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COVID transmission-related concerns impact on physical activity behavior: data from the iCare study across Americas

Preocupações relacionadas à transmissão de covid impactam no comportamento de atividade física: dados do estudo iCare nas Américas

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ABSTRACT

Objective**:** We explored the relationship between COVID-19 transmission-related concerns and reduced physical activity during COVID (RPAC). Methods: We analyzed data from 2,543 participants across Argentina, Brazil, Colombia, Canada, and the USA with at least 200 participants per country. The two primary concerns assessed were: a) fear of being infected, and 2) concern about personal health if infected. Participants were asked to report changes in their physical activity (PA) behavior since COVID-19 pandemic started. Results: The sample was predominantly female (75.7%), with 66.9% aged between 30-64 years. The prevalence of participants who reported RPAC remained stable in South American countries but increased in Canada (+7.8 percentage points [p.p.]; p = 0.001) and decreased in the USA (-9.7 pp; p = 0.003). Concerns about personal health were significantly associated with RPAC in South America (PR = 1.47; 95% CI: 1.09; 1.97), while no association was found in North America. Notably, participants from Colombia (PR = 1.90; 95% CI: 1.09; 3.31), and the USA (PR = 1.48; 95% CI: 1.01; 2.17) were more likely to report RPAC due to COVID-19 concerns. Conclusion**:** While participants reduced their PA behavior in South American countries and Canada during the first 15 months of the pandemic, COVID-19-related concerns stayed high. In contrast in the USA less participants reported RPAC, as concerns decreased, suggesting a shift in PA behavior as COVID-19-related concerns lessened.

Keywords: Physical activity; COVID-19; Pandemic; Health behaviors.

RESUMO

*Objetivo: Exploramos a relação entre preocupações relacionadas à transmissão da covid-19 e atividade física reduzida durante a covid (AFRC). Métodos**: Analisamos 2.543 participantes na Argentina, Brasil, Colômbia, Canadá e EUA com pelo menos 200 participantes por país. As duas principais preocupações avaliadas foram: a) medo de ser infectado e 2) preocupação com a saúde pessoal se infectado. Os participantes relataram mudanças em seu comportamento de atividade física (AF) desde o início da pandemia da covid-19. Resultado: A amostra era predominantemente feminina (75,7%), com 66,9% com idade entre 30-64 anos. A prevalência de AFRC permaneceu estável nos países da América do Sul, mas aumentou no Canadá (+7,8 pontos percentuais [p.p.]; p = 0,001) e diminuiu nos EUA (-9,7 pp; p = 0,003). Preocupações com a saúde pessoal foram significativamente associadas ao AFRC na América do Sul (RP = 1,47; IC 95%: 1,09; 1,97), enquanto nenhuma associação foi encontrada na América do Norte. Notavelmente, participantes da Colômbia (RP = 1,90; IC 95%: 1,09; 3,31) e dos EUA (RP = 1,48; IC 95%: 1,01; 2,17) foram mais propensos a relatar AFRC devido a preocupações com a covid-19. Conclusão: Enquanto o comportamento de AF reduziu e permaneceu baixo em países da América do Sul e Canadá durante os primeiros 15 meses da pandemia, as preocupações relacionadas à covid-19 permaneceram altas. Em contraste, a AF aumentou nos EUA à medida que as preocupações diminuíram, sugerindo uma mudança no comportamento de AF à medida que as preocupações relacionadas à covid-19 diminuíram.*

Palavras-chave*: Atividade física; Covid-19; Pandemia; Comportamentos de saúde.*

Introduction

Infection disease outbreaks, such as COVID-19, have significantly impacted people's lives. Increased time spent at home led to changes in daily routines, including heightened workloads (i.e., home chores and remote working) and reduced access to facilities, among other factors[1,2]. Concerns about infection, economic decay, the social impact of the pandemic, and restricted access to healthcare have been reported[3,4]. This environment of uncertainty has affected physical and men-

tal health[5], as well as health-related behaviors[6,7].

Physical activity (PA) is a complex behavior influenced by various factors, including social, psychological, and economic elements[8]. Limited access to facilities, lack of professional advice, and avoidance of public gatherings might have contributed to a decline in PA during the pandemic[9]. Environmental changes, such as those imposed by COVID-19 (e.g., social distancing, lockdowns), often left individuals feeling unsafe, uneasy, and anxious[10], further negatively influencing PA behavior. Concerns about contracting the virus and the potential health consequences of infection may also have played a role in this context[11].

The benefits of PA, especially during the pandemic, have been extensively studied due to its benefits for physical and mental health[12]. PA levels, particularly during leisure time, were already low in many low- and middle-income countries before the pandemic[13]. Several studies have reported a decline in PA during COVID-19, a worrying trend given that inactivity is associated with numerous health issues[14–16]. Additionally, PA has shown significant benefits for managing long-COVID symptoms, such as fatigue, cough, loss of smell and taste, and headache[17,18]. The impact of COVID-19, including the number of cases, death rates, and the policies adopted to reduce virus spread, likely affected PA behavior differently across countries[19–22]. Understanding these variations could provide valuable insights for managing future pandemics. Thus, the aim of this study was to explore the relationship between COVID-19 transmission-related concerns and changes in PA during the COVID-19 pandemic across various countries in North and South America.

Methods

Study design

The **I**nternational Assessment of **C**OVID-19-related **A**ttitudes, Concerns, **Re**sponses, and Impacts to Public Health Policies (iCARE) Study is a large-scale Canadian-led multi-wave international study that investigates public awareness, attitudes, concerns, and behavioral responses to public health policies (https://www.icarestudy.com). The iCARE study aims to provide a comprehensive understanding of how people were impacted by the pandemic. More details about the iCARE study can be found elsewhere[23].

This study was conducted in accordance with the Declaration of Helsinki on human research. All study protocols were approved by the Research Ethics Committee of the coordinating study site CIUSSS-NIM (REB#: 2020-2099 / 03-25-2020) and the ethics institutional board from the School of Physical Education, Federal University of Pelotas, Brazil (CAAE: 48632821.0.0000.5313). All participants provided written informed consent before taken part in the study.

Data collection and sampling strategy

The iCare study utilized two data collection methods: a global convenience sample and a representative sample in target countries. We used data from the convenience sample in this study. Briefly, an online snowball recruitment strategy was used, with a survey link (LimeSurvey©) distributed through the network of collaborators. These collaborators were encouraged to share the link widely. In addition, the study was disseminated through multiple international channels, such as professional networks, associations (e.g., International Society of Behavioral Medicine, Heart and Stroke Foundation); community organizations (e.g., Red Cross, Doctors Without Borders, YMCA network); social media (e.g., Twitter, Facebook, Instagram); and personal contacts.

The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020, and despite the introduction of vaccines and a reduction in cases and deaths, COVID-19 continues to be a public health emergency of international concern. For this study, we analyzed data collected between September 2020 and June 2021 from South and North American countries with sample sizes ≥ 200 participants, including Argentina, Brazil, Colombia, Canada, and the USA. Because Canada's sample size was disproportionately larger than the other countries, we randomly selected 20% of the Canadian participants to balance the sample sizes across countries.

Physical activity during COVID

Participants were asked on how their PA changed since the onset of the COVID-19 pandemic to the following question: In general, how have the following behaviours changed since the start of COVID-19?. They could choose from six response options: *1) I do this a lot more; 2) I do this more; 3) I do this as much as; 4) I do this less; 5) I do this a lot less; 6) I don't do this.* We excluded those participants who reported not practicing any PA. For analyses proposes, reduced PA during COVID (RPAC) was defined as those who reported doing "less" or "a lot less" comparing to prior pandemic. Based on this, a binary variable (yes/no) for RPAC was created.

COVID-19 transmission-related concerns

Participants were asked about their concerns related to COVID-19, including concerns about infection, health consequences, returning to normal routines, infecting others, and economic recession. To address our research question, two specific concern variables were analyzed: a) concern about being infected, and b) concern about personal health as a result of infection. Participants responded to these concerns using four options: 1) Not at all; 2) Very little; 3) Somewhat; 4) To a great extent. For analysis purposes, we merged options 1 and 2.

Covariates

Sociodemographic variables such as gender (male, female), age (years), and education level (High school or lower, and Graduate or postgraduate degree) are known determinants of PA and were included as covariates in adjusted analyzes[24].

Data analyzes

We reported descriptive data by proportions (%) and their respective 95% confidence interval (CI). We evaluated changes in the prevalence of RPAC and COVID-19 transmission-related concerns across three time periods (T1: from Sep 15 to Dec 14 2020, T2: from Dec 15 2020 to Mar 14 2021, T3: from Mar 15 to Jun 15) using a variance-weighted least squares regression. We present the estimates as percentage points (pp), with increasing or decreasing trends indicated by a p-value <0.05, while stability was indicated by a p > 0.05. We conducted crude and adjusted Poisson regression analyzes to evaluate the relationship between RPAC and health concerns (regarding infection and its impact on health). Analyses were adjusted for gender, educational level, and age. Regression results are presented as prevalence ratios (PR) and their 95% confidence interval (CI). A p-value < 0.05 was assumed for statistical significance. All analyses were conducted in Stata 15.1.

Results

Descriptive data

A total of 2,543 participants were analyzed (T1 n = 933; T2 n = 774; T3 n = 836). Most participants were women (75.7%), aged between 30 and 64 (66.9%), and held a graduate degree (82.4%). Brazil had a higher proportion of young adults (42.4%) and the lowest of elderly participants (1.7%). Regarding concerns about being infected with COVID-19, participants from South American countries reported the highest levels of concern, ranging from 45.1% to 60.2%. In contrast, participants from North American countries were predominantly "somewhat concerned" (38.7% to 42.8%). Concerns about the health impact of COVID-19 "to a great extent" were high in both South (53.1% to 62.9%) and North American (40% to 45.4%) countries (Table 1).

Figure 1 shows the proportions of RPAC in the overall sample, as well as in North and South America, and by country. The prevalence of participants reporting RPAC was higher in the South America compared to North America (48.6% versus 46.7%). Among South American countries, Argentina had the highest prevalence of RPAC (51.5%), while Brazil had the lowest (44.1%). In North America, RPAC was more prevalent in Canada (47.9%) compared to the USA (43.7%).

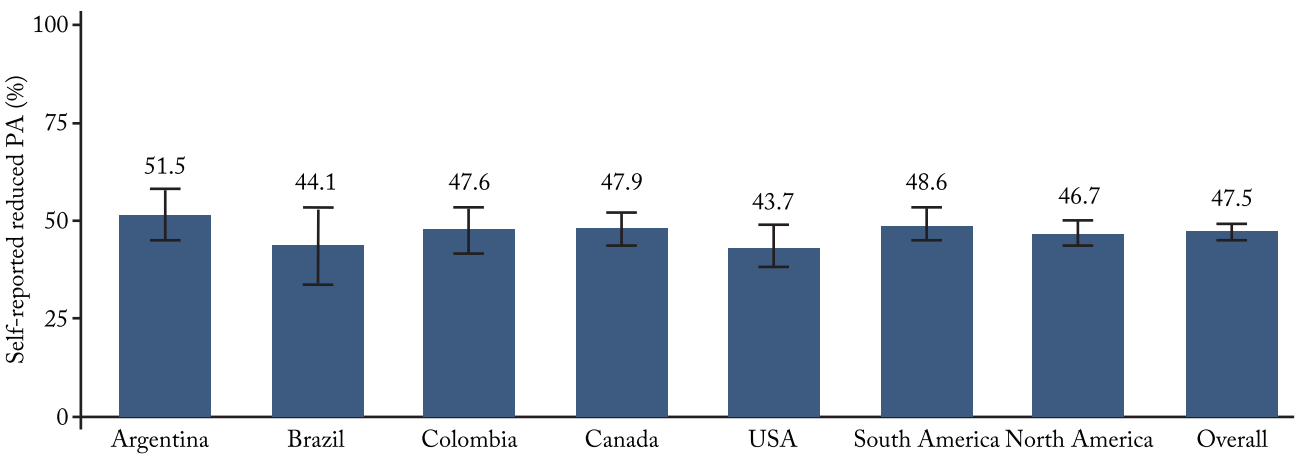

Figure 1 – Prevalence and their respective 95% confidence interval of reduced physical activity during COVID by country, Americas, and overall sample.

Table 1 – Descriptive characteristics of included sample on sociodemographic, and COVID-19 related concerns.

	Overall (n = 2,543)		South America (n = 1,222)		North America (n = 1,321)		Argentina (n = 453)		Brazil (n = 359)		Colombia (n = 410)		Canada (n = 909)		USA (n = 412)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Gender																
Female	75.7	(73.9; 77.4)	75.9	(73.5; 78.3)	75.4	(73.2; 77.7)	79.7	(75.7; 83.1)	73.7	(68.9; 78.0)	73.6	(69.1; 77.7)	77.0	(74.1; 79.7)	72.0	(67.4; 76.1)
Male	24.3	(22.6; 26.0)	24.1	(21.7; 26.5)	24.6	(22.3; 26.9)	20.3	(16.8; 24.3)	26.3	(22.0; 31.1)	26.4	(22.3; 30.9)	23.0	(20.3; 23.9)	28.0	(23.9; 32.6)
Age (years)																
≤ 29	18.9	(17.5; 20.6)	25.2	(22.8; 27.8)	13.2	(11.5; 15.1)	14.6	(11.6; 18.2)	42.4	(37.3; 47.6)	21.9	(18.2; 26.2)	12.8	(10.7; 15.2)	14.1	(11.0; 17.8)
30-64	66.9	(64.9; 68.7)	68.3	(65.6; 70.9)	65.5	(62.9; 68.1)	77.8	(74.0; 81.4)	55.9	(50.7; 61.0)	68.7	(64.0; 73.0)	61.4	(58.1; 64.5)	74.6	(70.1; 78.6)
≥ 65	14.2	(12.8; 15.6)	6.5	(5.2; 8.0)	21.3	(19.2; 23.6)	7.4	(5.5; 10.5)	1.7	(7.6; 3.7)	9.4	(6.9; 12.6)	25.8	(23.0; 28.8)	11.3	(8.6; 14.8)
Education level																
High School or lower	17.6	(16.1; 19.2)	16.1	(14.0; 18.5)	18.9	(16.7; 21.2)	16.3	(13.0; 20.1)	22.5	(18.0; 27.8)	11.1	(8.2; 14.7)	23.3	(20.6; 26.3)	8.8	(6.3; 12.2)
Graduate or postgraduate degree	82.4	(80.8; 83.9)	83.9	(81.6; 85.9)	81.1	(78.8; 83.2)	83.7	(79.8; 86.9)	77.5	(72.2; 81.9)	88.9	(85.3; 91.8)	76.7	(73.7; 79.4)	91.2	(87.8; 93.7)
Concern about infection																
Very little	20.5	(18.8; 22.3)	14.4	(12.2; 16.8)	25.7	(23.2)	17.9	(14.1; 22.6)	6.5	(4.1; 10.0)	17.5	(13.8; 22.1)	26.7	(23.7; 29.9)	23.3	(18.9; 28.3)
Somewhat	38.9	(36.8; 41.1)	35.7	(32.7; 38.9)	41.7	(38.8; 44.6)	36.3	(31.2; 41.7)	33.3	(28.0; 39.1)	37.3	(32.2; 42.6)	42.8	(39.4; 46.4)	38.7	(33.4; 44.2)
To a great extent	40.6	(38.4; 42.8)	49.9	(46.7; 53.1)	32.7	(29.8; 35.5)	45.7	(40.3; 52.1)	60.2	(54.3; 65.8)	45.1	(39.8; 50.6)	30.4	(27.3; 33.8)	38.0	(32.8; 43.5)
Concern about personal health																
Very little	19.6	(17.9; 21.4)	13.9	(11.9; 16.4)	24.3	(21.9; 26.9)	17.6	(13.7; 22.2)	10.4	(7.3; 14.5)	13.6	(10.3; 17.7)	24.1	(21.2; 27.2)	24.9	(20.4; 30.0)
Somewhat	32.1	(30.1; 34.2)	29.8	(26.9; 32.8)	34.1	(31.3; 36.9)	29.2	(24.5; 34.5)	26.8	(21.9; 32.3)	32.9	(28.0; 38.2)	35.8	(32.6; 39.3)	29.7	(24.8; 35.0)
To a great extent	48.3	(46.1; 50.5)	56.2	(52.9; 59.4)	41.5	(38.7; 44.5)	53.1	(47.6; 58.6)	62.9	(57.0; 68.3)	53.4	(48.1; 58.8)	40.0	(36.6; 43.5)	45.4	(39.9; 50.9)

Association between reduced physical activity and COVID-19 transmission-related concerns

Crude and multivariable models examining the relationship between COVID-19 related concerns and reduced PA are presented in Table 2. No significant association was found between RPAC and concern about being infected in the overall sample or in both South and North Americas. However, when analyzing countries individually, participants in the USA who were "somewhat concerned" about being infected were more likely to report RPAC.

Regarding concerns about participants' health, the overall sample analysis revealed that participants who were concerned "to a great extent" were more likely to report RPAC (PR = 1.17; 95% CI: 1.01; 1.35). In South America, high levels of concern were associated with RPAC (PR = 1.47; 95% CI: 1.09; 1.97); however, no association was observed in North America. When analyzing individual countries, an association was found in Colombia for participants who were "somewhat concerned" (PR = 1.96; 95% CI: 1.11; 3.46) and concerned "to a great extent" (PR = 1.90; 95% CI: 1.09; 3.31). A similar association was observed in the USA for those "somewhat concerned" (PR = 1.48 95% CI: 1.01; 2.17) (Table 2).

Trend analysis

The variation in the prevalence of RPAC and concerns over time is shown in Table 3. In South America, the prevalence of RPAC and both concerns remained stable, except in Argentina, where concerns about being infected decreased (-5.3pp, p = 0.045). When all South American countries were analyzed together, RPAC and concerns about health remained stable, while a negative trend was observed in concerns about being

Table 2 – Crude and adjusted analyzes between reduced PA during COVID and COVID-19 transmission-related concerns across American countries.

	Overall		South America		North America		Argentina		Brazil		Colombia		Canada		USA	
	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI
Concern about infection																
Crude																
Very little	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Somewhat	1.09	(0.95; 1.26)	1.15	(0.89; 1.49)	1.06	(0.90; 1.26)	1.09	(0.76; 1.57)	1.22	(0.23; 6.42)	1.26	(0.86; 1.86)	0.93	(0.77; 1.12)	1.64	(1.11; 2.43)[a]
To a great extent	1.14	(0.99; 1.31)	1.20	(0.94; 1.54)	1.11	(0.93; 1.32)	1.17	(0.83; 1.66)	1.39	(0.27; 7.08)	1.27	(0.87; 1.86)	1.05	(0.86; 1.27)	1.43	(0.95; 2.14)
Adjusted																
Very little	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Somewhat	1.08	(0.94; 1.25)	1.13	(0.87; 1.47)	1.06	(0.89; 1.26)	1.08	(0.75; 1.55)	1.33	(0.31; 5.72)	1.25	(0.84; 1.86)	0.93	(0.77; 1.13)	1.64	(1.10; 2.46)[a]
To a great extent	1.14	(0.99; 1.32)	1.17	(0.90; 1.50)	1.12	(0.94; 1.34)	1.13	(0.80; 1.61)	1.40	(0.34; 5.73)	1.25	(0.85; 1.84)	1.06	(0.96; 1.28)	1.48	(0.98; 2.23)
Concern about personal health																
Crude																
Very little	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Somewhat	1.13	(0.97; 1.32)	1.42	(1.04; 1.95)[a]	1.05	(0.88; 1.25)	1.08	(0.71; 1.63)	1.43	(0.40; 5.04)	2.11	(1.19; 3.73)[a]	0.93	(0.77; 1.13)	1.48	(1.01; 2.17)[a]
To a great extent	1.17	(1.01; 1.34)[a]	1.54	(1.14; 2.08)[a]	1.03	(0.87; 1.21)	1.35	(0.94; 1.94)	1.65	(0.50; 5.49)	2.01	(1.15; 3.53)[a]	0.94	(0.77; 1.13)	1.37	(0.96; 1.98)
Adjusted																
Very little	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Somewhat	1.12	(0.96; 1.31)	1.32	(0.97; 1.81)	1.07	(0.90; 1.29)	1.07	(0.70; 1.64)	1.15	(0.35; 3.73)	1.96	(1.11; 3.46)[a]	0.95	(0.77; 1.16)	1.52	(1.03; 2.25)[a]
To a great extent	1.17	(1.01; 1.35)[a]	1.47	(1.09; 1.97)[a]	1.06	(0.89; 1.27)	1.35	(0.94; 1.94)	1.35	(0.44; 4.12)	1.90	(1.09; 3.31)[a]	0.97	(0.80; 1.19)	1.40	(0.95; 2.05)

PA = Physical activity; PR = Prevalence ratio; CI = Confidence Interval. a = $p < 0.005$.

infected (-3.6pp, p = 0.006).

In Canada, concerns about being infected (-3.5pp, p = 0.093) and concerns about health (-3.8pp, p = 0.076) remained stable over time, while the prevalence of RPAC increased significantly (7.8pp, p = 0.001). However, the prevalence of participants reporting RPAC was lower in the USA (-9.7pp, p = 0.003), as well as on concerns about being infected (-4.6, p = 0.006), and concerns about health (-8.9pp, p = 0.001). Overall, North America showed stability in RPAC, while concerns showed a negative variation over time.

Discussion

The iCARE study collected data from multiple countries worldwide to assist researchers and policymakers in developing strategies and health policies to mitigate both the direct and indirect effects of the COVID-19 pandemic, as well as future pandemics[23]. Our findings suggest that COVID-19-related concerns – particularly fear of infection and its consequences – were negatively associated with PA, an important health behavior that provides several benefits during challenging times. Nearly half of the participants across the studied countries reported RPAC during the first 15 months of the pandemic, with the prevalence remaining stable in South American countries and increasing in Canada. Meanwhile, the prevalence of COVID-19-related concerns stayed high and stable, except in the USA, where a decline in both concerns was observed. Participants who were more concerned about the health consequences of infection were more likely to report RPAC compared to those who were less concerned.

Self-reported reduced physical activity

As expected, global PA levels decreased after the pandemic started[14–16,25]. Specific groups, such as women and individuals with chronic conditions, were more affected[14,26]. Previous research from southern Brazil demonstrated that PA practice at home remained stable during the first 10 months of social distancing

Table 3 – Prevalence of reduced PA during COVID and COVID-19-related concerns by trimester.

	T1	T2	T3	Variation (p.p.)	p-value	Prevalence variation
Reduced PA						
Argentina	52.2	46.2	53.7	1.9	0.637	Stable
Brazil	47.1	36.4	48.1	2.8	0.430	Stable
Colombia	47.7	38.3	55.3	3.4	0.319	Stable
Canada	41.8	47.9	57.8	7.8	0.001	Increased
USA	55.2	45.8	35.7	-9.7	0.003	Decreased
South America	48.9	40.8	53.2	2.9	0.208	Stable
North America	45.2	47.5	47.4	1.1	0.507	Stable
Concern about infection						
Argentina	85.7	89.9	77.1	-5.3	0.045	Decreased
Brazil	92.1	97.1	96.4	2.3	0.139	Stable
Colombia	85.0	82.9	78.9	-3.0	0.229	Stable
Canada	77.8	70.5	71.9	-3.5	0.093	Stable
USA	84.6	81.3	69.4	-7.6	0.005	Decreased
South America	88.7	87.9	80.9	-3.6	0.006	Decreased
North America	79.5	72.4	70.7	-4.6	0.006	Decreased
Concern about personal health						
Argentina	79.4	91.3	79.4	-2.6	0.357	Stable
Brazil	88.4	91.2	92.9	2.2	0.273	Stable
Colombia	87.4	85.1	86.4	-0.6	0.796	Stable
Canada	77.7	78.2	68.5	-3.8	0.076	Stable
USA	83.5	83.8	65.5	-8.9	0.001	Decreased
South America	86.6	88.5	83.9	-1.2	0.347	Stable
North America	79.2	79.2	67.1	-5.5	0.001	Decreased

(i.e., from March 2020 to January 2021), despite variability in the total PA levels[27]. Despite an anticipated adaption to a "new normal", where people would resume or modify PA habits (e.g., exercising at home), the prevalence of participants reporting reducing their PA behavior remained stable from September 2020 to June 2021 across all South American countries, and even increased in Canada. This suggests that despite expectations of adaptation, the perception of reduced PA behavior remained for most individuals.

In 2020, the WHO issued new guidelines recommending that adults engage in at least 30 minutes of moderate-intensity PA daily, totaling 150 minutes weekly[28]. However, policies encouraging healthy lifestyles were scarce until later in the pandemic. Most public health efforts were focused on reducing COVID-19 transmission and hospitalizations, leaving PA and other healthy behaviors as lower priorities.

Physical activity and COVID transmission-related concerns

During the data collection period (Sep 2020 to Jun 2021), South American countries showed higher rates of COVID-19 cases per million (Argentina: +261.21, Colombia: +393.9, Brazil: +190.17) compared to Canada (+7.99) and the USA (-79.40), despite a relatively lower stringency index in South America[29]. The stringency index was created by the Oxford Coronavirus Government Response Tracker (i.e., a composite measure of nine response policies to stop COVID spread, ranging from 0 to 100 where higher scores indicate a stricter response)[30,31]. Countries like Argentina, Brazil and Colombia eased restrictions (Argentina -15%, Brazil -13%, and Colombia -17%), while Canada slightly increased restrictions (+4%) and the USA decreased them (-8%).

The improving pandemic situation aligns with the observed decreased in COVID-19 related concerns and RPAC. Better pandemic scenarios likely reduced concerns, making people more confident in resuming PA. In contrast, South American countries, where cases were rising and restrictions were easing, maintained high levels of concern about infection, which likely impacted PA behavior negatively. People in these regions likely avoided public places, gatherings, and PA settings such as parks and walking trails due to fear of contamination and the uncertainty surrounding the

pandemic. This might explain the stability in both concerns and RPAC in South America. The association between COVID-19 transmission-related concerns and RPAC was stronger in South America, especially in Colombia, where the case rates were higher, and restrictions were more relaxed during this period[32].

PA can be practiced in various settings, including at home, without requiring access to specialized locations, such as gyms. Home-based workouts and outdoor activities like walking also provide physical and mental health benefits[33,34]. Initiatives such as the 24-hour PA, which promote active lifestyles regardless of the setting or intensity, can play a significant role in encouraging people to stay active[35]. However, many people still rely on gyms and sports facilities for PA, and transitioning to home-based exercise requires some adaptation and guidance. Future policies should aim to promote PA in different settings, ensuring that people remain active, regardless of available facilities.

Strength and limitations

The limitations of our study need to be acknowledged. First, the sample is overrepresented by women and highly educated individuals, which likely, reflects the characteristics of social media users and those with better internet access. Also, because of the sampling strategy adopted, the included sample might not represent the reality of the population of included samples. Second, the assessment of RPAC was based on retrospective self-reporting, which may introduce recall bias. Third, validated instruments were not used in the online survey, which, while potentially shortening response times and improving participation rates, may compromise the reliability of the data.

However, unlike many studies that focused on specific time points (e.g., lockdown periods), this study analyzed data over a nine-month period (September 2020 to June 2021). Furthermore, the study highlights the relationship between PA behaviors and countries' pandemic management strategies, suggesting that public policies should encourage maintaining healthy habits even during times of restriction. PA promotion aligned with pandemic status and local safety measures, supported by expert guidance and public campaigns, could significantly improve public health outcomes.

Conclusion

The prevalence of participants reporting reduced PA behavior during COVID was high in Canada and all South American countries throughout the first 15 months of the pandemic. South American countries also exhibited stability in COVID-19-related concerns, whereas the USA showed a decline in both concerns and RPAC, suggesting American individuals were less worried and resumed PA earlier than other countries.

These findings support the need for future PA promotion policies, which should be tailored to the pandemic status, local culture, and local safety measures. Following expert guidelines and launching public campaigns could lead to substantial public health benefits.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Caputo EL: Conceptualization; Formal analysis; Writing – original draft; Approval of the final version. Ribeiro PAB: Conceptualization; Methodology; Supervision; Writing review & editing; Approval of the final version. Lavoie KL: Methodology; Writing – review & editing; Approval of the final version. Reichert FF: Conceptualization; Supervision; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

The authors did not use artificial intelligence tools for preparation of the manuscript.

Availability of research data and other materials

After publication the data will be available on demand to authors - a condition justified in the manuscript.

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Reviewers' assessment

The reviews of this article were originally conducted in Portuguese. This version has been translated using ChatGPT and subsequently reviewed by the Chief Editors.

Reviewer A

Anonymous

Format

- Does the article meet the manuscript preparation guidelines for submission to the *Revista Brasileira de Atividade Física & Saúde*?
  Yes
- The manuscript is well-structured, containing the sections: introduction, methods, results, and discussion (conclusion as part of the discussion)?
  Yes
- Is the language appropriate, is the text clear, precise, and objective?
  Yes
- Was any indication of plagiarism observed in the manuscript?
  No
  Suggestions/Comments:
  Nothing to add.

Abstract

- Is the abstract adequate (including: objective, information about study participants, variables studied, main results, and a conclusion) and do they reflect the manuscript's content?
  Partially
  Suggestions/Comments:
- The abstract is well written and presents most of the core information related to the study. However, numerical results should be added to the results, including (e.g., related to the changes in prevalence of PA over the time points in the different countries; regression analysis results; prevalence ratios, confidence intervals, etc).

Introduction

- Was the research problem clearly stated and defined?
  Partially
- Is the research problem adequately contextualized in relation to the current knowledge, moving from general to specific?
  Partially
- Are the reasons justifying (including the authors' assumptions about the problem) the need for the study well established in the writing?
  Partially
- Are the references used to support the presentation of the research problem current and relevant to the topic?
  Yes
- Was the aim clearly stated?
  Yes
  Suggestions/Comments:
- This is a very well written introduction. However, the authors could improve the justification for including different countries in their analysis (Argentina, Brazil, Colombia, Canada, and the USA). In my opinion this is a strength of this study, however this should be better justified across the introduction.

Methods

- Are the methods appropriate for studying the research problem?
  Yes
- Are the methods sufficiently detailed?
  Yes
- Was the selection and recruitment appropriate and adequately described?
  Yes
- Were the inclusion and/or exclusion criteria for sample participants described and appropriate for the study?
  Not applicable
- Information about the instruments used in data collection, their psychometric qualities (e.g., reproducibility, internal consistency, and validity), and, when relevant, the operational definition of variables, were provided?
  No
- Is the data analysis plan appropriate and adequately described?
  Yes
- Did the authors provide clarification on the ethical procedures adopted for conducting the research?
  Yes
- Did the authors provide clarifications about the

ethical procedures adopted for conducting the research?
Yes
Suggestions/Comments:
- The methods are clear and allow replication of the study. I tried to access the link of the project, but the webpage was not found. Authors might want to link their methods with the larger study as this may offer additional information about the study protocol.

Results

- Are the use of tables and figures appropriate, facilitating the adequate presentation of the study's findings?
Partially
- Is the number of illustrations consistent with the journal's submission guidelines?
Yes
- Is the number of participants in each study stage, along with reasons for losses and refusals, presented in the manuscript?
Yes
- Are the participants' characteristics sufficiently described?
Yes
- Are the results presented adequately, emphasizing the main findings and avoiding unnecessary repetition?
Partially

Suggestions/Comments:
- If possible, the authors should provide socioeconomic data of the included sample as well.
- The phrasing "reduced PA" is a bit confusing in my opinion as it may give the wrong impression that these individuals were insufficient active, when in fact the data only shows the proportion of individuals that reduced their PA since the start of the pandemic. This should be better phrased across the manuscript to improve clarity.
- Overall bar is missing from Figure 1. Also, Figure 1 should be better explained in the Figure legend. Was there any stats performed to compare these proportions between countries. Could the stats results be added to the manuscript as well?

Discussion

- Are the main findings of the study presented?
Yes
- Are the study's strengths and limitations presented and discussed?
Partially
- Are the results discussed in light of the study's limitations and existing knowledge on the topic?
Partially
- Are the potential contributions of the study's main findings to scientific development, innovation, or real-world applications discussed?
Yes

Suggestions/Comments:
- As mentioned in the previous section, the phrasing "reduced PA" is a bit confusing in my opinion as it may give the wrong impression that these individuals were/became insufficient active, when in fact the data only shows the proportion of individuals that reduced their PA since the start of the pandemic. Specifically in the discussion, the authors mentioned that "However, from September 2020 (i.e., the inception date of this study) to June 2021 the prevalence of reduced PA was stable in all South American countries and increased in Canada. In other words, as the pandemic progressed and this new normal adaptation was expected, people remained physically inactive". I don't think the collected data allow the authors to conclude that the sample was/became/remained physically inactive or physically active. They can only talk about increase and decrease in PA levels relative to the beginning of the pandemic; but it is not possible to indicate the sample actual physical activity level at any time point.
- It is not clear what the authors mean by "... positive absolute and relative cases rate .." (Page 10, Lines 16-22).
- I appreciate and agree with the paragraph starting with "It is important to highlight that is not necessary to practice PA ...". However, I am not sure if this relates to the study findings. It looks more like a opinion/recommendation based on the general PA and COVID literature.
- The included sample involved mostly middle-aged women with a graduate degree. This is acknowledged as a limitation by the authors, but I am not sure if this is acknowledged to the full extent. It is very important to highlight with clarity that the included sample size does not represent the reality of the population of the included countries. For instance, in Brazil only 21% of the adults have a

graduate degree. Additionally, could the authors try to adjust their analysis based on education/socio-economic status?

Conclusion

- Was the study's conclusion adequately presented and consistent with its objective?
  Partially
- Is the study's conclusion original?
  Yes

Suggestions/Comments:

- I am not in agreement with the sentence "PA levels .... remained low throughout...". Based on the study data, it is not possible to conclude if PA levels were high or low, only if they increased or reduced throughout the 15 months.

References

- Are the references current and sufficient?
  Yes
- Are most references original articles?
  Yes
- Do the references comply with the journal's standards (quantity and format)?
  Yes
- Are citations in the text adequate, i.e., do they substantiate the claims made?
  Yes

Suggestions/Comments:
Nothing to add.

- **Comments to the author**
- Dear authors, this study assessed the associations between COVID-related concerns and physical activity behaviour in different countries. This study is part of a large -scale study of public awareness, attitudes, concerns, and behavioral responses to COVID-19 (iCARE study); which has generated several previous publications. I tried to access the provided link to the larger project (www.mbmc-cmcm.ca/covid19), however the page was not found.
- The study is reasonably well justified, the methods are sound and the results are original. Data from a total of 2,543 participants were analysed, which represents a large set of data.
- The biggest limitation of this study resides on the characteristics of the included sample, which probably do not represent the reality of the included countries. For instance, 82,4% of the sample had a graduate degree. This is much higher than the actual % of graduate degree in most of the included South American countries.
- Another concern relates to how the authors phrase the reduced PA behaviour throughout the manuscript. In my opinion, the study data does not allow the authors to conclude/indicate that PA levels were either low or high throughout the 15 months. It is only possible to make conclusions about the trajectory of PA behaviour. In other words, it can only be said if PA levels decreased or increased, but nothing can be said about the actual PA levels in the different timepoints of the manuscript. If you agree with that, I would recommend rephrasing "reduced PA" or "low PA levels" to something that reflects the trajectory of PA, instead.
- Please, see my specific comments per each manuscript session in the respective boxes above.

Decision

- Major revisions required.

Reviewer B

Did not authorize publication