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ORIGINAL PAPER

Covid-19 Social Distancing, Lifestyle and Health Outcomes Among Persons Living with HIV (PLWH): A Web-based Survey

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Abstract

We investigated changes in lifestyle, depressive symptoms, self-perception of health, and body weight changes of persons living with HIV (PLWH) during the COVID-19 social distancing (SD). In a Web-based cross-sectional survey, participants (n = 406) were questioned about lifestyle and health status before and during SD. Most responders were men, 50 + years old, high education level; 49.8% had their income reduced during SD. About 9% were diagnosed with COVID-19, of whom 13.5% required hospitalization. During SD: - most participants did not change their food intake, although 25% replaced healthy foods with unhealthy ones; -more than half mentioned poor sleep quality; -about 50% increased their sedentary behavior. Depressive symptoms (reported by 70.9%) were associated with sedentary behavior, poor sleep quality, and reduced income. About one-third had a negative perception of their health status, which was inversely associated with practicing physical exercises and positively associated with sedentarism and poor sleep quality. More than half increased their body weight, which was associated with a lower intake of vegetables. The older age reduced the odds of the three outcomes. Carefully monitoring PLWH regarding SD will enable early interventions toward health.

Keywords COVID-19 · HIV · Lifestyle · Depressive symptoms · Body weight · Health

Resumen

En este trabajo investigamos los cambios en el estilo de vida, síntomas depresivos, autopercepción de salud y cambios en el peso corporal de las personas que viven con el VIH (PVCV) durante el distanciamiento social (DS) de COVID-19. En una encuesta transversal en línea, se preguntó a los participantes (n = 406) sobre el estilo de vida y el estado de salud antes y durante el DS. La mayoría de los encuestados eran hombres, mayores de 50 años, con alto nivel educativo. El 49,8% tuvo una disminución en sus ingresos durante el DS. El 9,1% fue diagnosticados con COVID-19, de los cuales 13,5% requirió hospitalización. Durante el DS: - la mayoría de los participantes no cambió su ingesta de alimentos, aunque el 25% reemplazó los alimentos saludables por los no saludables; más de la mitad mencionó mala calidad del sueño; cerca del 50% aumentó su comportamiento sedentario. Los síntomas depresivos (referidos por el 70,9%), fueron incrementados por el sedentarismo, la mala calidad del sueño y reducción de la renta. Cerca de un tercio tenía una percepción negativa de su estado de salud, que se redujo con la práctica de ejercicio físico y aumentó con el sedentarismo y la mala calidad del sueño. Más de la mitad aumentó su peso corporal, lo que se asoció con una menor ingesta de vegetales. Una edad más avanzada redujo las probabilidades de los tres desenlaces. El monitoreo cuidadoso de las PVCV con respecto al DS permitirá intervenciones tempranas para la salud.

Palabras clave: COVID-19 · VIH · estilo de vida · síntomas depresivos · peso corporal · salud

Introduction

The COVID-19 pandemic reached impressive numbers of

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persons infected and deaths globally [1] (https://coronavirus.jhu.edu/map.html). Given the absence of effective treatment, the slow pace of vaccination, particularly in low- and middle-income countries, and the emergence of new variants, social distancing (SD) has been necessary to reduce the spread of SARS-CoV-2.

Despite having well-recognized favorable effects in reducing viral transmissibility, SD can promote worrisome behavioral and psychological consequences. Recent data have shown an increased incidence of mental disorders during the pandemic, especially in physically or socially vulnerable groups [2–6].

A longer time spent at home enhances the possibility of unfavorable lifestyle changes [7–11]. For instance, Ammar et al. [12] performed an international online survey showing that different levels of SD resulted in reduced physical activity, increased sitting time, and increased unhealthy eating habits. In another context, a study conducted during Israel's first quarantine [13] compared persons under treatment in a specialized obesity clinic with individuals under no medical follow-up. In that study, patients under medical follow-up presented better eating and physical activity behavior and showed a lower prevalence of mood disorders; we assume that this indicates the importance of engagement in health-promoting strategies with professional follow-up during the pandemic.

The impact of SD in different populations may vary considerably, depending on local, social, economic, cultural, and political contexts. Here, we intend to consider the vulnerability of persons living with HIV (PLWH). We hypothesize that this population group is at increased risk of experiencing unfavorable effects of SD for many reasons. They often face HIV stigma and discrimination, are more likely to live alone and be socially dissatisfied [14, 15], and have to cope with residual effects of HIV infection and side effects of antiretroviral therapy (ART) [16]. COVID-19-associated uncertainty and insecurity may impact PLWH in particular [15].

During the COVID-19 SD, adoption of an inappropriate lifestyle may compromise health, raising concerns about the risk of developing or worsening metabolic disorders and chronic diseases [17, 18]. We aimed to explore lifestyle changes and associated outcomes among PLWH during COVID-19 SD. There have been no previous reports in this regard, as far as we know.

Methods

We conducted a web-based cross-sectional survey from November 2020 to January 2021. The convenience sample was composed of patients registered at the HIV outpatient reference clinic affiliated with the University of São Paulo, Brazil, where 3,145 adults living with HIV are under multidisciplinary clinical follow-up. After having basic information retrieved from their medical records, patients with an active phone number were sent an app-based message briefly describing the study's aims and confidentiality and inviting them to participate. Those who accepted were invited to read details about the study and sign a consent form. After giving their informed consent, participants were asked to fill up an e-questionnaire settled at a web application called Google Forms®. The study was approved by the Institutional Review Board (protocol # 4,285,897).

The questionnaire, which was previously pilot-tested, included multiple-choice questions and intended to disclose changes in lifestyle by comparing information concerning attitudes and behaviors exhibited before and during COVID-19-SD.

The questions covered the following aspects. Age was reported in years and the gender in categories (male, female or other); formal education was informed according to the highest level of formal schooling. Participants were questioned about their employment status before and during SD and whether they had any change in income. They were questioned if they had been diagnosed with COVID-19 and whether they needed hospitalization. They also provided information about the degree of experienced SD. The presence of depressive symptoms was investigated using the CES-D-4 [19], which includes four questions related to satisfaction with and meaning of life, life insecurity, and happiness. An unfavorable answer to any of these questions characterizes the presence of depressive symptoms. Participants informed their self-perceived health status [20] and reported any changes in body weight during SD. Diet-related questions [20] investigated the number of weekly days they consumed different foods before and during SD. We organized the questions into three sets. The first set considered healthy eating markers, protective against chronic diseases (beans, raw and cooked vegetables, whole fruits, and fish). The second set included unhealthy eating markers (sodas and soft drinks, sweets and candies, and snacks replacing meals), and the third comprised the foods considered by different studies as neutral or controversial regarding chronic diseases risk (fruit juices, milk, red meat, chicken, or other poultry) [21, 22]. Questions about physical activity [23] included details about the type and location of the activity and the number of weekly days and daily duration of each activity. From the answers, we created a variable regarding practicing or not physical activity. Participants were asked about changes in their sitting time in front of the TV or the computer, cell phone, or other devices during SD. The diet, the self-perceived status, and physical activity questions were adapted from Brazilian epidemiological studies

[20–23]. Sleep parameters were investigated with questions adapted from the Pittsburg Sleep Quality Questionnaire [24], including self-evaluation of sleep.

Data analyses

Continuous variables were presented as mean and standard deviation or median and range (depending on data distribution), and categorical data were presented as frequencies. We performed various logistic regression models to investigate the associations between the health outcomes and lifestyle information, as described below.

Dependent variables: (i) presence of depressive symptoms ("yes" against the reference "no"); (ii) self-perceived health status "regular, bad, or very bad" against the category" "good or very good" as reference) and (iii) changes in body weight (reference category "did not change or reduced" against the category "increased").

Independent variables (during SD): food intake (reference intake category "moderate" against "low" and "high"), physical activity (categories "did not practice" as a reference against "practiced"), sedentary behavior ("increased" and "reduced" against the reference "maintained" the sitting time), and sleep quality (reference category "good" against "bad"). We maintained one dependent variable at a time, as follows: (i) Crude models for each health and each lifestyle variable; (ii) Multiple models including the dependent variables and all the dietary questions (healthy, unhealthy, and neutral/controversial eating markers); (iii) Multiple models including the dependent variables and physical exercises practice and sedentary behavior; (iv) Multiple models including the dependent variables, and simultaneous inclusion of dietary intake, sleep quality, physical activity practice, and sedentary behavior questions; (v) We added to the previous model the sociodemographic variables (sex, age, and changes in income). Analyses were performed using the Stata version 14 (Stata Corp College Station, USA), adopting a statistical significance of 5%.

Keeping in mind that the pandemic could more negatively impact women and persons who are less educated (essential workers), we performed the descriptive and logistic regression models considering two subgroups: (i) only women and (ii) only people at lower levels of education.

Table 1 Sociodemographic features of the sample, clinical and behavioral information about COVID-19 (n = 406)

Variables	n	%
Sex		
Women	127	31.3
Men	279	68.7
Age interval (years old)		
≤ 30	21	5.2
31–40	49	12.1
41–50	96	23.6
51–60	182	44.8
60 +	58	14.3
Education		
Up to middle school	39	9.6
Incomplete high school	129	31.6
Complete or above high school	237	58.4
Missing answer	1	0.2
Employed during SD		
No	138	34.0
Yes	268	66.0
Family income during SD		
Same as before	184	45.3
Increased	20	4.9
Decreased	202	49.8
COVID-19 diagnoses	n	%
No	369	90.9
Yes	37	9.1
In case of infection, hospitalization due to COVID-19		
No	32	86.5
Yes	5	13.5
Behaviour during social distancing		
Stayed in complete SD	59	14.5
Leave home only for mandatory or essential activities	308	75.9
Avoided agglomeration but leave home for non-essential activities	39	9.6
Remote working due to SD (from the ones who were working)		
No	154	55.2
Yes	125	44.8
Number of medical consultations in 2020		
None	40	9.9
One	168	41.5
Two	133	32.8
Three or more	64	15.8

Results

Out of 3,145 patients registered at the clinic, 1,968 were sent an app message, and 414 responded to the questionnaire. We excluded eight responders who were not HIV-infected, leading to a final sample of 406 PLWH. Material S1 Figure describes the steps to achieve the final sample.

Demographic, socioeconomic characteristics, and information regarding COVID-19 infection are shown in Table 1. Most responders were men and older than 50 years. More than half reported having a higher education degree and were employed. Nevertheless, 49.8% reported having reduced their income during SD. Among participants, 9.1% reported having acquired COVID-19, of whom 13.5% needed hospitalization. Most participants complied with COVID-19 SD recommendations of staying at home or leaving home only for essential activities; half of them have worked remotely. The number of visits to the outpatient reference clinic during 2020 was one or two for most of the sample, the usual number of visits before the COVID-19 pandemic.

Table 2 depicts mental and physical health status and sleep aspects before and during SD. The percentage of self-evaluation of health as “regular, bad, or very bad” increased during the SD, from 12.1 to 30%. More than half of the participants referred to increasing their body weight during the SD (56.9%). Almost 80% showed depressive symptoms during SD, more than twice the observed before SD (28.8%). All the CES-D questions worsened during SD (S1 Table). Also, 39.6% of the sample described poor sleep quality before SD, a proportion that increased to 54.6% during SD. The number of sleep hours did not show any observable difference among patients who slept poorly. INSERT FIGURE S1 after this paragraph

Table 2 Presence of depressive symptoms, body weight changes and self-perception of health, sleep quality before and during the social distancing (SD), with two categories (n = 406)

Variables	Before SD	During SD
	n (%)	n (%)
CES-D classification		
Presence of depressive symptoms	117 (28.8)	288 (70.9)
Absence of depressive symptoms	289 (71.2)	118 (29.1)
Perceived health status		
Good or very good	357 (87.9)	284 (69.9)
Regular, bad or very bad	49 (12.1)	122 (30.1)
Self-referred body weight changes		
Not changed or reduced		175 (43.1)
Increased		231 (56.9)
Sleep quality and time of sleep		
Good (6–8 h)	78(19.2)	42 (10.4)
Good (< 6 h)	155 (38.2)	104 (25.7)
Good (> 8 h)	12 (3.0)	38 (9.4)
Total of participants with good sleep quality	*245 (60.4)*	*184 (45.5)*
Poor (6–8 h)	83 (20.4)	108 (26.7)
Poor (< 6 h)	65 (16.0)	74 (18.3)
Poor (> 8 h)	13 (3.2)	39 (9.6)
Total of participants with poor sleep quality	*161 (39.6)*	*221 (54.6)*

Table 3 Physical exercise practice and sedentary behavior during social distancing (SD) (n = 404)

Physical activity and sedentary behavior	n (%)
Physical exercise information	
Performed any type of physical activity during the SD	173 (42.8)
Did not perform any type of physical activity during the SD	231 (57.2)
Sedentary behavior- sitting time	
Daily time watching TV	
Not changed	177 (43.6)
Reduced	28 (6.9)
Increased	201 (49.5)
Daily time on the computer, mobile phone or video games	
Not changed	177 (43.7)
Reduced	29 (7.2)
Increased	199 (49.1)

Figure 1 shows changes in the intake of the individual foods during SD. Although most participants did not change their overall intake, healthy eating markers, particularly vegetables and beans, reduced their ingestion by 23% and 16%, respectively. In turn, the intake of the unhealthy eating markers increased in an expressive proportion of participants (snacks replacing meals by 24.7%, sweets and candies by 31.4%, and soft drinks by 16.8%). A reduction in red meat intake was also observed in 22.7% of the sample. S2 Table describes the levels of eating markers before and during the SD.

According to Tables 3 , the proportion of 42.8% of the total sample reported performing any physical exercise during SD. Exercises performed at home were informed by 32.7%, while 22.7% practiced exercises outside the home (S3 Table); exercise types were distributed between aerobic (16.9%) and anaerobic types (15.1%), and mixed exercises

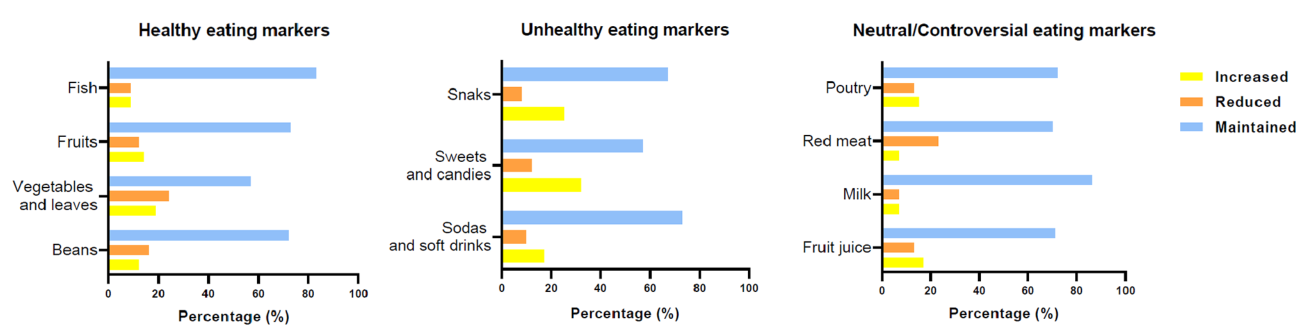

Fig. 1 Changes in the consumption of the food groups confronting the times before and during social distancing

were the less frequently practiced (6.9%). About half of the participants (49.4%) reported having increased their sitting times in front of the TV, computer, mobile, or other devices (49.1%).

Our regression models tested the associations between the dependent health variables and independent lifestyle variables during the SD. The simple models are detailed in the S4 Table, whereas the multiple regression models with diet components, physical exercises, and sedentary behavior are described in Tables S5 and S6. The final multiple models are presented in Table 4. The odds of presenting depressive symptoms from the crude models were increased by a poor sleep quality (OR = 2.00; p = 0.002), an increased sitting time in front of the TV (OR = 2.11; p = 0.001), or in front of the computer, mobile, or other devices (OR = 1.60; p = 0.037), and by income reduction (OR = 2.50; p < 0.001). The higher intake of fruit juices (OR = 0.52; p = 0.047) and the age (OR = 0.95; p < 0.001) decreased these odds (S4 Table). When data on dietary habits were included simultaneously in a multiple model (S5 Table), the odds of depressive symptoms were decreased with lower fruit juices intake (OR = 0.54; p = 0.043). In models including physical activity and sedentary behavior simultaneously (S6 Table), increased time in front of the TV enhanced (OR = 1.96; p = 0.01), and practicing physical exercises reduced the odds of depressive symptoms (OR = 0.64; p = 0.052). According to the final multiple models described in Table 4, increased time in front of the TV (OR = 1.90; p = 0.027) and poor sleep quality (OR = 1.98; p = 0.006) increased the odds of depressive symptoms; lower intake of fruit juices (OR = 0.54; p = 0.048) reduced these odds. When the sociodemographic variables were included in the model, the time in front of the TV (OR = 1.83; p = 0.044), the poor sleep quality (OR = 1. 78; p = 0.027), and reduced income (OR = 2.11; p = 0.005) enhanced the odds of depressive symptoms, while the age reduced these odds (OR = 0.96; p = 0.006).

The odds of increasing the body weight from crude models (S4 Table) were augmented with lower vegetable intake (OR = 2.61; p = 0.001), poor sleep quality (OR = 1.76; p = 0.005), increased time in front of the TV (OR = 1.98; p = 0.001), in front of the computer, mobile or other devices (OR = 2.08; p = 0.001) and with the reduction in income (OR = 1.84; p = 0.003). Low intake of sweets and candies (OR = 0.61; p = 0.04), low intake of snacks replacing meals (OR = 0.41; p = 0.001), and higher age (OR = 0.95; p < 0.001) reduced these odds. Multiple analyses including all food components (S5 Table) showed that the low intake of vegetables (OR = 2.96; p = 0.001) enhanced the odds of increasing body weight, while the low intake of poultries (OR = 0.57; p = 0.02) and the low intake of snacks replacing meals (OR = 0.54; p = 0.037) reduced these odds. The models that included physical activity and sedentary behavior simultaneously (S6 Table) pointed out that higher time in front of the computer, mobile, or other devices increased the odds of augmenting the body weight (OR = 1.71; p = 0.03). From the final multiple models (Table 4), the odds of increasing body weight were augmented with low vegetable intake (OR = 2.77; p = 0.002); when the sociodemographic variables were included in the model, whereas low intake of vegetables still increased (OR = 3.00; p = 0.001), the age reduced (OR = 0.95; p = 0.001) these odds.

The odds of self-perceiving health as regular, bad, or very bad from the crude models (S4 Table) were augmented with poor sleep quality (OR = 3.20; p < 0.001), with increased time in front of the TV (OR = 2.64; p < 0.001), in front of the computer, mobile or other devices (OR = 1.94; p = 0.004), with high intake of sweets and candies (OR = 1.72; p = 0.046), and with the reduced income (OR = 1.66; p = 0.029). Practicing physical exercises (OR = 0.30; p < 0.001), higher milk intake (OR = 0.50; p = 0.033), low intake of snacks replacing meals (OR = 0.54; p = 0.02), and older age (OR = 0.97; p = 0.006) reduced these odds. The model with all food components (S5 Table) showed that the self-perceived health as regular, bad, or very bad was reduced with high milk intake (OR = 0.48; p = 0.037). From the models with physical activity and sedentary behavior (S6 Table), the odds were increased with higher time in front of the TV (OR = 2.05; p = 0.01) and reduced with practicing physical exercises (OR = 0.31; p < 0.001). From the final multiple models (Table 4), the odds of regular, bad, or very bad self-perception of health were increased with time in front of the TV (OR = 1.95; p = 0.025) and with poor sleep quality (OR = 2.50; p < 0.001); practicing physical exercises (OR = 0.36; p < 0.001) reduced these odds. The inclusion of sociodemographic variables in the model showed that physical exercises (OR = 0.33; p < 0.001) and older age (OR = 0.97; p = 0.027) reduced the odds of a regular, bad, or very bad self-perception of health; the time in front of the TV (OR = 1.90; p = 0.032) and the poor sleep quality (OR = 2.46; p = 0.001) increased these odds.

We performed some nuanced analyses on the groups that possibly were more affected by the pandemic (subgroup considering only the women and subgroup considering only the persons at the lower formal schooling classification). S7 Table presents the description and changes in our primary outcome (depressive symptoms, body weight changes, and self-perception of health) according to our nuanced analyses. Depressive symptoms more than doubled (+ 42.52% and + 39.88% for females and people with the lower formal schooling, respectively), similar to the whole sample (+ 42.1%). Regarding the regular, bad, or very bad self-perception of health, women increased by 17.32%, and people with lower formal schooling increased by16.07% during SD; the whole sample increased by18.0%. Finally, 60.3% of the women and 51.79% of the people with lower formal

Table 4 Multiple models of logistic regression between the dependent variables (health) and independent (lifestyle and sociodemographic) variables during SD

		Unadjusted models						Adjusted Models@					
Inde-pendent variables		Depressive symptoms		Body weight changes		Perceived health status		Depressive symptoms		Body weight changes		Perceived health status	
	Categories	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value	OR (95%CI)	p-value
Healthy eating markers#													
Beans	Low Intake	1.02 (0.58–1.80)	0.925	0.72 (0.43–1.23)	0.240	1.24 (0.70–2.19)	0.460	1.05 (0.58–1.88)	0.863	0.67 (0.39–1.17)	0.164	1.26 (0.71–2.26)	0.421
	High intake	1.27 (0.69–2.31)	0.432	0.83 (0.47–1.45)	0.517	0.79 (0.41–1.52)	0.494	1.47 (0.79–2.75)	0.216	0.85 (0.48–1.52)	0.598	0.81 (0.42–1.59)	0.553
Vegetables and leaves (raw)	Low Intake	1.37 (0.67–2.77)	0.380	2.77 (1.44–5.30)	0.002	0.96 (0.50–1.85)	0.921	1.32 (0.63–2.75)	0.449	3.00 (1.53–5.85)	0.001	0.96 (0.49–1.86)	0.908
	High intake	1.18 (0.66–2.11)	0.569	1.48 (0.85–2.56)	0.161	0.69 (0.36–1.31)	0.266	1.21 (0.67–2.21)	0.513	1.49 (0.85–2.61)	0.163	0.71 (0.37–1.35)	0.302
Vegetables and leaves (cooked)	Low Intake	0.95 (0.50–1.81)	0.888	0.97 (0.54–1.74)	0.929	1.29 (0.69–2.40)	0.423	0.97 (0.50–1.89)	0.936	0.91 (0.50–1.65)	0.759	1.23 (0.65–2.32)	0.513
	High intake	0.72 (0.39–1.33)	0.298	1.15 (0.63–2.08)	0.633	1.65 (0.83–3.28)	0.149	0.66 (0.35–1.23)	0.195	1.01 (0.55–1.85)	0.956	1.61 (0.81–3.22)	0.172
Fish	Low Intake	1.50 (0.58–3.85)	0.392	1.80 (0.74–4.35)	0.190	0.71 (0.25–1.98)	0.523	1.53 (0.58–3.97)	0.382	1.72 (0.71–4.19)	0.228	0.66 (0.24–1.82)	0.431
	High intake	0.29 (0.01–4.39)	0.375	0.42 (0.02–6.42)	0.539	--	--	0.14 (0.00–2.69)	0.196	0.27 (0.01–4.64)	0.369	--	--
Fruits	Low Intake	1.57 (0.74–3.33)	0.239	1.25 (0.64–2.42)	0.500	0.84 (0.42–1.67)	0.637	1.63 (0.75–3.55)	0.212	1.23 (0.62–2.41)	0.547	0.83 (0.41–1.66)	0.610
	High intake	0.62 (0.35–1.11)	0.110	0.90 (0.52–1.54)	0.708	0.96 (0.52–1.77)	0.905	0.72 (0.39–1.31)	0.288	1.03 (0.59–1.80)	0.904	1.06 (0.57–1.99)	0.839
Unhealthy eating markers#													
Sodas and soft drinks	Low Intake	1.15 (0.61–2.19)	0.649	1.04 (0.58–1.88)	0.883	1.30 (0.68–2.47)	0.416	1.14 (0.59–2.19)	0.693	1.04 (0.56–1.91)	0.890	1.30 (0.68–2.49)	0.414
	High intake	1.63 (0.65–4.10)	0.295	0.90 (0.40–2.01)	0.806	2.19 (0.94–4.81)	0.070	1.73 (0.66–4.49)	0.260	0.83 (0.36–1.89)	0.668	2.19 (0.96–5.03)	0.062
Sweets and candies	Low Intake	1.09 (0.62–1.92)	0.756	0.64 (0.38–1.07)	0.092	1.14 (0.62–2.08)	0.664	1.11 (0.62–1.99)	0.722	0.64 (0.37–1.09)	0.103	1.25 (0.68–2.32)	0.461
	High intake	0.86 (0.46–1.58)	0.631	1.59 (0.88–2.85)	0.119	1.30 (0.69–2.45)	0.404	0.88 (0.46–1.67)	0.704	1.67 (0.91–3.04)	0.092	1.40 (0.73–2.66)	0.302
Snaks replaced a meal	Low Intake	1.22 (0.66–2.26)	0.522	0.59 (0.32–1.06)	0.078	0.74 (0.41–1.35)	0.339	1.33 (0.70–2.52)	0.379	0.61 (0.33–1.12)	0.112	0.76 (0.41–1.40)	0.388
	High intake	2.06 (0.56–7.50)	0.271	1.04 (0.32–3.34)	0.944	1.59 (0.52–4.87)	0.410	1.95 (0.52–7.37)	0.320	1.04 (0.30–3.59)	0.942	1.62 (0.51–5.13)	0.411
Neutral or controversial eating markers#													

Table 4 (continued)

		Unadjusted models						Adjusted Models@					
Red meat	Low Intake	0.94 (0.56–1.57)	0.815	0.65 (0.40–1.06)	0.089	1.06 (0.61– 1.82)	0.828	0.90 (0.53–1.53)	0.702	0.63 (0.39–1.04)	0.076	1.03 (0.59–1.79)	0.894
	High intake	0.93 (0.44–1.96)	0.858	1.12 (0.54–2.30)	0.749	1.10 (0.49–2.47)	0.806	0.92 (0.43–1.98)	0.842	1.12 (0.53–2.35)	0.755	1.04 (0.46–2.37)	0.916
Poultry	Low Intake	0.78 (0.47–1.30)	0.348	0.62 (0.38–1.01)	0.055	0.90 (0.53–1.55)	0.730	0.81 (0.48–1.37)	0.450	0.67 (0.41–1.09)	0.113	0.93 (0.54–1.60)	0.802
	High intake	1.05 (0.44–2.46)	0.904	0.83 (0.38–1.83)	0.657	1.01 (0.42–2.44)	0.976	0.98 (0.41–2.37)	0.979	0.86 (0.39–1.89)	0.714	1.02 (0.42–2.48)	0.953
Fruit juice	Low Intake	0.54 (0.29–0.99)	0.048	0.84 (0.48–1.45)	0.536	1.61 (0.86–3.00)	0.129	0.55 (0.29–1.04)	0.066	0.89 (0.50–1.57)	0.690	1.59 (0.85–2.97)	0.144
	High intake	0.61 (0.29–1.25)	0.179	0.98 (0.50–1.91)	0.964	0.81 (0.35–1.83)	0.618	0.67 (0.32–1.39)	0.286	1.10 (0.56–2.19)	0.768	0.82 (0.36–1.87)	0.641
Milk	Low Intake	0.59 (0.26–1.32)	0.202	0.78 (0.39–1.56)	0.486	0.66 (0.32–1.36)	0.266	0.63 (0.28–1.45)	0.285	0.86 (0.42–1.78)	0.703	0.70 (0.33–1.45)	0.341
	High intake	0.62 (0.28–1.37)	0.242	0.68 (0.34–1.37)	0.291	0.59 (0.29–1.22)	0.161	0.66 (0.29–1.47)	0.312	0.73 (0.36–1.50)	0.403	0.64 (0.31–1.33)	0.235
Sleep quality	Poor	1.98 (1.22–3.23)	0.006	1.52 (0.97–2.39)	0.066	2.50 (1.49–4.20)	0.000	1.78 (1.06–2.98)	0.027	1.34 (0.84–2.16)	0.215	2.46 (1.45–4.19)	0.001
	Good (ref.)	1		1		1		1		1		1	
Physical exercise practice	Yes	0.76 (0.46–1.25)	0.286	1.07 (0.67–1.71)	0.757	0.36 (0.21–0.63)	0.000	0.67 (0.40–1.13)	0.138	0.97 (0.60–1.56)	0.903	0.33 (0.19–0.59)	0.000
	No (ref.)	1		1		1		1		1		1	
Sitting time in front of the TV	Increased	1.90 (1.07–3.35)	0.027	1.45 (0.85–2.46)	0.168	1.95 (1.08–3.50)	0.025	1.83 (1.01–3.32)	0.044	1.41 (0.81–2.43)	0.213	1.90 (1.05–3.43)	0.032
	Reduced	2.20 (0.73–6.61)	0.158	1.12 (0.44–2.88)	0.803	0.83 (0.24–2.80)	0.768	1.98 (0.62–6.28)	0.244	0.98 (0.36–2.61)	0.971	0.74 (0.21–2.54)	0.633
	No change (ref.)	1		1		1		1		1		1	
Sitting time in front of cell phone and other devices	Increased	0.95 (0.52–1.72)	0.876	1.39 (0.80–2.40)	0.238	1.12 (0.60–2.07)	0.707	0.82 (0.44–1.55)	0.560	1.36 (0.77–2.40)	0.285	1.03 (0.55–1.93)	0.905
	Reduced	1.07 (0.37–3.07)	0.886	1.13 (0.45–2.82)	0.789	1.20 (0.44–3.28)	0.717	0.93 (0.31–2.80)	0.907	1.06 (0.41–2.75)	0.894	1.07 (0.38–2.98)	0.896
	No change (ref.)	1		1		1		1		1		1	
Sex	Male							1.47 (0.85–2.53)	0.163	0.67 (0.41–1.12)	0.134	1.15 (0.66–2.03)	0.604
	Female (ref.)							1		1		1	
Age (years)								0.96 (0.93–0.98)	0.006	0.95 (0.93–0.98)	0.001	0.97 (0.94–0.99)	0.027
Changes in income	Reduced							2.11 (1.25–3.55)	0.005	1.39 (0.87–2.22)	0.166	1.18 (0.70–1.98)	0.516
	Mantained or increased(ref.)							1		1		1	

Table 4 (continued)

Unadjusted models	Adjusted Models@

#Low Intake = 0–2 days/week; moderate intake = 3–4 days/week; High intake = 5 or more days/week (moderate intake is the reference category for all the diet questions); @Model including sex, age and changes in the income during SD

schooling referred to increasing their body weight during SD; this percentage was 56.9% in the whole sample.

We could not run the multiple regression models; the number of cases for the three outcomes (presence of depressive symptoms, body weight changes, and self-perception of health) was not sufficient to reach the required degrees of freedom number in the models [25]. Thus, we just tested the single models. In S8 Table, we demonstrate the single regression models between the outcomes and independent variables in the female group. The odds of depressive symptoms increased by sitting time in front of the TV (OR = 3.37; p = 0.003) and the reduced income (OR = 2.92; p = 0.006). The older ages reduced these odds (OR = 0.94; p = 0.042). Regarding changes in body weight, these odds were increased by low fish intake (OR = 6.24; p = 0.026), sitting time in front of the cell phone, computer, and other devices (OR = 2.78; p = 0.010), reduced income (OR = 2.12; p = 0.043), and lower formal schooling (OR = 2.20; p = 0.039); being older decreased these odds (OR = 0.94; p = 0.022). Finally, low fruits and poultry intake (OR = 4.10; p = 0.024 and OR = 3.14; p = 0.020, respectively), high soft drinks intake (OR = 5.50; p = 0.013), poor sleep quality (OR = 3.31; p = 0.011) and sitting time in front the TV (OR = 2.61; p = 0.021) increased the odds of having a poor self-perception of health; the higher milk intake (OR = 0.29; p = 0.033) and practicing physical exercises (OR = 0.35; p = 0.017) reduced these odds.

S9 Table depicts the single regression models between the dependent and independent variables in the lower formal schooling group. The presence of depressive symptoms had the odds increased by poor sleep quality (OR = 2.83; p = 0.003), sitting time in front of the TV, and in front of a cell phone, computer, and other devices (OR = 2.94; p = 0.004 and OR = 2.14; p = 0.042, respectively) and by the decreased income (OR = 2.95; p = 0.003); the older age reduced these odds (OR = 0.93; p = 0.006). The increase in body weight had the odds increased by low intake of vegetables (OR = 3.16; p = 0.014) and sitting time in front of the TV and in front of the cell phone, computer, and other devices (OR = 1.92; p = 0.043 and OR = 2.67; p = 0.003, respectively); being older decreased these odds (OR = 0.92; p = 0.001). The intake of cooked vegetables (OR = 2.26; p = 0.041), the poor sleep quality (OR = 4.18; p < 0.001), the sitting time in front of the TV and front of cell phones, computers, and other devices (OR = 2.27; p = 0.019 and OR = 2.97; p = 0.006 respectively) increased the odds of the poor self-perception of health; in turn, the low intake of snacks replacing meals (OR = 0.39; p = 0.031) and practicing physical exercise (OR = 0.27; p = 0.001) reduced these odds.

Discussion

We investigated changes in lifestyle of PLWH during COVID-19 SD and associated outcomes. Study participants, mainly well-educated and employed men aged over 50 years, reduced their income during SD. They followed SD correctly, and only a small proportion was infected by COVID-19, with few hospitalizations. Although most participants did not modify their diet, those who changed it reduced the intake of healthy eating markers and increased the ingestion of unhealthy ones. Most of the sample referred that their sleep quality worsened during SD. More than half did not practice physical exercises, and about half increased sedentary behavior. The negative self-evaluation of health increased twice during SD, whose odds increased by the sedentary behavior and poor sleep quality; otherwise, physical exercises reduced these odds. Most participants increased their body weight during SD, an outcome independently associated with the low intake of vegetables. Finally, depressive symptoms doubled during SD compared to previously, and this outcome had the odds enhanced by sedentary behavior, poor sleep quality, and reduced income. Interestingly, being older was associated with lower odds of the three outcomes investigated. Our nuanced analyses pointed to similar trends, but being female increased the strength of associations in the single regression models, particularly dietary intake (by higher odds ratio values).

Many published studies in 2020 with non-HIV participants have shown discordant results regarding lifestyle during SD. While in the NutriNet-France study [26] 56.2% of the participants reported a low intake of fresh and healthy foods, in NutriNet-Quebec (Canada) [27], the participants improved the quality of food intake during the early lockdown. Likewise, the NutriNet-Brasil study28 [28] showed that the consumption of healthy eating markers (i.e., vegetables, fruits, beans, and other legumes) increased, and the ingestion of unhealthy dietary markers (i.e., ultra-processed foods) did not change. Finally, an international survey conducted in several countries [12] found higher unhealthy food intake during home confinement. Similar to our results, these authors pointed to higher snack intakes during this period.

We planned our study based on many physiological assumptions. The first one was that the higher intake of healthy eating markers and the lower intake of unhealthy ones would be favorably associated with the study outcomes (depressive symptoms, body weight, and self-perception of health) [29, 30]. In fact, our results yielded some significant associations in our crude regression models, but most of these were not maintained when other independent variables were included in the models. The only exception was the association between body weight and vegetable intake; this association is in accordance with various studies that have shown beneficial components in vegetables, such as fiber, antioxidants, and anti-inflammatory [29]. Anywise, it is relevant to consider the long-term consequences of unhealthy changes in dietary intake during the SD.

Information about sitting time was one of the most outstanding findings in our results. Recent studies have highlighted differences between time in a sedentary state and physical inactivity or low level of physical activity. Sitting time is a state of very reduced energy expenditure and, when combined with stressful mental activities, can create glucose instability with significant physiological consequences. Therefore, sedentary behavior deserves special attention concerning long-term metabolic and mental disorders [31], which will assume greater relevance with the unique sedentary lifestyle imposed by COVID-19 SD; therefore, long-term consequences are yet to be disclosed.

Previous studies have shown associations between sedentary behavior, sleep quality, depressive symptoms, and poor health [31–33]. Thus, we can assume that all these variables created by the uncertainties caused by the pandemic constitute a network of interactions. We observed a simultaneous and independent association between sedentary behavior and low sleep quality, increasing the odds of depressive symptoms and lousy self-perception of health. Previous cross-sectional studies showed, for instance, that internet addiction and poor sleep quality coexist and increase the odds of depressive symptoms [34, 35]. It is essential to highlight that poor sleep quality is a common issue in PLWH, independently of the SD [36].

Apart from the pandemic, chronic conditions and diseases are frequent in PLWH, which are associated with low-grade systemic inflammation (LGSI) [37–39]. The LGSI occurs because of a residual viral action and many side effects of prolonged antiretroviral therapy [40, 41]. Besides the increased cardiovascular risk caused by this inflammatory condition, circulating inflammatory molecules can cross the blood-brain barrier, increasing neuroinflammation and modifying neurotransmitter syntheses, such as melatonin and serotonin. The altered neurotransmitter profile impacts the likelihood of mental health burden, with higher rates of stress and anxiety, and can be a risk factor for developing HIV-associated neurological disorders (HAND) [42, 43]. Therefore, considering the role of lifestyle in managing LGSI and chronic conditions, our results highlight the urgent need for interventions to prevent a future burden of health commitment in this population group [44].

Besides physiological and metabolic issues in the post-COVID-19 moments, the socioeconomic burden has emerged as a worrisome aspect. Cross-sectionally, our sample showed significant associations between reduction in income and the presence of depressive symptoms, verified in other surveys worldwide, with non-HIV-infected persons [45]. It is essential to highlight that the socioeconomic impact of the pandemic varies significantly in different areas of the globe; particularly in Brazil, evident economic inequalities that existed in pre-pandemic times have aggravated with COVID-19, which leads to very bleak expectations [46]. It is fundamental to address inequities in health for specific groups, and in this context, PLWH will need a particular agenda.

An unexpected finding of our study was that older age reduced the odds of the three investigated outcomes, which is discordant with the physiological assumptions we used and with recent publications. For instance, Plagg et al. [47] called attention to the fact that loneliness and social isolation experienced by older adults during COVID-19 may undermine their resilience. Other authors state that multiple comorbidities increase vulnerability to unfavorable outcomes during the pandemic [48, 49]. Based on our data, we hypothesize that the PLWH may have developed mechanisms to improve their resilience or ability to cope with stressful situations.

It is essential, at this point, to mention some limitations of our sample that can impede extrapolating this discussion to other groups of PLWH. Our research setting follows many patients living in more affluent areas of Sao Paulo City, and their privileged social conditions, such as high schooling and employment, could help them deal with the pandemic times. Also, assuming that older sample participants could be receiving the clinic's multidisciplinary follow-up for a long time could explain our analyses' particular findings. Another limitation is our cross-sectional design, which impairs the assumption of causality. Conversely, our findings still raise worrisome concerns about the impact of COVID-19 SD on PLWH and the need to have their long-term consequences carefully followed up and managed. In addition, to our knowledge, this is the first study investigating specifically the dietary habits of PLWH during COVID-19 SD.

In conclusion, we demonstrated relevant changes in lifestyle in PLWH during COVID-19-imposed SD that showed associations with depressive symptoms, body weight, and self-perception of health. These results call attention to the need to carefully follow these population groups to avoid the accumulation of personal and health system burdens.

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Authors' contributions BMV, JVN, MVLSQ and CMM participated in the collection, analyses, and interpretation of the data; RB, ECMS, CMP, KYI, VIAS, ACS participated in the writing and reviewing of the final version; SMLR supervised the project and participated in all steps of the work.

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Data Availability All the supporting data are presented as Supplementary files. Additional information may be obtained upon written request to the corresponding author.

Declarations

Conflict of interest and Source of Funding All the authors declare no conflicts of interest.

Ethics approval The study was approved by the Institutional (Public Health School- University of Sao Paulo)- Review Board protocol # 4,285,897.

Consent to participate All the study's participants signed an informed consent about the research.

Consent for publication Not applicable.

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