

Impact of COVID-19 Pandemic on Physical Activity and Sedentary Behaviors among Young Adults of G Dh. Thinadhoo, Maldives

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Abstract

The COVID-19 pandemic and preventive measures such as lockdown and curfew hours forced young adults to restrict their movement leading to physical inactivity. Moreover, during the lockdown period, staying home and avoiding social contact has resulted in a massive increase in their sedentary behaviors. The aim of this study was to identify the prevalence and differences in SB and PA among young adults of G Dh. Thinadhoo before and during the COVID-19 pandemic lockdown measures. Furthermore, it aimed to determine the reasons for physical inactivity among young adults during the period of lockdown on the island. For this quantitative study, a convenience sampling was used due to the limited timeframe of the study. A total of 300 young adults aged 18 to 25 filled the questionnaire online. Two validated questionnaires were used in this study, which are International Physical Activity Questionnaire, short-form IPAQ-SF, and Past-day Adults' Sedentary Time (PAST) Questionnaire. To determine whether SB and PA had any differences in before and during the lockdown period, a paired sample t-test was conducted. The result showed that the pandemic had caused severe increases in SB and a decrease in PA of young adults. The total sitting time averaged 8 hours per day prior to the lockdown and 16 hours per day during the lockdown. The PA compared to before and during the lockdown, a decrease was 40.3% for vigorous PA, 19.3% for moderate PA, and 57% for work for 10 minutes. These findings highlight the importance to doing future studies on larger amount of samples including all the age groups of the population and developing public health strategies and awareness in terms of PA and SB especially while during home confinement.

Keywords

Physical Activity, Sedentary Behaviors, COVID-19, Pandemic, Inactivity

1. Introduction

The World Health Organization (WHO) describes Coronavirus disease (COVID-19) as a contagious infection caused by a recently found coronavirus (WHO, 2021). Its spread has been slowed by strategies such as hand washing, social isolation, and mandated quarantine. However, the pandemic continues to pose significant challenges to societal structure (Zheng et al., 2020). Extensive social distancing regulations are in place around the world, eliciting global calls from governments to keep safe and remain at home and limiting people's everyday activities (Puccinelli et al., 2021). Several recent research shows that staying home has caused an impact on Physical Activity (PA) and increased Sedentary Behavior (SB) among young adults (Czenczek-Lewandowska et al., 2021; Zheng et al., 2020). Sedentary lifestyles are becoming more prevalent around the world as a result of a lack of accessible exercise spaces, increased SB such as office work, and increasing demand for screen-based devices (Park et al., 2020). The most significant measure of preventing the COVID-19 pandemic is social distancing due to which engaging in PA is challenging. As a result, a study of the problems associated with PA and SB is deemed more valuable at this time.

Globally, 28% of those aged 18 and above were physically inactive in the year 2016 (WHO, 2020a). However, that was before the COVID-19 pandemic. Since the pandemic, several studies were conducted to find out the impact of the COVID-19 on SB and PA of individuals. Furthermore, recent studies show significant decreases in PA and increases in SB, particularly among previously physically active and self-isolated or quarantined individuals (Brooks et al., 2020; Czenczek-Lewandowska et al., 2021; Luciano et al., 2021). A cross-sectional study done on 50 states of the USA, shows that after the COVID-19 pandemic, SB such as sitting time and screen time has increased and there was a significant drop in moderate and vigorous PA of adults between 18 - 24 years old (Meyer et al., 2020). One of the major risk factors for non-communicable disease mortality is physical inactivity. Insufficiently active people have a 20% to 30% greater risk of mortality than those who are sufficiently active (WHO, 2020a).

SB and physical inactivity can have a negative impact on an individual's wellness and quality of life. Physical inactivity is responsible for over 3 million deaths worldwide and it has been linked to causing coronary heart disease, diabetes, and cancers (Gichu et al., 2018). SB and physical inactivity are the most important modifiable factors in/of heart disease and all-cause mortality worldwide according to American Heart Association (Lavie et al., 2019). PA appears to be largely influenced by socio-demographic factors (Rahman et al., 2020). According to WHO (2021), adults above 18 should engage in at least 150 minutes of moderate-intensity physical activity per week, or at least 75 minutes of vigorous-intensity physical activity per week. PA regularly benefits both the body and the mind. It can lower blood pressure, aid in weight management, and lower the risk of heart disease, cerebrovascular disease, diabetes mellitus type 2, and several types of cancers (WHO, 2021).

2. Literature Review

The WHO declared the Chinese COVID-19 pandemic a public health emergency of international concern on 30th January 2020, posing a serious risk to nations with susceptible healthcare services (Sohrabi et al., 2020). In March 2020, it was declared a pandemic to highlight the seriousness of the situation and to encourage all nations to increase action in identifying infection and stopping the spread. No medication is been proved to improve the effect on the virus, however, the spread of it in the community is minimized mainly by hand hygiene, maintaining social distancing, and quarantine (Güner et al., 2020). The number of cases is increasing as the disease progresses. Careful preparation and restriction are assisting in controlling the transmission's trajectory. To prevent infection, various measures are taken, such as maintaining hygiene, using facemasks, isolation, quarantine, social distancing, and, in extreme cases, lockdown in hot spot areas or throughout the country (Kaur et al., 2021). During this pandemic, staying at home and away from others is regarded as a safe and important precaution (WHO, 2021). These lockdowns would have an effect on affiliated levels of PA and SB (Stockwell et al., 2021).

WHO (2020a) defines PA as "any bodily movement produced by skeletal muscles that require energy expenditure" while SB is defined as any waking behavior defined by an energy expenditure of 1.5 metabolic equivalents (METs) while in a sitting, reclining, or lying posture (Thivel et al., 2018). The METs is one method for more accurately estimating the intensity of physical activity. One unit of MET corresponds to the amount of energy expenditure while in rest. Therefore, "physical activity may be classified as of light-intensity (<3 METs), moderate-intensity (3 - 6 METs) and vigorous-intensity (>6 METs) physical activity" (Pate et al., 1995 as cited by González et al., 2017: 112). In other words, physical inactivity is a term used to describe people who do not engage in the recommended amount of physical activity on a regular basis. By using an accelerometer measured PA and self-reported measures, an individual's PA can be measured (Colley et al., 2018).

Several research was done to identify the prevalence of physical inactivity among young adults before the COVID-19 pandemic. In the year 2015, the WHO estimates that about 31% of the world's population is physically inactive (Sutin et al., 2016). In the year 2016, 28 % aged 18 and above globally were physically inactive which includes 23% of men and 32% of women (WHO, 2020a). A survey by Gichu et al. (2018) shows 7.2% of adults in Kenya were physically inactive. A study done by Tan in the year 2019, shows 36.3% of Malaysian adults had physical inactivity. A meta-analysis done by Sutin et al. (2016), shows that on average 31.44% of participants were not active. A study done by García-Fernández et al. (2019) on young adults of Spain shows that 17.3% were engaged in doing at least three types of PA. A survey done on Changes in SB among the United States population from 2001 to 2016 adults computer use representing a 29% to 50% increase among adults and from 2007 to 2016, sitting time increased

by 5.5 to 6.4 hours per day (Yang et al., 2019). Another study was done on the population of young adults by shows that 6 hours of sitting per day was reported by 69% of females and 46% of males (Vainshelboim et al., 2019).

Recent studies show that the COVID-19 pandemic has shown a high prevalence of physical inactivity and SB of individuals (Puccinelli et al., 2021; Stockwell et al., 2021; Fearnbach et al., 2021). A study done by Sañudo et al. (2020) to measure before and post COVID-19 home confinement changes showed that the walking time decreased to 92%, and moderate activity time decreased to 78%, vigorous activity time decreased to 53% during the COVID-19 pandemic.. Similarly, an American company that builds wearable tech that tracks an individual's physical activity level previously posted PA data from 30 million users that show a significant reduction ranging from 7% to 38% in average step counts for about all countries throughout the week ending March 2020, when compared to the same period last year (Fitbit, 2020). During the COVID-19 pandemic, physical inactivity is common among the Bangladeshi population, 38% of respondents were insufficiently active. Furthermore, one-fifth of the group revealed increased sedentary behavior (Rahman et al., 2020). A study done by Zheng et al. (2020) shows that during the COVID-19 pandemic, young adults were found to have low PA levels, and increased time spent on SBs, and long sleep duration.

SB prevalence varies according to assessment tools; nevertheless, it is predicted that adults spend 6 to 8 hours per day in sedentary behavior, which includes sitting, TV viewing, screen time, and computer use (Young et al., 2016). A study done by Rahman et al. (2020) shows that during the COVID-19 pandemic, which coincided with lockdown measures, a considerable number of Bangladeshis were physically inactive and identified sedentary behaviors 8 hours per day. A study done by Romero-Blanco et al. (2020) showed that university students spent more time sitting. Another study by Gallè et al. (2020) shows that all sedentary behaviors increased significantly, while all PA components decreased significantly. The highest level among sedentary components was recorded for electronic device activities, while walking was the PA element with the greatest decrease. According to Young et al. (2016) TV viewing, is a common leisure SB, which is a subset of sitting time; thus, time spent watching TV is less than total sedentary time.

There are numerous reasons why adults do not exercise, ranging from a busy schedule to a lack of results. Some adults do not enjoy exercise and keep on quitting, some are unable to afford a gym membership, some are unsure of how to exercise, some have childcare responsibilities and some are too stressed and tired (Waehner, 2019). Due to the COVID-19 pandemic, SB and PA are common, mainly due to quarantine and home isolation rules advised to be followed by the authorities. According to Park et al. (2020), sedentary lifestyles are becoming more common around the world due to a lack of accessible exercise spaces, increased SB such as office work, and increased demand for screen-based devices. Several studies looked at the associations between physical inactivity and other sources. According to a survey by Tan (2019) shows physical inactivity is associated with

age, education level, and income level while a survey by [Gichu et al. \(2018\)](#) shows a strong association between physical inactivity and age, gender, marital status, current behavior towards PA, and working hours.

One-third of the world's population aged 15 and up engage in inadequate physical activity, which has a negative impact on health ([Park et al., 2020](#)). There is epidemiological evidence that physical inactivity tends to cause risk factors that can increase morbidity and mortality. According to [Booth et al. \(2017\)](#), physical inactivity is a major contributor to at least 35 health problems, including the majority of the top ten causes of death in the United States. Increased PA lowers the risk of heart disease, diabetes mellitus, and stroke, as well as improves psychological health. Even without any other risk factors, not getting enough physical activity can lead to heart disease. It could also increase the risk of developing other cardiovascular disease risk factors such as obesity, hypertension, hyperlipidemia, and type 2 diabetes. According to the Center for Chronic Disease Prevention (CDC), PA promotes normal growth and development, lowers the risk of several chronic diseases, and improves day-to-day functioning and sleep quality. Even relatively short bursts of PA can benefit one's health and well-being ([CDC, 2019](#)).

People are becoming more mentally and physically susceptible during this period of social distancing, which impacts individuals their ability to combat fight COVID-19 infection ([Puccinelli et al., 2021](#)). According to [Spraul \(2020\)](#), PA improves the function of the immune system, which will lead to fewer common illnesses as well as a lower risk of more serious illnesses. Previously active individuals are becoming inactive as a result of the COVID-19 pandemic and quarantine rules. According to [Narici et al. \(2020\)](#), muscle wasting occurs quickly and can be detected within two days of inactivity. This loss of muscle mass is connected with fiber denervation, neuromuscular junction injury, and an increase in the breakdown of proteins, and it is primarily explained by a reduction in muscle protein synthesis. Furthermore, [Newtonraj et al. \(2017\)](#) state that, inactivity also has an impact on glucose homeostasis because even a few days of reduced activity reduces insulin sensitivity, particularly in muscle.

SB is not equated with a lack of physical activity. Even if an individual gets enough exercise, sitting for more than 7 to 10 hours a day is bad for their health. SB is associated with cardiovascular morbidity and mortality in adults, as per epidemiological evidence, and some countries have issued broad guidelines recommending sedentary behavior reduction ([Young et al., 2016](#)). Confinement-induced reductions in PA levels and increases in SB may result in a rapid worsening of cardiovascular health and mortality in high-risk populations. Even brief periods of inactivity (1 - 4 weeks) have been associated with deterioration in cardiovascular function, as well as an increase in heart disease risk ([Peçanha et al., 2020](#)). Increased SB results not only in risk for heart diseases but lead to other conditions as well. Several studies have shown that SBs were linked to an increased risk of developing type 2 diabetes mellitus ([Davies et al., 2018](#); [Mira-](#)

vet-Jiménez et al., 2020). A study by Vainshelboim et al. (2019) shows that female students who sat for 7.5 hours per day had a roughly 10-fold increased risk of becoming obese.

The COVID-19 pandemic has created plenty of challenges for people's health and well-being. According to Petersen et al. (2021), understanding ways to support positive adaptation processes during the changing public health restrictions is vital. Lockdowns and mobility restrictions have hampered the ability to engage in physical activity as a natural part of daily life. Active transportation, such as walking and cycling, as well as opportunities for sport and exercise, have been temporarily restricted or eliminated in most countries. Fitness institutes have been shut down for many months, and physical distance frequently limits opportunities for PA (WHO, 2020b). Kaur et al. (2020) also stated that the applied lockdown, which ended up in the closure of economic activities, public areas, fitness and activity facilities, and general social life, has hindered so several aspects of people's lives, including regularly scheduled fitness activities of fitness freaks, resulting in a variety of psychological issues as well as serious fitness and health concerns. Furthermore, this research showed that Individuals began to consider their normal routines and attempted to find ways to replace their daily activities.

Replacing sedentary time with PA of any intensity promotes health benefits, and all adults should target to do more than the required guidelines of moderate-to vigorous-intensity PA to significantly minimize the harmful effects of increased levels of SB on health (WHO, 2020b). According to Chastin and Diaz (2021) 30 minutes of daily exercise reduced the chance of an early death by up to 80% for the individuals who also spent fewer than seven hours a day sitting. Hence, it is important to implement public health strategies to promote PA and guide on decreasing SB during a lockdown (Stockwell et al., 2021). According to Gallè et al. (2020) promoting healthier lifestyles during the non-pandemic period may have had a positive effect in the event of a lockdown. Reducing SB among young adults could be a public health measure for health promotion and prevention of chronic disease (Vainshelboim et al., 2019).

Several activities can be performed during the pandemic. For instance, small amounts of PA add up to the weekly guidelines. Ways to stay active at home include dancing, playing with children, and doing housework such as cleanup and gardening. Also, to participate in an online exercise class and taking the advantage of the numerous online exercise classes available. Walking in the place can help to stay active even in small spaces. Even if going for a walk or exercise outside, keep at least a 1-meter distance from other people (WHO, 2020b). A study done by Kaur et al. (2020), showed that regular fitness workouts at home during the lockdown greatly aided in overcoming psychological issues and fitness concerns. To increase PA, some equipment free aerobics such as free fitness apps can be installed to phone or yoga class video can be watched and perform a variety of exercises can be performed at home. To decrease SB, can take breaks while sitting for long hours. Stockwell et al. (2021) recommends implementing public health

strategies to promote PA and guide on decreasing SB during a lockdown.

Daily exercise is critical for reversing the effects of inactivity; low to medium-intensity, high-volume resistive exercise appears to be ideal for preventing neuromuscular degeneration, increasing protein synthesis, and combating muscle atrophy (Narici et al., 2020). Adults need a variety of activities to stay healthy, according to the Physical Activity Guidelines for Americans, which include at least 150 minutes per week of moderate-intensity aerobic activity or two days per week of muscle-strengthening activity (ODPHP, 2020). However, WHO (2020) recommends 18 and above adults engage in at least 150 - 300 minutes of moderate-intensity aerobic exercise or at least 75 - 150 minutes of vigorous-intensity aerobic exercise or a weekly approximately equal combination of moderate and vigorous-intensity exercise. Moreover, WHO suggests that individuals should reduce sedentary time. Even if total daily sedentary time cannot be reduced due to unavoidable causes, it is suggested to participate in adequate activity equivalent per week, as research has shown that physical exercise can reduce the negative impacts of a sedentary lifestyle (Park et al., 2020).

To conclude, the COVID-19 spread in the community is being controlled primarily through measures including hand hygiene, using facemasks, maintaining social distance, isolation, and quarantine. However, due to some of these measures and due to the pandemic, most countries' opportunities for sport and exercise have been temporarily restricted, limiting people's ability to engage in physical activity and increasing sedentary time. Inadequate PA and increased SB are linked to morbidity and mortality in adults, as well as a variety of health issues. Therefore, it is essential to implement public health strategies to promote PA and provide guidance on how to reduce SB. As research has shown that physical exercise can mitigate the negative effects of a sedentary lifestyle, it is recommended to engage in an adequate amount of activity equivalent per week.

3. Methodology

Increased sedentary behaviors and decreased physical activities among young adults due to the COVID-19 pandemic lockdown measures are very serious issues that have a negative impact on their health (WHO, 2020b). The purpose of this study is to examine sedentary behaviors and physical activity among young adults (age 18 - 25) in G Dh. Thinadhoo. The study was specifically designed to find out the prevalence of SB and PA, to find out the causes of physical inactivity among young adults of G Dh. Thinadhoo during the COVID-19 pandemic. Furthermore, differences between SB and PA before and during the COVID-19 pandemic lockdown measures were identified as well. This chapter will address the research design, sampling, data collection, instrumentation, and data analysis of this study.

3.1. Research Design

This study is designed quantitatively, aimed to determine the prevalence and dif-

ferences between PA and SB before and during the COVID-19 pandemic lockdown, and causes of physical inactivity during the lockdown period. The quantitative method to scientific inquiry originated from logical positivism, a branch of philosophy that operates on rigid rules of logic, reality, laws, assumptions, and predictions, while the philosophical leanings of qualitative studies use interpretivism, intending to assist those involved in understanding the meaning of their social interactions of phenomenon (Gray et al., 2016). The goal of this study focuses on finding numerical values, which is why the positivist approach was used in this study. For instance, it looks for respondent's number of hours sitting, number of days doing physical activity, how much time spend on doing activities, etc. According to (Bhandari, 2020) quantitative research is a method for the collection and analysis of numerical data which can be used to identify variations and averages, predict results and test causal relationships. Therefore, this is the best-suited method for answering the research questions and achieving the study's objectives.

Non-experimental designs do not have random assignment, variable manipulation, or comparative group, and also can be descriptive (Rutberg & Bouikidis, 2018). Descriptive design is chosen for this study as it does not include any random task, variable manipulation, or comparative groups. According to (Gray et al., 2016) descriptive research is conducted when collective knowledge about a concept is incomplete; either no study has been undertaken or research knowledge is limited. There are several research done on this area, however, this is the first study done among young adults of G Dh. Thinadhoo, Maldives from the best of the researcher's knowledge. The study began after two weeks of lockdown rules were applied at the study place; G Dh. Thinadhoo, Maldives.

Cross-sectional designs are used for population-based studies and for determining the prevalence in clinic-based studies. These studies are typically comparatively quicker and cheaper, and the participants are selected based on the inclusion and exclusion requirements laid down for the research (Setia, 2016). When used in research that is proposed to be analytical, researchers with deep experience in this specific area of knowledge must interpret the results, using a considerable amount of discretion and good judgment (Zangirolami-Raimundo et al., 2018). Since it is more feasible, consumes less time, and identifies prevalence, thereby; this design was used to measure and achieve the objectives of this study.

3.2. Sampling

The study sample includes 300 young adults (study sample detail is provided in **Table 1**) across G Dh. Thinadhoo, Maldives the minimum recommended sample size of 262 was determined using an online tool; the Raosoft sample size calculator. To obtain data from the participant, one of the non-probability sampling methods known as convenience sampling was used as a technique. This method was used to get data conveniently from a larger population. The focus

Table 1. Study sample detail.

Description		No.	%
Gender	Male	81	27
	Female	219	72
Age range	18-20	90	30
	21-23	120	40
	24-45	90	30
Marital status	Married	162	54
	Unmarried	138	46

group was easily accessible from different social media platforms. The inclusion criteria included young adults' age between 18 to 25, who were citizens of G Dh. Thinadhoo, and currently residing in G Dh. Thinadhoo. The exclusion criteria included young adults age between 18 to 25, who were not citizens of G Dh. Thinadhoo. One of the main reasons this method was chosen was to collect data quickly since the timeframe of the study was very limited and also it was low in cost. If an another method was chosen, such as random sampling, obtaining a list of names would have been extremely difficult due to COVID-19 pandemic lockdown measures, which was causing respective institutes of G Dh. Thinadhoo to reduce office hours and work from home. Even if the name list was available, there would have been issues such as unavailability of individuals chosen as random samples due to them not currently living in G Dh. Thinadhoo and unavailability to get contact information. Therefore, convenience sampling was the easiest, and most suitable method of sampling for this research.

3.3. Instrumentation

The survey questions were connected with SB and PA before and during the COVID-19 period. Before the COVID-19 period was considered as the time before G Dh. Thinadhoo was under monitoring, and during the COVID-19 period was considered as the time after one week the island was placed under lockdown. The questionnaire was divided into four sections. The first section from which items 1 to 5 include the demographic information. Items 6 to 14 were in Section 2 which was regarding SB and Past-day Adults' Sedentary Time (PAST) questionnaire was used to measure SB. One item (item 9 which was regarding sitting for transport) from the PAST questionnaire was omitted because it was not relevant when the whole island was under mandatory lockdown and home confinement was followed 24/7. In Section 3, items 15 to 21 were regarding PA which was measured using International Physical Activity Questionnaire short form (IPAQ-SF). One question from IPAQ-SF was omitted (item 21 which measures sitting time) because for measuring sitting time PAST questionnaire was used. In Section 4, items 22 to 27 were modified questions added to measure PA and SB before the COVID-19 pandemic and to find out the causes of physical

inactivity of young adults in G Dh. Thinadhoo, during the pandemic. The tool was designed in such a way that it received all of the answers to the research questions of this study.

3.4. Data Collection

A self-administered questionnaire was used to collect data quickly from the target population in this study. The questionnaire with 4 Sections (Section 1: demographic information, Section 2; PAST questionnaire, Section 3; IPAQ-SF questionnaire, Section 4; added questions to measure PA and SB before the COVID-19 pandemic and to find out the causes of physical inactivity) were created in a Google form and was sent to the participants via online platforms. The research was conducted from July 11th to August 2nd, 2021, at the time when G Dh. Thinadhoo had a community spread of COVID-19. In such circumstances the use of online surveys would be the most convenient method for conducting the research. According to Geldsetzer et al. (2020), online surveys are a promising way to assess knowledge and perceptions during fast-expanding disease outbreaks such as COVID-19. This is why the data collection was done using online Google form, for avoiding any physical contact with participants. Moreover, it was low in cost, flexible and respondent's answers were stored automatically making it much easier to analyze the data.

To check reliability, a pilot study of pre-testing was conducted among the 33 selected participants. According to the results, the necessary changes were made to the questionnaire after analysis of the pre-test questionnaire. Furthermore, to ensure validity, the existing results of previous research were precisely evaluated and validated questionnaires were used. Both the IPAQ-SF questionnaire and PAST questionnaire are validated questionnaires (Sanda et al., 2017; Freene et al., 2020). Moreover, the IPAQ-SF questionnaire was used in recent studies to measure the PA of the adults (Rahman et al., 2020).

3.5. Data Management and Data Analysis

Data from Google form was collected and compiled into the software IBM SPSS (statistical package for the social science) statistics, version 22, from which it was analyzed. The pilot study or pre-test questionnaire was also analyzed using the software SPSS. However, those 33 samples used for the pilot study were omitted from the actual study. Descriptive and inferential statistics were used to find the answers to the research questions. Descriptive statistics were performed to give a full picture of the data and it was organized in histograms, and table formats. The interpretations of these tables, histograms and pie charts were explained in detail. The central tendency was used to find the center of the dataset and the measures used for it were mean. This method was used as it is intended to provide an accurate summary of all the details. Standard deviation was used to understand the variability of the data sets and to get an accurate picture of the distribution of measurement. Using paired sample t-tests, the change in partici-

pants and PA, SB, was determined and was used as means \pm SD.

Physical activity was determined by using how much time participants were physically active in 7 days of the week, using the International Physical Activity Questionnaire. Physical inactivity was also determined using the same instrument. SB was measured using the Past-day Adults' Sedentary Time (PAST) Questionnaire.

4. Results

A total of 300 participants aged 18 to 25 who met the eligibility criteria were included in the study. The demographic characteristics of the participants are shown in **Table 2**. The study group includes 81 males (27%) and 219 females (73%). The mean value of the participant was 22. Specifically, 30% of them between age 18 - 20, 40% aged between 21 - 23, and 30% between ages 24 - 45. Of that 162 were married (54%), and 138 were unmarried (46%). There were 135 participants (44%) who were employed (27 males and 108 females) while 165 participants were unemployed (54 males and 111 females).

Sedentary behavior

Table 3 shows sedentary behaviors during the COVID-19 lockdown period. If the sitting time is ≥ 6 h/day, it is considered as a sedentary behavior (Vainshelboim et al., 2019). The mean overall SB was 10.64 hours/day, concluding that young adults of G Dh Thinadhoo had spent too much time on sedentary behaviours. How much time the young adults had spent on those activities was also being found. The prevalence of sitting or lying to work from home more than 2 hours per day was 79%, the prevalence of sitting or lying down to watch TV (≥ 2 h/d)

Table 2. Demographic characteristics of 300 participants who filled the questionnaire.

Demographic characteristics	Sample (%)
Gender (n = 300)	
Male	27
Female	73
Age (years) (n = 300)	
18 - 20	30
21 - 23	40
24 - 45	30
Marital status (n = 300)	
Married	54
Unmarried	46
Employment (n = 300)	
Employed	44
Unemployed	55

Table 3. Sedentary behaviors (n = 300).

Behaviors	Mean	SD	≥2 h/d
Sitting or lying down to work from home	3.00	2.09	79%
Sitting or lying down to watch TV	4.00	2.39	79.3%
Sitting or lying down to use a computer for leisure	2.00	1.56	68.3%
Sitting or lying down to read for leisure	3.00	1.61	72.6%
Sitting or lying down for hobbies	2.00	1.20	50.7%
Sitting or lying down for other activities	3.00	1.18	75.7%
Overall sedentary behavior	10.64	4.30	

Table 4. PA levels in mean hours/week.

Physical activities	Mean	SD	Activity level
Walking to Exercise	0.18	0.19	low
Moderate Physical Activity	0.11	0.26	low
Vigorous Physical Activity	0.09	0.21	low

was 79.3%, the prevalence of sitting or lying down to use a computer for leisure (≥2 h/d) was 68.3%, the prevalence of sitting or lying down to read for leisure (≥2 h/d) was 72.6%, the prevalence of sitting or lying down for hobbies was 50.7% and the prevalence of sitting or lying down for other activities such as socializing with friends, time on the telephone or eating meals was 75.7%.

Physical Activity

This study showed that there was a very low level of PA among young adults during the period of COVID-19 lockdown in G Dh Thinadhoo. **Table 4** is the PA levels of study participants during a week before the study was conducted. PA levels were classified according to **WHO (2020a)** recommendations in which an adult need 150 - 300 minutes (2.5 to 5 hours) of moderate-intensity aerobic exercise or at least 75 - 150 (1.25 to 2.5 hours) minutes of vigorous-intensity aerobic exercise or a weekly approximate equal combination of moderate and vigorous-intensity exercise. The mean of walking to exercise was 1.18 hours, the mean of moderate PA was 0.11 hours and the mean of vigorous PA was 0.09 hours which indicates that the activity level of young adults were low.

Physical inactivity during the lockdown

Physical inactivity was also evidently identified from the results. During the lockdown period, 79.3% of the participant did not engage with vigorous PA on any weekday, while 79% did not do any moderate PA and 45% did not walk for 10 minutes. Several reasons were identified as for the young adults not being able to participate in physical activities and **Figure 1** shows the identified reasons and frequency percentage. The reasons of participants include they have a busy schedule (27.3%), lack of accessible exercise spaces at home for exercise (34%), do not enjoy exercise (30.3%), have no interest to do exercise (28.7%), can't afford equip-

ment such as treadmill for exercising (9.3%) don't know how to do exercise (3.3%), and a few participants had no reasons for being unable to participate in physical activities (1.33%).

PA routine before the COVID-19 pandemic, was also revealed. **Figure 2** shows the routine PA of the participants. 63 participants (21%) did not do PA at all, while 155 participants (52%) did PA but not regularly, and 82 participants (27%) did PA regularly before the lockdown.

Figure 3 shows the effects of the lockdown on PA and SB based on the amount of agreement reached by the participants. The majority of the study participants (254) 84.7% agreed that COVID-19 preventive measures such as lockdown, quarantine, curfew and home isolation make it difficult to do PA while 46 participants (15.3%), did not believe it affects their PA. On the other hand, the majority of the participants 282 (94%) agreed that the COVID-19 preventive measures increases their SB, while 18 participants (6%) disagreed that it increases their SB.

SB and PA before and during COVID-19 pandemic.

Table 5 shows the difference in PA and SB for two time periods; before and

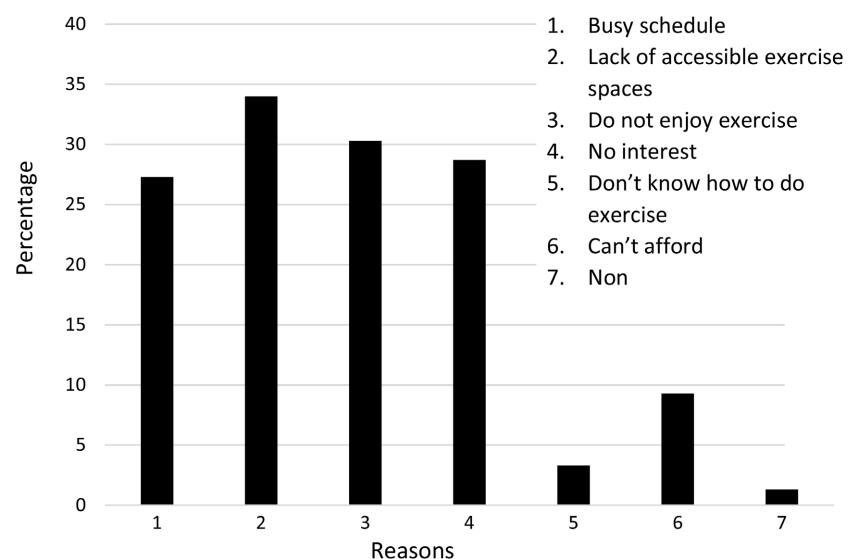


Figure 1. Reasons for not being able to participate in physical activities.

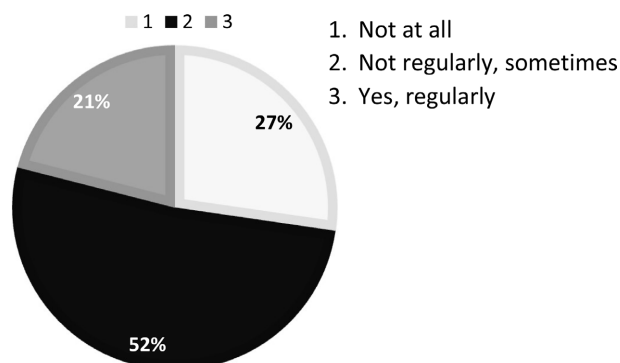


Figure 2. PA routine before the lockdown.

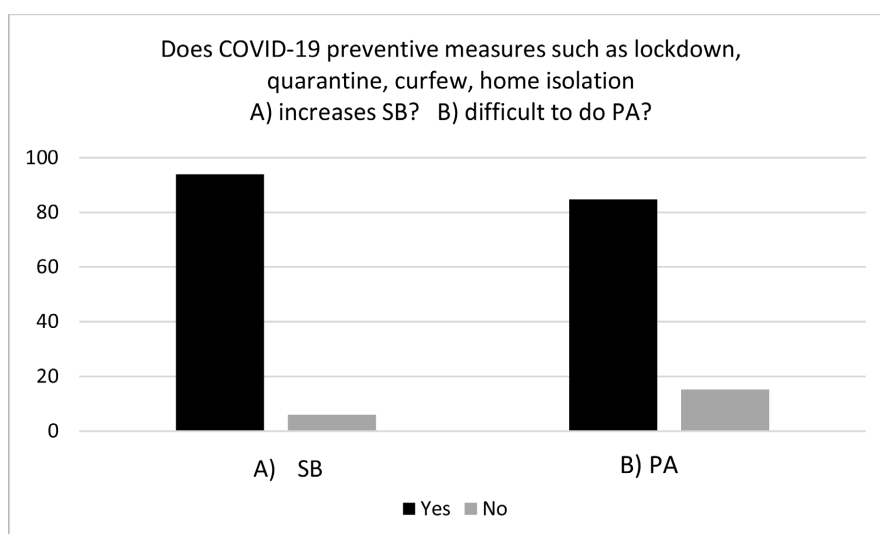


Figure 3. Effect of lockdown on PA and SB.

Table 5. Paired samples test.

Behaviors	Mean	Std. Deviation	Std. Error Mean	95% CI of the difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Vigorous PA Before—During	1.833	2.498	.144	1.550	2.117	12.712	299	.000
Moderate PA Before—During	1.723	2.033	.117	1.492	2.691	14.681	299	.000
Walk Before—During	1.580	3.271	.189	1.208	1.952	8.366	299	.000
SB During—Before	8.312	5.115	.295	7.730	8.893	28.143	299	.000

during the lockdown in G Dh Thinadhoo. According to Minitab (2019), if the p-value is less than or equal to the level of significance, the null hypothesis is rejected. Therefore, it is concluded that there is a significant difference between vigorous PA before and during the lockdown period ($t_{299} = 12.712$, $p < 0.000$). On average, before the lockdown vigorous PA was 1.833 points higher than during the lockdown (95% CI [1.550, 2.117]). Similar results were found on moderate PA and walk for 10 minutes. There is a significant difference between moderate PA before and during the lockdown period ($t_{299} = 14.681$, $p < 0.000$). On average, before the lockdown moderate, PA was 1.723 points higher than during the lockdown (95% CI [1.492, 2.691]). There is a significant difference between walk for 10 minutes before and during the lockdown period ($t_{299} = 8.366$, $p < 0.000$). On average, before the lockdown walk for 10 minutes was 1.580 points higher than during the lockdown (95% CI [1.208, 1.952]).

The SB before and during the COVID-19 pandemic lockdown period were positively correlated ($r = 0.142$, $p = 0.001$). There was a significant difference between SB before and during the COVID-19 pandemic lockdown period ($t_{299} = 28.143$, $p < 0.001$). The mean of SB before the lockdown was 8 hours/per day and during the lockdown, it was 16 hours/day. Therefore, this study observed a total of 8 hours (50%) increase in SB of young adults in G Dh Thinadhoo as a result of

the lockdown. During the lockdown, SB was 8.312 higher than before lockdown (95% CI [7.730, 8.893]). To verify the assumption of normality, the Shapiro-Wilk normality test was done and the null hypothesis which states that there will be no statistically significant difference between SB, PA during and before the lockdown was rejected. A few legitimate outliers were identified and it was not removed nor changed because it did not skew the data set.

On the other hand, the results show a decrease in PA drastically during the lockdown. Before the lockdown, the participants were doing vigorous PA 61% (mean: 2.25 days, 95% CI [1.98, 2.52], SD: 2.33) on the weekdays. However, during the lockdown it was 20.7% (mean: 0.41 days, 95% CI [0.31, 0.52], SD: 0.941). This means there was a 40.3% decrease in vigorous PA due to the lockdown. Before lockdown moderate PA was 40% (mean: 2.28 days, 95% CI [2.01, 2.55], SD: 2.37), during the lockdown it was 20.7% (mean: 0.56 days, 95% CI [0.56, 0.42], SD: 1.21). This means there was 19.3% decrease in moderate PA. At last, before lockdown, walk for 10 minutes was 77.7% (mean: 3.79 days, 95% CI [3.49, 4.09], SD: 2.64) and during lockdown it was 20.7% (mean: 2.27 days, 95% CI [1.91, 2.50], SD: 2.57). This means there was a 57% decrease in walk for 10 minutes.

The research hypothesis was “due to the COVID-19 pandemic lockdown measures, SB of the young adults will increase and PA will decrease compare to the period of before lockdown”. The paired sample t test confirmed that there was a significant increase in SB and decrease in PA during the lockdown period when compared to before lockdown. **Figure 4** shows changes in (A) SB and (B) PA of young adults of G Dh Thinadhoo during and before lockdown.

To sum up, the result showed that there was a significant difference between SB before and during the COVID-19 pandemic lockdown period. The pandemic had caused severe increases in SB and a decrease in PA in young adults. A total of 8 hours (50%) increase in SB as a result of the lockdown. The PA compared to before and during the lockdown, decreased by 40.3% for vigorous PA, 19.3% for

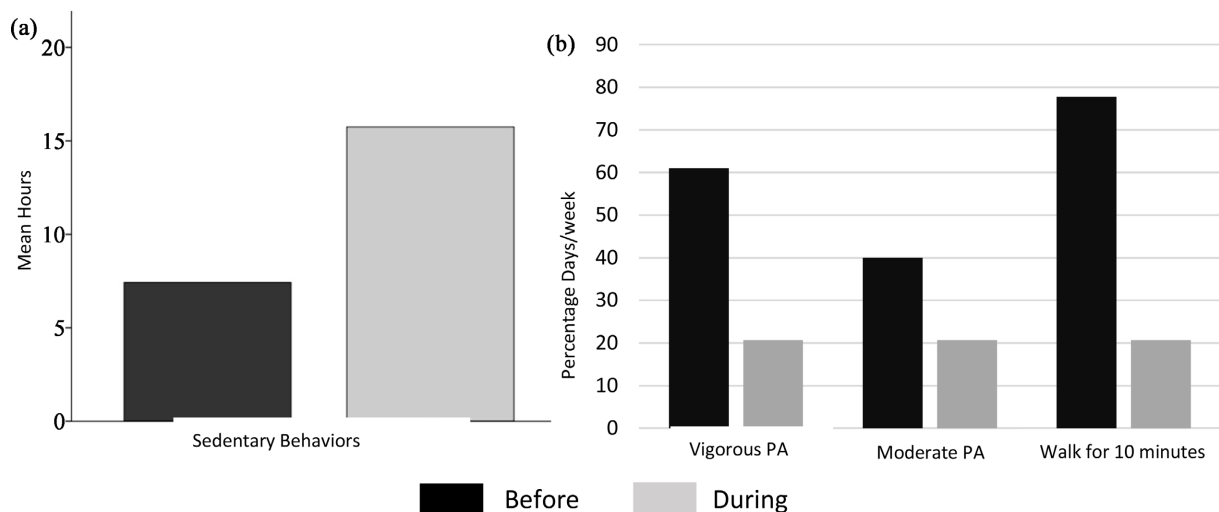


Figure 4. Changes in SB and PA compared with before lockdown.

moderate PA, and 57% for work for 10 minutes. The majority of the study participants (84.7%) agreed that COVID-19 preventive measures such as lockdown, quarantine, curfew, and home isolation make it difficult to do PA, and also majority (94%) agreed it increases their SB. Some of the reasons identified for the young adults not being able to participate in PA include they have a busy schedule, a lack of accessible exercise spaces at home for exercise, do not enjoy exercise, and have no interest in doing exercise.

5. Discussion

During the COVID-19 pandemic, it is important to be physically active and reduce sedentary time as it enhances immunity. However, the problem is due to the specific preventive measures of COVID-19 pandemic such as lockdown, home quarantine, or isolation rules followed in the island G Dh. Thinadhoo; the Maldives, young adults are becoming physically inactive and their SB has increased, raising the risk for a variety of health conditions. The results indicate a significantly increased SB and a decreased PA among young adults. Of note, the result suggests that the increase in SB and decrease in PA among young adults was attributable due to rules followed by the island; G Dh Thinadhoo as a preventive measure for COVID-19.

5.1. Sedentary Behaviors

This study showed a high prevalence of sitting and lying time hours/day for young adults in G Dh Thinadhoo. SB is not synonymous with a lack of PA. Even with enough exercise, sitting for more than 7 to 10 hours a day is bad for the health (WHO, 2020a). This study showed a prevalence of sitting and lying more than 2 hours per day for; work was 79%, use of computer for leisure was 68.3%, read for leisure was 72.6, hobbies were 50.7% and for other activities were 75.7%. According to previous research, SB prevalence varies according to assessment tools while the result predicted that adults spend 6 to 8 hours per day in sedentary behavior, which includes sitting, TV viewing, screen time, and computer use (Young et al., 2016). However, this amount was predicted before the COVID-19 pandemic, and it should now be expected to be higher as a result of several changes in people's lives that resulted in staying at home as a preventive measure for the spread of the disease, which lead to increase in sitting time.

The results of this research are in line with the hypothesis that state due to the COVID-19 pandemic lockdown measures such as lockdown, home isolation, and quarantine, SB of the young adults will increase. This study observed total sitting time averaged 8 hours per day prior to the lockdown and 16 hours per day during the lockdown. There was a total of 8 hours/day increase, due to the lockdown. This was a surprisingly massive increase, making it much higher than the expected result. Correspondingly, 94% of study participants agreed that COVID-19 prevention measures such as lockdown, quarantine, curfew, and home isolation increased their SB. A research that was done before the pandemic showed

from the year 2001-2016 an increase of 5.5 hours/day in adults. This amount was increased much higher in several other studies done during the pandemic, most of them show time spent on SB more than 8 hours/day (Rahman et al., 2020; Czenczek-Lewandowska et al., 2021). In addition, a systematic review done by Stockwell et al. (2021) found that increased SB in 26 studies and was reported as a result of COVID-19 lockdown across the reviewed population. This concludes that the pandemic had increased SB massively despite the fact that government authorities are recommending to stay active while such measures are implicated.

5.2. Physical Activity

This study shows that, before lockdown, 21% was not at all doing PA, 52% did PA sometimes but not regular and only 27% was doing PA regularly. Also, this study observed a high prevalence of physical inactivity during the lockdown. Specifically, 79.3% did not do vigorous PA any day of the week, 79% did not do moderate PA any day of the week and 45% did not even walk for 10 minutes on any day of the week. This means, except those who were not at all doing PA (21%), the rest (79%) had a gradual decline in the PA which might lead to serious health issues in the future. On the other hand, the results showed a significant decrease in PA during the lockdown when compared to before lockdown. The decrease was 40.3% for vigorous PA, 19.3% for moderate PA, and 57% for walking for 10 minutes. These results were also expected, as at the time, this study was done, staying home was implemented which can result in a decrease in PA. Moreover, these findings were comparable to a recent study that found a low level of PA during the COVID-19 pandemic, with 37.9% of participants being physically inactive, 38.3% being moderately active, and 23.9% being very active (Rahman et al., 2020).

Some of the reasons why the study participants were unable to do physical activities were as expected. For an instance, a 24-hour lockdown forces everyone to stay at home, and not everyone has space at home to exercise, and some may not be able to afford indoor exercise equipment. According to this study, 27.3% had a busy schedule, 34% had no space at home, 30.3% do not enjoy exercise, 28.7% had no interest to do exercise, 3.3% don't know how to do exercise, 9.3% can't afford exercising equipment and 1.33% had no reasons for being unable to participate in physical activities. Many of these participants had more than one reason and it was a very obvious finding. Someone might not have space at home, and at the same time might not have an interest do exercise. Every individual will have their reasons for not being able to do physical activities. However, it is important to educate them about the benefits of PA.

5.3. Limitations

This study was done at the time of the community spread of COVID-19 in G Dh Thinadhoo while the island was on monitoring and a mandatory lockdown was

announced by the Health Protection Agency of the Maldives. One of the limitations is the inability to conduct objective research that necessitates direct contact with the participants. The online method of data collection was used for avoiding physical contact with the participants. However, very commonly used validated questionnaires were used in this study. Another limitation was the sampling method; convenience sampling. It was used to get a response from a larger population in a minimal timeframe.

5.4. Recommendations

The researcher urges the Maldives governmental organizations such as the Health Protection Agency, Regional, Atoll Hospitals, and other health care facilities to promote more awareness about the importance of PA and to reduce SB. It is recommended to implement public health strategies to promote PA and guide on decreasing SB during a lockdown (Stockwell et al., 2021). According to WHO (2021), adults above 18 should engage in at least 150 minutes of moderate-intensity physical activity per week, or at least 75 minutes of vigorous-intensity physical activity per week. To increase PA during a lockdown, variety of activities can be performed at home. For instance, preferred exercises can be done according to convenience of the individual. Furthermore, workout videos can be watched and fitness application can be installed on the phone to encourage to develop healthy habits and to track exercise. Even with adequate PA, sitting for long period of time can increase risk for chronic disease. Therefore, it is suggested take break when sitting for extended periods of time. 2020 WHO guidelines on PA and SB of adults suggest to limit the time spend being sedentary and replace SB with PA of any intensity (Okely et al., 2021).

5.5. Conclusion

This study was done during the COVID-19 pandemic when the island was under monitoring and measures such as curfew and 24 hours lockdown was implemented at the time of the study. As a result, the findings of this study focused primarily on the effects of the lockdown, although the physical activity and sedentary behavior prior to the lockdown were measured using the recall method. During the pandemic, the SB of the young adults was twice higher than before the lockdown and reduced their physical activity levels. Reducing sedentary time and staying physically active are important for health. To the best of the researchers' knowledge, this is the first study to look at PA levels and time spent in SB during the COVID-19 pandemic and following the COVID-19 outbreak in G Dh Thinadhoo. Since this study focuses on only the young adults' aged 18 to 25, further studies are needed to establish the impact of COVID-19 on SB and PA of other age groups. Also, post effects of sudden increased SB and reduced PA can be studied. In addition, mental health and eating habits in the G Dh Thinadhoo population during a pandemic is also an important area of study, during a pandemic.

5.6. Ethical Consideration

Ethical approval was taken from the Villa College ethics committee (ref no: VC/CPS/2021/E-093). Also, approval from the secretariat of the Thinadhoo council was obtained. Participation in this study was anonymous and voluntary. Confidentiality was maintained. All required information about the study was provided and afterward, consent was taken by clicking 'yes' in the form provided.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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