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## Original Article

## Increased physical inactivity and weight gain during the COVID-19 pandemic in Sri Lanka: An online cross-sectional survey

Piumika Sooriyaarachchi <sup>a, b</sup>, Tormalli V Francis <sup>b</sup>, Neil King <sup>a</sup>, Ranil Jayawardena <sup>a, c, \*</sup><sup>a</sup> Queensland University of Technology, School of Exercise & Nutrition Sciences, Brisbane, Queensland, Australia<sup>b</sup> Health and Wellness Unit, Faculty of Medicine, University of Colombo, Colombo, Sri Lanka<sup>c</sup> Department of Physiology, Faculty of Medicine, University of Colombo, Colombo, Sri Lanka

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## ABSTRACT

**Aims:** This study aimed to investigate the immediate impact of COVID-19 quarantine measures on physical inactivity and weight gain among Sri Lankans.

**Methods:** An online cross-sectional survey was conducted from the 27th of May to 2<sup>nd</sup> of June 2021 using Google forms. The questionnaire including socio-demographics and physical activity related questions was distributed through social media platforms.

**Results:** A total of 3707 respondents were included in the analysis (59.6% females). The majority were employed, resided in Colombo district and, as a minimum, had a degree. More than half of the respondents (52.4%) reported decreased exercise levels, 63.5% increased sitting time and 82.7% increased screen time. Adults of 31–35 (OR 1.96; 95% CI, 1.321–2.894,  $p < 0.001$ ) and 36–40 (OR 1.67; 95% CI, 1.099–2.524,  $p < 0.016$ ) had increased sitting times compared to other age groups. A weight gain was reported by 38.5% with a mean (SD) increase of 3.61 ( $\pm 2.35$ ) kg. There was a significant difference in weight gain between genders ( $p < 0.001$ ) and ethnic groups ( $p < 0.001$ ).

**Conclusions:** An overall increase in physical inactivity such as reduced exercises, increased sitting time and screen time were observed. Furthermore, a considerable proportion of the population has increased body weight.

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## Introduction

The Corona virus disease 2019 (COVID-19) is an unprecedented public health crisis, with ominous health and socioeconomic challenges. The pandemic has resulted in more than 170 million cases and 3.5 million deaths as of May 2021 [1]. The condition has sent billions of people into lockdown due to unprecedented spread of the virus. Therefore, physical distancing, including orders to stay at home, travel restrictions, curfews, closing nonessential businesses and mandatory quarantines for residence and interstate travellers have been implemented by country leaders and state governors [2]. These lockdown measures have forced many people to stay home and to limit their physical activities [3], and an increase in use of screen devices [4]. In addition, majority of the schools, colleges, and universities use online mode to deliver

teaching, causing young adults to become inactive [5]. This sedentary behaviour is associated with higher incidence of overweight, obesity and related health-risks as well as several non-communicable diseases [6].

Physical inactivity contributes to positive energy balance and subsequent fat deposition and weight gains [7]. During confinement period, the time spent on exercise or other physical activities has been restricted due to several reasons. Closed gyms and sports centres, walking distance limited, lack of space and infrastructure in houses for physical exercise, and lack of technical knowledge of the population on appropriate training routines are some of the reasons [3]. A survey conducted in Italy reported a significant decrease in physical activity before and during COVID-19 pandemic across all age groups and especially in men [8]. In a study among UK adults which investigated the association of screen time and mental health during COVID-19, reported the mean (SD) number of hours of screen time per day as 7.2 ( $\pm 3.8$ ) in the overall population. This was even higher in younger adults during the pandemic [9] and people's mental well-being has also been adversely affected due to the current pandemic [10].

\* Corresponding author. Department of Physiology, Faculty of Medicine, University of Colombo, Sri Lanka.

E-mail address: [ranil@physiol.cmb.ac.lk](mailto:ranil@physiol.cmb.ac.lk) (R. Jayawardena).

Sri Lanka reached its peak of COVID-19 in May 2021 and the government has taken strict measures to mitigate the pandemic [11]. During the third wave of the pandemic, from 21<sup>st</sup> May 2021, the country went into extremely stringent lockdown for weeks with a strict ban on inter-district travel and prohibition of social gatherings. Unlike other countries, citizens could drive to the shop or go for a walk in the park whereas the Sri Lankan authorities completely restricted people's movements [12].

Regular physical activity is a key public health behaviour as it has a remarkable impact on both mental and physical well-being [13]. Even before the pandemic, Over 50% of Sri Lankan adults were either inactive or had low levels of physical activity [14]. Moreover, because of the unique body composition with a higher body fat percentage at a lower body mass index (BMI) [15], Sri Lanka has a high prevalence of obesity and obesity-related non-communicable diseases (NCDs) [16]. As a result, diseases such as insulin resistance, metabolic syndrome, type 2 diabetes mellitus (T2DM), and coronary heart disease are escalating among Sri Lankan adults [17]. Therefore, the current COVID-19 pandemic may further worsen this situation.

Furthermore, obesity is a known risk factor and COVID-19 weight gain during the pandemic might further increase the risk for the disease [18]. A recent study among Chinese youth found increased weight and body mass index during the lockdown period [19]. A similar study conducted in Massachusetts reported that a significant proportion of participants gained weight during the COVID-19 lockdown [20]. The reduced physical activity could contribute to the weight gain during the pandemic period [21]. Therefore, understanding the impact of the COVID-19 pandemic on physical activity patterns among Sri Lankan adults is important to implement future preventive strategies to overcome the burden of the NCDs, where health systems are already overburdened as a result of the epidemic. Thus, in this online survey, we aimed to present associated factors for physical inactivity and weight gain during the COVID-19 pandemic.

## Methods

### Study design and sampling

The present study is a national level cross-sectional online survey conducted using Google Forms web survey platform from 27<sup>th</sup> May to 2<sup>nd</sup> June 2021. The country lockdown for the third COVID-19 wave in Sri Lanka commenced on 21<sup>st</sup> May and lasted during the period of data collection.

Multiple strategies were used to recruit participants. The link to the online survey was shared through social media, such as Facebook, Instagram, Twitter and WhatsApp. We also encouraged the participants to recruit others by various methods such as forwarding to their contact list and/or posting the online questionnaire in their personal Facebook wall and WhatsApp groups. The invitation was not posted nor sent to medical and nutrition related professional organizations and teaching institutions to minimize the bias. No incentives were given to the participants and active promotion of the questionnaire was totally voluntary.

Before beginning the questionnaire, the participants were given a brief description of the study and its aim and the declaration of anonymity and confidentiality. Then the respondents provided their informed consent to proceed and completed a self-reporting questionnaire. The study was conducted in full agreement with the national and international regulations, and the Declaration of Helsinki (2000) [22]. The survey did not require approval by the ethics committee because of the anonymous nature of the online survey and the inability of tracking sensitive personal data [23,24]. Completion of responses to all of the questions was compulsory for

successful submission. Once completed, each questionnaire was transmitted to the Google platform and the final database was downloaded as a Microsoft Excel sheet.

### Questionnaire

The online questionnaire was specifically built using Google Form. The questionnaire was available in the three main official languages in Sri Lanka, English, Sinhala and Tamil, so that the participants could select the preferred language. The questionnaire required an estimated time of 5–10 minutes to complete. It included multiple choice and open-ended questions divided into three different sections, demographic, diet and lifestyle related. For this study, demographic, physical activity, and body weight related data were used. Reliability of the adopted questionnaire was tested through piloting, prior to survey administration. The questionnaire is provided (See supplementary file 1).

The first section of the questionnaire investigated the demographic details of the participants. Respondents' details of age, gender, area of residence, ethnicity, educational status, current employment status, family details including the monthly income were collected by both open-ended and multiple-choice questions.

Only the birth year was asked to minimize the disclosure of personal details. The residing district was asked to select from a drop down list with the 25 districts in Sri Lanka arranged in alphabetical order. The residential areas were divided as municipal council, city council and rural according to the nature of local authorities. The respondent's gender was inquired using "male", "female" or "prefer not to say" categories. The ethnicity of the respondents were asked to select from the categories, Sinhalese, Sri Lankan Tamil, Indian Tamil, and Sri Lankan Moors. Another option as "other" was available to those who don't belong under any of the given categories. The respondent's highest education level was assessed by the categories no schooling, primary education, secondary education, tertiary education, and degree or above. A preferred not to say option also was available. The nature of the current employment status was collected. The monthly income categories were created considering the average monthly family income in Sri Lankans [25].

The second part of the questionnaire comprised of activity related questions. All the questions were asked to determine if there was a change in certain activities during the COVID-19 pandemic period by selecting the options increased, decreased or no change. Mainly the questions were related to the changes in daily exercise routine, sitting time, screen time, sleep duration, and quality of sleep. In addition, we collected details on body weight changes during the COVID-19 epidemic. Current body weight and height were not asked because the previous studies have reported that only one-quarter of adults can recall their body weight and height accurately in this population [26]. Therefore, the respondents' were asked to mention the changes in body weight during the COVID-19 period. A drop-down list with weight changes from <1 kg to >10 kg was available to select the response. During the analysis, 0.5 kg was assigned to <1 and 12.5 kg was assigned to >10 kg.

### Statistical analysis

All the variables were analysed qualitatively and were expressed as a percentage (%) and numbers (n). Descriptive statistics were employed to explore the demographic parameters of the study sample. Results were presented as frequency and percentage in parentheses (%) for categorical variables or mean and standard deviation (SD) for continuous variables. One-way analysis of variance (ANOVA) was performed for data comparison among groups.

Multivariable binary logistic regression analyses were conducted to investigate the association between categorical variables (dependent) and continuous or categorical ones (independent). For regression analysis, demographic variables representing less than 1% of the sample were removed. The income groups <10,000 LKR and 10,000–24,999 LKR were combined as a new category <25,000 LKR. The results of logistic regression analyses were expressed as odds ratio (OR) and 95% confidence intervals (95% CI). For all analyses,  $p \leq 0.05$  was considered significant. Statistical analysis was performed using SPSS ver. 23.0 (IBM, Chicago, IL, USA).

**Results**

A total of 3714 responses were received. After removing potential duplicates and incomplete data, 3707 respondents, aged  $\geq 16$  years, were included in the analysis. The socio-demographic characteristics of the participants are presented in Table 1. The mean age (SD) of the participants was 32.95 ( $\pm 9.82$ ) years with the largest group of people belonging to the age group 26–30 years. The female gender represented the majority of the population (59.6%). Respondents covered all 25 districts in Sri Lanka while the highest numbers were from Colombo, Gampaha, and Kandy districts. The majority lived in rural areas 40.1% (1488) while 27.3% (1011) and 32.6% (1208) in city and municipal council regions respectively. The survey population represented all ethnic groups in Sri Lanka with the highest and lowest contributions from Sinhalese and other minority groups respectively. Most respondents had a degree level (69.1%; 2563) or tertiary level (25.6%; 948) education. In terms of employment status, 2336 (63.0%) participants were employed, 200 (5.4%) self-employed, 272 (7.3%) unemployed, 618 (16.7%) full time students and 56 (1.5%) were retired. Almost half of the respondents (48.4%; 1796) had a net monthly family income of more than 100,000 LKR per month.

With regards to physical activity changes (Fig. 1), more than half of the respondents (52.4%) declared that their daily exercise routine has reduced during the COVID-19 pandemic. Specifically, 63.5% of the participants reported that their sitting time has increased during the same period. In addition, more than 80% of the respondents reported an increase of screen time spent on television,

cell phones and laptops. Furthermore, nearly half of the respondents (49.4%) reported an increase in sleep duration while there was no change in the quality of sleep for the majority (43.5%).

The association of socio-demographic factors with sedentary behaviour is presented in Table 2. The results of the binary logistic regression analysis indicated that, all age groups were more likely to have reduced exercise levels than the youngest group, however, 31–35 years (OR 1.96; 95% CI, 1.321–2.894,  $p < 0.001$ ) and 36–40 years (OR 1.67; 95% CI, 1.099–2.524,  $p < 0.016$ ) age categories reached the significance levels. In comparison to the youngest group, all other age groups were significantly less likely to report increased sitting times and increased screen times. Regarding gender, females were less likely to remain seated compared to men (OR 0.559; 95% CI, 0.480–0.651,  $p < 0.001$ ), but no significant difference could be observed for the other two activities. Respondents from the Kurunegala district were more likely to report increased exercise (OR 0.608; 95% CI, 0.398–0.928;  $p < 0.021$ ) during this period compared to Colombo district. The area of residence also seemed to have had no influence on activity patterns. In comparison to Sinhalese, Sri Lankan Tamils had a significantly less likely to report decreased exercise levels (OR 0.53; 95% CI, 0.382–0.734;  $p < 0.001$ ). Even so, both Tamil ethnic groups were possibly to have had increased sitting times than all the other ethnic groups. The level of education showed no relation to any of the changes in activities. In addition, the unemployed respondents had significantly higher odds for decreased exercise levels than the employed. Full-time students were almost two times more likely to have increased sitting time than the people who were employed (OR 1.90; 95% CI, 1.379–2.627;  $p < 0.001$ ). Similarly, people who engaged in domestic duties also had a significantly higher likelihood for increased sitting time but their odds were less in regards to the increased screen time. Moreover, the respondents with a monthly income over 200,000 LKR were significantly less likely to have reduced exercise levels (OR 0.64; 95% CI, 0.424–0.963;  $p < 0.032$ ).

The results demonstrated that 38.5% ( $n = 1429$ ) of respondents have reported weight gain during the pandemic. The mean weight gain of the respondents was 3.61 ( $\pm 2.35$ ) kg (Table 3). A significant difference in weight gain was observed among genders ( $p < 0.001$ ) and different ethnic groups ( $p < 0.001$ ) in the sample.

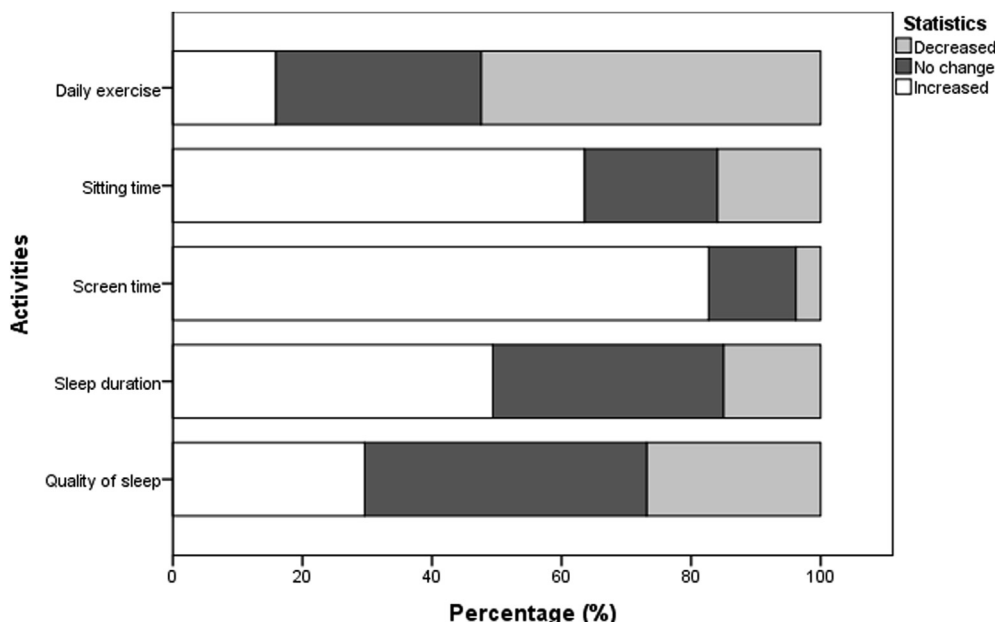


Fig. 1. Changes of the activity related variables during the COVID-19 pandemic.

**Table 1**  
Sample characteristics.

Variables	Total (n = 3707)	
	n	%
<b>Age</b>		
16–25 years	826	22.3
26–30 years	913	24.6
31–35 years	758	20.4
36–40 years	496	13.4
>40 years	704	19.0
<b>Gender</b>		
Male	1468	39.6
Female	2209	59.6
Not specified	30	0.8
<b>District</b>		
Colombo	1404	37.9
Gampaha	502	13.5
Kandy	351	9.5
Kalutara	235	6.3
Kurunegala	183	4.9
Batticaloa	108	2.9
Others	924	25.0
<b>Area of residence</b>		
Municipal council area	1208	32.6
City council area	1011	27.3
Rural area	1488	40.1
<b>Ethnicity</b>		
Sinhala	3036	81.9
Sri Lankan Tamil	304	8.2
Indian Tamil	57	1.5
Sri Lankan Moors	259	7.0
Others	51	1.4
<b>Education level</b>		
No schooling	2	0.1
Primary education (up to grade 5)	0	0
Secondary education (up to O/L)	160	4.3
Tertiary education (up to A/L)	948	25.6
Degree or above	2563	69.1
Prefer not to say	34	0.9
<b>Employment status</b>		
Employed	2336	63.0
Self-employed	200	5.4
Unemployed	272	7.3
Engaged in home duties	114	3.1
Retired from employment	56	1.5
Full time student or pupil	618	16.7
Other	84	2.3
Prefer not to say	27	0.7
<b>Monthly family income (in LKR)</b>		
Less than 10,000	89	2.4
10,000–24,999	231	6.2
25,000–49,999	605	16.3
50,000–99,999	986	26.6
100,000–199,999	887	23.9
>200000	909	24.5

**Discussion**

To the best of our knowledge, this is one of the largest national-level online surveys conducted in Sri Lanka to investigate the immediate impact of the COVID-19 pandemic on the lifestyle of its residents. This population-based survey received nearly 4000 responses within a period of one week when the country was under lockdown. The respondents to the questionnaire were mainly young adults below the age of 35 years, who use social media platforms very actively when compared to the older generation. Our sample reflects the population of Sri Lankan Internet users from prior online surveys of Sri Lanka [27]. Similar patterns were observed in studies from other countries such as Italy [28], Cyprus [29] and Poland [24]. A sustained physically inactive lifestyle, or becoming physically inactive during the young age is a serious health problem that increases the risk for NCDs in adulthood [30].

Besides, Obesity and weight gain have been linked to an increased risk of coronary heart disease among young adults [31]. Therefore, we believe that the responses from the young population are vital. Additionally, our respondents were predominately females showing similar representation patterns to previously conducted national surveys [32]. Around 38% of the responders represented the Colombo district which is the largest and the main economical hub in the country. The Sri Lankan population comprises Sinhalese 74.9%, Sri Lankan Tamil 11.2%, Sri Lankan Moors 9.2%, Indian Tamil 4.2%, and other ethnic groups 0.5% according to 2012 estimates [33]. Our sample reflects similar proportions showing the well distribution of each ethnic group in the country. In addition, the majority of the respondents were well educated and employed. However, online surveys especially in developing countries have their own methodological challenges, such as sampling, coverage and response issues due to relatively less technology literacy among the general population. Although the median household income in Sri Lanka was reported as Rs. 30,400, majority of respondents reported incomes much higher than this amount.

With regards to sedentary behaviours, the majority of the young adults aged between 31 and 40 years reported decreased daily exercise routine. Physical and social environmental elements that influence access, availability, and use are the major determinants of physical activity involvement [34]. Therefore the possible reasons of inactivity could be lack of equipment, insufficient spaces to exercise at home [3], closed gyms and other sports facilities and being fearful of exposure to COVID-19 [35].

Surprisingly, people with higher income levels were less likely to report reduced exercise levels. This could be explained by the fact that these people are more likely to have access to their own exercise equipments at home and to paid online exercise programs, which might have helped them to preserve their exercise levels during the COVID-19 restrictions. Moreover, the time spent on sitting and screening seemed to be highest in the lower age groups compared to the older counterpart. These findings are in accordance with the results observed in a previous research studies [36]. The screen time and sitting time might increase due to the closure of educational institutions and hence conducting online teaching [5]. Furthermore, youngsters might be spending more time on social media platforms to communicate with their peers owing to the social distancing.

Physical inactivity is a major cause of death worldwide, accounting for 3.2 million deaths per year [37]. It can also increase the risk for several other diseases such as developing heart disease, obesity, high blood pressure, high blood cholesterol levels, and type 2 diabetes [38].

Prior research has suggested that regular practice of physical exercises strengthens the immune system, reducing the risk of developing systemic inflammatory processes and stimulating cellular immunity [39,40]. Regular physical activity may reduce the acute inflammatory response through several mechanisms such as by; reducing the inflammatory signaling pathway, increasing anti-inflammatory cytokines, reducing lung inflammation through the activation of Activated Mitogen Protein Kinase (AMPK) and increasing nitric oxide levels to counteract endothelial dysfunction, resulting in pulmonary vasodilation and antithrombotic activity [41].

Obesity and obesity associated NCDs are major health issues in Sri Lanka. In the country, the level of obesity has increased three folds during the last two decades [42]. The body weight gain around 3.5 kg is close to 5% of body weight gain in this population. It has been reported that each 5 kg weight gain from early to middle adulthood was associated with an approximately 10% elevated all-cause mortality and a greater than 20% cardiovascular disease-related mortality in later life among individuals who reached a BMI of 23 kgm<sup>-2</sup>

**Table 2**  
Odds Ratios (OR) for the likelihood of reduced physical activities by socio-demographic variables.

Covariates	Decreased daily exercise		Increased sitting time		Increased screen time	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
<b>Age</b>						
16–25 years <sup>a</sup>	1		1		1	
26–30 years	1.266 (0.890–1.801)	0.189	0.728 (0.543–0.976)	0.034	0.673 (0.456–0.993)	0.046
31–35 years	1.955 (1.321–2.894)	0.001	0.584 (0.429–0.795)	0.001	0.535 (0.357–0.802)	0.002
36–40 years	1.665 (1.099–2.524)	0.016	0.387 (0.279–0.538)	0.001	0.431 (0.282–0.659)	0.001
>40 years	1.091 (0.746–1.596)	0.654	0.464 (0.338–0.637)	0.001	0.459 (0.304–0.694)	0.001
<b>Gender</b>						
Male <sup>a</sup>	1		1		1	
Female	1.164 (0.963–1.407)	0.117	0.559 (0.480–0.651)	0.001	0.834 (0.690–1.007)	0.059
<b>District</b>						
Colombo <sup>a</sup>	1		1		1	
Gampaha	1.026 (0.750–1.404)	0.870	0.965 (0.763–1.220)	0.767	0.909 (0.679–1.217)	0.521
Kandy	1.111 (0.753–1.676)	0.596	0.784 (0.587–1.046)	0.098	0.795 (0.553–1.144)	0.217
Kalutara	0.713 (0.484–1.052)	0.088	0.677 (0.499–0.920)	0.013	0.796 (0.543–1.165)	0.240
Kurunegala	0.608 (0.398–0.928)	0.021	0.732 (0.519–1.033)	0.076	0.766 (0.503–1.166)	0.214
Batticaloa	0.777(0.453–1.331)	0.358	1.171 (0.666–2.059)	0.583	1.712 (0.828–3.541)	0.147
Others	0.918 (0.707–1.193)	0.524	0.691 (0.565–0.845)	0.001	0.809 (0.630–1.040)	0.098
<b>Area of residence</b>						
Municipal council area <sup>a</sup>	1		1		1	
City council area	1.075 (0.848–1.361)	0.550	0.979 (0.811–1.182)	0.827	0.875 (0.691–1.108)	0.268
Rural area	1.074 (0.836–1.380)	0.575	0.846 (0.696–1.028)	0.092	0.828 (0.648–1.059)	0.133
<b>Ethnicity</b>						
Sinhala <sup>a</sup>	1		1		1	
Sri Lankan Tamil	0.529 (0.382–0.734)	0.001	1.417 (1.040–1.930)	0.027	0.857 (0.596–1.231)	0.403
Indian Tamil	0.566 (0.301–1.064)	0.077	2.000 (1.008–3.966)	0.047	1.254 (0.551–2.852)	0.589
Sri Lankan Moors	1.092 (0.743–1.606)	0.654	1.218 (0.900–1.649)	0.202	0.738 (0.522–1.043)	0.085
Others	1.314 (0.546–3.163)	0.543	1.038 (0.550–1.961)	0.907	0.881 (0.401–1.939)	0.753
<b>Education level</b>						
Secondary education <sup>a</sup>	1		1		1	
Tertiary education	1.021 (0.604–1.726)	0.938	0.976 (0.653–1.458)	0.904	0.907 (0.535–1.539)	0.718
Degree or above	0.819 (0.486–1.379)	0.452	1.078 (0.720–1.614)	0.714	0.882 (0.521–1.494)	0.641
Prefer not to say	2.020 (0.430–9.484)	0.373	0.820 (0.323–2.083)	0.677	1.343 (0.355–5.088)	0.664
<b>Employment status</b>						
Employed <sup>a</sup>	1		1		1	
Self-employed	0.933 (0.622–1.400)	0.738	0.964 (0.704–1.320)	0.819	0.778 (0.539–1.123)	0.180
Unemployed	1.655(1.064–2.573)	0.025	1.113 (0.829–1.495)	0.476	1.054 (0.725–1.534)	0.782
Engaged in home duties	1.495 (0.781–2.861)	0.225	0.421 (0.277–0.640)	0.001	0.375 (0.248–0.569)	0.001
Retired from employment	1.561 (0.683–3.568)	0.291	1.202 (0.670–2.159)	0.537	0.834 (0.423–1.643)	0.599
Full time student or pupil	1.131(0.773–1.656)	0.526	1.904 (1.379–2.627)	0.001	1.492 (0.968–2.302)	0.070
Other	0.812 (0.467–1.413)	0.462	1.339 (0.823–2.178)	0.239	0.824 (0.473–1.438)	0.496
<b>Monthly family income (LKR)</b>						
<25,000 <sup>a</sup>	1		1		1	
25,000–49,999	0.785 (0.526–1.172)	0.237	0.862 (0.628–1.183)	0.358	0.993 (0.677–1.457)	0.971
50,000–99,999	1.170 (0.789–1.737)	0.435	0.861 (0.635–1.166)	0.332	1.280 (0.880–1.862)	0.197
100,000–199,999	0.786 (0.526–1.173)	0.239	0.918 (0.668–1.261)	0.597	1.216 (0.824–1.795)	0.325
>200000	0.639 (0.424–0.963)	0.032	0.973 (0.702–1.350)	0.872	1.280 (0.857–1.913)	0.228

<sup>a</sup> Reference variable.

or higher at middle adulthood [43]. In a meta-analysis of women and men, the pooled incident rate ratios per 5 kg weight gain was 1.31 (95% CI, 1.28–1.33) for type 2 diabetes (I2 = 59%); 1.14 (95% CI, 1.10–1.17) for hypertension (I2 = 93%); 1.08 (95% CI, 1.08–1.09) for cardiovascular disease (I2 = 0%); 1.06 (95% CI, 1.02–1.09) for obesity-related cancer (I2 = 72%) and 1.05 (95% CI, 1.04–1.07) for mortality (I2 = 60%) [44].

One of the main inherited limitations of any online survey is the poor representativeness of the study population. In developing countries, online surveys have methodological challenges, such as sampling, coverage and response issues [45], due to the difficulty in reaching the poor and lack of technology and IT literacy among the elderly population. Therefore, our sample mainly consisted of young educated people; however, similar patterns are reported in other countries too [8]. In addition, as the investigators are from the health background and also from Colombo district, there is a higher chance to get more participants from the same district and background. We avoided the bias as to our best capability by not sharing the questionnaire among known professionals and institutions in

the field. However, there was a fair representation of the sample as it covered all districts of the island including each ethnic group. Another limitation is that we were unable to measure the changes in physical activity level. This is mainly the participants' perception of the change in activity levels and therefore should be treated with caution. It would have been more accurate to have subjective values of physical activity levels for before and during the COVID-19 lockdown period [46]. Similarly, the weight gain was not measured but self-reported by the respondents. However, as the literacy rate of the current sample of respondents was very high (>69% are graduates), we believe that high accuracy in self-reporting.

The strengths of our study include utilisation of the online survey, which allowed us to swiftly reach a sufficiently large sample and a mixed population from different districts in the country during the lockdown period. Our findings highlighted the importance of being aware of the effects of this circumstance and improving physical activity in people who have become more sedentary due to the COVID-19 pandemic.

**Table 3**  
Mean weight gain according to socio-demographic variables.

Variables	Weight gain (kgs)		P-value
	Mean	±SD	
Total	3.61	2.353	
<b>Age</b>			
16–25 years	3.62	2.398	0.279
26–30 years	3.76	2.510	
31–35 years	3.49	2.183	
36–40 years	3.53	2.316	
>40 years	3.53	2.275	
<b>Gender</b>			
Male	4.15	2.515	<0.001
Female	3.29	2.192	
<b>District</b>			
Colombo	3.76	2.402	0.098
Gampaha	3.80	2.397	
Kandy	3.46	2.581	
Kalutara	3.47	2.194	
Kurunegala	3.51	2.438	
Batticaloa	4.33	2.669	
Others	3.25	2.106	
<b>Area of residence</b>			
Municipal council area	3.72	2.426	0.430
City council area	3.75	2.515	
Rural area	3.39	2.136	
<b>Ethnicity</b>			
Sinhala	3.55	2.340	<0.001
Sri Lankan Tamil	3.88	2.402	
Indian Tamil	2.89	1.7783	
Sri Lankan Moors	3.91	2.285	
Others	4.55	3.128	
<b>Education level</b>			
Secondary education (up to O/L)	3.84	2.814	0.147
Tertiary education (up to A/L)	3.60	2.399	
Degree or above	3.61	2.317	
Prefer not to say	2.88	1.808	
<b>Employment status</b>			
Employed	3.54	2.309	0.302
Self-employed	3.96	2.590	
Unemployed	3.86	2.419	
Engaged in home duties	3.92	2.230	
Retired from employment	3.00	1.683	
Full time student or pupil	3.62	2.404	
Other	3.69	2.791	
<b>Monthly family income (in LKR)</b>			
<25,000	3.67	2.579	0.159
25,000–49,999	3.78	2.439	
50,000–99,999	3.51	2.163	
100,000–199,999	3.58	2.409	
>200000	3.63	2.382	

Further studies should be conducted to identify the reasons for the reduced activity in this population. Moreover, educational programs should be implemented at the national level to increase the awareness on the importance of regular physical activity during the COVID-19 lockdown period to overcome infection and other NCDs. Cultural specific, online physical activity sessions such as yoga, Zumba etc. should be broadcasted or made available to the general population [47]. Integrating physical activity sessions during distance teaching is highly recommended to increase the physical activity of students. In addition, walking in large, outdoor open spaces should be encouraged.

**Conclusion**

The overall results of the study revealed that sedentary behaviours such as physical inactivity, sitting time, screen time and sleep duration have increased during the COVID-19 pandemic period. The increase of these sedentary behaviours might be due to home confinement and other considerable constraints imposed due to

the pandemic. The findings of this study may help in the development and implementation of programs aimed at preventing weight gain, promoting physical activity, and reducing other sedentary behaviours during the COVID-19 pandemic.

**Authors' contribution**

PS, RJ, TVF conceived and designed the online survey questionnaire; distributed the questionnaire; PS analyzed and interpreted the data; PS, RJ drafted the manuscript, NK revised the manuscript. All authors read and approved the final manuscript.

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**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.

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