International Journal of Africa Nursing Sciences 16 (2022) 100407

Contents lists available at ScienceDirect

International Journal of Africa Nursing Sciences

journal homepage: www.elsevier.com/locate/ijans

Adherence to physical exercise recommendations among type 2 diabetes patients during the COVID-19 pandemic

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ARTICLE INFO

Keywords:
Adherence: exercise
COVID-19
Coronavirus
Diabetes
Type 2
Ethiopia

ABSTRACT

Background: In the era of the COVID-19 pandemic, nonadherence to the recommended physical exercise for diabetic patients is a difficult issue. Regular physical exercise is critical for reducing further complications of diabetes mellitus and the COVID-19 pandemic. The purpose of this study was to determine the predictors of type 2 adult diabetes patients' exercise recommendations during the COVID-19 pandemic.

Methods: An institution-based cross-sectional study was conducted among 576 diabetes mellitus patients from August 1, 2020, to September 28, 2020. A systematic random sampling technique was used to select the study participants. An interviewer-administered questionnaire was used to collect the data. Frequency tables and percentages were used to explain the study variables. A binary logistic regression was used to investigate the relationship between the dependent and independent variables.

Result: A total of 576 diabetes mellitus patients participated in the study, with a response rate of 99.3%. The overall prevalence of exercise adherence was 26.4%, whereas 73.6% were non-adherents to exercise recommendations. Rural residency (AOR = 1.95, 95% CI: 1.16–3.27) and COVID-19 related knowledge (AOR = 9.95, 95% CI: 41.14–5.24) were both strongly associated with exercise recommendations.

Conclusion: In this study, only one-fourth of patients had exercised adherence during the era of the COVID-19 pandemic. Knowledge about COVID-19 was one of the factors that was strongly associated with adherence to exercise recommendations for diabetes patients. During the COVID-19 pandemic, encouraging home-based exercises can improve adherence to exercise recommendations.

1. Introduction

Non-communicable chronic diseases (NCD) cause a higher burden of mortality and morbidity in the period of the novel coronavirus disease-2019 (COVID-19) pandemic (Alyammahi et al., 2020). Evidence showed that diabetes is the second most common NCD, with high comorbidities with COVID-19 and about 10% of the diabetes population, and that disease severity during the COVID-19 era was highly correlated with diabetes severity (Guo et al., 2020). COVID-19 may be the most common cause of death among COVID-19 patients (Corona et al., 2021; Muniyappa & Gubbi, 2020).

Non-adherence to exercise recommendations is a challenging issue in the era of the COVID-19 pandemic (Marçal, Fernandes, Viana, & Ciolac, 2020). Regular physical activity is essential in the COVID-19 era to reduce exposure to COVID-19 as well as the complications of diabetes mellitus (ADA, 2020). However, to reduce the spread of COVID-19, authorities around the world have ordered lockdown measures. This important measure is hindered by a lack physical activity, sedentary time, stress, and glycemic variability (Zhou et al., 2020).

COVID-19 has disrupted everyone's normal routine of exercise. It is, however, critical to stay on track, particularly for those with diabetes. Physical exercise boosts the immune system and helps to prevent COVID-19 complications. It also plays an important role in the management of diabetic patients because it regulates blood glucose levels (Banerjee, Chakraborty, & Pal, 2020; Mendes et al., 2016).

Evidence showed that COVID-19 has resulted in a serious impact on the blood glucose monitoring of diabetes patients due to a lack of physical activity (J. Zhou & Tan, 2020). Regular physical activity and maintaining a normal body weight are ways to prevent or delay the onset of type 2 diabetes. It has been estimated that up to 60% to 90% of

Abbreviations: AOR, adjusted odds ratio; COR, crude odds ratio; COVID19, novel coronavirus disease, 2019; DM, diabetes mellitus; FBG, fasting blood glucose; NCDs, Non-communicable chronic disease; SPSS, Statistical Package for Social Science; UOGCSH, University of Gondar comprehensive specialized hospital.

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https://doi.org/10.1016/j.ijans.2022.100407
Received 5 July 2021; Received in revised form 25 February 2022; Accepted 14 March 2022
Available online 16 March 2022

the diabetic disease risk variation occurs. If we do not act upon it now, the prevalence is expected to rise to more than 47 million by 2045 (Bazzano, Serdula, & Liu, 2005).

Regular physical activity can help individuals to avoid or delay the onset of type 2 diabetes. Many people with type 2 diabetes can maintain their blood glucose at normal levels and reduce their risk of type 2 diabetes by 35% while doing 30 min of regular exercise for about five days a week. (Alhariri, Daud, & Saghir, 2017; Bazzano et al., 2005).

According to WHO, 67% of patients with type 2 diabetes do not increase their level of exercise after being diagnosed (WHO, 2013). Despite this, rates of nonadherence to exercise recommendations are still as high as 70% (Mujuni, 2014; Mumu, Saleh, Ara, Afnan, & Ali, 2014). In Ethiopia, about 64.3% of diabetic patients had poor adherence to physical exercise (Ayele et al., 2018a; Zeleke Negera & Charles Epiphanio, 2020).

Studies showed that variables like information, wrong perception of illness, lack of an exercise partner, low income, increasing age, and coexisting disease were significantly associated with nonadherence to exercise recommendations (Ganiyu, Mabuza, Malete, Govender, & Ogunbanjo, 2013; Mumu et al., 2014; Nelson, Reiber, & Boyko, 2002).

In the past few years, solutions have been tried to correct nonadherence problems among type 2 diabetes mellitus (DM) patients. Health professionals have been struggling to encourage patients by educating them on the importance of lifestyle modification through regular exercise, but we still have not achieved the desired outcome (Sheri R. Colberg et al., 2016; Cooper, Booth, & Gill, 2003).

Now, in the time of the COVID-19 pandemic disease, the struggle to implement lifestyle modification through regular physical exercise is important. Adherence to physical exercise during the time of COVID-19 has not been investigated yet in the study area. Therefore, this study will explore most of the problems that hinder exercise adherence during COVID-19.

Therefore, the current study was conducted to assess the prevalence and predictors of adherence to physical activity recommendations among type 2 diabetes adult patients at the University of Gondar comprehensive specialized hospital (UOGCSH), Northwest Ethiopia.

2. Methods

2.1. Study setting

The study was conducted at the UOGCSH Northwest Ethiopia's diabetic follow-up clinic. The hospital is located in Gondar town, Amhara regional state, 748 km from Addis Ababa. It has more than 14 outpatient medical service units and more than 250,000 people have visited the services. This hospital provides for the population who are living in and outside of Gondar town. The provision of follow-up and treatment for diabetes mellitus (DM) patients is one of the chronic illness services that have been offered at the chronic illness care clinic. Besides, the hospital serves as a tertiary level referral center for over seven million people in Gondar town and Northwest Ethiopia. This hospital provides services for about 1200 diabetic patients per month.

2.2. Study design and period

A cross-sectional institutional-based study was conducted from August 1, 2020, to September 28, 2020.

2.3. Source and study population

All adult DM patients attending the DM clinic at the UOGCSH were the source population, whereas all randomly selected type 2 DM patients attending the follow-up clinic during the study period were the study population.

2.4. Inclusion and exclusion criteria

All type 2 diabetes patients having follow-up at the hospital during the study period were included in this study, whereas patients who were newly diagnosed or those unable to exercise due to disability or surgical problems in the extremities during the data collection period were excluded from the study.

2.5. Sample size determination and sampling procedure

The sample size was calculated by using the single population proportion formula, $n = \left(Z\frac{\alpha}{2}\right)2{*}p(1-p)/(d)2$. In the formula, "n" denotes the sample size, "$\frac{\alpha}{2}$" is the reliability coefficient of standard error at the 5% level of significance with $z = 1.96$, "p" is the proportion, and "d" is the level of standard error. The prevalence of exercise adherence was taken as 64.3% from the study done in Jimma (Zeleke Negera & Charles Epiphanio, 2020). By using the above assumption, the final value was estimated at 580.

Nearly 1500 diabetic patients attend the outpatient department each month. A systematic random sampling technique was employed to select the study participants with the calculation of the K interval (1500/580 = 3) at every three intervals. To avoid the recycling of data, special marks were used for the interviewed patients' charts to indicate whether they participated or not in the previous visit.

2.6. Operational definition

Adherence: The behavior of the patients ensures that what has been advised by health professionals (García-Pérez, Álvarez, Dilla, Gil-Guillén, & Orozco-Beltrán, 2013).

Exercise adherence: Getting 30 min of regular exercise per day (like brisk walking, strength training, and stretching exercise) or 150 min/week of moderate-intensity physical activity to keep the blood glucose level in a normal state (Akumiah, Samuel, Azumah Nayembil, Ofosu Agyapong, & Fataw, 2017; Sheri R Colberg et al., 2010; Sheri R. Colberg et al., 2016).

COVID-19 related knowledge: The participants who scored mean and above (≥12.25) had good knowledge, whereas participants who scored less than the mean (<12.25) had poor knowledge (Nigussie & Azmach, 2020).

Wealth status: Based on principal component analysis (PCA), the wealth status was classified as low status, which was the first percent quartile; medium; which indicates the second percentile group, and high-level wealth status, which was the third percent quartile (Hackman, Hruschka, & Vizireanu, 2020).

Alcohol drinker: Participants who drank 750 ml of any of the alcoholic beverages for females or 1000 ml for males were considered alcohol drinkers in this study (Abuse & Alcoholism, 1995).

2.7. Data collection tools and procedures

A structured interviewer-administered questionnaire was adapted from other related studies to collect the data (supplementary file 1). It incorporates five sections: the first section includes socio-demographic related questions; the second section incorporates the participants' health status and health information; the third section was the exercise adherence of the participants during the COVID-19 pandemic; the fourth section of the questionnaire was the COVID-19 related knowledge, and the last part of the questionnaire items was the income level measurement tool/wealth status.

The exercise adherence incorporated four questions, which measure the habit of exercise in the era of COVID-19. Participants who responded to the four questions and performed the recommended exercise by WHO and the American Diabetic Association were interpreted as having exercise adherence, whereas those who could not perform the

recommended exercise were operationalized as exercise non-adherence (Colberg et al., 2010). The questionnaire assessed 16 questions of COVID-19 related knowledge with "Yes" (1 point) and "No" (0 points) options. The total knowledge score ranged from 0 to 16.

The questionnaire that assessed the wealth status level incorporated items like monthly income, agricultural products, and household assets. It was calculated with the principal PCA by ensuring its assumptions. In the PCA, wealth status was categorized as in the first percent quartile, medium, which indicated the second percentile group, and high-level wealth status, which indicated the third percent quartile (Hackman et al., 2020).

The Cronbach's alpha for exercise adherence and knowledge related to COVID-19 items was 0.76 and 0.82, respectively. The validity of the questionnaire was assessed by two experts in the area of interest in this research paper, which validates the content of the questionnaire items and their recommended modifications, such as contextual meaning and grammatical issues, have been made.

The Amharic version of the questionnaire was used for data collection. Data were collected using an interviewer-based structured questionnaire. Verbal informed consent was obtained from each study participants before actual data collection procedure. The study participants were interviewed while they were coming to the diabetic follow-up clinic, and it lasted about 20–25 min. The data collectors were the principal investigators (five in number). Upon data collection, the data collectors interviewed the participants independently to maintain the transmission of information or information bias between the participants.

2.8. Data quality assurance

To maintain data quality, a pretest was done on 22 (5%) diabetes patients from Felege Hiwot Referral Hospital. The questionnaire was prepared in English and translated into the local Amharic language for the sake of better understanding by the study participants. During the data collection, entry, and analysis processes, the data were checked for completeness.

2.9. Data processing and analysis

The collected data were checked for its accuracy before analysis. For analysis, the data was exported to the Statistical Package for Social Science (SPSS) version 22 software. The data was then recoded and cleaned before being subjected to appropriate statistical analysis with SPSS. Descriptive statistics such as frequency and percentage were used. Tables and graphs were used to describe the sample characteristics and responses to the questionnaire items. Model fitness was checked by using the Hosmer-Lemeshow goodness of fit test ($p = 0.32$) and interpreted as a model fit. All variables fulfilled the chi-square assumption and checked its odds ratio. Multicollinearity was checked using the variance inflation factor (VIF) and its values lie between 1 and 10, which was interpreted as no multicollinearity. Bivariable and multivariate logistic regression analyses were used to identify associated factors. Those variables with a p-value less than 0.25 in the bivariable analysis were entered into the multivariable analysis. The backward selection process was used to see the final associated variables. Those variables with a p-value less than 0.05 with a 95% confidence interval were considered significantly associated with outcome variables.

2.10. Ethical approval and consent

The study was performed based on the ethical standards put down in the declaration of Helsinki. An ethical clearance was found from the School of Nursing and College of Medicine and Health Science of the University of Gondar, institutional ethical review committee, with an ethical approval number of SN/2013/133/213. An official permission letter was obtained from the University of Gondar hospital administration. All respondents were asked for voluntary participation and verbal informed consent was obtained from them. Each study participant was also informed that they could withdraw at any time if they were not interested in the questionnaire. To maintain confidentiality, the information obtained from the participant data was kept anonymously.

3. Result

3.1. Socio-demographic characteristics of the study participants

A total of 576 diabetic mellitus clients participated in the study, with a response rate of 99.3%. The mean age of the participants was 51.63, with a standard deviation (SD) of 15.81 years. More than half, 344 (59.7%) of them, were female participants, and 447 (77.6%) of them were married. The majority, 391 (67.9%) of the participants were Christian, and 251 (43.6%) of the participants had attended primary school. About 458 (79.5%) of the participants lived in urban areas, and 352 (61.1%) were unemployed. Almost half, 279 (48.4%), had a family size of less than 5 (Table 1).

3.2. Physical exercise adherence of the participants

In this study, more than half 406 (70.5%) of participants were doing physical exercise during the COVID-19 pandemic. Of those participants, 129 (31.8%) performed brisk walking. A total of 152 (77.9%) of the participants had done aerobic exercise for ≥30 min/day and 195 (48%) of the participants had done exercise for ≥5 days. In this study, the overall physical exercise adherence was 26.4% [95%CI (23–30)], whereas nonadherence was 73.6% with a 95% CI (70–77) (Table 2).

Table 1
The socio-demographic characteristics of participants at the University of Gondar Comprehensive Specialized Hospital, Gondar, Ethiopia, (n = 576).

Variables	Frequency	Percentages (%)
Sex		
Male	232	40.3
Female	344	59.7
Age in years		
≤40	120	20.8
>40	456	79.2
Educational status		
Can't read & write	246	42.7
Primary school	35	6.1
Secondary school	44	7.6
College &above	251	43.6
Marital status		
Single	40	6.9
Married	447	77.6
Divorced	32	5.6
Widowed	57	9.9
Religious		
Orthodox	391	67.9
Muslim	146	25.3
Protestant	39	6.8
Residence		
Urban	458	79.5
Rural	118	20.5
Occupation		
Government employee	224	38.9
Unemployed	352	61.1
Family size		
<5	297	51.6
>=5	279	48.4
Wealth-status		
Low	177	30.7
Medium	198	34.4
High	201	34.9

Table 2
The participants' response on exercise adherence during the covid-19 pandemic (n = 576).

Physical exercise during COVID-19	Frequency		Percentage
Doing physical exercise	Yes	406	70.5
	No	170	29.5
Type of exercise performed	Brisk walking	129	31.8
	Cycling	88	21.7
	Running	66	16.3
	Climbing stairs	31	7.6
	Swimming	72	17.7
	Other aerobic exercises	20	4.8
Duration of aerobic exercise	< 30 min/day	43	22.1
	≥ 30 min/day	152	77.9
No of days exercises per week	< 5 days	195	48.0
	≥ 5 days	43	22.1
Adherence to recommended exercise	Yes	152	26.4
	No	424	73.6

Abbreviation: COVID-19; novel coronavirus disease 2019.

3.3. Participants' health status and health information

About half of the participants, 301 (52.3%), had less than a five-year diabetic history, and 125 (30.9%) of the participants had comorbidities. Of the total participants, 172 (29.9%) had fasting blood glucose levels below <129 mg/dl. More than half of the participants, 414 (68.6%) had gotten diabetic health education about DM, and 153 (37.9%) of them had gotten information from TV. Of the participants, 375 (65.1%) had family support (Table 3).

3.4. Participants' behavioral and food-related information

Among the study participants, 13 (2.3%) and 61 (10.6%) had the habit of smoking and drinking alcohol, respectively. Of the participants, 66 (11.5%) had checked their fasting blood glucose (FBG) levels and 109 (18.9%) had used a glucometer to check their blood glucose levels at home. About 431 (74.8%) and 146 (25.3%) of the participants had appropriately prepared their meals and had no difficulty in choosing food items, respectively (Table 4).

Table 3
Health status and available health information for type 2 diabetes patients at the University of Gondar comprehensive specialized hospital, Gondar, Ethiopia (n = 576).

Variables	Frequency		Percentages
Duration of DM	<5 years	301	52.3
	5–10 years	202	35.1
	11–15 years	52	9.0
	>15 years	21	3.6
FBG level	< 126 mg/del	172	29.9
	≥ 126 mg/del	404	70.1
Presence of other chronic illness	Yes	125	30.9
	No	279	69.1
Presence of complication	Yes	181	31.4
	No	395	68.6
Have you got an education about DM?	Yes	414	71.9
	No	162	28.1
Having a family history of DM?	Yes	163	28.3
	No	413	71.7
Do you have a journal pamphlet about DM?	Yes	54	13.4
	No	350	86.6
Do you get education from TV about DM?	Yes	153	37.9
	No	251	62.1
Do you have family support?	Yes	375	65.1
	No	201	34.9

Abbreviation: DM-diabetes mellitus, TV-television.

Table 4
Frequency distribution of participants' behavioral-related information at the University of Gondar Comprehensive specialized hospital, Gondar, Ethiopia (n = 576).

Variables	Frequency		Percentage (%)
Habit of smoking	Yes	13	2.3
	No	563	97.7
Habit of drinking	Yes	61	10.6
	No	515	89.4
Considered holidays as other free days in celebration	Yes	135	23.4
	No	441	76.6
Checked FBG every day	Yes	66	11.5
	No	510	88.5
Do you have a glucometer	Yes	109	18.9
	No	467	81.1
Appropriate meals prepared for DM	Yes	431	74.8
	No	145	25.2
The difficulty in choosing foods	Yes	146	25.3
	No	430	74.6
Eating at a restaurant without a good plan in social events	Yes	319	55.4
	No	257	44.6

Abbreviations: FBG; fasting blood glucose, DM; diabetes mellitus.

3.5. Factors associated with physical exercise adherence among type 2 diabetic patients during the COVID-19 pandemic

Among the independent variables entered into the multivariable analysis, being female, rural residency, being unemployed, family history of diabetes, having a glucometer, and COVID-19 related knowledge were significantly associated with physical exercise adherence of type 2 diabetes patients. In this regard, being female was nearly two (AOR = 1.86, 95%CI (1.27–2.72)) times more likely to adhere to exercise during the era of COVID-19. Those rural dwellers were also nearly two (AOR = 1.95, 95%CI (1.16–3.27)) times more adherent to physical exercise compared to urban dwellers. Being unemployed was found to be nearly two-fold (AOR = 1.81, 95%CI (1.01–3.26)) more adherent to physical exercise. Those having a family history of diabetes were 1.26 (AOR = 1.26, 95%CI (1.09–1.89)) more likely to adhere to physical exercise according to the recommendations compared to those having no family history. Those having no glucometer were found to be 51% (AOR = 0.49, 95% CI (0.23–0.78)) less likely to adhere to physical exercise compared to those having a glucometer. Those with good knowledge of COVID-19 were 33% (AOR = 1.33, 95%CI (1.14–5.24)) more likely to adhere to the physical exercise recommendations (Table 5).

4. Discussion

In this study, nonadherence to physical activity was 73.6% (95% CI (70–77)). This finding was in line with the study done in Nepalese (78.7%) (Nelson et al., 2002) and the study done in Debre Tabor, Ethiopia (74.3%) (Ayele et al., 2018b). The possible reason was that these two countries still have no improvement in adherence to physical exercise, which may be due to fear of the current situation of COVID-19 and the limitation on exercise due to lockdown measures (Alshareef, Al Zahrani, Alzahrani, & Ghandoura, 2020). The finding was higher than the study done in Ghana (19.3%) (Akumiah et al., 2017), Botswana (52%) (Ganiyu et al., 2013), Surat city (54.4%) (Jadawala et al., 2017), Bangladesh (25%) (Mumu et al., 2014), Kathmandu (67.3%) (Pandey, 2019), and Jimma, Ethiopia (64.3%) (Zeleke Negera & Charles Epiphanio, 2020). The possible reason might be due to the study period in which the current study was conducted during the COVID-19 pandemic. This could have led to limited use of physical activity due to the authorities' lockdown measures, which didn't allow performing outdoor physical exercise (Khare & Jindal, 2020; Marçal et al., 2020). This study result was lower than the study done in Hodeidah City, Yemen (84.8%) (Alhariri, Daud, & Saghir, 2017). This might be due to some of this study

Table 5
Bivariate and multiple logistic regression analysis of factors affecting exercise adherence of type 2 diabetes patients in Gondar University Comprehensive Specialized Hospital, Northwest, Ethiopia (n = 576).

Variables	Physical exercise Adherence		COR (95%CI)	AOR(95%CI)
	Yes	No		
Sex				
Male	76	156	1	1
Female	76	268	1.72(1.18–2.49)	1.86(1.27–2.72)**
Age in years				
≤40	36	84	0.79(0.51–1.24)	0.74(0.41–1.31)
>40	116	340	1	1
Marital status				
Single	12	28	1	1
Married	120	327	0.83(0.34–2.04)	0.78(0.32–1.88)
Divorced	5	27	0.97(0.52–1.82)	1.52(0.40–5.75)
Widowed	15	42	1.93(0.63–5.92)	0.59(0.19–1.80)
Educational status				
Can't read and write	55	191	1	1
Primary school	8	27	0.97(0.42–2.26)	
Secondary school	13	31	0.69(0.34–1.40)	
College and above	76	175	0.66(0.44–0.99)	
Residency				
Urban	130	328	1	1
Rural	22	96	1.73(1.04–2.87)	1.95(1.16–3.27)*
Occupation				
Gov't employed	73	115	1	1
Unemployed	79	273	1.67(1.15–2.43)	1.81(1.01–3.26)*
Family size				
<5	88	209	1	1
≥5	84	215	1.41(0.97–2.06)	1.13(0.72–2.77)
Wealth status				
Low	52	125	1	
Medium	52	146	1.17(0.74–1.84)	1.23(0.78–2.09)
High	48	153	1.33(0.84–2.09)	1.56(0.67–4.37)
Family support				
Yes	96	279	1.12(0.76–1.65)	1.12(0.65–1.52)
No	56	145	1	1
Family Hx of DM No	114	299	1	1
Yes	38	125	1.25(0.82–1.91)	1.26(1.09–1.89)*
Health education No				
No	93	236	1	1
Yes	59	188	1.26(0.86–1.83)	1.41(0.93–2.13)
Duration of DM				
<5 years	78	223	1	1
5–10 years	54	148	1.08(0.61–1.91)	0.90(0.57–1.43)
>10 years	20	53	1.03(0.57–1.89)	0.81(0.42–1.56)
Use glucometer				
No	113	354	0.57(0.37–0.89)	0.49(0.23–0.78)**
Yes	39	70	1	1
COVID-19 knowledge				
Good	62	199	1.28(1.08–1.87)	1.33(1.14–5.24)**
Poor	90	225	1	1

Note: ** p ≤ 0.01 strongly significant association * p ≤ 0.05, significantly associated.
Abbreviations: AOR; adjusted odds ratio, COR; crude odds ratio, COVID19; novel coronavirus disease, 2019, DM; diabetes mellitus,

participants being illiterate (42.7%) whereas, in the study done in Yemen, about 32.4% were illiterate. As a result, this study's participants may have had less information on exercise adherence than usual. This finding was also supported by the evidence which states that DM patients are equipped with information on the severity of DM comorbidity with the COVD-19 pandemic. Therefore, this comorbid patient could understand the importance of physical exercise for a better prognosis of COVID-19 and DM (Chesnut, MacDonald, & Wambier, 2021).

In the multivariable analysis, variables like being female, rural residency, being unemployed, family history of diabetes, having a glucometer, and knowledge of COVID-19 were significantly associated with exercise adherence of diabetic patients in the era of COVID-19. Regarding this being, a female was 1.8 times more likely to adhere to physical exercise during the COVID-19 pandemic. This finding was in line with studies done in India (Priya et al., 2020) and Surat city (Jadawala et al., 2017). The possible reason might be that women can do more exercise with their families than ever due to the pandemic COVID-19 giving women more chances to do exercise with their families at home due to lockdown measures. This possible reason was supported by the study done across European countries (Dasgupta et al., 2013). Rural dwellers were nearly two times more adherent to physical exercise compared to urban dwellers. This finding was supported by a study done in Nepal (Parajuli, Saleh, Thapa, & Ali, 2014). The possible reason might be that urban residents can determine their level of physical activity by their fitness status and body indices during COVID-19, which showed a decreased level of activity, but such evidence was not found in rural areas (Zenic et al., 2020). Being unemployed was found to be 1.81 times more adherent to physical exercise than being employed. This finding was supported by the study done in Yemen (Alhariri, Daud, Almaiman, & Saghir, 2017). This might be because unemployed participants have time to perform the recommended physical activity (Adams, 2013; Schutgens, Schuring, Voorham, & Burdorf, 2009). Those having a family history of diabetes were 1.26 times more likely to adhere to the recommended physical exercise compared to those with no family history. This finding is supported by the study done in Eastern Ethiopia (Mohammed, Adem, Tadiwos, Woldekidan, & Degu, 2020). The possible justification might be that those with diabetic relatives share information about diabetic self-care practices (Pamungkas, Chamroonsawasdi, & Vatanasomboon, 2017). Those having no glucometer were found to be 51% less likely to adhere to physical exercise compared to those having a glucometer. This finding was supported by a study conducted in Pakistan (Farhan et al., 2017). The possible justification might be that using a glucometer can aid in monitoring the level of glucose, thereby enhancing regular physical exercise (Muktabhant et al., 2012). Those with good knowledge of COVID-19 were 33% more likely to adhere to the recommended physical exercise. This finding was supported by a study done in Spain (Ruiz-Roso et al., 2020). The possible justification might be that having knowledge of COVID-19 promotes an understanding of the impact and severity of diabetes with COVID-19 comorbidity (Apicella et al., 2020).

5. Conclusion

The magnitude of exercise nonadherence was high compared to most of the previous studies conducted worldwide. Being female, having rural residency, being unemployed, having no glucometer, having a family history of diabetes, and having COVID-19 related knowledge were significantly associated with adherence to exercise recommendations during the era of the COVID-19 pandemic. Healthcare professionals should give attention to the recommendations for exercise adherence during COVID-19. Advising self-glucose monitoring using a glucometer and encouraging home-based exercise can improve adherence to exercise recommendations. Special education is also required for patients who are in rural residency and have poor COVID-19 knowledge to achieve better exercise adherence outcomes.

6. Limitations of the study

Since it was an institutional-based study, the issue of generalizability is the limitation of the study. The participants might also respond only to socially acceptable answers. The cross-sectional nature of the study cannot rule out the cause-effect relationship.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgment

Our deepest gratitude goes to the University of Gondar for all expenses of this research work and the study participants who participated in this research. The authors also would like to give great appreciation to data collectors and supervisors for their contribution to this paper.

Consent to publication

Not applicable.

Authors' contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijans.2022.100407.

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