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Use of wearable technology to monitor physical activity in conditions of social isolation.

Uso de tecnologia vestível no monitoramento da atividade física em condições de isolamento social.

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ABSTRACT

During the COVID-19 pandemic, people around the world have been affected by strict restrictions on movement and social isolation, thus limiting access to physical activity. The objective of this study was to analyze the variations in the level of physical activity related to the time of physical exercise, number of steps and time standing in Apple Watch users. Regardless of gender, a significant reduction in the number of steps during the period of social isolation was observed in eutrophic and overweight subjects. An increase in the percentage of Exercise Days (%/mo) was observed only in the obese in June. In overweight subjects of both genders, they were the ones who presented a greater physical exercise levels per day and per week. The main reduction in Stand (hr/day) occurred in eutrophic men, and the greatest increase in obese women. Based on the results, we conclude that in the same way that the implementation of restrictive measures of social isolation initially provided an increase in sedentary behavior and a reduction in the practice of exercises, with the extension of these measures, new opportunities and alternatives emerged for changing behavior related to physical activity due to the increase in free time and greater concern with health care.

Keywords: Covid-19; Physical activity; Wearable Electronic Devices.

RESUMO

Durante a pandemia do COVID-19, pessoas do mundo todo foram afetadas pelas rígidas restrições de movimento e isolamento social, limitando assim o acesso à atividade física. O objetivo do estudo foi analisar as variações do nível de atividade física relacionadas ao tempo de exercício físico, número de passos e do tempo em pé, em usuários do Apple Watch. Independentemente do sexo, observou-se uma redução significativa no número de passos durante o período de isolamento social em indivíduos eutróficos e com sobrepeso. Um aumento no percentual de Dias de Exercício (%/mês) foi observado apenas nos obesos. Nos indivíduos com sobrepeso em ambos os sexos, foram os que apresentaram o maior tempo de exercício físico por dia e por semana. A principal redução do tempo em pé ocorreu nos homens eutróficos. Com base nos resultados, concluímos que da mesma forma que a implementação de medidas restritivas de isolamento social inicialmente proporcionou aumento do comportamento sedentário e redução da prática de exercícios, com a ampliação dessas medidas surgiram novas oportunidades e alternativas para a prática de atividade física devido ao aumento do tempo livre e maior preocupação com os cuidados com a saúde.

Palavras-chave: Covid-19; Atividade física; Dispositivos Eletrônicos Vestíveis.

INTRODUCTION

In order to slow down the spread of COVID-19, many countries around the world have adopted restrictive policy measures that have had an impact on the population's freedom of movement, thus drastically changing people's daily routine (CHEN; MAO; NASSIS; HARMER *et al.*, 2020). Government-imposed restrictions mainly affected indoor activities such as gym, but even outdoor activities were limited by these measures (GUERRERO; VANDERLOO; RHODES; FAULKNER *et al.*, 2020). This undoubtedly had an impact on the physical activity patterns and contributed to the increase in sedentary behavior (MARGARITIS; HOUDART; EL OUADRHIRI; BIGARD *et al.*, 2020).

Physical inactivity is used to describe people who are not performing sufficient amounts of moderate and vigorous-intensity physical activity, not meeting the World Health Organization's (WHO) and the American College of Sports Medicine’s (ACSM) physical activity guidelines (VAN DER PLOEG; HILLSDON, 2017). Even brief periods of sedentary behavior and physical inactivity can be deleterious to muscle tissue (NARICI; DE VITO; FRANCHI; PAOLI *et al.*, 2020). Studies have shown that a reduction of 1000 to 1500 steps/day for two weeks leads to increased visceral fat, reduced insulin sensitivity and impaired lipid metabolism, with a decrease in fat-free mass and cardiovascular capacity (PINTO; DUNSTAN; OWEN; BONFÁ *et al.*, 2020).

The advance of wearable technologies with a built-in accelerometer system in smartphones and smartwatches has allowed continuous and long-term data to be obtained on the physical activity patterns (NISSEN; SLIM; JÄGER; FLAUCHER *et al.*, 2022). Consequently, wearable tracking technology has automated the process of monitoring physical activity, with acceptable accuracy and with the possibility of replicating free-living behavior (GERMINI; NORONHA; BORG DEBONO; ABRAHAM PHILIP *et al.*, 2022).

Recently, smartwatches have been recognized as an effective tool for monitoring physical activity patterns in clinical and research environments, due to the convenience of their use and the real-time monitoring of physical activities, energy expenditure, number of steps and heart rate (CREASER; CLEMES; COSTA; HALL *et al.*, 2021).

Released in 2015, Apple Watch sold 31 million units in 2019 (ANALYTICS, 2019), making it the most popular smartwatch available. Considering its growing popularity and unique features, Apple Watch has enormous potential for use in epidemiological research on physical activity (KWON; KIM; BAI; BURNS *et al.*, 2021).

A study in youth and adults that examined the validity of the estimated caloric expenditure in Apple Watch reported moderate to strong correlations (range: r=0.71 to 0.88) and acceptable measurement error (14.1% to 24. 3%) when compared to indirect calorimetry (ZHANG; GODIN; OWENS, 2019). Additionally, Apple Watches have demonstrated a moderate to high level of validity and reliability in measuring physical activity (FULLER; COLWELL; LOW; ORYCHOCK *et al.*, 2020).

The objective of this study was to analyze the variations in the level of physical activity related to the time of physical exercise, number of steps and time standing in Apple Watch users, as well as the association between gender and nutritional status with the periods before and during the implementation of social isolation measures due to the COVID-19 pandemic.

METHODS

Study design

A retrospective longitudinal observational study was performed. The subjects were invited to the research through social networks in July 2020. Those who agreed to participate in the survey received an explanatory video via WhatsApp on how to share Apple Watch data.

The procedures used in this research complied with the Criteria of Ethics in Research with Human Beings according to resolution nº 466/12 of the National Health Council, opinion number: 4.450.145. After receiving guidance on the protocols and objectives of the study, the participants signed the Informed Consent Term (ICT), which was carried out online.

Study variables

After completing the informed consent form, Apple Watch users provided information on their health conditions during the period from January to June 2020, in order to verify if they had any health problems that prevented them from exercising. Data on age (years), gender, body mass (kg) and height (meters) were also obtained. Body mass and height were used to calculate the body mass index (BMI) and also to classify the nutritional status into: underweight, normal weight, overweight and obese (MANCINI, 2016).

After being instructed on how to access the monthly physical activity reports, subjects sent them to the researcher via WhatsApp to be examined.

The number of registered days that the user used the smartwatch in each month was obtained from the records available in the activities calendar, this data was used to establish smartwatch usage patterns. Considering that the months don't have the same number of days, this data was converted into a percentage of days of use per month, being called "Active days (%/mo)". These data were obtained to analyze whether there were differences between months regarding the number of days of use and to control for possible sources of bias.

Also in the activities calendar, information was obtained on the number of days of physical exercise recorded per month, which was also converted into a percentage of days of monthly physical activity, called "Exercise Days (%/mo). The purpose of this data is to analyze the variation in the proportion of the number of days of the month in which the subject performed training sessions.

The Exercise variable (min/day) represents the average daily minutes of activities for days with training sessions. To calculate the minutes of physical activity per week, Exercise (min/day) and the number of days with a training session per month were used. Physical Activity (min/wk) was used to classify the subjects' Physical Activity Level (PAL) (min/wk) in: Sedentary (0 min/wk); Little active (<150 min/wk); Active (150-300 min/wk); and Very active (> 300 min/wk) (BULL; AL-ANSARI; BIDDLE; BORODULIN *et al.*, 2020).

The number of steps per day Steps (n/day) was used to analyze the level of physical activity related to commuting in: Sedentary (<5000 steps/day); Little active (5000 - 7499 steps/day); Insufficient active (7500 - 9999 steps per day); Active (10000 - 12500 steps/day); Very active (> 12500 steps/day) (MAHMOOD; NETTLEFOLD; ASHE; PUYAT *et al.*, 2022). Standing time Stand (hr/day) was interpreted as a physical activity parameter related to work and daily activities.

All data were stratified into non-systematized and systematized physical exercise data. Non-systematized physical activity corresponds to physical activity performed at work, study and commuting. For the analysis of non-systematized physical activity, information on standing time (hr/day) and number of steps (n/day) were used. Regarding systematized physical exercise, information on Exercise Day (%/mo), Exercise (min/day) and Physical Activity (min/wk) were used.

Considering that in the state of São Paulo the decree instituting the beginning of social isolation measures only started on March 23, 2020, we consider the month of March as a pre-social isolation period. According to Decree nº 64.953, restrictive social isolation measures such as suspension of non-essential activities, closure of retail stores and recommendation for the population to wear a mask remained unchanged from April to June 2020 (SECRETARIA DE, 2020).

For results analysis the follow-up period was stratified into pre- and during- social isolation phase. The pre-phase corresponds to the months of January, February and March, and during-phase corresponds to the months of April, May and June in which social isolation measures were implemented by the state government (São Paulo). To compare the pre- and during- phases, the average of the three months corresponding to each phase was calculated for the parameters of physical activity and energy expenditure.

Statistical analysis

Qualitative variables were described by the absolute (N) and relative (%) frequency distribution. Quantitative variables were described by mean and standard deviation (SD). The comparison of means between the months was performed using the repeated measures ANOVA. The homogeneity of variances was analyzed using Levene's test, and Mauchly's test was used to test the hypothesis of sphericity, in case of sphericity rejection, analyzes would be based on the Greenhouse-Geisser multivariate test. Post-Hoc comparisons were performed using the Bonferroni test. For all analyses, SPSS software version 19.0 for Windows was used, with a significance level of 5%.

RESULTS

The sample consisted of 94 subjects of both gender, 46.8% men and 53.2% women. Regarding the nutritional status analyzed by the body mass index (BMI), 50.0% eutrophic, 42.6% overweight and 7.4% obese. When comparing the gender, using the t Student test, no significant difference was observed for age (male 34.4 ± 7.5 and female 34.2 ± 7.1 years; p-value = 0.901), however, for BMI (male 26.2 ± 2.8 and female 24.5 ± 3.9 kg/m2; p-value = 0.0.018); p-value = 0.901) significantly higher values were observed in males.

No significant variation was observed in the PAL (min/wk) for Physical Activity (min/wk) between the months (Table 1). For PAL (min/wk) classification by Steps (n/day), a significant increase of sedentary subjects was observed in April and May when compared to January and February, but without significant variation for the other months (Table 2).

Table 1 - Absolute (N) and relative (%) frequency distribution of physical activity level PAL (min/wk) considering Physical Activity (min/wk) from January to June.

		N	%	CI95%	
				Inferior	Superior
January	Sedentary	13	13,8	7,4	21,3
	Little active	40	42,6	31,9	52,1
	Active	19	20,2	12,8	27,7
	Very active	22	23,4	16,0	33,0
February	Sedentary	9	9,6	4,3	16,0
	Little active	38	40,4	29,8	50,0
	Active	25	26,6	18,1	35,1
	Very active	22	23,4	16,0	31,9
March	Sedentary	4	4,3	1,1	8,5
	Little active	47	50,0	39,4	59,6
	Active	24	25,5	17,0	34,0
	Very active	19	20,2	11,7	28,7
April	Sedentary	8	8,5	3,2	14,9
	Little active	50	53,2	43,6	63,8
	Active	14	14,9	8,5	22,3
	Very active	22	23,4	14,9	33,0
May	Sedentary	8	8,5	3,2	14,9
	Little active	46	48,9	38,3	59,6
	Active	19	20,2	11,7	28,7
	Very active	21	22,3	13,8	31,9
June	Sedentary	5	5,3	1,1	9,6
	Little active	45	47,9	37,2	57,4
	Active	20	21,3	13,8	29,8
	Very active	24	25,5	17,0	35,1

Note: 95% confidence interval (95%CI) for relative frequency distribution (%).

Table 2 - Distribution of absolute (N) and relative (%) frequency of PAL (min/wk) considering Steps (n/day) from January to June.

		N	%	CI95%	
				Inferior	Superior
January	Sedentary	32	34,0	**24,5**	**43,6**
	Little active	38	40,4	29,8	51,1
	Insufficiently active	17	18,1	10,6	25,5
	Active	6	6,4	2,1	11,7
	Very active	1	1,1	0,0	3,2
February	Sedentary	30	31,9	**22,3**	**41,5**
	Little active	42	44,7	34,1	55,3
	Insufficiently active	19	20,2	12,8	28,7
	Active	1	1,1	0,0	4,2
	Very active	2	2,1	0,0	5,3
March	Sedentary	39	41,5	30,9	52,1
	Little active	37	39,4	29,8	48,9
	Insufficiently active	16	17,0	9,6	25,5
	Active	2	2,1	0,0	5,3
	Very active	0	0,0	0,0	0,0
April	Sedentary	53	56,4	**46,8**	**66,0**
	Little active	28	29,8	21,3	38,3
	Insufficiently active	9	9,6	4,3	16,0
	Active	2	2,1	0,0	5,3
	Very active	2	2,1	0,0	5,3
May	Sedentary	55	58,5	**48,9**	**68,1**
	Little active	27	28,7	20,2	37,2
	Insufficiently active	11	11,7	5,3	19,1
	Active	1	1,1	0,0	3,2
	Very active	0	0,0	0,0	0,0
June	Sedentary	47	50,0	40,4	60,6
	Little active	31	33,0	23,4	42,6
	Insufficiently active	11	11,7	5,3	19,1
	Active	3	3,2	0,0	7,4
	Very active	2	2,1	0,0	5,3

Note: STEPS (n/day); 95% confidence interval (95%CI) for relative frequency distribution (%).

No significant variation was observed between the months for Active Days (%mo), Exercise Days (%/mo), Exercise (min/day) and Physical Activity (min/wk). In March and April, an increase in Exercise Days (%/mo) was observed compared to February. April showed a significant reduction in Stand (h/day) compared to February, March and June. In June, there was a significant increase in Stand (h/day) compared to May (Table 3).

As for Steps (n/day), a great variation was observed between the months. In March, there was a significant reduction in Steps (n/day) compared to January and February. In April and May, a significant reduction was observed in Steps (n/day) compared to January, February and March. In June, although a significant increase in Steps (n/day) was observed in relation to April and May, it still presented lower values in comparison to January and February (Table 3).

Table 3 - Comparison of the mean and standard deviation (SD) of the data obtained on active days, physical activity, standing time and steps.

	Months												
	January		February		March		April		May		June		p-valor
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Active Days (%/mo)	68,0	37,1	74,5	33,9	71,4	29,5	68,4	33,8	70,4	33,2	75,4	31,7	0,171
Exercise Days (%/mo)	26,9	29,5	**26,6a**	26,5	**32,5b**	29,5	**34,9b**	32,9	31,7	30,9	33,3	30,5	0,002*
Exercise (min/day)	28,1	27,9	29,3	26,8	30,0	25,8	27,9	28,0	27,9	27,9	31,2	30,0	0,357
Physical Activity (min/wk)	192,9	218,8	188,0	188,1	194,3	207,3	180,9	214,5	188,8	221,9	203,8	219,5	0,451
Stand (hr/day)	8,3	4,5	**8,7ac**	4,3	**8,2ac**	3,9	**6,9b**	4,3	**7,7ab**	4,4	**8,3c**	4,5	0,001*
Steps (n/day)	**5858ac**	2737	**6173a**	2560	**5291,9 bc**	2325	4552 d	2611	4655 d	2411	5181 bc	2680	<0,001 *

Note: * indicates significant difference by repeated measures Anova for p-value ≤ 0.05. Different letters indicate a significant difference by the Post-hoc Bonferroni test for p-value ≤ 0.05. Physical Activity (PA); hours per day in a standing position (Stand); number of steps per day (Steps).

Regarding Exercise (min/day), Physical Activity (min/wk) and Stand (hr/day) a significant reduction was observed between the moments before and during social isolation among eutrophic men. In obese women, an increase in Stand (hr/day) was observed during social isolation in relation to the period before. Considering Steps (n/day), eutrophic and overweight men and women showed a significant reduction during the period of social isolation. However, in obese women, an increase in Steps (n/day) was observed during social isolation (table 4).

Table 4 - Comparison of the mean and standard deviation (SD) of the study variables for the interaction between gender, nutritional status and period (pre: January, February and March mean; during: April, May and June mean).

Variable	Nutritional Status	Male				Female				**Anova**
		Pre		During		Pre		During		**p-valor**
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	**Interaction**
Exercise Days (%/mo)	Eutrophic	19,2	17,7	13,4	12,2	**31,6**	**28,3**	**39,3ǂ**	28,2	**0,018****
	Overweight	33,3	30,5	38,0	34,2	30,2	26,9	35,2	33,9	
	Obese	25,4	20,6	27,8	40,8	**16,4**	**17,2**	**41,4ǂ**	**19,7**	
Exercise (min/day)	Eutrophic	**22,3**	**14,9**	**13,5ǂ**	8,6	27,3	20,5	31,9	23,9	**0,021****
	Overweight	39,0	31,0	36,7	31,6	29,8	31,9	29,6	36,0	
	Obese	26,2	14,0	24,6	25,3	12,7	18,2	27,8	17,9	
Physical Activity (min/wk)	Eutrophic	**129,0**	**101,1**	**67,4ǂ**	**60,6**	174,5	164,5	193,5	187,2	**0,049****
	Overweight	267,0	232,0	269,1	242,1	205,8	246,4	206,6	280,5	
	Obese	169,4	115,6	173,4	199,4	96,6	139,5	183,9	107,9	
Stand (hr/day)	Eutrophic	**7,0**	**3,3**	**4,7ǂ**	**3,3**	7,5	3,9	6,6	3,7	**0,011****
	Overweight	10,4	3,8	10,2	3,8	8,8	3,2	7,8	3,9	
	Obese	9,8	2,0	9,8	1,3	**6,9**	**6,2**	**11,0ǂ**	**3,1**	
Steps (n/day)	Eutrophic	**4520**	**1808**	**2993ǂ**	**1791**	**5480**	**2086**	**4615ǂ**	**2371**	**0,007***
	Overweight	**7109**	**2012**	**6040ǂ**	**2172**	**6058**	**2207**	**4642ǂ**	**2302**	
	Obese	6397	836	6302	3075	**3710**	**3899**	**6099ǂ**	**2070**	

Note: ǂ difference in relation to the pre-period between gender and nutritional status; *** Significant interaction between gender, nutritional status and period (pre vs. during); ** Significant interaction between sex and period (pre vs. during); * Significant interaction between nutritional status and period (pre vs. during).

DISCUSSION

Although recent studies indicate that the COVID-19 pandemic has had important impacts on reducing the levels of physical activity of the population in all countries (URZEALA;

DUCLOS; CHRIS UGBOLUE; BOTA *et al.*, 2022), and the association of social isolation recommendations with a reduction in energy expenditure in physical activities of daily living, this should not prevent the practice of physical exercises to maintain health (WORLD HEALTH, 2020).

Even though the use of wearable technologies can contribute to an increase in PAL (min/wk) (DIFRANCISCO-DONOGHUE; JUNG; STANGLE; WERNER *et al.*, 2018), we observed that in the months prior to social isolation (January, February and March) a large part of the sample was classified as little active in terms of minutes of physical exercise per week.

Although the results did not show statistically significant differences regarding the distribution of PAL (min/wk) between the months, in April we observed the lowest proportion of active subjects and the highest proportion of less active subjects. However, in the following months, May and June, a PAL (min/wk) distribution similar to the pre-isolation period was observed, suggesting a reorganization to return to physical activity patterns after the implementation of social isolation measures.

Regarding Exercise Days (%/mo), a significant increase was observed in March and April compared to February. This can be explained by the carnival holiday, which in 2020 took place in February. It is worth noting that on June 1st, 2020, the “São Paulo Plan” was implemented, which initiated actions related to health protocols for the economic resumption of non-essential services and activities during the pandemic. (GOVERNO DO ESTADO DE SÃO, 2020). Thus, in June, even with limitations on schedules and number of users per hour, the gyms were reopened. The factor that may explain the increase in Exercise Days (%/mo) in April (period when social isolation measures was imposed) may be associated to the greater availability of free time, which is consider the main barrier to physical exercise practice (DIAS; LOCH; GONZÁLEZ; ANDRADE *et al.*, 2017).

When analyzing the gender effect on the variation in Exercise Days (%/mo), it was observed that only women showed a significant increase in March, April and June compared to February. Among the factors that may be associated with this increase in women alone is the greater concern with health care among women (COSTA-JÚNIOR; COUTO; MAIA, 2016). However, no significant difference was observed between genders in Days of Exercise (%/mo), Exercise (min/day) and Physical Activity (min/wk), although studies indicate higher levels of physical activity in men (FRONTINI; REBELO-GONÇALVES; AMARO; SALVADOR *et al.*, 2021).

Nutritional status had a significant influence on Exercise (%/mo). Obese women showed a significant increase in the proportion of training sessions in the isolation period compared to the previous period. Among the factors that may have contributed to the increase in Exercise Days (%/mo) among obese individuals, we can highlight the fact that obesity represents a risk factor for complications and hospitalizations due to COVID-19 (SAWADOGO; TSEGAYE; GIZAW;

ADERA, 2022), and this may have increased the motivation of these subjects to adopt healthy habits.

When analyzing the data, regardless of gender and nutritional status, no significant variation was observed between the months for the Physical Activity (min/wk) and Exercise (min/day), although April showed lower mean values. However, when grouping the months in pre and during social isolation period, a significant interaction was observed between gender and Physical Activity (min/wk) and Exercise (min/day) in eutrophic men, who showed a significant reduction during social isolation.

Studies indicate that men prefer to perform strength training with the use of equipment (BAI; WELK; NAM; LEE *et al.*, 2016), and less frequently perform physical exercises at home (LI; PROCTER-GRAY; CHURCHILL; CROUTER *et al.*, 2017). Considering that during social isolation access to gyms was restricted, a greater reduction in physical exercise time is expected among those with a preference for strength training.

The greater Physical Activity (min/wk) and Exercise (min/day) levels, was observed in overweight subjects in both genders. Although studies indicate that the impacts of social isolation measures would have been greater in reducing physical activity level in more active individuals (MARTÍNEZ-DE-QUEL; SUÁREZ-IGLESIAS; LÓPEZ-FLORES; PÉREZ, 2021; MCCARTHY; POTTS; FISHER, 2021), our results indicate that the most active subjects had the smallest variation.

Another way to classify the PAL (min/wk) is through step number (SAINT-MAURICE; TROIANO; BASSETT; GRAUBARD *et al.*, 2020). The number of steps per day has been identified as an important parameter to quantify and classify the population's physical activity patterns (BASSETT; TOTH; LAMUNION; CROUTER, 2017), in addition it represents an achievable goal for all age groups and health conditions. (KRAUS; JANZ; POWELL; CAMPBELL *et al.*, 2019).

It is worth mentioning that the number of steps per day reflects the pattern of physical activity in a broad way, as it includes both systematic activities associated with physical exercise, as well as for commuting and work activities. When classifying PAL (min/wk) by Steps (n/day), a significant increase of sedentary subjects was observed in April and May when compared to January and February.

Regardless social isolation measures, a large sample proportion had a sedentary PAL (min/wk), little active and/or insufficiently active related to Steps (n/day). This reflects the current way of life with reduced active work functions (COURTEMANCHE; PINKSTON; RUHM; WEHBY, 2016), increased technological innovation and the influence of the home office on the total amount of physical activity performed during working hours (GUPTA; HEIDEN; AADAHL; KORSHØJ *et al.*, 2016).

Regardless of gender, a significant reduction in Steps (n/day) during the period of social isolation was observed in eutrophic and overweight subjects. However, in obese women an increase in Steps (n/day) was observed in the same period, possibly due to the use of walking as physical exercise. For obese women walking represents a low-impact exercise for the joints, with relevant contributions to physical conditioning and body composition (STEINHILBER, 2018), in addition, the fact that it can be performed anywhere and at any time makes this type of physical exercise the best option for this group (KAUPKE, 2020).

Although in the present study it was not possible to directly assess the sitting time, which is used to estimate the sedentary time, Stand (hr/day) reflects sedentary behavior in an inverse and indirect way. Thus, the reduction in Stand (hr/day) suggests an increase in sitting and sedentary time. In April we observed a reduction in Stand (hr/day) compared to February and March. In June, an increase in Stand (hr/day) was observed compared to April and May.

The main reduction in Stand (hr/day) during the period of social isolation occurred in eutrophic men, and the main increase in obese women. A study that analyzed the relationship of screen time with gender and age, it was found that women aged between 31 and 50 have less screen time than men (CAVAZZOTTO; DE LIMA STAVINSKI; QUEIROGA; DA SILVA *et al.*, 2022). Although both gender showed an increase in sedentary time during the COVID-19 pandemic, it was found that in men, this increase was more expressive than in women (ELVÉN; KERSTIS; STIER; HELLSTRÖM *et al.*, 2022). In general, both the adoption of social isolation measures and the population's concern to reduce exposure to the risk of COVID-19 contagion contributed to a reduction in physical activity level and an increase in sedentary time (AMMAR; BRACH; TRABELSI; CHTOUROU *et al.*, 2020).

CONCLUSION

Based on the results we conclude that in the same way that the implementation of restrictive measures of social isolation initially provided an increase in sedentary behavior and a reduction in the practice of exercises, with the extension of these measures new opportunities and alternatives emerged for changing behavior related to physical activity due to the increase in free time and greater concern with health care.

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