Gessel S, Murphy A. Growing epidemic of coronary heart disease in low- and middle-income countries. Curr Probl Cardiol 2010; 35(2): 72-115. http://dx.doi.org/10.1016/j.cpcardiol.2009.10.002 PMID: 20109979

[10] Celermajer DS, Chow CK, Marijon E, Anstey NM, Woo KS. Cardiovascular disease in the developing world: Prevalences, patterns, and the potential of early disease detection. J Am Coll Cardiol 2012; 60(14): 1207-16. http://dx.doi.org/10.1016/j.jacc.2012.03.074 PMID: 22858388

[11] Bovolini A, Garcia J, Andrade MA, Duarte JA. Metabolic syndrome pathophysiology and predisposing factors. Int J Sports Med 2021; 42(3): 199-214. http://dx.doi.org/10.1055/a-1263-0898 PMID: 33075830

[12] Mathew Joseph N, Strunk FA, Dhar B, Strong LL. Cardiovascular disease in South Asian Americans: A serious health concern. J Nurse Pract 2023; 19(10): 104789. http://dx.doi.org/10.1016/j.nurpra.2023.104789

[13] Guelly C, Abilova Z, Nuralinov O, *et al*. Patients with coronary heart disease, dilated cardiomyopathy and idiopathic ventricular tachycardia share overlapping patterns of pathogenic variation in cardiac risk genes. PeerJ 2021; 9: e10711. http://dx.doi.org/10.7717/peerj.10711 PMID: 33552729

[14] Bozkurt B, Colvin M, Cook J, *et al*. Current diagnostic and treatment strategies for specific dilated cardiomyopathies: A scientific statement from the American Heart Association. Circulation 2016; 134(23): e579-646. http://dx.doi.org/10.1161/CIR.0000000000000455 PMID: 27832612

[15] Taniguchi D, Baernstein A, Nichol G. Cardiac arrest: A public health perspective. Emerg Med Clin North Am 2012; 30(1): 1-12. http://dx.doi.org/10.1016/j.emc.2011.09.003 PMID: 22107970

[16] Adams RJ, Chimowitz MI, Alpert JS, *et al*. Coronary risk evaluation in patients with transient ischemic attack and ischemic stroke: A scientific statement for healthcare professionals from the stroke council and the council on clinical cardiology of the american heart Association/American Stroke Association. Circulation 2003; 108(10): 1278-90. http://dx.doi.org/10.1161/01.CIR.0000090444.87006.CF PMID: 12963684

[17] Staley J, Weiner B, Linnan L. Firefighter fitness, coronary heart disease, and sudden cardiac death risk. Am J Health Behav 2011; 35(5): 603-17. http://dx.doi.org/10.5993/AJHB.35.5.9 PMID: 22040621

[18] Levchenko NO. Firefighters and cardiovascular disease risk: Implications for occupational health nurses. Master's paper, University of North Carolina at Chapel Hill 2018. http://dx.doi.org/10.17615/t823-dc97.

[19] Staley JA. "Get firefighters moving": Marketing a Physical fitness intervention to reduce sudden cardiac death risk in full-time firefighters. Soc Mar Q 2009; 15(3): 85-99. http://dx.doi.org/10.1080/15245000903131384

[20] Wooding C, Bernstein M, Cormier ML, Zizzi S. An exploration of the factors that influence west virginia firefighters health behaviors. J Ethnogr Qual Res 2018; 13(2): 134-54.

[21] Elliot DL, Goldberg L, Kuehl KS, Moe EL, Breger RKR, Pickering MA. The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) firefighter study: Outcomes of two models of behavior change. J Occup Environ Med 2007; 49(2): 204-13. http://dx.doi.org/10.1097/JOM.0b013e3180329a8d PMID: 17293760

[22] Ranby KW, MacKinnon DP, Fairchild AJ, Elliot DL, Kuehl KS, Goldberg L. The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) firefighter study: Testing mediating mechanisms. J Occup Health Psychol 2011; 16(4): 501-13. http://dx.doi.org/10.1037/a0023002 PMID: 21728433

[23] Haricharan S. Leadership, management and organisational implications for public service employee well-being and performance. SA J Hum Resour Manag 2023; 21: 2080. http://dx.doi.org/10.4102/sajhrm.v21i0.2080

[24] Botha MM. Responsibilities of companies towards employees. Potchefstroom Electron Law J 2015; 18(2): 1-67. http://dx.doi.org/10.4314/pelj.v18i2.01

[25] Sehume OM. Evidence-based guidelines to promote the health and safety of health care workers in selected public hospitals in the Tshwane health care district in Gauteng, South Africa. Doctoral Dissertation 2016.

[26] WHO healthy workplace framework and model. 2010. Available from: https://www.who.int/publications/i/item/who-healthy-workplace-framework-and-model

[27] Cappelli P, Do Neumark D. "High-performance" work practices improve establishment-level outcomes? Ind Labor Relat Rev 2001; 54(4): 737-75.

[28] Kloutsiniotis PV, Mihail DM. The effects of high performance work systems in employees' service-oriented OCB. Int J Hospit Manag 2020; 90: 102610. http://dx.doi.org/10.1016/j.ijhm.2020.102610 PMID: 32834351

[29] Smith DL, Fehling PC, Frisch A, Haller JM, Winke M, Dailey MW. The prevalence of cardiovascular disease risk factors and obesity in firefighters. J Obes 2012; 2012(1): 1-9. http://dx.doi.org/10.1155/2012/908267 PMID: 22888409

[30] Hard DL, Marsh SM, Merinar TR, *et al*. Summary of recommendations from the national institute for occupational safety and health fire fighter fatality investigation and prevention program, 2006–2014. J Safety Res 2019; 68: 21-5.

http://dx.doi.org/10.1016/j.jsr.2018.10.013 PMID: 30876513

[31] Kahn SA, Palmieri TL, Sen S, Woods J, Gunter OL. Factors implicated in safety-related firefighter fatalities. J Burn Care Res 2017; 38(1): e83-8. http://dx.doi.org/10.1097/BCR.0000000000000434 PMID: 27606562

[32] Stevenson RDM. Establishing and ensuring the health, fitness and operational performance of UK Fire & Rescue Service Personnel. PhD Thesis, University of Bath 2017.

[33] Gumieniak R J. Establishing a legally defensible physical employment standard for canadian wildland fire fighters. PhD thesis, York university 2017.

[34] Ras J, Leach L. Firefighters' health knowledge, cardiovascular disease risk factors, and sociodemographic characteristics as predictors of firefighters attitudes toward health. J Occup Environ Med 2022; 64(11): e705-13. http://dx.doi.org/10.1097/JOM.0000000000002679 PMID: 35973044

[35] Andrews KL, Gallagher S, Herring MP. The effects of exercise interventions on health and fitness of firefighters: A meta-analysis. Scand J Med Sci Sports 2019; 29(6): 780-90. http://dx.doi.org/10.1111/sms.13411 PMID: 30779389

[36] Bhojani FA, Castillejo-Picco LA, Cathcart D, *et al*. Fitness-for-duty assessments of industrial firefighters: guidance for occupational medicine physicians. J Occup Environ Med 2018; 60(2): e82-9. http://dx.doi.org/10.1097/JOM.0000000000001256 PMID: 29280776

[37] Soteriades ES, Vogazianos P, Tozzi F, *et al*. Exercise and occupational stress among firefighters. Int J Environ Res Public Health 2022; 19(9): 4986. http://dx.doi.org/10.3390/ijerph19094986 PMID: 35564381

[38] Ras J, Soteriades ES, Smith DL, Kengne AP, Leach L. Association between physical fitness and musculoskeletal health in firefighters. Front Physiol 2023; 14: 1210107. http://dx.doi.org/10.3389/fphys.2023.1210107 PMID: 37469568

[39] Storer TW, Dolezal BA, Abrazado ML, *et al*. Firefighter health and fitness assessment: A call to action. J Strength Cond Res 2014; 28(3): 661-71. http://dx.doi.org/10.1519/JSC.0b013e31829b54da PMID: 24566608

[40] Vancampfort D, De Soir E, van Winkel R, *et al*. Physical activity, sedentary behaviour and mental health outcomes in firefighters: A cross-sectional study. J Workplace Behav Health 2024; 39(1): 88-105. http://dx.doi.org/10.1080/15555240.2023.2191203

[41] Cox M, Norris D, Cramm H, Richmond R, Anderson GS. Public safety personnel family resilience: A narrative review. Int J Environ Res Public Health 2022; 19(9): 5224. http://dx.doi.org/10.3390/ijerph19095224 PMID: 35564618

[42] Krakauer RL, Stelnicki AM, Carleton RN. Examining mental health knowledge, stigma, and service use intentions among public safety personnel. Front Psychol 2020; 11: 949. http://dx.doi.org/10.3389/fpsyg.2020.00949 PMID: 32547443

[43] Guidotti TL, Clough VM. Occupational health concerns of firefighting. Annu Rev Public Health 1992; 13(1): 151-71. http://dx.doi.org/10.1146/annurev.pu.13.050192.001055 PMID: 1599583

[44] Xanthopoulos G, Leone V, Delogu GM. The suppression model fragilities. Extreme Wildfire Events and Disasters. 2020; pp. 135-53. http://dx.doi.org/10.1016/B978-0-12-815721-3.00007-2.

[45] Penman TD, Eriksen C, Blanchi R, *et al*. Defining adequate means of residents to prepare property for protection from wildfire. Int J Disaster Risk Reduct 2013; 6: 67-77. http://dx.doi.org/10.1016/j.ijdrr.2013.09.001

[46] Stults-Kolehmainen MA, Sinha R. The effects of stress on physical activity and exercise. Sports Med 2014; 44(1): 81-121. http://dx.doi.org/10.1007/s40279-013-0090-5 PMID: 24030837

[47] Rogerson MC, Murphy BM, Bird S, Morris T. "I don't have the heart": A qualitative study of barriers to and facilitators of physical activity for people with coronary heart disease and depressive symptoms. Int J Behav Nutr Phys Act 2012; 9(1): 140. http://dx.doi.org/10.1186/1479-5868-9-140 PMID: 23194091

[48] Kivimäki M, Steptoe A. Effects of stress on the development and progression of cardiovascular disease. Nat Rev Cardiol 2018; 15(4): 215-29. http://dx.doi.org/10.1038/nrcardio.2017.189 PMID: 29213140

[49] Martin ZT, Schlaff RA, Hemenway JK, *et al*. Cardiovascular disease risk factors and physical fitness in volunteer firefighters. Int J Exerc Sci 2019; 12(2): 764-76. PMID: 31156744

[50] Wohlgemuth K, Sekiguchi Y, Mota J. Overexertion and heat stress in the fire service: A new conceptual framework. Am J Ind Med 2023; 66(8): 705-9. http://dx.doi.org/10.1002/ajim.23482 PMID: 37062940

[51] Games KE, Winkelmann ZK, McGinnis KD, McAdam JS, Pascoe DD, Sefton JM. Functional performance of firefighters after exposure to environmental conditions and exercise. J Athl Train 2020; 55(1): 71-9. http://dx.doi.org/10.4085/1062-6050-75-18 PMID: 31876454

[52] Armstrong LE, Casa DJ, Millard-Stafford M, Moran DS, Pyne SW, Roberts WO. American college of sports medicine position stand. Exertional heat illness during training and competition. Med Sci Sports Exerc 2007; 39(3): 556-72. http://dx.doi.org/10.1249/MSS.0b013e31802fa199 PMID: 17473783

[53] Christison KS, Gurney SC, Williamson-Reisdorph CM, *et al*. Muscle soreness and damage during wildland firefighter critical training. Int J Exerc Sci Conf Proc 2020; 8(8)

[54] Perroni F, Tessitore A, Cibelli G, *et al*. Effects of simulated firefighting on the responses of salivary cortisol, alpha-amylase and psychological variables. Ergonomics 2009; 52(4): 484-91. http://dx.doi.org/10.1080/00140130802707873 PMID: 19401900

[55] Rogers R. First responders lived experiences of traumatic stress and exercise: A phenomenological study. Doctoral dissertation, Northcentral University 2021.

[56] Schweitzer M, Gilpin L, Frampton S. Healing spaces: Elements of environmental design that make an impact on health. J Altern Complement Med 2004; 10: S-71-83. http://dx.doi.org/10.1089/acm.2004.10.S-71 PMID: 15630824

[57] Hellsten Y, Nyberg M. Cardiovascular adaptations to exercise training. Compr Physiol 2015; 6(1): 1-32. PMID: 26756625

[58] Scheuer J, Tipton CM. Cardiovascular adaptations to physical training. Annu Rev Physiol 1977; 39(1): 221-51. http://dx.doi.org/10.1146/annurev.ph.39.030177.001253 PMID: 139843

[59] Ekblom-Bak E, Hellénius ML, Ekblom Ö, Engström LM, Ekblom B. Independent associations of physical activity and cardiovascular fitness with cardiovascular risk in adults. Eur J Cardiovasc Prev Rehabil 2010; 17(2): 175-80. http://dx.doi.org/10.1097/HJR.0b013e32833254f2 PMID: 19809331

[60] Fire brigade services act: White paper on fire services. Department of cooperative governance. 2020. Available from: https://www.cogta.gov.za/cgta_2016/wp-content/uploads/2016/06/White-Paper-on-Fire-Services-Gazette-No-43734-25-September-2020.pdf

[61] Heydari A, Ostadtaghizadeh A, Ardalan A, Ebadi A, Mohammadfam I, Khorasani-Zavareh D. Exploring the criteria and factors affecting firefighters' resilience: A qualitative study. Chin J Traumatol 2022; 25(2): 107-14. http://dx.doi.org/10.1016/j.cjtee.2021.06.001 PMID: 34144886

[62] Korre M, Sotos-Prieto M, Kales SN. Survival Mediterranean style: Lifestyle changes to improve the health of the US fire service. Front Public Health 2017; 5: 331. http://dx.doi.org/10.3389/fpubh.2017.00331 PMID: 29326915

[63] Nystoriak MA, Bhatnagar A. Cardiovascular effects and benefits of exercise. Front Cardiovasc Med 2018; 5: 135. http://dx.doi.org/10.3389/fcvm.2018.00135.

[64] Kang SJ, Kim E, Ko KJ. Effects of aerobic exercise on the resting heart rate, physical fitness, and arterial stiffness of female patients with metabolic syndrome. J Phys Ther Sci 2016; 28(6): 1764-8.
http://dx.doi.org/10.1589/jpts.28.1764 PMID: 27390411

[65] Farpour-Lambert NJ, Aggoun Y, Marchand LM, Martin XE, Herrmann FR, Beghetti M. Physical activity reduces systemic blood pressure and improves early markers of atherosclerosis in pre-pubertal obese children. J Am Coll Cardiol 2009; 54(25): 2396-406.
http://dx.doi.org/10.1016/j.jacc.2009.08.030 PMID: 20082930

[66] Nakamura M, Sadoshima J. Mechanisms of physiological and pathological cardiac hypertrophy. Nat Rev Cardiol 2018; 15(7): 387-407.
http://dx.doi.org/10.1038/s41569-018-0007-y PMID: 29674714

[67] Rodríguez A, Becerril S, Hernández-Pardos AW, Frühbeck G. Adipose tissue depot differences in adipokines and effects on skeletal and cardiac muscle. Curr Opin Pharmacol 2020; 52: 1-8.
http://dx.doi.org/10.1016/j.coph.2020.04.003 PMID: 32387807

[68] Stinkens R, Goossens GH, Jocken JWE, Blaak EE. Targeting fatty acid metabolism to improve glucose metabolism. Obes Rev 2015; 16(9): 715-57.
http://dx.doi.org/10.1111/obr.12298 PMID: 26179344

[69] Corpeleijn E, Saris WHM, Blaak EE. Metabolic flexibility in the development of insulin resistance and type 2 diabetes: effects of lifestyle. Obes Rev 2009; 10(2): 178-93.
http://dx.doi.org/10.1111/j.1467-789X.2008.00544.x PMID: 19207879

[70] Vieira R, Souto SB, Sánchez-López E, *et al*. Sugar-lowering drugs for type 2 diabetes mellitus and metabolic syndrome—Review of classical and new compounds: *Part-I*. Pharmaceuticals (Basel) 2019; 12(4): 152.
http://dx.doi.org/10.3390/ph12040152 PMID: 31658729

[71] Nyberg M, Gliemann L, Hellsten Y. Vascular function in health, hypertension, and diabetes: Effect of physical activity on skeletal muscle microcirculation. Scand J Med Sci Sports 2015; 25(S4): 60-73.
http://dx.doi.org/10.1111/sms.12591 PMID: 26589119

[72] Di Francescomarino S, Sciartilli A, Di Valerio V, Di Baldassarre A, Gallina S. The effect of physical exercise on endothelial function. Sports Med 2009; 39(10): 797-812.
http://dx.doi.org/10.2165/11317750-000000000-00000 PMID: 19757859

[73] Ras J, Smith DL, Soteriades ES, Kengne AP, Leach L. Association between physical fitness and cardiovascular health in firefighters. Int J Environ Res Public Health 2023; 20(11): 5930.
http://dx.doi.org/10.3390/ijerph20115930 PMID: 37297534

[74] Lefferts WK, Heffernan KS, Hultquist EM, Fehling PC, Smith DL. Vascular and central hemodynamic changes following exercise-induced heat stress. Vasc Med 2015; 20(3): 222-9.
http://dx.doi.org/10.1177/1358863X14566430 PMID: 25939655

[75] Myers J, McAuley P, Lavie CJ, Despres JP, Arena R, Kokkinos P. Physical activity and cardiorespiratory fitness as major markers of cardiovascular risk: Their independent and interwoven importance to health status. Prog Cardiovasc Dis 2015; 57(4): 306-14.
http://dx.doi.org/10.1016/j.pcad.2014.09.011 PMID: 25269064

[76] Lobelo F, Rohm Young D, Sallis R, *et al*. Routine assessment and promotion of physical activity in healthcare settings: A scientific statement from the American Heart Association. Circulation 2018; 137(18): e495-522.
http://dx.doi.org/10.1161/CIR.0000000000000559 PMID: 29618598

[77] Klein S, Burke LE, Bray GA, *et al*. Clinical implications of obesity with specific focus on cardiovascular disease: A statement for professionals from the American Heart Association Council on nutrition, physical activity, and metabolism: Endorsed by the *American College of Cardiology Foundation*. Circulation 2004; 110(18): 2952-67.
http://dx.doi.org/10.1161/01.CIR.0000145546.97738.1E PMID: 15509809

[78] Bogers RP, Bemelmans WJ, Hoogenveen RT, *et al*. Association of overweight with increased risk of coronary heart disease partly independent of blood pressure and cholesterol levels: A meta-analysis of 21 cohort studies including more than 300 000 persons. Arch Intern Med 2007; 167(16): 1720-8.
http://dx.doi.org/10.1001/archinte.167.16.1720 PMID: 17846390

[79] Mora S, Cook N, Buring JE, Ridker PM, Lee IM. Physical activity and reduced risk of cardiovascular events: Potential mediating mechanisms. Circulation 2007; 116(19): 2110-8.
http://dx.doi.org/10.1161/CIRCULATIONAHA.107.729939 PMID: 17967770

[80] Farioli A, Yang J, Teehan D, Baur DM, Smith DL, Kales SN. Duty-related risk of sudden cardiac death among young US firefighters. Occup Med (Lond) 2014; 64(6): 428-35.
http://dx.doi.org/10.1093/occmed/kqu102 PMID: 25104277

[81] Morey M, Sullivan RJ Jr. Medical assessment for health advocacy and practical strategies for exercise initiation. Am J Prev Med 2003; 25(3): 204-8.
http://dx.doi.org/10.1016/S0749-3797(03)00180-6 PMID: 14552945

[82] Thompson WR, Sallis R, Joy E, Jaworski CA, Stuhr RM, Trilk JL. Exercise is medicine. Am J Lifestyle Med 2020; 14(5): 511-23.
http://dx.doi.org/10.1177/1559827620912192 PMID: 32922236

[83] Ellapen TJ, Strydom GL, Swanepoel M, Hammill H, Paul Y. Biokinetics: A South African health profession evolving from physical education and sport. Sport and Exercise Science. 2018.
http://dx.doi.org/10.5772/intechopen.73126.

[84] Kriel C, Weilbach JT, Caldwell LL. Interpretive description of recreational therapy within the curricula of selected healthcare professions in South Africa. World Leis J 2022; 64(4): 309-24.
http://dx.doi.org/10.1080/16078055.2022.2043424

[85] Jordaan A. Physical activity prescription for the prevention of metabolic disease after a spinal cord injury: A systematic review. Master of Science in Biokinetics, North-West University 2018.

[86] Hills AP, Mokhtar N, Byrne NM. Assessment of physical activity and energy expenditure: An overview of objective measures. Front Nutr 2014; 1: 5.
http://dx.doi.org/10.3389/fnut.2014.00005 PMID: 25988109

[87] Mileva KN, Zaidell L. Sport and exercise science and health. Health studies: An Introduction. Singapore: Springer Singapore 2022; pp. 85-124.
http://dx.doi.org/10.1007/978-981-16-2149-9_4

[88] Ainsworth BE, Haskell WL, Whitt MC, *et al*. Compendium of physical activities: An update of activity codes and MET intensities. Med Sci Sports Exerc 2000; 32: S498-504.
http://dx.doi.org/10.1097/00005768-200009001-00009

[89] Lee I-M, Paffenbarger RS Jr. Associations of light, moderate, and vigorous intensity physical activity with longevity. The Harvard Alumni Health Study. Am J Epidemiol 2000; 151(3): 293-9.
http://dx.doi.org/10.1093/oxfordjournals.aje.a010205 PMID: 10670554

[90] Jane M, Hagger M, Foster J, Ho S, Kane R, Pal S. Effects of a weight management program delivered by social media on weight and metabolic syndrome risk factors in overweight and obese adults: A randomised controlled trial. PLoS One 2017; 12(6): e0178326.
http://dx.doi.org/10.1371/journal.pone.0178326 PMID: 28575048

[91] Lovejoy S, Gillespie GL, Christianson J. Exploring physical health in a sample of firefighters. Workplace Health Saf 2015; 63(6): 253-8.
http://dx.doi.org/10.1177/2165079915576922 PMID: 26012517

[92] Poston WSC, Haddock CK, Jahnke SA, Jitnarin N, Day RS. An examination of the benefits of health promotion programs for the national fire service. BMC Public Health 2013; 13(1): 805.
http://dx.doi.org/10.1186/1471-2458-13-805 PMID: 24007391

[93] Jeong C. Does experiential live-fire training exercise improve firefighting readiness? Masters Thesis, Oklahoma State University 2018.

[94] Poudevigne M, Day C, Campbell E, *et al*. Fit for Fire: A 10-Week

Low-Cost HIFT experiential learning initiative between underrepresented kinesiology undergraduates and hypertensive deconditioned firefighters improves their health and fitness. Educ Sci (Basel) 2021; 11(1): 33.
http://dx.doi.org/10.3390/educsci11010033

[95] Day RS, Jahnke SA, Haddock CK, Kaipust CM, Jitnarin N, Poston WSC. Occupationally tailored, web-based, nutrition and physical activity program for firefighters: Cluster randomized trial and weight outcome. J Occup Environ Med 2019; 61(10): 841-8.
http://dx.doi.org/10.1097/JOM.0000000000001685 PMID: 31348415

[96] Lockie RG, Dulla JM, Higuera D, *et al*. Body composition and fitness characteristics of firefighters participating in a health and wellness program: Relationships and descriptive data. Int J Environ Res Public Health 2022; 19(23): 15758.
http://dx.doi.org/10.3390/ijerph192315758 PMID: 36497832

[97] Melton BF, Ryan G, Snarr RL, Weeks M, Langford E, Villafuerte M. Fitness policies within the fire service: A pilot investigation of exercise adherence on fitness outcomes among rural firefighters. Am J Lifestyle Med 2023; 17(3): 437-42.
http://dx.doi.org/10.1177/15598276211011586 PMID: 37304748

[98] Gold J, Panesar-Aguilar S, Aguilar E. Educational and mandatory fitness standards in the firefighting profession. IJMRA 2022; 5(1): 185-93.
http://dx.doi.org/10.47191/ijmra/v5-i1-23

[99] Agostinelli P, Hirschhorn R, Sefton J. Exercise habits and resources for southeastern US firefighters. J Occup Environ Med 2023; 65(5): e351-7.
http://dx.doi.org/10.1097/JOM.0000000000002822 PMID: 36914371

[100] Hershey MS, Chang CR, Sotos-Prieto M, *et al*. Effect of a nutrition intervention on mediterranean diet adherence among firefighters: A cluster randomized clinical trial. JAMA Netw Open 2023; 6(8): e2329147.
http://dx.doi.org/10.1001/jamanetworkopen.2023.29147 PMID: 37589978

[101] Eastlake AC, Knipper BS, He X, Alexander BM, Davis KG. Lifestyle and safety practices of firefighters and their relation to cardiovascular risk factors. Work 2015; 50(2): 285-94.
http://dx.doi.org/10.3233/WOR-131796 PMID: 24284685

[102] Waldman HS, Renteria LI, McAllister MJ. Time-restricted feeding for the prevention of cardiometabolic diseases in high-stress occupations: A mechanistic review. Nutr Rev 2020; 78(6): 459-64.
http://dx.doi.org/10.1093/nutrit/nuz090 PMID: 31774508

[103] Kwan SY, Petersen PE, Pine CM, Borutta A. Health-promoting schools: An opportunity for oral health promotion. Bull World Health Organ 2005; 83(9): 677-85.
PMID: 16211159

[104] Paskett C. Overcoming training barriers in a medium size fire department: A phenomenological study. Doctoral dissertation, Wilmington University

[105] Fisher P, Etches B. A comprehensive approach to workplace stress & trauma in fire-fighting: A review document prepared for the international association of firefighters. 17th Redmond Symposium. 2003San Francisco, CA.

[106] Davis AL, Allen J, Shepler L, *et al*. Moving FOCUS–the fire service organizational culture of safety survey–from research to practice. J Safety Res 2020; 74: 233-47.
http://dx.doi.org/10.1016/j.jsr.2020.06.011 PMID: 32951788

[107] Zhang Y, Wildemuth BM. Qualitative analysis of content. Applications of Social Research Methods to Questions in Information and Library Science. 2009; pp. 1-12.

[108] Popay J, Rogers A, Williams G. Rationale and standards for the systematic review of qualitative literature in health services research. Qual Health Res 1998; 8(3): 341-51.
http://dx.doi.org/10.1177/104973239800800305 PMID: 10558335

[109] Salyer SJ, Maeda J, Sembuche S, *et al*. The first and second waves of the COVID-19 pandemic in Africa: A cross-sectional study. Lancet 2021; 397(10281): 1265-75.
http://dx.doi.org/10.1016/S0140-6736(21)00632-2 PMID: 33773118

[110] Zoumpourlis V, Goulielmaki M, Rizos E, Baliou S, Spandidos D. The COVID-19 pandemic as a scientific and social challenge in the 21st century. Mol Med Rep 2020; 22(4): 3035-48.
http://dx.doi.org/10.3892/mmr.2020.11393 PMID: 32945405

[111] Leggat PA, Frean J, Blumberg L. COVID-19: Current status and future prospects. Trop Med Infect Dis 2023; 8(2): 94.
http://dx.doi.org/10.3390/tropicalmed8020094 PMID: 36828510

[112] Thabane L, Ma J, Chu R, *et al*. A tutorial on pilot studies: The what, why and how. BMC Med Res Methodol 2010; 10(1): 1-0.
http://dx.doi.org/10.1186/1471-2288-10-1 PMID: 20053272

[113] Van Teijlingen E, Hundley V. The importance of pilot studies. Nurs Stand 2002; 16(40): 33-6.
http://dx.doi.org/10.7748/ns2002.06.16.40.33.c3214.

[114] Gray J, Brain K, Iredale R, Alderman J, France E, Hughes H. A pilot study of telegenetics. J Telemed Telecare 2000; 6(4): 245-7.
http://dx.doi.org/10.1258/1357633001935329 PMID: 11027129

[115] In J. Introduction of a pilot study. Korean J Anesthesiol 2017; 70(6): 601-5.
http://dx.doi.org/10.4097/kjae.2017.70.6.601 PMID: 29225742

[116] Anney VN. Ensuring the quality of the findings of qualitative research: Looking at trustworthiness criteria. J Emerg Trends Educ Res Policy Stud 2014; 5(2): 272-81.

[117] Gonzalez DE, Lanham SN, Martin SE, *et al*. Firefighter health: A narrative review of occupational threats and countermeasures. Healthcare 2024; 12(4): 440.
http://dx.doi.org/10.3390/healthcare12040440.

[118] Durand G, Tsismenakis AJ, Jahnke SA, Baur DM, Christophi CA, Kales SN. Firefighters' physical activity: Relation to fitness and cardiovascular disease risk. Med Sci Sports Exerc 2011; 43(9): 1752-9.
http://dx.doi.org/10.1249/MSS.0b013e318215cf25 PMID: 21364484

[119] Suchomel TJ, Nimphius S, Bellon CR, Stone MH. The importance of muscular strength: Training considerations. Sports Med 2018; 48(4): 765-85.
http://dx.doi.org/10.1007/s40279-018-0862-z PMID: 29372481

[120] Sanchez-Sanchez J, Rodríguez-Fernández A. Equipment and training devices. Resistance Training Methods. 2021; pp. 67-79.
http://dx.doi.org/10.1007/978-3-030-81989-7_4.

[121] Baraki A, Feigenbaum J, Sullivan J. Practical guidelines for implementing a strength training program for adults. Available from: https://medilib.ir/uptodate/show/116613

[122] Saravanakumar P, Johanna Higgins I, Jane van der Riet P, Marquez J, Sibbritt D. The influence of tai chi and yoga on balance and falls in a residential care setting: A randomised controlled trial. Contemp Nurse 2014; 48(1): 76-87.
http://dx.doi.org/10.1080/10376178.2014.11081929 PMID: 25410198

[123] LaSala TT, Run-Kowzun T, Figueroa M. The effect of a Hatha Yoga practice on hamstring flexibility. J Bodyw Mov Ther 2021; 28: 439-49.
http://dx.doi.org/10.1016/j.jbmt.2021.06.012 PMID: 34776176

[124] Kwok JYY, Kwan JCY, Auyeung M, Mok VCT, Chan HYL. The effects of yoga *versus* stretching and resistance training exercises on psychological distress for people with mild-to-moderate Parkinson's disease: Study protocol for a randomized controlled trial. Trials 2017; 18(1): 509.
http://dx.doi.org/10.1186/s13063-017-2223-x PMID: 28049491

[125] Butry DT, Butry DT, Webb D, Gilbert S, Taylor J. The economics of firefighter injuries in the United States. 2019. Available from: https://www.nist.gov/publications/economics-firefighter-injuries-united-states(Accessed on: August 13, 2024)

[126] Kuehl KS, Elliot DL, Goldberg L, Moe EL, Perrier E, Smith J. Economic benefit of the PHLAME wellness programme on firefighter injury. Occup Med (Lond) 2013; 63(3): 203-9.
http://dx.doi.org/10.1093/occmed/kqs232 PMID: 23416849

[127] Barger LK, Rajaratnam SMW, Wang W, *et al*. Common sleep disorders increase risk of motor vehicle crashes and adverse health outcomes in firefighters. J Clin Sleep Med 2015; 11(3):

233-40.
http://dx.doi.org/10.5664/jcsm.4534 PMID: 25580602
[128] Creswell JW, Creswell JD. Research design: Qualitative, quantitative, and mixed methods approaches. 2017.
[129] Denzin NK, Lincoln Y. Collecting and Interpreting Qualitative Materials. SAGE Publications 2007.
[130] Veldhuijzen van Zanten JJCS, Rouse PC, Hale ED, *et al*. Perceived barriers, facilitators and benefits for regular physical activity and exercise in patients with rheumatoid arthritis: A review of the literature. Sports Med 2015; 45(10): 1401-12.
http://dx.doi.org/10.1007/s40279-015-0363-2 PMID: 26219268
[131] Miles L. Physical activity and health. Nutr Bull 2007; 32(4): 314-63.
http://dx.doi.org/10.1111/j.1467-3010.2007.00668.x
[132] Costello E, Kafchinski M, Vrazel J, Sullivan P. Motivators, barriers, and beliefs regarding physical activity in an older adult population. J Geriatr Phys Ther 2011; 34(3): 138-47.
http://dx.doi.org/10.1519/JPT.0b013e31820e0e71 PMID: 21937904
[133] Kgokong D, Parker R. Physical activity in physiotherapy students: Levels of physical activity and perceived benefits and barriers to exercise. S Afr J Physiother 2020; 76(1): 1399.
http://dx.doi.org/10.4102/sajp.v76i1.1399 PMID: 32391443
[134] Lee IM, Sesso HD, Oguma Y, Paffenbarger RS Jr. Relative intensity of physical activity and risk of coronary heart disease. Circulation 2003; 107(8): 1110-6.
http://dx.doi.org/10.1161/01.CIR.0000052626.63602.58 PMID: 12615787
[135] Franklin BA, Eijsvogels TMH, Pandey A, Quindry J, Toth PP. Physical activity, cardiorespiratory fitness, and cardiovascular health: A clinical practice statement of the American Society for Preventive Cardiology Part II: Physical activity, cardiorespiratory fitness, minimum and goal intensities for exercise training, prescriptive methods, and special patient populations. Am J Prev Cardiol 2022; 12: 100425.
http://dx.doi.org/10.1016/j.ajpc.2022.100425 PMID: 36281325
[136] Silva VR, Belozo FL, Pereira RM, *et al*. The effects of ninety minutes per week of moderate intensity aerobic exercise on metabolic health in individuals with Type 2 Diabetes: A pilot study. J Rehabil Ther 2020; 2(2)
[137] Melissa R, Lama M, Laurence K, *et al*. Physical activity in eating disorders: A systematic review. Nutrients 2020; 12(1): 183.
http://dx.doi.org/10.3390/nu12010183 PMID: 31936525
[138] Santos PC, Maciel LYS, Abreu S, *et al*. Cultural adaptation and validation of the “Pregnancy Physical Activity Questionnaire” for the Portuguese population. PLoS One 2023; 18(1): e0279124.
http://dx.doi.org/10.1371/journal.pone.0279124 PMID: 36626393
[139] Sando OJ, Kleppe R, Sandseter EBH. Risky play and children’s well-being, involvement and physical activity. Child Indic Res 2021; 14(4): 1435-51.
http://dx.doi.org/10.1007/s12187-021-09804-5
[140] Michaelides MA, Parpa KM, Henry LJ, Thompson GB, Brown BS. Assessment of physical fitness aspects and their relationship to firefighters’ job abilities. J Strength Cond Res 2011; 25(4): 956-65.
http://dx.doi.org/10.1519/JSC.0b013e3181cc23ea PMID: 20703167
[141] Dennison KJ, Mullineaux DR, Yates JW, Abel MG. The effect of fatigue and training status on firefighter performance. J Strength Cond Res 2012; 26(4): 1101-9.
http://dx.doi.org/10.1519/JSC.0b013e31822dd027 PMID: 22446677
[142] Hofman J. Health concerns with the fire service and the benefits of a health and wellness program for a fire department. Strength Condit J 2015; 37(4): 69-73.
http://dx.doi.org/10.1519/SSC.0000000000000134
[143] Yang YJ. An overview of current physical activity recommendations in primary care. Korean J Fam Med 2019; 40(3): 135-42.
http://dx.doi.org/10.4082/kjfm.19.0038 PMID: 31122003
[144] Brown M, Sinacore DR, Ehsani AA, Binder EF, Holloszy JO, Kohrt WM. Low-intensity exercise as a modifier of physical frailty in older adults. Arch Phys Med Rehabil 2000; 81(7): 960-5.
http://dx.doi.org/10.1053/apmr.2000.4425 PMID: 10896013
[145] Blair CK, Morey MC, Desmond RA, *et al*. Light-intensity activity attenuates functional decline in older cancer survivors. Med Sci Sports Exerc 2014; 46(7): 1375-83.
http://dx.doi.org/10.1249/MSS.0000000000000241 PMID: 24389524
[146] Price JH, Murnan J. Research limitations and the necessity of reporting them. Am J Health Educ 2004; 35(2): 66-7.
http://dx.doi.org/10.1080/19325037.2004.10603611
[147] Walby K. Marshall, Catherine, and Gretchen B. Rossman, Designing Qualitative Research, Sixth Edition. Can J Sociol 2015; 40(3): 399-402.
http://dx.doi.org/10.29173/cjs25398