Behavioral and Demographic Predictors of Exercise During A COVID-19 Lockdown in Three Ghanaian Cities

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Abstract

Background: This study assessed behavioral and demographic correlates of exercise during a COVID-19 lockdown in three cities. A cross-sectional design was employed. An online survey was used to collect data from residents of three Ghanaian cities, namely Accra, Kumasi, and Tamale.

Methods: A total of 621 residents participated in the study. Most of the participants had tertiary educational qualifications and were aged 18 to 54 years. A binary logistic regression was used to present findings.

Results: The results indicate that unemployed participants were about 13 times more likely to exercise than those who were employed. Individuals aged 25 to 30 years were about 0.7 times less likely to exercise compared with those aged 18 to 24 years. Participants with one or more chronic diseases were about 19 times more likely to exercise compared with those without a chronic condition. Residents who reported a reduction in moderate physical activity time of between 30 to 60 minutes were less likely to exercise compared with those who did not.

Conclusion: The study concludes that the behavioral and demographic correlates of exercise during the lockdown are age, chronic disease status, employment, physical activity time lost, smoking, and domestic violence experience.

Introduction

The maintenance of physical activity (PA) over the life course has been evidenced by researchers [1–3] to benefit optimal health and longevity. This evidence has facilitated the promotion of PA as a healthy behavior and provision of public systems that encourage the maintenance of PA over time [4, 5]. It is, therefore, not surprising that PA promotion at the regional and national levels has become a global public health agenda [5, 6]. As a result, the development of active communities, prescription of PA in healthcare, and the provision of evidence-based exercise recommendations have become imperative [7, 8]. With these programs, governments design interventions to mitigate or reduce the risk of social isolation and its adverse influence on mental health [9, 10].

In the wake of natural disasters such as Coronavirus 2019 (COVID-19), social isolation can hardly be avoided at the individual and population levels. COVID-19 was first detected in Wuhan City, China [11] and in a short time grew from being a local epidemic to a scary pandemic. Covid-19 is considered a highly contagious virus not only because it has infected over 240 million people globally but also because it has taken a relatively short time to spread to every country (as of October 14, 2021) and most regions of the world [12]. As the case was with many previous pandemics, social distancing has been adopted by affected countries as the ultimate containment strategy [9, 11]. This approach brought about a complete or partial lockdown of cities in countries including the US, UK, Italy, Spain, India, and Ghana. With this measure, a major economic downturn is unavoidable [11]. Some researchers [9, 10, 13, 14] have opined that this intervention, as necessary as it is, would discourage exercise in the general population. This is

rightly so because a lockdown increases social disengagement and limits access to public services that facilitate exercise adherence and physical activity. As a consequence, physical inactivity may increase, PA trajectories curtailed, and the burden of non-infectious diseases and disability increased.

Given that COVID-19 may be with us for a long time, and the fact that similar pandemics are likely to break out in the future, it is necessary for policymakers to understand how exercise is affected by changes in behaviors resulting from the enforcement of social distancing protocols. The meeting of recommended PA levels has been identified as the ideal way to maintain optimal health [15–17], more so during a lockdown or the outbreak of a pandemic [18]. While many studies have assessed factors associated with exercise or PA uptake during a COVID-19 lockdown [18–20], no identifiable study has examined personal and behavioral factors associated with the ability of individuals to meet recommended exercise levels, which include exercising for at least 10 minutes in a typical day [8]. Since exercising is not an aspect of the culture in Africa [13, 21], a study assessing behavioral predictors of the ability of residents in an African setting to meet recommended exercise levels during a COVID-19 lockdown can provide very useful information for health promotion, at least in developing countries. Information from such a study is needed to develop a profile of those who could exercise during a COVID-19 lockdown and draw on this profile to develop a public health education program aimed at enabling individuals who are not used to the culture of exercising to keep active during a lockdown. The development of this program is a way to prepare for future pandemics and natural events that may make social distancing measures inevitable. This study, therefore, examined the association between changes in behaviors resulting from a COVID-19 lockdown and exercise, operationally defined as whether the individual exercised for *at least 10 minutes a day in the last week* (World Health Organization, 2018) during a COVID-19 lockdown.

Methods

Study approach and participants

We adopted the cross-sectional approach and online surveys targeting the general population. Online surveys were utilized to collect data since these were the only applicable options. The setting of this study was three Ghanaian cities under a COVID-19 mandatory lockdown, namely Accra, Kumasi, and Tamale. Law enforcement agencies enforced the lockdown, which made it impossible for residents to break the rules. The population was city residents aged 18 years or more, who were socially isolated due to the lockdown. Participants were selected with four inclusion criteria: (a) being a resident of one of the cities under lockdown; (b) having at least a basic educational qualification instructed in English, the medium in which the survey was administered; (c) being socially disengaged due to the lockdown; and (d) consent to participate voluntarily. We could not use a representative or powered sample in this study for a couple of factors. The first reason is that we did not find any existing study utilizing our context. Moreover, we could not have used information from existing studies to calculate a sample size because no previous study applied methods suited for our study. Our in-depth review of the literature suggested

that previous web-based studies had utilized sample sizes ranging between n = 32 and n = 4,222 to reach useful findings [22, 23]. Hence, we hoped to achieve a sample size between 250 and 700.

Survey design and validation

The survey was hosted on Survey Monkey, a survey creation platform that allows data sharing and analysis between research team members. It was chosen because of the researchers' ample experience with it and the fact that it provides user-friendly data transfer and analysis tools. The survey was developed from scratch, as opposed to using a template, because no existing template was suited for our study. The survey comprised 23 multiple-choice questions and a question introducing the mental health measure. The first question included the ethics statement and instructions for completing the survey. The next two questions (i.e., Q2 and Q3) screened for individuals who did not meet the inclusion criteria. Questions 4-8 and 13 captured demographic variables and covariates. Changes in behaviors were measured with questions 9-12 as well as 15-23. Question 24 presented the 4-item scale used to measure physical health. The ‘one question per page’ design option that comes with the most legible text [21] was chosen.

The survey was developed after the researchers discussed with two groups on what could be the ideal measures for exercise, the potential behavioral predictors, and other covariates. The first group, which included four of the authors, was a WhatsApp-based group made up of research fellows of a Center of Excellence. Members, through the use of text messages and audio recordings, suggested potential measures for the study. Over Skype, the researchers then consulted with the second group, comprising two psychometricians and a statistician, to agree on an initial list of items for the survey. The lead researcher then developed a questionnaire of the items proposed. Following this, 10 copies of the questionnaire in sealed envelopes were sent through a private courier to individuals aged 24 years or more who had agreed to complete it in the neighborhood of the lead researcher. This step was part of the survey piloting arrangement. Over two days, questionnaires were completed and returned by 8 out of the 10 participants through the courier. Respondents commented on ambiguities and wording problems associated with the questionnaire. Through a voice call, the lead researcher contacted the participants to confirm and better understand the issues reported, enabling the researchers to further improve the wording of the items. A major change made to the instrument was replacing the word 'self-isolation' with 'social isolation' in most of the measures. An online survey of the final items (including an ethics statement) was then developed and piloted online with 10 different participants (WhatsApp = 4; Facebook = 5; Twitter = 1). With no issues identified in the second pilot study, we sent the survey back to the two psychometricians consulted earlier for approval.

Table 1
Predictor variables and their operationalization

Variable	Indicators	Operational definition	Levels(groups)
Active behaviors	Moderate PA time lost	Time lost per day for moderate physical activities such as walking	None; 1-30 mins; 30-59 mins; 1-3 hrs; 4-6 hrs; > 6 hrs
	Vigorous PA time lost	Time lost per day for vigorous physical activities such as jogging and weight lifting	None; 1-30 mins; 30-59 mins; 1-3 hrs; 4-6 hrs; > 6 hrs
	Sedentary time added	Time added per day in sedentary behaviors such as sitting idle and watching TV	None; 1-30 mins; 30-59 mins; 1-3 hrs; 4-6 hrs; > 6 hrs
	Exercising	Whether or not the individual exercised for at least 10 minutes on a typical day during the lockdown.	Yes; no
Lifestyle behaviors	Smoking frequency	Whether the individual's smoking frequency had increased because of social isolation	Unchanged; non-smoker; increased; decreased
	Alcohol intake	Whether the individual was drinking more alcohol or alcoholic beverages because of social isolation	Unchanged; not applicable; increased; decreased
	Eating frequency	Whether the individual's eating frequency had change owing to social isolation	Increased; decreased; no change
	Sexual activity	Whether the individual's frequency of sexual activity or romance had increased or decreased during social isolation	Increased; decreased; no change
	Domestic violence increase	Whether the individual experienced domestic violence or faced a higher risk of it due to social isolation	Yes; no
CDS	—	Whether the individual has at least one chronic disease	None; ≥1
Gender	—	Sex of the individual	Male; female
Employment status	—	Whether the resident was gainfully employed or not	Employed; Not employed
Education	—	The highest educational level of the individual	Basic; secondary; tertiary
Age	—	How old the individual was at the time he/she was completing the survey	Under 18 yrs; 18-24 yrs; 25-34 yrs; 35-44 yrs; 45-54 yrs; 55-64 yrs; 64+ yrs

Note: ‾‾‾ Not applicable. CDS – chronic disease status

Variable	Indicators	Operational definition	Levels(groups)
Income	—	The individual's gross monthly income	None; < 500; 500-1,000; >1,000
Note: ¯¯¯ Not applicable. CDS – chronic disease status			

Measures

Exercise was operationally defined as structured activities to improve a certain aspect of fitness [7]. To measure exercise in line with our operational definition and best practices [18], individuals were asked whether they exercised for at least 10 minutes a day in the last week during the lockdown. Exercise was dichotomized (i.e., yes vs no), with 'yes' indicating individuals who exercised for at least 10 minutes and 'no' indicating those who did not. In measuring this variable, exercise was defined clearly to ensure that participants did not mistake routine physical activities performed through house chores for exercise. Two categories of predictors were considered in this study, namely changes in behaviors (i.e., behavioral predictors) resulting from COVID-19 social distancing measures and demographic variables. We focused on changes in behaviors that were reported in the recent literature as possible outcomes of COVID-19 social distancing measures [18–20]. Table 1 shows a summary of the independent variables, including covariates. Physical health was the only continuous variable considered in this study and measured with 4 items [with descriptive anchors *strongly disagree (1), disagree (2), somewhat agree (3), agree (4), strongly agree (5)]* from the short-form (SF-36) quality of life questionnaire. The four items produced a Cronbach's alpha $\alpha = 0.844$.

Research ethics

An institutional ethics review committee reviewed the study protocol and ethics statement and subsequently provided ethical approval (# 0012020-ACE) for the study. Based on Balhara and Verma [24], we made the first question of the survey the ethical statement of the study. By this step, only individuals who agreed to participate voluntarily (by ticking 'Yes') completed the survey. The ethical statement included the selection criteria and instructions for completing the survey.

Data collection procedure

The online survey was compatible with various social media platforms including WhatsApp and Facebook. We published the survey a week after the lockdown by sending a link of it to all our contacts using WhatsApp and asking them to complete the questionnaire and share it with their contacts. Following this, the researchers published the link on Facebook, Twitter, and LinkedIn. The link shared took the participant to a pop-up survey that could be completed with a relatively weak internet network. The survey was distributed and completed over two weeks (April 4 – 16, 2020) and was closed on April 16, 2020. The survey's average completion time was about 7 minutes. We programed the survey at Survey

Monkey to prevent multiple responses from the same participant and allow individuals outside the study setting to respond for future research purposes. No incentives for participation were provided.

Statistical analyses method

Data in a Microsoft Excel format were downloaded from Survey Monkey. Coding was done in MS Excel and the resulting data transported to SPSS version 25 (IBM Inc., NY, USA), which was used for data analysis. Descriptive statistics (frequency and percent points) were used to summarize the data after five questionnaires with missing items were discarded in line with the recommendation of Garson [25]. Pearson's Chi-square test was performed to assess group differences, after which binary logistic regression was utilized to test the association between exercise and the potential predictors. Statistical significance of results was detected at $p<0.05$.

Table 2
Respondent characteristics

Category	Variable	Levels(groups)	*Frequency/mean*	%/SD
Demographic variables	Gender (n = 621)	Female	215	34.6
		Male	406	65.4
	Educational level (*n* = 621)	Secondary level	35	5.6
		Tertiary level	586	94.4
	Age (n = 621)	18-24 yrs	110	17.7
		25-34 yrs	213	34.3
		35-44 yrs	143	23.0
		45-54 yrs	120	19.3
		55-64 yrs	35	5.6
	Income (₦, *n* = 621)	None	105	16.9
		< 500	50	8.1
		500-1,000	115	18.5
		>1,000	351	56.5
	CDS (*n* = 621)	None	556	89.5
		≥1	65	10.5
	Employment status (*n* = 621)	Employed	491	79.1
		Unemployed	130	20.9
Other covariates	MPA time lost (*n* = 621)	None	124	20
		1-30 mins	45	7.2
		30-59 mins	73	11.8
		1-3 hrs	174	28
		4-6 hrs	75	12.1
		> 6 hrs	130	20.9
	VPA time lost (*n* = 621)	None	184	29.6
		1-30 mins	65	10.5

₦₦ CDS – Chronic disease status; MPA – moderate physical activity; VPA – vigorous physical activity; SD = standard deviation.

Category	Variable	Levels(groups)	*Frequency/mean*	%/SD
		30-59 mins	144	23.2
		1-3 hrs	158	25.4
		4-6 hrs	35	5.6
		> 6 hrs	35	5.6
	Sedentary behavior time added (*n* = 621)	None	114	18.4
		1-30 mins	35	5.6
		30-59 mins	49	7.9
		1-3 hrs	153	24.6
		4-6 hrs	150	24.2
		> 6 hrs	120	19.3
	Exercise uptake (*n* = 621)	Exercising	397	63.9
		Not exercising	224	36.1
	Smoking frequency (*n* = 621)	Unchanged	173	27.9
		Non-smoker	448	72.1
	Alcohol intake (*n* = 621)	Increased	19	3.1
		Unchanged	164	26.4
		Not applicable	438	70.5
	Eating frequency (*n* = 621)	Decreased	75	12.1
		Increased	262	42.2
		No change	284	45.7
	Sexual activity (n = 621)	Decreased	125	20.1
		Increased	77	12.4
		No change	419	67.5
	Domestic violence experience (*n* = 621)	No	571	91.9
		Yes	50	8.1
	Physical health		15.93	2.10

□□ CDS – Chronic disease status; MPA – moderate physical activity; VPA – vigorous physical activity; SD = standard deviation.

Table 3
Groups differences with respect to exercise uptake

Variable	Group	Exercise uptake		Total	X^2	p
		Exercising (*n* = 397)	Not exercising (*n* = 224)		1.76	0.185
Gender	Female	23%	11%	35%		
	Male	41%	25%	65%		
Education	Secondary level	2%	3%	6%	7.142	0.008
	Tertiary level	62%	33%	94%		
Age	18-24 yrs	7%	10%	18%	44.971	0.000
	25-34 yrs	21%	13%	34%		
	35-44 yrs	15%	8%	23%		
	45-54 yrs	15%	4%	19%		
	55-64 yrs	5%	1%	6%		
Income (□)	None	10%	6%	17%	26.743	0.000
	< 500	4%	4%	8%		
	500-1,000	9%	10%	19%		
	>1,000	41%	16%	57%		
CDS	None	55%	34%	90%	13.472	0.000
	1+	9%	2%	10%		
Employment	Employed	51%	28%	79%	0.408	0.523
	Unemployed	13%	8%	21%		
MPA Time Lost	None	10%	10%	20%	51.006	0.000
	<30 mins	5%	2%	7%		
	30-60 mins	9%	2%	12%		
	1-3 hrs	14%	14%	28%		
	4-6 hrs	10%	2%	12%		
	> 6 hrs	16%	5%	21%		

¶CDS – chronic disease status; MPA – moderate physical activity; VPA – vigorous physical activity; SB – sedentary behavior; DVE – domestic violence experience

VPA Time Lost	None	15%	14%	30%	52.969	0.000
	<30 mins	6%	5%	10%		
	30-60 mins	18%	6%	23%		
	1-3 hrs	15%	10%	25%		
	≥ 4 hrs	10%	1%	11%		
SB Time Added	None	9%	10%	18%	33.265	0.000
	30-60 mins	10%	3%	14%		
	1-3 hrs	16%	9%	25%		
	4-6 hrs	16%	8%	24%		
	> 6 hrs	13%	6%	19%		
Smoking frequency	Unchanged	15%	13%	28%	9.572	0.002
	Non-smoker	49%	23%	72%		
Alcohol intake	Increased	2%	1%	3%	1.493	0.474
	Unchanged	16%	10%	26%		
	Not applicable	46%	25%	71%		
Eating frequency	Decreased	6%	6%	12%	13.771	0.001
	Increased	29%	13%	42%		
	No change	29%	17%	46%		
Sexual activity	Decreased	11%	9%	20%	7.758	0.021
	Increased	9%	3%	12%		
	No change	43%	24%	67%		
DVE	No	60%	32%	92%	4.575	0.032
	Yes	4%	4%	8%		

¶CDS – chronic disease status; MPA – moderate physical activity; VPA – vigorous physical activity; SB – sedentary behavior; DVE – domestic violence experience

Findings

The survey completion rate was 100%, which means that all participants (n = 643) completed the survey. Twenty-two (22) questionnaires were, however, dropped after applying the selection criteria. Of the 621 remaining questionnaires analyzed, 55% (n = 342) were completed by residents of Accra, 25% (n = 157)

by residents of Kumasi; and 20% (n = 122) by residents of Tamale. In Table 2, approximately 35% (*n* = 215) of residents were female whereas 65% (n = 406) were male. The frequency of smoking did not change for about 28% (*n* = 173) of residents but eating frequency decreased for 12% (*n* = 75) of residents; increased for 42% (*n* = 262), and remained the same for about 46% (*n* = 284) of the sample. About 64% (*n* = 397) exercised whereas 36% (*n* = 224) did not. Table 2 shows summary statistics associated with other demographic and behavioral characteristics. In Table 3, there is no significant relationship between exercise and each of gender, employment status, and alcohol intake (i.e., frequency of drinking alcohol. On the other hand, education and other characteristics are related to exercise.

Table 4
The association between exercise uptake and behavioral and demographic variables of residents

Predictor	Group	OR	95% CI		p
			Lower	Upper	
Gender	female	1.000	—	—	—
	male	0.673	0.366	1.237	0.202
Education	Secondary	1.000	—	—	—
	Tertiary	2.129	0.826	5.490	0.118
Age	18-24 yrs	1.000	—	—	—
	25-34 yrs	0.704	0.107	1.805	0.001
	35-44 yrs	0.968	0.273	3.428	0.960
	45-54 yrs	0.991	0.278	3.536	0.989
	55-64 yrs	1.046	0.278	3.932	0.947
Income (□)	None	1.000	—	—	—
	< 500	1.717	0.540	5.455	0.359
	500-1,000	2.253	0.878	5.780	0.091
	>1,000	1.908	0.816	4.463	0.136
CDS	None	1.000	—	—	—
	1+	19.498	5.682	66.912	0.000
Employment	Employed	1.000	—	—	—
	Unemployed	12.912	3.006	55.457	0.001
MPA time lost	None	1.000	—	—	—
	<30 mins	1.873	0.708	4.956	0.206
	30-60 mins	0.140	0.034	0.571	0.006
	1-3 hrs	0.464	0.150	1.435	0.182
	4-6 hrs	1.461	0.664	3.212	0.346
	> 6 hrs	0.475	0.161	1.401	0.177
VPA time lost	None	1.000	—	—	—

¶CI = confidence interval; OR = odd ratio (adjusted); Nagelkerke = 0.496

Predictor	Group	OR	95% CI		p
			Lower	Upper	
	<30 mins	11.822	2.849	49.050	0.001
	30-60 mins	16.111	3.574	72.635	0.000
	1-3 hrs	7.144	1.720	29.675	0.007
	≥ 4 hrs	9.100	2.336	35.448	0.001
SB time added	None	1.000	—	—	—
	30-60 mins	2.035	0.905	4.576	0.085
	1-3 hrs	0.000	0.000		0.997
	4-6 hrs	0.489	0.191	1.250	0.135
	> 6 hrs	1.217	0.565	2.622	0.616
Smoking	Smoker	1.000	—	—	—
	Non-smoker	3.569	1.396	9.123	0.008
Alcohol intake	Increased	1.000	—	—	—
	Decreased	0.285	0.056	1.456	0.131
	Not applicable	1.465	0.617	3.478	0.386
Eating frequency	Increased	1.000	—	—	—
	Decreased	2.020	0.882	4.629	0.097
	No change	0.743	0.406	1.360	0.335
Sexual activity	Increased	1.000	—	—	—
	Decreased	0.810	0.387	1.697	0.577
	No change	0.516	0.211	1.264	0.148
DVE	No	1.000	—	—	—
	Yes	0.025	0.006	0.111	0.000
Physical health	—	1.105	0.977	1.251	0.112
¶CI = confidence interval; OR = odd ratio (adjusted); Nagelkerke = 0.496					

In Table 4., individuals aged 25 to 30 years were about 0.7 times less likely to exercise compared with those aged 18 to 24 years (OR = 0.704; p = 0.001; 95% CI = 0.11 - 1.81). Residents who had one or more chronic diseases were about 19 times (OR = 19.50; p = 0.000) more likely to exercise than those without

any chronic disease. Unemployed participants were about 13 times (OR = 12.91; p = 0.001) more likely to exercise than those who were employed. Residents who lost moderate physical activity time of between 30-60 minutes per day were 0.14 times less likely to exercise than those who lost no moderate physical activity time. Non-smokers were about 4 times more likely to exercise than individuals who were smoking during the lockdown. Finally, residents who experienced domestic violence were 0.03 times less likely to exercise compared with those who did not. Education, income, sedentary behavior time added, alcohol intake, eating frequency, sexual activity, and physical health had no association with exercise.

Discussion

This study assessed behavioral and demographic correlates of exercise during a COVID-19 lockdown in three cities in Ghana. The study found that individuals aged 25-34 years were less likely to exercise than those aged 18-24 years. That is, the younger group of city residents were more likely to exercise during the lockdown. This result is consistent with studies [15–17] indicating that older adults are less active and less frequently exercise owing to their physiological limitations. Empirical evidence has also consistently shown that younger adults are more active [26, 27]. Studies [18–20] have revealed that younger adults, compared with adults aged 65 years or more, were more active during a COVID-19 lockdown. Since access to the built environment and community services were limited during the lockdown, residents may have utilized domestic resources (including online exercise lessons) to exercise. This reasoning is premised around studies [28, 29] that have indicated that access to online exercise classes and the utilization of indoor spaces for exercise increased significantly during the lockdown.

Those who had a chronic disease status were 19 times more likely to exercise during the lockdown compared to those without any chronic disease. This result confirms some previous studies [5, 27, 30, 31] focused on the general population in developed and developing countries. In their cross-sectional study, for instance, Asiamah et al. [5] found that older adults with one or more chronic diseases were more likely to exercise than those without any of these diseases. This result could be the effect of two advantages people with clinically diagnosed chronic diseases have. Firstly, such individuals often receive special medical care that includes lifestyle counselling [27, 30]. Compared with people without chronic disease, individuals with non-infectious diseases are more mindful and aware of the risks of disease and mortality accompanied by sedentary behavior and would, as a result, better adhere to standard physical activity recommendations [5, 30, 31]. People with long-term health conditions are more likely to exercise because they have better access to exercise counseling and are more conscious of their health [5]. The import of these explanations is that having limited access to the built environment and services owing to a lockdown would not necessarily discourage physical activity in people with chronic conditions. In other words, people would be compelled by their ill-health to use indoor facilities to exercise in a pandemic context where access to the built environment is limited.

Residents who were not employed were about 13 times more likely to exercise than those who were employed. This result counteracts some studies [32–34] that have assessed the association between employment status and physical activity as well as sedentary behavior. In the US, for example, Van

Domelen and colleagues [33] found that, compared with people who were not working, individuals who were employed (including those working in sedentary sectors) had a higher level of physical activity. In Sweden, Macassa et al. [32] found that individuals working full-time were more likely to exercise than those who were not employed. Given this disagreeing evidence in the literature, it could be argued that the lockdown made it impossible for working residents to perform physical activities. Another scenario may be that most employees were working at home during the lockdown [35], so they may not have had enough time to exercise.

Individuals who lost 30 to 60 minutes of moderate physical activity time were 0.14 times less likely to exercise compared with those who did not lose moderate physical activity time. This result implies that the lockdown necessitated social isolation and therefore took away the time residents spent on walking and other moderate free-living physical activities. Furthermore, residents who had never smoked were about 4 times more likely to exercise than those who smoked. While the literature shows mixed results on this relationship [36], our result may suggest that non-smokers better understood the health benefits of exercise and, therefore, more frequently exercised during the lockdown than smokers. As reported by some commentators [5, 37], a smoking status may connote that an individual knows nothing or little about the consequences of unhealthy behaviors such as exercise and is unwilling to make sacrifices to maintain health, an idea that explains why smokers were less likely to exercise during the lockdown.

Residents who experienced domestic violence or faced a higher risk of it were about 0.03 less likely to exercise than those who did not. This result may be due to victims of domestic violence lacking the emotional, psychological, and physical strength to exercise during the lockdown. These residents may have been forcefully denied resources and the freedom to exercise at home. In the long-term, the physical and mental health of victims of domestic violence may significantly deteriorate due to the joint impact of a lack of exercise and trauma. Our results suggest that public education before a lockdown may be necessary, at least in developing countries where many people lack formal education [38] and may not understand the dynamics and consequences of taking to some behaviors in response to the lockdown. Public education is a way to conscientize people to avoid potentially harmful behaviors and adapt to the lockdown with new health-supporting behaviors. Finally, this study contributed to knowledge by indicating segments of the population (e.g., smokers, workers) that face the risk of sedentariness during a lockdown. This information can enable stakeholders to design public education programs targeting specific groups.

This study, however, has some limitations. By utilizing a non-powered sample in this study, our results may not be generalizable to other cities. In harmony with previous studies [39, 40], most of our sample is made up of highly educated people, which means that residents who were uneducated or poorly educated were underrepresented in the study. As a result, studies that employ representative samples and more resilient designs (e.g., randomized controlled interventions) are needed in the future. Older adults were underrepresented in the study possibly because older adults in Ghana hardly use the internet and social media platforms [40]. With most older adults in Ghana having poor English skills [39, 40], our reliance on a survey administered solely in English could have prevented some older adults from participating. Our

results are ideally applicable to educated populations aged 18 to 55 years. Since Africa's population is generally young [40], this study, despite the above limitations, provides lessons applicable to Africa, sets the foundation for future studies, and can help stakeholders to identify younger segments of the population that face a higher risk of sedentary behavior during a lockdown. If so, this study would not only encourage public education before a lockdown but would also indicate the focus of viral public education programs, particularly in Africa and related developing countries.

Conclusion

It is concluded that behavioral and demographic factors associated with exercise during the lockdown are age, chronic disease status, employment, physical activity time lost, and smoking. The likelihood of exercising reduced with smoking, employment, and domestic violence experience. To better prepare for future pandemics, interventions that encourage specific segments of the general population (e.g., older people, smokers) to exercise during a lockdown are needed.

Abbreviation

CDS Chronic disease status

CI Confidence Interval

COVID-19 Coronavirus disease 2019

DVE Domestic violence experience

IBM International Business Machines

MPA Moderate physical activity

PA Physical activity

OR Odd Ratio

SB Sedentary behaviour

SPSS Statistical Package for the Social Sciences

VPA Vigorous physical activity

Declarations

Funding

Funding was not received for this study.

Conflicts of interest

None declared

Ethics approval

An institutional ethics review committee reviewed the study protocol and ethics statement and subsequently provided ethical approval (# 0012020-ACE) for the study.

Consent to participate

All authors provided informed consent to participate in this study.

Consent for publication

Not applicable

Availability of data and material

Data will be made available upon request

Code availability

Not applicable

Authors' contributions

NA conceived the research idea, analysed the data, and drafted the original manuscript. EM searched and reviewed the literature whereas ED and FFO supervised data collection and coding. All authors critically reviewed and approved the draft manuscript.

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