Factors associated with changes in sedentary behavior after ICU hospitalization in COVID-19 patients: a cross-sectional study

Fatores associados às mudanças no comportamento sedentário após internação em UTI em pacientes com COVID-19: um estudo transversal

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ABSTRACT

Introduction: Elevated levels of sedentary behavior (SB) are associated with health risks. Patients hospitalized due to COVID-19 complications experienced sequelae that affected their quality of life and lifestyle, leading to significant changes in sedentary behavior. **Objective:** This study aimed to analyze sociodemographic, behavioral, health, and clinical factors associated with changes in different types of sedentary behavior after Intensive Care Units (ICU) hospitalization due to COVID-19. **Material and Methods:** This cross-sectional study, conducted according to the STROBE Statement, included patients hospitalized in ICUs in southern Brazil. Outcomes were self-reported changes in various SB indicators (TV watching, computer use, cell phone use, sitting time during commuting, and work), categorized as maintained, increased, or decreased after hospitalization. Multinomial logistic regression was used, with results expressed as odds ratio (OR) and 95% confidence intervals (95% CI). **Results:** Among 148 participants, 50% were male, with a mean age of 50.1 ± 13.2 years. The perception of increased television viewing time after hospitalization was associated with female sex (OR: 2.45; 95% CI: 1.08; 5.54) and physical inactivity during commuting (OR: 0.17; 95% CI: 0.04; 0.77). Higher education level was associated with the perception of increased computer use (OR: 1.47; 95% CI: 1.12; 1.92) and cell phone use (OR: 1.21; 95% CI: 1.06; 1.37), while the consumption of ultra-processed foods was associated with a lower chance of perceiving a reduction in computer use (OR: 0.59; 95% CI: 0.36; 0.97). **Conclusion:** After ICU hospitalization, sociodemographic, health, and lifestyle factors were associated with changes in sedentary behavior. Particularly, education level and age were strong predictors of changes in different SB types.

Keywords: Health Risk Behaviors; Quality of Life; Hospitalization; Intensive Care Units; COVID-19.

RESUMO

Introdução: Elevados níveis de comportamento sedentário (CS) estão associados a riscos à saúde. Pacientes internados por complicações da COVID-19 apresentaram sequelas que afetaram sua qualidade de vida e estilo de vida, provocando mudanças significativas nos comportamentos sedentários. **Objetivo:** Este estudo teve como objetivo analisar os fatores sociodemográficos, comportamentais, de saúde e clínicos associados a alterações em diferentes tipos de comportamento sedentário após internação em Unidades de Terapia Intensiva (UTI) devido à COVID-19. **Material e Métodos:** Este estudo transversal, conduzido de acordo com a Declaração STROBE, incluiu pacientes internados em UTIs no sul do Brasil. Os desfechos foram mudanças autorrelatadas em diferentes indicadores de CS (tempo de assistência de TV, uso de computador, uso de celular, tempo sentado durante o deslocamento e durante o trabalho), com respostas de manutenção, aumento ou diminuição de cada comportamento após a internação hospitalar. Foi utilizada regressão logística multinomial, com resultados expressos em odds ratio (OR) e intervalos de confiança de 95% (IC 95%). **Resultados:** Entre os 148 participantes entrevistados, 50% eram do sexo masculino, com idade média de 50,1 ± 13,2 anos. A percepção de aumento no tempo assistindo à televisão após a hospitalização foi associado ao sexo feminino (OR: 2,45; IC 95%: 1,08; 5,54) e à inatividade física durante o transporte (OR: 0,17; IC 95%: 0,04; 0,77). A maior escolaridade foi relacionada a percepção de aumento no uso de computador (OR: 1,47; IC 95%: 1,12; 1,92) e celular (OR: 1,21; IC 95%: 1,06; 1,37), enquanto o consumo de alimentos ultraprocessados esteve associado a menor chance de percepção de redução no uso de computador (OR: 0,59; IC 95%: 0,36; 0,97). **Conclusão:** Após a hospitalização em UTI, fatores sociodemográficos, de saúde e de estilo de vida foram associados às mudanças percebidas no comportamento sedentário, sobretudo a escolaridade e idade, foram fortes preditores de mudanças nos diferentes tipos de CS.

Palavras-chave: Comportamentos de Risco à Saúde; Qualidade de Vida; Hospitalização; Unidades de Terapia Intensiva; COVID-19.

INTRODUCTION

Studies on sedentary behavior have gained prominence in recent years, indicating that, at high levels, it can directly impact individuals' health, being associated with a higher incidence of cardiovascular diseases,[1] cancer, depression, and type 2 diabetes,[2] as well as an increased risk of all-cause mortality.[2] Characterized as a type of low-energy expenditure activity performed while awake in a sitting, reclining, or lying position,[3] sedentary behavior occupies the majority of an individual's daily time.[4] This behavior tends to accumulate throughout the day and can occur in different domains, such as during leisure (e.g., time spent in front of screens like television, tablets, or smartphones); work (e.g., sitting in meetings or in front of a computer); and during transportation, as driver or a passenger.[5]

With the COVID-19 pandemic and its restrictive measures, such as social isolation, remote work, and distance learning, sedentary behavior gained greater visibility, reflecting a significant increase worldwide.[6] Although the public health emergency has been declared over,[7] and despite COVID-19 being a potentially severe and recent disease, there is limited evidence on its long-term repercussions, particularly concerning health risk behaviors in patients who experienced severe clinical conditions.

Among COVID-19 survivors who were admitted to Intensive Care Units (ICUs), it is common to experience post-recovery sequelae, such as dysfunctions and disabilities resulting from the hospitalization period, including fatigue, dyspnea, and sleep disturbances.[8] Moreover, excessive sedentary behavior has been associated with higher risks of acute and post-acute COVID-19 sequelae,[9] with this behavior being particularly elevated in this population, showing a median of 9.8 hours per day, three to six months after hospitalization.[10]

Indeed, the main post-COVID-19 symptoms in more severe cases involve fatigue, weakness, dyspnea, and post-exertional malaise,[11] which may contribute to increased sedentary activities and risk behaviors in different types and contexts. Furthermore, emerging evidence in non-critical populations shows that sociodemographic factors, such as older age, female sex, living alone or unemployment, are consistently associated with longer daily sedentary time, independent of physical activity levels.[12] Behavioral risk factors, including insufficient physical activity and unhealthy lifestyle patterns, often co-occur with increased sedentary behavior and may further compromise recovery after severe illness,[12,13] particularly in the context of COVID-19.[14]

Finally, in critical-care populations, clinical indicators such as longer duration of mechanical ventilation or prolonged ICU/hospital stay have been associated with persistently high levels of sedentary behavior and poorer physical function during recovery.[15] Thus, identifying the population subgroups that increased their sedentary behavior after the critical period of ICU hospitalization and investigating how these variables relate to post-ICU changes in sedentary behavior may assist in preventive actions through health education and rehabilitation, such as promoting and encouraging healthy habits.[16]

However, despite the growing evidence on sedentary behavior and post-COVID-19 sequelae, little is known about which sociodemographic, behavioral, health, and clinical factors are associated with changes in different types of sedentary behavior after ICU hospitalization due to COVID-19. Identifying these determinants is also essential to support targeted rehabilitation strategies and reduce long-term health risks in this vulnerable population.

Given the above, this study aimed to analyze the sociodemographic, behavioral, health, and clinical factors associated with changes in time spent in different types of sedentary behavior after ICU hospitalization in patients admitted due to COVID-19. We hypothesized that older age, female sex, worse health indicators, lower physical activity levels, and more severe clinical characteristics (e.g., longer ICU stay and mechanical ventilation) would be associated with greater increases in sedentary time after discharge.

MATERIAL AND METHODS

This was a cross-sectional study conducted via a census involving adult and elderly patients who were hospitalized in the ICU due to COVID-19 at a university hospital in southern Brazil, from April 2020 to December 2021, and who were treated by a multidisciplinary healthcare team consisting of doctors, nurses, nursing technicians, physiotherapists, and speech therapists. This research followed the STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology) to ensure proper reporting of observational studies.[17]

Patients who contracted COVID-19 during hospitalization for another primary cause and those who passed away due to the disease or other reasons were excluded from the study. All participants received an Informed Consent Form sent via WhatsApp® or email for them to read and later confirm through verbal consent, recorded via a telephone call. Data collection was conducted through telephone interviews and a review of medical records from June 2022 to July 2023. For cases in which consent was indicated, up to three contact attempts were made before considering the participant a sampling loss.

The study's questionnaire was developed based on various validated instruments in the literature,[18-21] as well as the patients' medical records. Given the brief

post-COVID-19 period in which the study was conducted, no instruments had been formally validated for post-ICU COVID-19 patients in Brazil at that time. Nevertheless, the selected instruments have established validity in other populations and contexts related to sedentary behavior and lifestyle factors.

The outcomes for the present study were self-reported changes in risk behaviors related to sedentary behavior (time spent watching television, using a computer, using a cell phone, sitting during transportation, and sitting at work), structured according to the multi-domain approach proposed by Mielke et al,[20] with response options related to the maintenance, increase, or decrease in these indicators after ICU hospitalization for COVID-19.[19]

The exposures included the following variables: a) demographic variables, such as sex (male and female), age (completed years), skin color (white and black/mixed race, with other categories excluded due to a small number of subjects), and marital status (with or without a partner); b) socioeconomic variables, including education level, categorized according to years of completed schooling (0–4 years: primary school; 5–8 years: middle school; 9-11 years: high school and ≥12: higher education); c) behavioral variables, based on the Surveillance System of Risk and Protective Factors for Chronic Diseases by Telephone Survey for adults in Brazil (VIGITEL),[21] including physical inactivity across (leisure, transportation, occupational and domestic domains), (based on self-reported absence of activity in the previous week), consumption of ultra-processed foods (days per week), and excessive alcohol consumption (≥ 5 drinks on one occasion for men and ≥ 4 drinks for women); d) health conditions, such as quality of life (physical and mental domains), using items derived from the Brazilian version of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) with scores ranging from 0 to 100[18], with higher scores indicating better quality of life, and self-reported conditions such as respiratory diseases (asthma, bronchitis, and/or chronic obstructive pulmonary disease), mental health conditions (anxiety and/or depression), and cardiovascular/metabolic diseases (diabetes, obesity, and/or hypertension); and e) clinical conditions, based on medical records regarding ICU stay duration (days) and length of respiratory support during hospitalization (days).

For data analysis, the Stata statistical software package, version 15.0 (Stata Corporation, College Station, United States), was used. Descriptive statistics included estimates of absolute (n) and relative (%) frequencies and 95% confidence intervals (95% CI) for categorical variables, as well as means and standard deviations (SD) for continuous variables. Analytical statistics employed multinomial logistic regression, with results expressed as odds ratios (OR). The OR was interpreted based on the reference value of 1.0; an OR > 1.0 indicates a higher likelihood of the outcome occurring in the exposed group compared to the reference group, OR < 1.0 indicates a lower likelihood, and OR = 1 indicates no association.[22] Adjustments for all analyses were made hierarchically, considering the following blocks of variables: a) demographic; b) socioeconomic; c) behavioral; d) health conditions; and e) clinical conditions. The backward selection technique was used, with a critical p-value of ≤ 0.20 for variables to remain in the statistical model, in order to control for possible confounding factors. A significance level of 5% was adopted for all analyses.

This research was approved by the Department of Physical Education of the Federal University of Santa Catarina, under Sigpex registration: 202202622 and by the Research Management of the Polydoro Ernani de São Thiago University Hospital, under registration number 1664, and by the Human Research Ethics Committee of the Federal University of Santa Catarina, under opinion number 54352821.7.0000.0121.

RESULTS

Among the 198 eligible patients for the study, 148 were interviewed. Their mean age and schooling were 50.1 (±13.2) and 10.4 years (±3.5), respectively. The average time between hospital discharge and the interview was 19.2 months (575.4 days (±161.8)), while the average ICU stay was 12.4 days (±8.8), and the duration of respiratory support was 9.0 days (±8.6). Table 1 presents the main characteristics of the study sample. The Table 2 presents the different types of sedentary behavior.

The analysis of self-reported changes in different types of sedentary behavior (Figure 1) indicates that, with the exception of cell phone use, which showed a slight increase, most patients reported maintaining their behaviors after hospitalization for COVID-19.

Table 1: Characteristics of patients hospitalized in intensive care units due to Covid-19 at the University Hospital of Florianópolis, 2020–2022 (n = 148).

Variables	n	%	95%CI
Sex			
Male	74	50.0	41.9; 58.1
Female	74	50.0	41.9; 58.1
Age (years)			
≤29	7	4.7	2.3; 9.7
30-39	28	18.9	13.3; 26.1
40-49	33	22.3	16.2; 29.8
50-59	36	24.3	18.0; 32.0
60-69	34	23.0	16.8; 30.5
≥70	10	6.8	3.6; 12.2
Skin color			
White	100	69.0	61.0; 76.0
Black/Brown	45	31.0	24.0; 39.1
Marital status			
No partner	52	35.9	28.4; 44.1
With partner	93	64.1	55.9; 71.6
Education (years)			
Primary school (0-4)	13	9.2	5.4; 15.2
Middle school (5-8)	28	19.7	13.9; 27.2
High school (9-11)	49	34.5	27.1; 42.8
Higher education (≥12)	52	36.6	29.0; 44.9
Physical inactivity in leisure			
No	59	42.1	34.2; 50.6
Yes	81	57.9	49.4; 65.8
Physical inactivity during commuting			
No	20	20.8	13.7; 30.3
Yes	76	79.2	69.7; 86.3
Physical inactivity at work			
No	48	63.2	51.6; 73.4
Yes	28	36.8	26.6; 48.4
Physical inactivity at home			
No	74	52.1	43.8; 60.3
Yes	68	47.9	39.7; 56.2
Smoking			
Non-smoker	138	97.9	93.5; 99.3
Smoker	3	2,1	0.7; 6.5
Excessive alcohol consumption			
No	109	77.3	69.6; 83.5
Yes	32	22.7	16.5; 30.4
Consumption of ultra-processed foods (days/week)			
Does not consume	26	17.6	12.2; 24.6
Consumes 1–2 days	47	31.7	24.7; 39.8
Consumes ≥3 days	75	50.7	42.6; 58.7

Respiratory diseases			
No	102	73.9	65.9; 80.1
Yes	36	26.1	19.4; 34.1
Metabolic and cardiovascular diseases			
No	41	29.3	22.3; 37.4
Yes	99	70.7	62.6; 77.7
Mental disorders			
No	46	33.1	25.7; 41.4
Yes	93	66.9	58.6; 74.3
ICU Time			
≤ 10 days	75	50.7	42.6; 58.7
≥ 11 days	73	49.3	41.3; 57.4
Mechanical ventilation time			
Not used	22	14.9	9.9; 21.6
≤ 10 days	73	49.3	41.3; 57.4
≥ 11 days	53	38.8	28.4; 43.9
Time from hospital discharge to interview			
≤1 year	11	7.4	4.1; 13.0
1–2 years	100	67.6	59.5; 74.7
>2 years	37	25.0	18.6; 32.7

Legend: n: absolute frequency; %: relative frequency; 95%CI: 95% confidence interval. Excessive alcohol consumption was defined as ≥5 drinks (men) and ≥4 drinks (women) on a single occasion in the past month. Respiratory diseases included asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). Metabolic and cardiovascular diseases included diabetes, obesity, and arterial hypertension. Mental disorders included anxiety and depression. Intensive Care Units (ICU).

Table 2: Time spent in different types of sedentary behavior during weekdays and Sundays among patients hospitalized in intensive care units due to Covid-19 at the University Hospital of Florianópolis, 2020–2022 (n = 148).

Type of sedentary behavior	**Mean (hours/day)**	**95%CI**
Cell phone		
During weekdays	4.16	3.65; 4.68
Sunday	3.51	3.03; 3.99
Computer		
During weekdays	0.92	0.55; 1.28
Sunday	0.53	0.26; 0.80
Television		
During weekdays	2.49	2.08; 2.91
Sunday	2.82	2.35; 3.28
Time spent sitting in vehicles		
During weekdays	1.39	1.07; 1.70
Sunday	0.93	0.70; 1.16
Time spent sitting at work		
During weekdays	2.26	1.67; 2.84
Sunday	0.71	0.32; 1.10

Legend: "During weekdays" refers to a typical day from Monday to Friday.

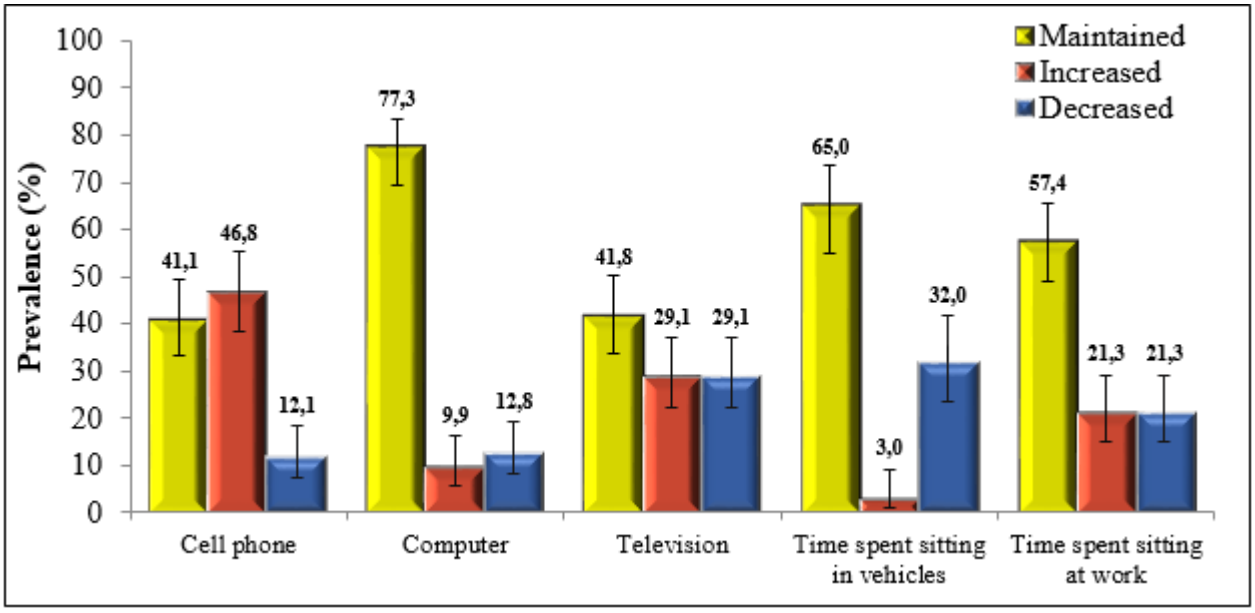

Figure 1: Changes in the duration of different types of sedentary behavior following intensive care unit hospitalization among patients admitted for COVID-19 at the University Hospital of Florianópolis (n = 148).

Adjusted analyses of factors associated with perceived changes in sedentary behavior following ICU hospitalization for COVID-19 identified female sex as associated with higher chances of perceived increase in TV time (OR: 2.45; 95% CI: 1.08; 5.54), whereas individuals who were physically inactive during transportation had lower chances of reporting a decrease in TV time (OR: 0.17; 95% CI: 0.04; 0.77). Regarding computer use, higher education level was associated with higher chances of perceived increase in computer use, while consumption of ultra-processed foods was associated with lower chances of reporting a reduction in computer use (OR: 0.59; 95% CI: 0.36; 0.97). Regarding cell phone use, higher education was again associated with higher chances of perceived increase (OR: 1.21; 95% CI: 1.06; 1.37).

Individuals with more years of education had lower chances of perceived increase in TV time (OR: 0.86; 95% CI: 0.75; 0.98), and those physically inactive at work had higher chances of reporting a reduction in this sedentary behavior (OR: 10.60; 95% CI: 1.74; 64.38). Age was associated with lower chances of perceived increase in computer use (OR: 0.95; 95% CI: 0.91; 1.00), suggesting that younger individuals were more likely to experience this change. For transportation, participants reporting better mental health-related quality of life had lower chances of perceived increase in sitting time (OR: 0.98; 95% CI: 0.96; 1.00), while older age was associated with higher chances of reporting a reduction in this behavior (OR: 1.04; 95% CI: 1.01; 1.07). Regarding time spent sitting at work, individuals with a metabolic and/or cardiovascular disease had higher chances of reporting a reduction in sitting time (OR: 6.40; 95% CI: 1.12; 36.48). Table 3 summarizes the significant results for the different types of sedentary behavior.

Table 3: Factors associated with changes in different indicators of sedentary behavior after intensive care unit hospitalization for Covid-19 (n = 148). Southern Brazil, 2022 - 2023.

Variables	Increase versus Maintenance				Reduction versus Maintenance			
	Crude Analysis		Adjusted Analysis		Crude Analysis		Adjusted Analysis	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Television time								
Sex								
Male	1.00		1.00		1.00		1.00	
Female	2.45*	1.08; 5.54	2.46*	1.08; 5.60	1.81	0.81; 4.06	1.80	0.80; 4.03
Education (years)	0.86*	0.76; 0.97	0.86*	0.75; 0.98	0.97	0.86; 1.10	0.95	0.83; 1.08
Physical inactivity during commuting								
No	1.00		1.00		1.00		1.00	
Yes	0.33	0.09; 1.27	0.34	0.06; 1.90	0.32	0.09; 1.08	0.17*	0.04; 0.77
Physical inactivity at work								

No	1.00		1.00		1.00		1.00	
Yes	0.39	0.11; 1.33	0.81	0.16; 4.00	3.52	0.87; 14.19	10.60*	1.74; 64.38
Quality of life								
Physical domain	0.98*	0.96; 1.00	0.97	0.95; 1.00	0.99	0.97; 1.00	0.98	0.96; 1.01
Mental domain	0.98*	0.97; 1.00	0.99	0.92; 1.06	0.98*	0.96; 1.00	0.99	0.94; 1.04
Computer time								
Age (years)	0.95*	0.91; 1.00	0.95*	0.91; 1.00	0.99	0.95; 1.02	0.99	0.95; 1.02
Education (years)	1.50*	1.15; 1.94	1.47*	1.12; 1.92	1.17	0.99; 1.39	1.17	0.98; 1.40
Physical inactivity in leisure								
No	1.00		1.00		1.00		1.00	
Yes	0.29*	0.09; 1.02	0.31	0.05; 1.87	1.32	0.46; 3.79	1.41	0.31; 6.37
Ultra-processed food (days)	1.12	0.84; 1.51	0.75	0.42; 1.35	0.86	0.65; 1.15	0.59*	0.36; 0.97
Cell phone time								
Education (years)	1.20*	1.07; 1.34	1.21*	1.06; 1.37	1.13	0.96; 1.33	1.11	0.93; 1.33
Physical inactivity in leisure								
No	1.00		1.00		1.00		1.00	
Yes	0.57	0.27; 1.20	0.44	0.16; 1.19	0.25*	0.08; 0.79	0.34	0.06; 1.97
Physical inactivity at home								
No	1.00		1.00		1.00		1.00	
Yes	0.93	0.46; 1.88	0.67	0.24; 1.84	0.12*	0.02; 0.55	0.11	0.01; 1.04
Time spent sitting in vehicles								
Age (years)	1.02	0.99; 1.05	1.02	0.99; 1.05	1.04*	1.01; 1.07	1.04	1.01; 1.07
Excessive alcohol								
No	1.00		1.00		1.00		1.00	
Yes	0.52	0.19; 1.40	0.57	0.21; 1.54	0.36*	0.13; 1.00	0.42	0.15; 1.20
Quality of life								
Physical domain	0.98*	0.96; 1.00	0.99	0.96; 1.03	0.98*	0.97; 1.00	0.99	0.96; 1.01
Mental domain	0.98*	0.96; 1.00	0.98*	0.96; 1.00	0.99	0.97; 1.00	0.99	0.97; 1.01
Time spent sitting at work								
Education (years)	1.15	1.00; 1.31	1.14	0.99; 1.32	1.06	0.94; 1.20	1.04	0.91; 1.19
No	1.00		1.00		1.00		1.00	
Yes	1.61	0.61; 4.24	1.12	0.24; 5.12	1.35	0.53; 3.44	6.40	1.12; 36.48

Legend: OR: Odds Ratio; 95% CI: 95% Confidence Interval; *: P-value ≤ 0.05; Ultra-processed food (days): consumption of at least 1 day/week; Excessive alcohol consumption: ≥ 5 drinks on one occasion (men) and ≥ 4 drinks on one occasion (women); Physical domain: functional capacity, limitations due to physical aspects, pain, and general health status; Mental domain: vitality, social aspects, emotional aspects, and mental health; Mental disorders: anxiety and/or depression; Metabolic and cardiovascular diseases: diabetes, obesity, and/or hypertension.

DISCUSSION

This study aimed to investigate factors associated with changes in the duration of different types of sedentary behavior following ICU hospitalization among patients admitted for COVID-19. Higher level of education was identified as a significant risk factor for increased time spent on computers and cell phones, while it was associated with a lower risk of increased television time. Age also emerged as a significant variable, where younger people were more likely to increase computer use, and older individuals had a greater likelihood of reducing sitting time during transportation. Additionally, other factors, particularly behavioral ones such as physical inactivity and health conditions, also appeared to influence sedentary behaviors.

Higher education level was associated with an increased likelihood of spending more time on computers and mobile phones, but with a lower risk of increased television viewing. This pattern has been observed in the general population before the pandemic, largely due to greater access to digital technologies, occupational demands involving computer use,[23] and higher purchasing power and internet accessibility.[24] However, among COVID-19 ICU survivors, these disparities may be amplified by post-hospitalization inequalities. Individuals with lower education and income tend to experience more physical and psychological complications after ICU discharge,[25] which may limit engagement in active leisure and favor television as a more accessible form of sedentary entertainment. These findings suggest that rehabilitation programs should account for digital access and socioeconomic context when designing post-ICU behavioral interventions.

Age also played a significant role. Younger individuals were more likely to increase computer use, whereas older individuals were more likely to reduce sitting time during transportation. Screen-based sedentary behaviors tend to decline with advancing age,[26] often due to difficulties in handling digital technologies.[27] In contrast, older adults may reduce transportation-related sitting due to persistent physical sequelae, such as fatigue, myalgia, and functional limitations,[28] as well as fear of infection and retirement status.[29,30] These findings indicate that post-ICU rehabilitation strategies should be age-sensitive, addressing digital sedentary exposure among younger survivors and mobility limitations among older adults.

Gender differences were also observed, with women more likely to increase television viewing. Population-based studies show that women generally watch more television content, such as movies and series than men,[31] and in the post-COVID-19 ICU context this tendency may be intensified. A meta-analysis demonstrated that women have a higher risk of developing post-COVID-19 syndrome for any symptom, including fatigue, respiratory, and mental health issues,[32] which may reinforce social isolation and passive leisure. Additionally, accumulated domestic responsibilities during recovery may further restrict opportunities for active behaviors. These findings underscore the importance of gender-sensitive rehabilitation and social support strategies.

Behavioral factors were strongly associated with changes in sedentary domains. Physically inactive individuals during commuting were less likely to decrease television time. The resumption of in-person work may have reintroduced active commuting, reducing time available for television viewing.[33] For ICU survivors, restoring mobility, even in the presence of persistent symptoms, may function both as a necessity and as a rehabilitation strategy.[34] Conversely, individuals physically active at work were less likely to reduce television viewing, possibly because post-work fatigue leads to passive recovery behaviors such as watching television.[35] This compensatory pattern may be accentuated in post-ICU patients due to reduced functional reserve.

Additionally, higher consumption of ultra-processed foods was associated with a lower probability of reducing computer use. According to Pereira et al. (2021), the high consumption of ultra-processed foods is related to higher education levels among Brazilian adults.[36] Furthermore, more years of schooling are associated with longer screen exposure times.[23] This suggests an interconnected relationship between educational level, ultra-processed food consumption, and screen-related behaviors.

Mental health emerged as a protective factor. Better quality of life in the mental health domain was associated with a lower likelihood of increased sitting time in vehicles. The relationship between mental health and physical activity is bidirectional,[37] and psychological distress is highly prevalent among post-ICU COVID-19 patients.[38] Thus, incorporating psychological screening and support into rehabilitation programs may indirectly reduce sedentary behavior by facilitating engagement in active routines.

Furthermore, individuals with better quality of life in the mental health domain exhibited a lower likelihood of increased sitting time in vehicles. This finding may reflect the bidirectional relationship between mental health and physical activity, whereby better psychological well-being facilitates engagement in active behaviors, such as active commuting, while psychological distress is associated with lower physical activity levels.[37] This association is particularly relevant among post-ICU patients, in whom persistent psychological symptoms and long COVID manifestations may hinder both physical activity resumption and social reintegration.[38]

Additionally, individuals with metabolic and/or cardiovascular diseases were more likely to reduce

sitting time at work, possibly due to increased health awareness and medical recommendations encouraging physical activity and lower sedentary behavior.[39] Given the elevated cardiometabolic risk among post-COVID ICU survivors,[40] structured counseling and follow-up may represent an important opportunity to promote long-term behavioral change.

This study is, to our knowledge, pioneering in investigating different types of sedentary behavior among patients who were hospitalized in the ICU due to COVID-19. Additionally, it explored different associated variables and factors, including clinical aspects of the disease, by collecting data from medical records. However, several limitations should be noted. First, the variability in the time between hospitalization and the interview for each patient may have impacted their health and quality of life at the time of the survey, potentially introducing recall bias, as participants were required to compare current behaviors with their pre-hospitalization period, which may have occurred up to two years earlier. This may have influenced the accuracy of self-reported changes in sedentary behaviors. Another limitation is the risk of reverse causality, especially in analyses involving behavioral changes and participant perceptions, which makes it difficult to establish clear cause-and-effect relationships. Furthermore, the difficulty in contacting ward patients, due to the lack of connection with healthcare professionals, limited the sample to ICU patients, potentially restricting the representativeness of the broader population affected by COVID-19. Although the study had a satisfactory sample size, it was limited to patients who participated until May 2023, potentially missing behavioral changes that may have occurred afterward.

From a public health perspective, these findings support the development of structured post-ICU rehabilitation pathways that explicitly address sedentary behavior. Interventions should include cardiovascular and respiratory rehabilitation programs tailored to functional limitations, health education initiatives focused on reducing prolonged screen exposure, and strategies promoting active commuting when feasible. Policies must also consider the expansion of digital technologies and remote work models, which may perpetuate screen-based sedentary behaviors. Longitudinal studies are needed to clarify the long-term trajectory of sedentary behavior after ICU discharge and to inform sustainable public health strategies.

CONCLUSION

In conclusion, following ICU hospitalization, patients exhibited distinct conditions associated with increases in different types of sedentary behavior, including sociodemographic, health, and lifestyle factors, with particular emphasis on education and age. These findings should be considered in the development of public health prevention and rehabilitation policies.

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