Empowering First Responders to Be Physically Active Through Establishment of Mini Gyms: The Case of Murang'a County Fire Services and Disaster Management Unit

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Abstract

Each county in Kenya has a fire services and disaster management unit (FSDMU) with personnel designated as first responders (FRs). The physically demanding nature of FRs' job requires them to carry heavy equipment, move and drag objects within restrictive and hazardous environments. First Responders, therefore, are required to have optimal physical fitness by actively engaging in adequate physical activity (PA). This study aimed at promoting participation in PA among the FRs by establishing convenient and affordable exercise facilities and equipment at their worksite. This implementation science research used a quasi-experimental design to 1) Establish mini-gyms in three FSDMU sub-stations, 2) Design and implement a functional fitness training program, 3) train peer fitness leaders (PFLs') in each sub-station. Results indicated an increased uptake of PA from 38.1% observed previously to 100%. The guidelines for PA as prescribed for health and wellbeing in the National Action Plan on Physical Activity 2018-2023 was exceeded by an additional 30 minutes. The increased participation in PA per week, and number of steps per day as measured using the Red MI Smart Band 2 indicate that the intervention of the mini-gyms, the training of PFLs and establishment of a training regimen positively influenced the PA levels of the FRs in Murang'a County.

Keywords: Disaster, First Responders, Mini-Gyms, Peer Fitness Leaders, Physically Active, Physical Activity

Introduction

First responders are persons with specialized training who are among the first to arrive and aid at the scene of an emergency in order to protect and preserve life, property, evidence and the environment (Canadian Institute of Public Safety, Research and Treatment, 2023). Emergency situations warranting response can range from fires, accidents, building-collapse to natural disasters including floods, earthquakes and famine (Kong et al., 2022). Due to the hazardous nature of the profession, FRs are required to put on an extra load of insulated personal protective equipment (PPE) which places an additional physical strain on the body (Park et al., 2018). Additionally, the perilous nature of the occupation which involves lifting, dragging or pulling and pushing activities places a high demand of physical fitness and capabilities on the FRs (Cornell et al., 2021). The job of FRs involves operating hose lines, carrying equipment, making forcible entries, climbing ladder raises, crawling and searching and dragging victims and/or casualties within restrictive and hazardous environments (Andrews et al., 2019). As such, they need to have optimal fitness through engaging in appropriate levels of physical activity so that they can be physically fit for the sake of public safety as well as one's individual health. Fitness components that are crucial to a FR include a compendium of cardiovascular endurance, muscular strength and endurance, power and flexibility (Ras et al., 2022).

Numerous studies indicate that FRs require a high level of cardiovascular endurance due to the physiological demand placed on the body during fire suppression and other rescue related operations (Chizewski et al., 2021; Giuliani et al., 2020; Ras et al., 2021). Sub optimal aerobic endurance combined with high demand energy levels placed on the body during emergency operation are likely to trigger cardiac events ((Chizewski et al., 2021). This is mainly attributed to sudden increase in heart rate of up to 90% of maximum heart rate and increased oxygen uptake of up to 40ml/kg/min (Xu et al., 2020) causing physical overexertion. Therefore, there is a need for FRs to actively participate in PA to maintain a substantial level of cardiovascular endurance.

Strength training has been shown to improve overall muscular strength power and endurance crucial to the FRs profession and consequently reducing physical exertion associated with musculoskeletal injuries prevalent among FRs (Debusk, 2022; Kong et al., 2022; Ras et al., 2023).

Despite the irrefutable need and the benefits associated with participation in PA, the majority of FRs fail to meet and maintain an optimal fitness level across the globe (Chizewski et al., 2021; Pelozato de Oliveira et al., 2022; Ras et al., 2021); Ras et al., 2021). Supples et al., (2021) studied 1367 emergency medical services professionals in North Carolina and observed low adherence to the Centre for Diseases Control (CDC) PA guidelines with only 48.2% of the respondents meeting the guidelines. Additionally, a high prevalence of obesity at 55.9% and high incidence of injury were reported. The aforementioned findings were attributed to lack of energy, willpower, time, social influence and resources. Ras et al., (2021) conducted a study in South Africa among 136 firefighters in the City of Cape Town Fire and Rescue Service to determine their knowledge and behaviour regarding physical activity. The results indicated that the majority (53%) of the firefighters had poor knowledge of PA and 80% reported poor behaviour towards PA. These findings point towards poor participation in PA by the first responders. In Sub-Saharan Africa, there is limited research on participation in PA among FRs. A study by Kamau et al., (2021) among 40 FRs in Murang'a County, Kenya recorded a relatively low score on participation in PA (38%). From this percentage, the majority (92%) did not follow the guidelines for the recommended level of PA for health

and wellbeing by the ministry of health (i.e. accumulating 150 minutes of moderate to vigorous PA per week). This low participation in PA was mainly attributed to lack of knowledge of such guidelines and fitness training facilities and equipment as well as a structured training program.

Being a relatively new area of devolution in Kenya, the main focus in the establishment of Fire services and disaster management units across all the 47 counties is on the tactical training of the FRs with no attention to their physical training. In Murang'a County, disasters have been handled without a coordinated disaster management policy, legal and institutional frameworks (Murang'a County Government [MCG], 2023). Additionally, disaster response activities have not been well coordinated, due to lack of cooperation and implementation of standard operational procedures and Disaster Emergency Operation Plans which are in existence (MCG, 2023). This situation indicates that there are more operational challenges to navigate in the county such that physical training of the FRs may not be a priority. Furthermore, the participating institutions charged with handling disasters in the county are faced with inadequate budgetary allocation and conditional donor support; such that the funds made available for disaster management are far less than the realistic amount actually needed to manage successfully (MCG,2023).

Poor funding and reallocation of development funds during times of emergencies denotes that development priorities and disaster management initiatives are undermined (MCG, 2023). This has resulted in unavailability of specialized equipment in addition to inadequately trained human personnel during emergency response (MCG, 2023). Poor resource management and inadequate coordination of finances, human resources and equipment has also weakened disaster interventions. In such a resource constrained work environment, priority may not be given to establishment of physical training facilities, exercise programs and capacity development of peer fitness leaders (PFLs), without reliability of development partners and collaborators by the County.

In response to this overt gap in the preparation of the FRs for their physically-demanding role, this study sought to promote participation in PA among the FRs in Murang'a County by providing affordable training equipment using locally available materials to establish the training facilities and equipment that resemble conventional gym equipment in addition to a structured fitness program at the worksite. This was meant to encourage participation and adherence to physical activity among FRs in Murang'a County enabling them to maintain optimal fitness levels consistent with their professional requirements. The success of this implementation science research relied on a collaborative undertaking anchored on UN-SDG number 17 on partnerships for attainment of sustainable development goals by bringing together members of the academia, the county government and the local artisans to support first responders in their endeavor to adopt and sustain active lifestyles not only for job efficiency but also for their individual health and wellbeing.

Experts in exercise and sports science from Kenyatta University through a community outreach and extension initiative offered guidance in the design and establishment of the mini-gyms, as well as the training program. The team also trained the PFLs for the project sustainability. The county government was involved in approving the piloting of the project with the FRs in Murang'a county FSDMU and allowed the use of grounds in the three substations namely; Kenol, Kangari and Murang'a headquarters. The project also involved the FRs by influencing them to adopt active lifestyles for efficiency in job performance and health promotion. They were involved in the planning, designing, and construction of the mini-gyms to ensure that the gyms met their specific needs and preferences. This involvement was hoped to foster a sense

of ownership and pride, increasing the likelihood of sustained usage and maintenance of the training facilities. Additionally, the research incorporated a fitness training component for the PFLs who were trained on fitness instruction and administration of the training program in their respective substations 3 times per week. This was to promote skill development within the FRs who would then carry forward fitness training and instruction long after the close-out of the research as a legacy for sustainability. Artisans in Murang'a County were hired by the Chief Fire Officer to provide their expertise in construction and maintenance of the mini-gym equipment using locally sourced materials.

Study Purpose

The purpose of this study was to promote participation in PA among the FRs by providing convenient and affordable exercise facilities and equipment at their worksite.

Study Objectives

This study was guided by the following objectives:

i. To design and establish mini gyms for the first responders (FRs) in Murang'a County fire services and disaster management unit (FSDMU).
ii. To design and implement a functional fitness training program for FRs in Murang'a county FSDMU.
iii. To train peer fitness leaders (PFLs) in Murang'a county FSDMU.

Research Design.

This implementation science research used a quasi-experimental design to establish mini-gyms in three FSDMU sub-stations in Murang'a County. The development of the mini-gyms was done with the involvement of the FRs and accommodated various types of exercises, including cardiovascular workouts, strength training, and flexibility exercises. To ensure sustainability and affordability, locally available materials were used to design the mini-gyms. Recycled tires were used for flooring and padding of equipment, plastic containers of different sizes were used to design free weights that mimicked regular dumbbells and barbells. Open spaces were utilized for group training sessions and cardiorespiratory training such as aerobics. Local artisans contributed their skills by assembling exercise equipment. This ensured a reduction in the cost of construction, promotion of local industries and a reduction in the environmental impact witnessed through dumping of non-biodegradable plastic containers. This innovativeness is what is desired and outlined in the UN-SDG 9.

Target Population

This study targeted FRs in Murang'a County FSDMU composed of firefighters and rescuers. The unit was established in 2013 and has 38 personnel deployed in 3 stations namely: Murang'a-headquarter (20), Kangari (6) & Kenol (12) (Muchiri, 2021). These FRs continually address disasters that pose risks to the community such as loss of life and damage to property. They evacuate people from danger and provide them with emergency shelter, medical aid, food and clean water.

Murang'a County is in the central region of Kenya with an estimated population of approximately 1.1 million people; 54.55% of whom are youths under the age of 35. This high number of young citizens

presents both opportunities and challenges in terms of employment, education, and social services (Murang'a County Government, 2022).

The terrain of Murang'a County ranges from hilly landscapes to fertile valleys. Some areas reach over 2,000 meters above sea level. Due to its mountainous terrain and steep valleys, the county has a high risk of natural disasters related to climate change impacts such as floods and landslides that are frequent during the rainy seasons (Omondi et al., 2022). Landslides have led to loss of life, displacement of families, and destruction of property as well as road accidents that are a common occurrence due to many blind spots. Flooding in Murang'a County is caused by heavy rainfall or poor drainage systems. Murang'a County residents also contend with fires caused by accidents or arson, and health emergencies, such as disease outbreaks like malaria and cholera(Omondi et al., 2022).

Responding promptly to these emergencies necessitates that the team of FRs be physically fit in terms of muscular strength and endurance, cardiovascular endurance and flexibility(Graetzer, 2022).

Sampling Procedure and Sample Size

Given the small number (38) of the FRs in FSDMU, the study used census sampling to involve them all to pilot the feasibility of establishing the mini-gyms using locally available materials, designing and implementing a functional physical training program and training PFLs among the FRs.

Intervention

The intervention process involved the following:

- *Designing of the mini-gyms:* The mini-gyms were designed in each fire station after surveying the premises and selecting suitable exercise locations within each compound. The FRs gave their input on the selection of suitable exercise spaces, and recyclable materials for constructing exercise equipment. Empty jerry cans, plastic bottles, concrete and metal bars were used to construct free weights such as dumbbells and barbells. Old tires were used for cross training exercise routines. Local artisans were engaged in constructing exercise benches and pull-up stations using locally available materials such as steel and wood. All free weights were weighed to the nearest Kilogram using a 200kg portable Mini crane digital hanging scale available at the Murang'a FSDMU. The scale has an accuracy of 0.05% of the maximum capacity which makes it reliable for professional use.

- *Implementing a Functional Exercise Training program:* The FRs were guided on use of the mini-gym equipment for training in moderate-to-vigorous physical activity (MVPA) for 60 minutes 3 times per week. Two PFLs were recruited from each of the stations and taken through further training by experts in Physical training program design from Kenyatta University Departmen of Physical Education, Exercise and Sports Science to support the PA program in their respective sub-stations during the first and second training sessions in the week. The research team would then join the FRs for the third session every Friday morning, with all FRs exercising at the headquarters in Murang'a town. Each week, a debriefing session was held to take account of the previous training sessions. The FRs were also issued with a digital PA monitor- Redmi Smart Band 2 to help them measure exercise intensity, frequency and duration, number of calories expended per day and the number of steps accumulated per day. The Redmi Smart Band 2 is suitable in measuring steps with a standard of 5% absolute error (Paradiso, et al., 2020).

Logistical and Ethical considerations

Before establishing the mini-gyms and rolling out the physical training program, a stakeholders' meeting was held at the FSDMU. The FRs were informed about the benefits of physical training for their job efficiency and health. Permission was sought from the county secretary to use the FRs as well as the facilities within the FSDMU for this study. The chief fire officer (CFO) helped in mobilizing the FRs to assemble the recyclable and locally available materials for repurposing for the establishment of the mini-gyms. Local artisans were contracted by the CFO to help in the construction process. Before commencement of the exercise program, each of the participating FRs signed an informed consent and filled in the Physical Activity Readiness Questionnaire (PAR-Q) as per the American College of Sports Medicine (ACSM) guidelines (Kluwer, 2021).The study excluded FRs who opted not to participate in the programme, and those with injuries and medical reports that exempted them from participating in PA.

Results And Discussions

The results were organized into themes as guided by the objectives:

Objective 1: To Design and Establish Mini-Gyms for the Frs in Murang'a County FSDMU.

This process began with a stakeholders' engagement meeting to plan on the process of assembling the locally available materials and designated spaces to accommodate the equipment for each substation as shown in Figure 1. This meeting involved collaborators from Kenyatta University's department of Physical Education, Exercise and Sports Science, the county government and FSDMU.

The second phase involved the designing and establishment of the training equipment and facilities**.** The FRs collected and assembled materials required for establishment of physical training equipment for the mini-gyms at the FSDMU headquarters in Murang'a town for standardization and collaboration. Each substation was then provided with the equipment depending on the number of FRs. Figure 2 shows the step-by-step procedure for the construction of the mini gyms by the FRs and the local artisans, a process that took two weeks. The mini-gyms were designed using locally available materials to provide convenient exercise facilities within the worksite of the FRs. This eliminated the barriers of distance and cost that often hinder individuals from engaging in regular PA.

Furthermore, the use of recycled materials especially plastic containers helped to reduce the environmental impact witnessed through dumping of non-biodegradable plastic containers.

Objective 2. To Design and Implement a Functional Fitness Training Program for Frs in Murang'a County Fire Services and Disaster Management Unit

A 60-minutes MVPA program to be administered 3 days per week was designed by the Physical Education, Exercise and Sport Science experts from Kenyatta University. This was undertaken as a Community Outreach and Extension Corporate Social Responsibility (COE-CSR) by the members as a core mandate that is desired for each member of the university. The program targeted the physical fitness components that are specific for FRs and was developed in strict adherence to the principles of training and conditioning. The program incorporated resistance training, cardiovascular training, plyometric training and stretching to improve muscular strength and endurance, cardiorespiratory function, body composition and flexibility which are vital fitness components specific to a FR's job. The program included functional exercises such

as deadlifts, squats, push-ups, chin-ups and core training that targeted multiple muscle groups and mimicked the FRs' daily activities. Every third training session of the week took place at the headquarters to foster a sense of camaraderie among the FRs. They were provided with a weekly opportunity to engage with the research team to ask questions regarding the program and to be guided on overload and progression for the subsequent week. To promote continuous gains, the program implemented progressive overload through increasing resistance during strength training for strength gains, and increasing intensity for cardiovascular exercises. The FRs were provided with Redmi Smart Band 2 which assisted them to quantify daily PA and provided them with an easy method of tracking exercise intensity and setting goals during exercise thus motivating them to increase PA levels in the long term. The Smart bands also provided the FRs with real time feedback and guidance to optimize their workouts even in absence of the research team and after the close out of the project since the monitors were left with them. Figures 4 and 5 present training sessions taking place in the FSDMU in Murang'a County and the real time PA monitoring using the Red MI Smart Band 2 respectively.

Objective 3. To Train Peer Fitness Leaders in Murang'a County Fire Services and Disaster Management Unit

Peer Fitness Leaders (PFLs) were recruited from the FRs and underwent further training to support the PA program in their respective stations during the first and second training sessions in the week. The training of the PFLs enabled mentorship, empowerment and capacity development in fitness instruction among the FRs. This was meant to assure sustainability of fitness training and instruction beyond the research project period. Figures 6 and 7 show training sessions of the PFLs and PFLs conducting physical instruction sessions in their respective substations respectively.

From these interventions, PA uptake increased from 38.1% observed in a previous study by (Kamau et al., 2022) to 100%. The result also indicated that the FRs met the guidelines for PA as prescribed in the National Action Plan on Physical Activity 2018-2023 whereby, adults aged 18 - 64 years should do at least 150 minutes of moderate intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous intensity activity. The FRs exceeded this requirement for health and wellbeing by engaging in moderate-to-vigorous intensity PA for 60 minutes three times per week. This could be attributed to the establishment of functional training equipment and facilities and design and implementation of a training program.

Additionally, the training of the PFLs enabled adherence to the training program by the FRs thus promoting and sustaining participation in PA. In their systematic analysis, Ginis et al., (2013) found out that there was an increased participation in PA in the peer-delivered intervention group of FRs. They further observed that the peer-delivered interventions were as effective at increasing participation in PA as professionally delivered interventions. This analysis supports the finding of the current study whereby the trained PFLs enhanced participation in PA by the FRs in their respective substations through guiding and instructing them during two sessions in a week.

This was in addition to the PA monitors that kept the FRs updated on their PA levels in terms of intensity, duration and frequency as well as the number of steps accumulated per day and the numbers of calories they expended per day. The PA monitors recorded progressive increase in the average number of steps from

week 1-week 4 whereby in week1, the average number of steps =4991 with the highest number of steps = 9288, week 2, average number of steps=7530 s with the highest being 12218, week 3 average number of steps= 8785 with the highest being 13737 and week 4 average number of steps=10,523 with the highest being 16789.The FRs reported feeling more energized and better prepared for their demanding duties. Electronic pedometers are currently being used to measure PA among all populations because of their ability to count and monitor steps taken throughout the day during ambulatory activities such as walking, jogging and running. The results of the current study are similar to those observed by Bravata et al., (2007) whereby participation in PA increased by 27% over baseline levels among pedometer users. According to Masi et al., (2019), when adults accumulate 10,000 steps per day, this translates to an equivalent of walking roughly 8.045kilometers. These authors recommend 10,000 to 12,500 steps per day for health and wellbeing. The observed increase in average number of steps per day by the FRs in Murang'a which exceeded these recommendations points towards increased participation in PA above the minimum guideline for health and wellbeing. The mini-gyms have fostered a sense of camaraderie among the FRs, as they work out together and motivate each other to achieve their fitness goals.

Conclusion

The results on participation in PA indicate that the intervention of the mini-gyms, the training of PFLs and establishment of a training regimen positively influenced the PA levels of the FRs in Murang'a County. The main strength of this study is that it mobilized the FRs to identify resources within their reach which would otherwise pollute the environment (old tires, empty plastic jars and bottles and metal bars) to develop functional training equipment, barbells, dumbbells, agility ladders, and monkey-bars) in a sustainable way. The strength of this research lies in actively engaging with, involving and empowering the community of FRs in Murang'a County to adopt active lifestyles for efficiency in job performance and health promotion. They have been involved in the planning, designing, and construction of the mini gyms to ensure that the gyms meet their specific needs and preferences. This involvement has fostered a sense of ownership and pride, increasing the likelihood of sustained usage and maintenance of the facilities. Additionally, the training of PFLs on fitness instruction and administration of the training program in their respective substations 2 days per week has promoted skill development within the FRs who will be expected to carry forward fitness training and instruction long after the close-out of the research as a legacy for sustainability. Kenyatta University has a core mandate on community outreach and engagement, thus, the research team will continue engaging with the FRs even after the close out of this research to offer technical support and share any emerging knowledge and technology around physical fitness.

Recommendations

This study recommends that:

- The establishment of mini-gyms in all the other 46 counties in Kenya be implemented to promote participation in PA by the FRs across the country.
- The designed and implemented program should be evaluated to measure its impact on the physical fitness attributes/ components specific to FRs' job.
- Training of PFLs to be conducted in all other 46 FSDMUs across the country so as to build physical training capacity among the FRs.

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