



Knowledge and Behaviours Regarding Physical Activity of Firefighters in the City of Cape Town Fire and Rescue Service – a Cross-sectional Study

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ABSTRACT

Background: Firefighters have a higher prevalence of chronic diseases due to the relationship between a lack of knowledge and poor behaviours regarding physical activity (PA). The aim of the study was to determine the knowledge and behaviours regarding physical activity of firefighters in the City of Cape Town Fire and Rescue Service, as well as address the current dearth of literature on physical activity to decrease firefighters' risk of chronic diseases.

Design and Methods: This cross-sectional study recruited 136 firefighters in the City of Cape Town Fire and Rescue Service. A researcher-generated self-administered questionnaire on the knowledge and behaviours regarding physical activity was completed online using Google Forms. Statistical significance was set at a p-value less than 0.05.

Results: The results showed that 53% of firefighters had a poor knowledge of physical activity, and 47% had a good knowledge of physical activity, while 80% reported poor behaviours toward physical activity and 20% had good behaviours toward physical activity. There was a significant difference between firefighters' knowledge of physical activity and their physical activity behaviour ($p < 0.05$), particularly related to marital status, age, and years of experience ($p < 0.05$). A safe environment was significantly associated with recreational PA ($p < 0.05$) and sleep behaviour was significantly associated with overall PA behaviour ($p < 0.001$).

Conclusion: Firefighters knowledge about physical activity did not translate into better behaviours regarding PA. Education and behavioural interventions are warranted to increase firefighters' knowledge of and improving their attitudes toward PA.

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INTRODUCTION

Firefighting is a physically strenuous occupation where firefighters are required to perform duties that place a significant strain on their bodies, particularly their cardiovascular and musculoskeletal systems (Le *et al.*, 2020; Ras, Kengne, *et al.*, 2023; Smith *et al.*, 2019). In addition, firefighters are encouraged to remain physically active, recreationally, to cope with these various stressors, however, many firefighters do not meet the minimum required levels of physical activity (Durand *et al.*, 2011; Nowak *et al.*, 2018). Furthermore, current literature has found that inadequate physical activity behaviours of firefighters contributed to various health problems, such as hypertension, diabetes and obesity (Chizewski *et al.*, 2021). This becomes especially problematic in older firefighters as research has shown that firefighters tend to become physically inactive as they age, coinciding with the increase in the prevalence of cardiovascular disease risk factors (Durand *et al.*, 2011; Yu *et al.*, 2015a).

Previous studies have shown that firefighters' behaviours, such as smoking, alcohol consumption, and leading a sedentary lifestyle can have negative consequences, such as weight gain, cardiovascular disease, diabetes, and hypertension (Chizewski *et al.*, 2021; Durand *et al.*, 2011; Yu *et al.*, 2015b). A lack of knowledge regarding the advantages of physical activity may be the underlying cause of poor health habits, which have become rather problematic in the firefighting occupation (Kay *et al.*, 2001; Palmer and Yoos, 2019; Ras and Leach, 2022a; Yu *et al.*, 2015a). Gold (2022) explained that the consequences of poor lifestyle habits and a lack of knowledge go beyond health and extend to work productivity, such as a firefighter being unable to complete rigorous tasks that are required in an emergency situation, as well as one's overall quality of life. Health issues, such as obesity can significantly affect work productivity, as poor habits lead to decreased physical capabilities, resulting in lower output (Lowery and Cassidy, 2022). According to Ras and Leach (2022a), firefighters' overall health knowledge and health risk behaviours were significant predictors of attitudes toward health. Moreover, the study noted that firefighters, often, engaged in physical activity as a means to remain fit for duty, rather than for their personal health and wellbeing (Ras and Leach, 2022a). Despite the physically demanding nature of firefighting, firefighters in the City of Cape Town Fire and Rescue Service (CoCTFRS) are not required to participate in any mandatory exercise routines or meet specific physical fitness standards after employment (Ras, Smith, *et al.*, 2023). The absence of mandatory annual assessments or fitness testing perpetuates the negative consequences of physical inactivity (Ras *et al.*, 2021; Ras, Smith, *et al.*, 2023; Ras and Leach, 2022a). According to Kling *et al.* (2020), extended inactivity during shift work leads to an increase in poor physical activity habits, which further contributes to continued problem of firefighter physical inactivity. Moreover, studies have shown that firefighters tended to have more negative attitudes and behaviours toward their health as they aged, which was particularly prominent in female and married firefighters (Kay *et al.*, 2001; Ras *et al.*, 2021; Ras and Leach, 2022a).

Globally, there is a high prevalence of physical inactivity in firefighters, which ranged between 50–70%, which is unacceptably high (Barry *et al.*, 2019; Martin *et al.*, 2019; Noh *et al.*, 2020; Yu *et al.*, 2015b). In the CoCTFRS the prevalence of physical inactivity is roughly 65–70% (Ras, Soteriades, *et al.*, 2023; Ras and Leach, 2021, 2022b). Moreover, firefighters are well educated on the benefits of remaining healthy, but, often, engage in negative health behaviours (Ras *et al.*, 2021; Ras and Leach, 2022a). Although firefighters show negative behaviours toward physical activity and a good knowledge of physical activity, there have not been studies conducted investigating the relationship between firefighters' knowledge of and behaviours related toward physical activity. Therefore, the study aimed to investigate the knowledge and behaviours of firefighters regarding physical activity within the CoCTFRS.

DESIGN AND METHODS

The study used a descriptive, quantitative, non-experimental, and cross-sectional research design. The CoCTFRS had roughly 900 full-time employees at the time of this study. Using the Slovin's formula, a sample size of 274 was required for this study. In total, 136 full-time firefighters, males and females aged 20–60+ years from the City of Cape Town Fire and Rescue Service were recruited to participate in the study. The sample collected accounts for roughly 12% of the total population. In addition, to ensure a representative sample was collected, using randomization, 8 out of the 33 fire stations located in the CoCT were selected to participate in the

DATA COLLECTION, INSTRUMENT AND PROCEDURES

Online questionnaires were filled out in person at various City of Cape Town Fire and Rescue Service stations. Firefighters who voluntarily agreed to take part in the study were given a QR code that, when scanned, led them to a self-administered questionnaire based on their knowledge and behaviours regarding physical activity. The questionnaire had a total of 67 questions. The questionnaire was divided into three sections (sections A to C). The first section (section A) was 8 questions and entailed obtaining personal information, such as gender, age, years of experience, marital status, home language, smoking habits, frequency of exercise, and the presence of a safe environment to exercise. The following section had 10 questions, namely, section B, and was on the firefighters' knowledge about exercise and physical activity, specifically their knowledge of types of physical activities and the intensity category that the activity would fall under. Questions included those related to knowledge related to exercise intensity classifications, which exercise intensities result in improved health, what the minimum exercise intensity is needed to see health improvements, the frequency of strength training needed for muscular strength improvements, frequency of exercise to improve flexibility, which activities are likely to improve one's health and the changes in exercise load needed to improve one's health.

The last section, namely, section C, was on the firefighters' behaviour regarding exercise and physical activity, specifically their level of involvement in physical activity. This section consisted of six parts. Part 1 encompassed exercise as part of firefighters' occupation or work only (8 questions), which included their work-related physical activity, specifically days performing light, moderate or vigorous intensities and the time spent performing duties at those intensities. Part 2 encompassed exercise as part of traveling only (8 questions) and included questions on the type of physical activity performed when traveling, the intensity of the physical activity and time spent performing the physical activity at the specified intensity. Part 3 encompassed exercise as part of recreation only (8 questions) and included questions on the type of recreational activity performed, the intensity of the recreational activity and the time spent performing the recreational activity at the specific intensity. Part 4 encompassed exercise as part of firefighters' domestic work only (8 questions) and included questions on whether or not they perform physical activity, the frequency firefighters are engaged in domestic work, the intensity at which the domestic work is performed, and the time spent performing the domestic work. Part 5 encompassed sleeping behaviour (1 question) where firefighters reported their average sleep time per night. Lastly, part 6 encompassed sedentary behaviour/sitting (13 questions) and included questions on sedentary behavior, related to sitting during working hours, time spent sitting when traveling and time spent sitting as part of their recreational behavior (watching television). The questionnaire was validated based on face validity using a small panel of experts in the field of firefighters. In addition, a pilot study was conducted to assess the reliability of the questionnaire, where a Cronbach alpha score of 0.636 was achieved, indicating acceptable reliability of the questionnaire.

QUESTIONNAIRE SCORING

The questionnaire's knowledge section consisted of 10 questions (section B), each question scored on a scale with the most correct answer receiving the most points and the least correct answer scoring the lowest score. The section of the questionnaire on the behaviours toward physical activity (Subsection A-F) consisted of 49 questions that were scored the same as the Knowledge section. Knowledge of physical activity was graded as "Good" $\geq 80\%$ or "Poor" $< 80\%$. Firefighters' behaviours toward physical activity were graded as "Positive" $\geq 70\%$ or "Negative" $< 70\%$. The cut-off values were chosen based on similar percentages being used in a previous study to categorize firefighters who had good or poor knowledge and positive or negative attitudes (Ras et al., 2021; Ras, Visagie, et al., 2023).

STATISTICAL ANALYSIS

The research data was captured by double-entry into a Microsoft Office Excel spreadsheet and then cleaned and cleared of errors. Thereafter, the data was transferred to the Statistical Package for the Social Sciences (SPSS) version 28 for descriptive and inferential data analysis. In the instance where missing data was observed, the participant was excluded completely from

the analysis. The Kolmogorov–Smirnov test was performed, and the data was determined to be not normally distributed. The data was analyzed using descriptive statistics (means, standard deviations and frequencies) and inferential statistics (Mann-Whitney U, Kruskal-Wallis H, Spearman’s correlation coefficient and linear and binary regression) were utilized to determine firefighter’s knowledge of and behaviours toward physical activity, to compare firefighters’ knowledge of and behaviours toward physical activity with their socio-demographic data. For the linear and binary regression, to ensure normality of the data, a two-step data normalization technique was preferred, where data were fractionally ranked, and then normalized using the inverse DF, IDF.NORMAL transformation (Templeton, 2011). A p-value of less than 0.05 was used to indicate statistical significance.

RESULTS

The mean age of the firefighters was 39.8 ± 10.3 where the male mean age was 39.8 ± 10.6 and the female mean age was 37.4 ± 7.7 out of a range between 20 to 61 years and older. Table 1 shows that 47.0% of firefighters had a good knowledge of physical activity and 53.0% of firefighters had a poor knowledge of physical activity, and 80.0% had a negative attitude toward physical activity. Based on gender, male firefighters had a poorer knowledge compared to female firefighters. however, female firefighters had a more negative attitude toward physical activity. The youngest and oldest groups of firefighters had the poorest knowledge about physical activity (41.7% and 42.1%); however, the age groups of 30–39 and 40–49 years had the most negative behaviors toward physical activity (82.9% and 87.5%). Firefighters with 20 years and over years of experience had the poorest knowledge of physical activity (57.9%) and those with 16–20 years’ experience had the most negative behaviours toward physical activity (94.1%).

In Table 2 we delineate the differences in knowledge of and attitudes toward physical activity in firefighters. The results indicated that female firefighters participated in less recreational

VARIABLE	n	%	KNOWLEDGE OF PHYSICAL ACTIVITY (%)		BEHAVIOURS TOWARD PHYSICAL ACTIVITY (%)	
			GOOD	POOR	POSITIVE	NEGATIVE
Total	136	100.0	47.0	53.0	20.0	80.0
Gender						
Male	115	85.0	45.2	54.8	21.7	78.3
Female	21	15.0	57.1	42.9	9.5	90.5
Age category (years)						
20–29 years	39	26.0	41.7	58.3	25.0	75.0
30–39 years	43	28.7	51.2	48.8	17.1	82.9
40–49 years	46	30.7	50.0	50.0	12.5	87.5
50 and over years	22	14.7	42.1	57.9	31.6	68.4
Years of experience						
0–5	30	22.0	56.7	43.3	26.7	73.3
6–10	24	17.6	50.0	50	20.8	79.2
11–15	25	18.3	48.0	52.0	16.0	84.0
16–20	17	12.5	41.2	58.8	5.9	94.1
21+	40	29.4	40.0	60.0	22.5	77.5
Marital status						
Single	49	36.0	55.1	44.9	22.4	77.6
Cohabiting/living together	5	4.0	60.0	40.0	0.0	100.0
Married	74	54.0	37.8	62.2	18.9	81.1
Divorced	7	5.0	71.4	28.6	28.6	71.4
Separated	1	1.0	100.0	0.0	0.0	100.0

Table 1 Firefighters’ knowledge of and behaviours toward physical activity based on gender, age category, years of experience and marital status in the fire service.

Note: n – number of participants; % – percentage.

Table 2 Knowledge and behaviours of firefighters based on gender, age category and years of experience in the fire service.

* – indicates statistical significance <0.05; ** – indicates statistical significance <0.01; $\bar{x}$ – mean; SD – standard deviation; PAB – physical activity behaviour; TPAB – transportation-related physical activity behaviour; RPAB – recreational physical activity behaviour; DPAB – domestic physical activity behaviour; – sedentary behaviour.

VARIABLE	n	KNOWLEDGE OF PHYSICAL ACTIVITY (POINT SCORE) $\bar{x} \pm SD$	BEHAVIOURS TOWARD PHYSICAL ACTIVITY (POINT SCORE) $\bar{x} \pm SD$	PAB (POINT SCORE) $\bar{x} \pm SD$	TPAB (POINT SCORE) $\bar{x} \pm SD$	RPAB (POINT SCORE) $\bar{x} \pm SD$	DPAB (POINT SCORE) $\bar{x} \pm SD$	SB (POINT SCORE) $\bar{x} \pm SD$
Total	136	34.1 $\pm$ 5.6	103.7 $\pm$ 20.2	20.7 $\pm$ 3.8	15.4 $\pm$ 6.5	18.3 $\pm$ 5.6	17.0 $\pm$ 6.2	29.9 $\pm$ 7.4
Gender								
Male	115	34.1 $\pm$ 5.6	104.2 $\pm$ 20.3	20.7 $\pm$ 3.9	15.6 $\pm$ 6.6	18.8 $\pm$ 5.5	16.7 $\pm$ 6.0	29.9 $\pm$ 7.4
Female	21	33.8 $\pm$ 6.1	101.0 $\pm$ 20.0	20.7 $\pm$ 3.7	14.1 $\pm$ 5.6	15.6 $\pm$ 5.2	18.8 $\pm$ 6.9	29.2 $\pm$ 7.6
p-value		0.937	0.545	0.481	0.172	0.007**	0.079	0.341
Age category (years)								
20–29	36	33.8 $\pm$ 4.9	108.4 $\pm$ 18.1	21.4 $\pm$ 3.1	16.1 $\pm$ 5.9	19.1 $\pm$ 4.9	18.2 $\pm$ 5.3	31.1 $\pm$ 7.2
30–39	41	33.9 $\pm$ 6.3	102.9 $\pm$ 21.5	20.6 $\pm$ 3.6	15.5 $\pm$ 5.9	18.7 $\pm$ 5.1	16.2 $\pm$ 6.5	29.6 $\pm$ 7.5
40–49	40	34.2 $\pm$ 5.9	102.2 $\pm$ 17.8	20.4 $\pm$ 4.4	14.8 $\pm$ 6.9	18.9 $\pm$ 5.8	17.9 $\pm$ 6.3	28.8 $\pm$ 7.7
50 and over	19	34.5 $\pm$ 5.1	99.3 $\pm$ 25.5	20.1 $\pm$ 4.4	14.9 $\pm$ 7.0	17.1 $\pm$ 7.2	14.5 $\pm$ 6.5	30.2 $\pm$ 7.4
p-value		0.974	0.371	0.528	0.821	0.536	0.117	0.595
Years of experience								
0–5 years	30	35.4 $\pm$ 4.5	104.1 $\pm$ 22.7	21.4 $\pm$ 3.8	15.0 $\pm$ 6.9	19.1 $\pm$ 5.8	16.6 $\pm$ 6.2	29.4 $\pm$ 7.9
6–10 years	24	34.5 $\pm$ 5.2	102.7 $\pm$ 21.7	20.4 $\pm$ 3.8	15.3 $\pm$ 7.9	19.5 $\pm$ 5.5	15.0 $\pm$ 7.5	29.9 $\pm$ 6.9
11–15 years	25	33.8 $\pm$ 6.5	106.6 $\pm$ 22.5	21.3 $\pm$ 3.3	15.9 $\pm$ 5.6	18.2 $\pm$ 6.4	18.3 $\pm$ 6.1	30.2 $\pm$ 7.4
16–20 years	17	32.1 $\pm$ 7.5	102.5 $\pm$ 11.3	20.1 $\pm$ 4.3	15.8 $\pm$ 6.3	17.5 $\pm$ 5.2	17.4 $\pm$ 6.6	29.5 $\pm$ 9.1
21 years and over	40	33.8 $\pm$ 5.1	102.6 $\pm$ 19.6	20.1 $\pm$ 3.9	15.2 $\pm$ 5.9	17.4 $\pm$ 5.0	17.5 $\pm$ 5.1	30.1 $\pm$ 7.1
p-value		0.473	0.739	0.555	0.983	0.537	0.397	0.995
Marital status								
Single	49	34.8 $\pm$ 5.4	106.6 $\pm$ 19.5	21.6 $\pm$ 3.6	15.8 $\pm$ 6.6	19.1 $\pm$ 5.8	17.5 $\pm$ 6.4	30.1 $\pm$ 7.5
Cohabiting/living together	5	36.8 $\pm$ 2.2	107.0 $\pm$ 5.1	22.0 $\pm$ 2.3	16.4 $\pm$ 3.2	19.4 $\pm$ 2.4	17.2 $\pm$ 4.5	29.2 $\pm$ 5.4
Married	74	32.9 $\pm$ 5.8	103.4 $\pm$ 20.1	20.3 $\pm$ 3.6	15.8 $\pm$ 6.4	17.9 $\pm$ 5.4	17.4 $\pm$ 5.9	29.9 $\pm$ 7.7
Divorced	7	38.4 $\pm$ 3.7	83.7 $\pm$ 25.7	18.1 $\pm$ 6.8	8.1 $\pm$ 5.2	16.3 $\pm$ 6.7	10.4 $\pm$ 7.3	27.4 $\pm$ 7.4
Separated	1	38.0	103.0	18.0	11.0	23.0	13.0	36.0
p-value		0.034*	0.330	0.097	0.041*	0.528	0.063	0.925
Smoking status								
Smoking	56	33.3 $\pm$ 5.8	104.4 $\pm$ 24.1	20.5 $\pm$ 3.9	15.6 $\pm$ 6.6	18.4 $\pm$ 6.3	17.3 $\pm$ 6.3	30.2 $\pm$ 7.8
Non-smoker	80	34.6 $\pm$ 5.5	103.2 $\pm$ 17.2	20.8 $\pm$ 3.9	15.2 $\pm$ 6.4	18.3 $\pm$ 5.0	16.8 $\pm$ 6.1	29.6 $\pm$ 7.2
p-value		0.097	0.361	0.296	0.384	0.452	0.307	0.311
Exercise Environment								
Safe environment	84	34.9 $\pm$ 5.4	106.1 $\pm$ 20.2	21.4 $\pm$ 3.4	16.0 $\pm$ 6.8	20.1 $\pm$ 4.6	16.6 $\pm$ 6.3	29.6 $\pm$ 7.5
Unsafe environment	22	31.3 $\pm$ 4.9	99.1 $\pm$ 19.0	20.2 $\pm$ 4.4	13.1 $\pm$ 5.6	13.7 $\pm$ 5.6	17.9 $\pm$ 5.3	31.6 $\pm$ 6.9
p-value		0.002**	0.071	0.088	0.034*	<0.001**	0.172	0.120

physical activity compared to male firefighters ($p = 0.007$). Based on marital status, married firefighters had a point score of 32.9 ± 5.8 , which was the lowest among the marital groups ($p = 0.034$). Based on the exercise environment, firefighters that had a higher knowledge of physical activity were more likely to have a safe environment to exercise in ($p = 0.002$). According to transportation related physical activity, firefighters that had a safe environment to exercise participated in more transportation-related physical activity ($p = 0.034$). In addition, firefighters that were married were less likely to participate in transportation-related physical activity ($p = 0.041$). When analyzing recreational physical activity, male firefighters were more likely to participate in recreation physical activity ($p = 0.007$), firefighters that had a safe environment to exercise were more likely to participate in physical activity recreationally ($p < 0.001$).

Table 3 describes the differences between knowledge of physical activity and behaviors toward physical activity based on sociodemographic characteristics. There was a significant difference between firefighters' knowledge of and behaviours toward physical activity based on gender ($p < 0.001$), age-category ($p < 0.001$), years of experiences ($p < 0.001$), marital status ($p < 0.001$), smoking status ($p < 0.001$) and environmental safety concerns ($p < 0.001$).

VARIABLE	n	KNOWLEDGE OF PHYSICAL ACTIVITY (PERCENTAGE SCORE) $\bar{x} \pm SD$	BEHAVIOURS TOWARD PHYSICAL ACTIVITY (PERCENTAGE SCORE) $\bar{x} \pm SD$	p-value
Total	136	75.7 $\pm$ 12.5	61.9 $\pm$ 11.3	<0.001**
Gender				
Male	115	75.8 $\pm$ 12.3	62.7 $\pm$ 11.4	<0.001**
Female	21	75.1 $\pm$ 13.6	57.9 $\pm$ 9.9	<0.001**
Age category (years)				
20–29	36	75.2 $\pm$ 11.1	64.1 $\pm$ 10.1	<0.001**
30–39	41	75.5 $\pm$ 13.9	57.6 $\pm$ 10.8	<0.001**
40–49	40	76.0 $\pm$ 13.1	63.9 $\pm$ 12.0	<0.001**
50 and over	19	76.7 $\pm$ 11.3	63.9 $\pm$ 10.4	<0.001**
Years of experience				
0–5 years	30	78.7 $\pm$ 10.1	62.1 $\pm$ 12.5	<0.001**
6–10 years	24	76.7 $\pm$ 11.6	59.2 $\pm$ 11.7	<0.001**
11–15 years	25	75.1 $\pm$ 14.5	64.4 $\pm$ 11.4	0.005**
16–20 years	17	71.4 $\pm$ 16.6	62.0 $\pm$ 9.9	0.054
21 years and over	40	75.2 $\pm$ 11.3	62.0 $\pm$ 10.7	<0.001**
Marital status				
Single	49	77.4 $\pm$ 11.9	62.5 $\pm$ 11.8	<0.001**
Cohabiting/living together	5	81.8 $\pm$ 4.8	65.2 $\pm$ 5.4	<0.001**
Married	74	73.2 $\pm$ 12.9	62.4 $\pm$ 10.9	<0.001**
Divorced	7	85.4 $\pm$ 8.3	52.9 $\pm$ 11.3	<0.001**
Separated	1	84.4	54.8	–
Smoking status				
Smoking	56	74.1 $\pm$ 12.8	61.8 $\pm$ 12.6	<0.001**
Non-smoker	80	76.9 $\pm$ 12.2	62.1 $\pm$ 10.3	<0.001**
Exercise Environment				
Safe environment	84	76.2 $\pm$ 12.1	62.4 $\pm$ 11.2	<0.001**
Unsafe environment	22	70.1 $\pm$ 15.9	57.7 $\pm$ 12.0	0.053

Table 3 Differences between knowledge of physical activity and behaviours toward physical activity in firefighters.

* – indicates statistical significance <0.05;
** – indicates statistical significance <0.01.

In Table 4 we delineate the correlation between sociodemographic characteristics, health knowledge of physical activity and behaviours related to physical activity. Knowledge about physical activity was positively correlated with physical activity behaviours ($r = 0.246$, $p = 0.004$), physical activity behaviours ($r = 0.375$, $p < 0.001$) and sleep behaviour ($r = 0.195$, $p = 0.023$). Behaviours regarding physical activity was positively correlated with sleep behaviour ($r = 0.195$, $p = 0.023$). Sleep behaviour was negatively correlated with sedentary behaviour ($r = -0.220$, $p = 0.010$).

	1	2	3	4	5	6	7	8	9
Age	–								
YoE	0.851**								
Knowledge about PA	0.070	0.070							
Behaviours regarding PA	–0.092	–0.053	0.063						
PA behaviours	–0.106	–0.062	0.246**	0.585**					
Traveling PA behaviour	–0.038	–0.039	–0.049	0.734**	0.364**				
Recreational PA behaviour	–0.060	–0.044	0.375**	0.679**	0.467**	0.452**			
Domestic PA behaviour	–0.111	–0.046	0.022	0.667**	0.370**	0.366**	0.375**		
Sleep behaviour	0.031	–0.070	0.195*	0.068	0.155	–0.058	0.192*	0.130	
Sedentary Behaviour	–0.055	–0.015	–0.128	–0.551**	0.042	–0.284**	0.161	–0.186*	–0.220*

1 – Age; 2 – years of experience; 3 – knowledge about physical activity; 4 – behaviours regarding physical activity; 5 – physical activity behaviours; 6 – behaviours regarding traveling; 7 – recreational physical activity; 8 – domestic physical activity behaviours; 9 – sleep behaviours; 10 – sedentary behaviours; PA – physical activity.

Table 5 indicates the association between health knowledge of and behaviours toward physical activity. The results indicated that recreational physical activity was significantly associated with good health knowledge ($p < 0.001$), which remained significant after adjustment for age and sex ($p < 0.001$). In addition, sleep behaviour was significantly associated with health knowledge ($p = 0.017$) and behaviours regarding physical activity ($p < 0.001$). After adjustment, sleep behaviour remained significantly associated with health knowledge ($p = 0.019$) behaviors regarding physical activity ($p < 0.001$).

	UNIVARIATE MODELS ^a				MULTIVARIATE MODELS ^b			
	β	SE	R ²	p-value	β	SE	R ²	p-value
Model: Health knowledge								
Behaviours related to PA	0.389	0.285	0.014	0.125	–	–	–	–
Years of experience	0.246	0.418	0.003	0.556	–	–	–	–
Recreational PA behaviour	0.353	0.082	0.122	<0.001**	0.837	0.187	0.134	<0.001**
Sleep behaviour	3.463	1.432	0.042	0.017*	3.438	1.447	0.044	0.019*
Model: Behaviours regarding PA								
Sleep behaviour	2.303	0.200	0.498	<0.001**	2.282	0.199	0.514	<0.001**

Table 6 describes the association between health knowledge of and behaviours related to physical activity. We found that male firefighters were more likely to engage in recreational physical activity (OR = 1.10). In addition, the likelihood (OR = 1.18) of engaging in physical activity increased if firefighters had a safe environment to exercise in. This remained significant after adjustment for age ($p = 0.006$).

Table 4 Relationship between years of experience, overall knowledge, and overall behaviours toward physical activity.

* – indicates statistical significance <0.05;
** – indicates statistical significance <0.01.

Table 5 Linear regression indicating the association between health knowledge of physical activity and behaviours regarding physical activity.

Note: * – indicates statistically significance <0.05;
** – indicates statistical significance <0.01.
a – univariable linear regression; b – multivariable linear regression adjusted for age and sex.
B – unstandardized beta coefficient; SE – standard error; R² – R squared; PA – physical activity.

	UNIVARIATE MODELS ^a			MULTIVARIATE MODELS ^b		
	OR (95% CI)	SE	p-value	OR (95% CI)	SE	p-value
Exploratory variable: Health knowledge						
Marriage	1.17 (0.80, 1.60)	0.166	0.342	–	–	–
Exercise environment	1.62 (0.45, 5.79)	0.652	0.462	–	–	–
Exploratory variable: Recreational physical activity						
Gender (male)	1.10 (1.02, 1.19)	0.042	0.018*	1.32 (0.25, 6.66)	0.827	0.739
Safe environment to exercise	1.18 (1.06, 1.32)	0.056	0.004**	1.17 (1.01, 1.31)	0.043	0.006**
Exploratory variable: Transportation physical activity						
Exercise environment	1.05 (0.95, 1.15)	0.047	0.330	–	–	–

Table 6 Odds ration indicating the association between health knowledge and behaviours related to physical activity.

Note: * – indicates statistically significance <0.05; ** – indicates statistical significance <0.01; a – univariable linear regression; b – multivariable linear regression adjusted for age and sex; OR – odds ratio, SE – standard error; CI – confidence intervals; PA – physical activity.

DISCUSSION

The results of the study showed that 47.0% of firefighters had good knowledge of physical activity while 53.0% had poor knowledge. In terms of behaviour, 80.0% demonstrated poor behaviour towards physical activity, with only 20.0% showing positive behaviour. In addition, across all sociodemographic categories, there were significant differences between firefighters' knowledge of physical activity and their behaviours toward physical activity. This is similar to studies conducted on the firefighter population in this region, where it has been reported that firefighters had a good knowledge, however, had negative behaviours (Ras et al., 2021; Ras and Leach, 2022a). Gender differences showed that 57.1% of female firefighters had good knowledge of physical activity compared to 45.2% of male firefighters. However, male firefighters seemed to exhibit slightly better behaviour towards physical activity, with 21.7% showing good behaviour compared to 90.5% of females. Previous studies have shown female firefighters tended to have more negative behaviours compared to male firefighters (Kay et al., 2001; Ras et al., 2021; Ras and Leach, 2022a), which is consistent with the present study's findings. Moreover, the results of the current study showed that both males and females had significant differences present between their knowledge of and attitudes toward physical activity. A previous study reported a similar finding, where, regardless of sex, firefighters tended to have a good knowledge of positive health behaviours, but had negative attitudes toward their health, thus engaged in unhealthy behaviours (Ras et al., 2021). The negative behaviours in females may be a result of stigma toward female firefighters, working in a male dominated field, sexual harassment and discrimination, leading to more negative attitudes and ultimately negative behaviours in the profession (Jahnke et al., 2019; Sinden et al., 2013).

We found that the 20–25 age group had the highest knowledge of physical activity (72.7%) but also a high percentage of negative behaviour (81.8%). The 36–40 years age group also had a majority with good knowledge (56.5%), but negative behaviour was very high at 91.3%. Interestingly, the 51–55 age group had the least knowledge of physical activity (20% good knowledge) but a higher percentage of positive behaviour (40%) compared to other age groups. In addition, there were significant differences between each age-group and their knowledge and behaviors related to physical activity. A study has shown that firefighters tend to become less active as they age and, along with the slow deterioration of the musculoskeletal system, which is associated with both an increase in age and years of experience (Ras et al., 2021). Previous studies have also shown that as firefighters age, their attitudes become more negative, as a result of the stress of the profession (Bucala and Sweet, 2019; Dobson et al., 2013; Ras et al., 2021; Ras and Leach, 2022a). In addition, Bucala and Sweet (2019) reported that the lack of promotional opportunities in the job further added to the negative behaviours toward their health. All these factors, ultimately, results in firefighters' adopting more negative attitude toward their health and a lack of motivation to remain fit for their profession (Dobson et al., 2013; Muegge et al., 2020). A possible explanation for the discrepancies in firefighter behaviors between the younger and older firefighter groups may be due to a possible decline

in firefighters health, which necessitates a change in behaviour (Bucala and Sweet, 2019; Dobson et al., 2013; Ras et al., 2021; Ras and Leach, 2022a). Exercise is often prescribed as a positive health behaviour in order to correct many health conditions, such as obesity, diabetes, hypercholesterolemia (Carbone et al., 2019; Durand et al., 2011; Robertson and Vohora, 2008).

The results of the present study showed that firefighters with 0–5 years showed the best knowledge of physical activity (56.7%) and the best behaviour (26.7% positive behaviour). The group with 16–20 years of experience exhibited the worst behaviour (94.1% poor), with those having 21+ years also showing predominantly negative behaviour (77.5% poor). Similarly, Firoozeh et al. (2017), reported that firefighters with less than five years of service presented better behaviour in terms of physical activity. This may be a result of them being new to the profession and, being younger, having the energy to remain physically active outside of the job. This was supported by a study that reported a barrier to exercising in their leisure time was a lack of motivation to exercise and a lack of energy to remain physically active (Muegge et al., 2020). Our results are comparable with studies conducted by Ras et al. (2021) and Ras and Leach (2022a), as it is evident that the firefighters had a good base of knowledge regarding physical activity, however, this does not translate into their behaviors regarding physical activity. One reason for this may be due to factors such as hours worked as they can work up to 48-hour shifts. Factors such as lack of onsite training equipment, partnered with overall displacement with overall funding may have caused a growing rift between their behaviors and actual participation in physical activity. A study by Barry et al. (2020) reported that the firefighting profession consists of around 60% sedentary activity while on-duty and 61% when off-duty. These figures are alarming as only 30.7% (on duty) and 30.1% (off duty) make up moderate to vigorous physical activity per day, which in turn shows the low level of physical activity levels within this occupation especially since they spend a large portion of their day to day lives at the fire station (Barry et al., 2020). In addition, when engaged in work-related physical activity, firefighters are often engaged in moderate-to-vigorous physical activity while on-duty (Barry et al., 2019; Durand et al., 2011; Yu et al., 2015b). This, in turn, has a negative consequence of demotivating firefighters from remaining physically active when not on active call-outs and when off duty. Firefighters, often, believe that the physical activity they are engaged in while on-duty is sufficient, however, many do not reach the minimum recommended levels of weekly physical activity (Durand et al., 2011; Ras et al., 2021; Yu et al., 2015b).

Marital status seemed to impact physical activity knowledge and behaviour as well, with single firefighters having better knowledge (55.1%) but negative behaviour (77.6%). Married firefighters showed a significant lack of knowledge (62.2% poor) and high prevalence of negative behaviour (81.1%). Cohabiting and separated firefighters, though a small sample, showed 100% negative behaviour towards physical activity, while divorced firefighters had the highest percentage of positive behaviour (28.6%). In contrast, Pettee et al. (2006) conducted a study on the physical activity levels amongst older adults and concluded that when compared with their single counterparts, married men reported higher median levels of exercise participation and married women reported higher levels of total and non-exercise activity, with a trend toward higher exercise participation. Previous studies by Ras et al. (2021) and Ras and Leach (2022a) reported similar results where married firefighters tended to have more negative behaviours than single firefighters and may be a result of the additional burden of supporting a family. It has been suggested that the burden of marriage, stress related to supporting their family and domestic issues may burden firefighters, leading to more negative behaviours and a general reluctance to participate in positive behaviours (Oosthuizen. and Koortzen., 2007; Ras et al., 2021; Rodrigues et al., 2018). Moreover, these firefighters tended to participate in additional negative behaviours, such as binge drinking, smoking and recreational drug use, to name a few (Kay et al., 2001; Oosthuizen. and Koortzen., 2007; Ras et al., 2021).

The results indicated that there was a weak positive relationship between firefighters' knowledge of physical activity and how physically active they are during working hours and during recreation. A study conducted by Smith (2011) found that firefighters do not have sufficient knowledge on health which includes physical activity as a factor translating into their attitudes about maintaining a good health status where they had negative behaviours towards physical activity. Firefighters who had a positive attitude to physical activity showed that they understood the benefit of physical activity which was able to motivate them to become physically active (Ras et al., 2021). In addition, we found that sedentary behaviour was significantly and inversely related

to sleeping behaviours in firefighters. This may be due to work related stress/trauma as well as their poor sleeping patterns which may place strain on the individual's psychological wellbeing and overall lifestyle, impacting their home life immensely (Wooding, 2014).

A study conducted by Vancampfort et al. (2023) indicated that firefighters that showed sedentary behaviours during working hours also lead a sedentary lifestyle in their leisure time. This is supported with the current study, as a moderately positive correlation was seen between overall physical activity as part of occupation/work and overall physical activity as part of recreation ($r = 0.467$). A reason for this correlation could be that firefighters who partake in exercise in their recreation time often do self-selected activities which are rewarding or enjoyable and allow them to focus on physiological responses (Vancampfort et al., 2023). This allows firefighters to participate in activities that don't correlate to their work, relieving them of their high stress levels (Vancampfort et al., 2023). The current study found that being male and having a safe environment was significantly associated with firefighters participating in recreational physical activity. Similarly, Humpel et al. (2002) reported that safety and access to recreational facilities were significantly associated with physical activity behaviours. Promotion of safe environments for firefighters may be essential in ensuring firefighters meet the minimum recommendations for physical activity.

STRENGTHS AND LIMITATIONS

The strength of this study was that the findings assisted in developing an understanding of the knowledge and behaviors of firefighters regarding physical activity. This would allow the data to be used to develop effective means of education for these firefighters as well as acting as a way to inform government entities about the current situations within these sectors of public service. This in essence would allow for physical activity education and possible dietary interventions to be put into place by these government entities. These firefighters were also able to get a better idea of their current level of exposure to physical activity, allowing for some introspection to be done if these levels were not adequate. A weakness of this study was that it was conducted within the city of Cape Town, thus limiting the sample size and possibly the overall variability to the larger firefighter population in South Africa. Female firefighters seemed to make up a small percentage of the participants as they only made up 15% of the total number, showing that they were under-represented. Follow up studies would be suggested, following intervention in order to see possible changes in the behaviors and knowledge of firefighters.

CONCLUSION

Based on this study, 53.0% of firefighters had a poor knowledge on physical activity and 80.0% had negative behaviours towards physical activity. Females had greater knowledge with 57.1% while males had better behaviours with 21.7%. The age group of 20–25 years had the highest knowledge with 72.7% while the age group of 51–55 years had the best behaviours. The results highlight the need for educational programs about physical activity and its benefits. Moreover, this study highlighted the high percentage of firefighters that have an overall poor knowledge of physical activity and a high percentage of overall negative behaviours towards physical activity. Firefighters may benefit from educational programmes along with a physical activity programme designed to improve their knowledge and behaviours towards physical activity.

RECOMMENDATIONS

Follow-up studies should be conducted to discern the reasons for firefighters' negative behaviours towards physical activity. There should be a focus on a larger representation of female firefighters as their low numbers could not contribute to validity. There needs to be a better generalizability of the study so incorporating a larger sample or population of other areas in the Western Cape or the greater South Africa would help.

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