Moderate to vigorous physical activity and sedentary behavior changes in self-isolating adults during the COVID-19 pandemic in Brazil: a cross-sectional survey exploring correlates

Schuch, F. B., Bulzing, R. A., Meyer, J., López-Sánchez, G. F., Grabovac, I., Willeit, P., Vancampfort, D., Caperchione, C. M., Sadarangani, K. P., Werneck, A. O., Ward, P. B., Tully, M., & Smith, L. (2021). Moderate to vigorous physical activity and sedentary behavior changes in self-isolating adults during the COVID-19 pandemic in Brazil: a cross-sectional survey exploring correlates. *Sport sciences for health*. Advance online publication. https://doi.org/10.1007/s11332-021-00788-x

Link to publication record in Ulster University Research Portal

Moderate to vigorous physical activity and sedentary behavior changes in self-isolating adults during the COVID-19 pandemic in Brazil: A cross-sectional survey exploring correlates

Felipe B. Schuch[1,a] (0000-0002-5190-4515), Rugero A. Bulzing[1] (0000-0001-9249-0614), Jacob Meyer[2] (0000-0003-3180-5728), Guillermo F. López-Sánchez[3] (0000-0003-3180-5728), Igor Grabovac[4] (0000-0001-9605-1467), Peter Willeit[5,6] (0000-0002-1866-7159), Davy Vancampfort[7] (0000-0002-4592-8625), Cristina M. Caperchione[8] (0000-0003-2290-5946), Kabir P. Sadarangani[9,10] (0000-0002-3757-3799), André O. Werneck (0000-0002-9166-4376)[11], Philip B. Ward[12,13] (0000-0002-5779-7722), Mark Tully[14*] (0000-0001-9710-4014), Lee Smith[15*] (0000-0002-5340-9833)

1- Department of Sports Methods and Techniques, Federal University of Santa Maria, Santa Maria, Brazil.
2- Iowa State University, Ames, IA, United States of America.
3- Faculty of Sport Sciences, University of Murcia, Murcia, Spain.
4- Department of Social and Preventive Medicine, Centre for Public Health, Medical University of Vienna, Vienna, Austria.
5- Department of Neurology, Medical University of Innsbruck, Innsbruck, Austria.
6- Department of Public Health and Primary Care, University of Cambridge, Cambridge, UK.
7- KU Leuven Department of Rehabilitation Sciences, Leuven, Belgium.
8- School of Sport, Exercise and Rehabilitation, Human Performance Research Centre, University of Technology Sydney, Sydney, NSW, Australia.
9- Universidad Autónoma de Chile, Chile.
10- Escuela de Kinesiología, Facultad de Salud y Odontología, Universidad Diego Portales, Santiago 8370057, Chile.
11- Department of Nutrition, School of Public Health, University of São Paulo (USP), São Paulo, Brazil.
12- School of Psychiatry, UNSW Sydney, New South Wales, Australia;
13- Schizophrenia Research Unit, Ingham Institute for Applied Medical Research, Liverpool, New South Wales, Australia.
14- Institute of Mental Health Sciences, School of Health Sciences, Ulster University, Newtownabbey, UK.
15- The Cambridge Centre for Sport and Exercise Sciences, Anglia Ruskin University, Cambridge, CB1 1PT, UK.

*Joint final author

a=Corresponding author:
Felipe Barreto Schuch (felipe.schuch@ufsm.br)
Federal University of Santa Maria, Santa Maria, RS, Brazil.
Av. Roraima, 1000, Prédio 51 (CEFD), sala 1025.
CEP:07105-900 Phone: +55 55 3220 7788

Abstract:

Background: The COVID-19 pandemic imposed major changes on daily life-routine worldwide. To the best of our knowledge, no study quantified the changes on moderate to vigorous physical activity (MVPA) and sedentary behaviors (SB) and its correlates in Brazilians. This study aimed to (i) evaluate the changes (pre-versus during pandemic) in time spent in MVPA and SB in self-isolating Brazilians during the COVID-19 pandemic, and (ii) to explore correlates.

Methods: A cross-sectional, retrospective, self-report online web survey, evaluating the time spent in MVPA and SB pre and during the COVID-19 pandemic in self-isolating people in Brazil. Sociodemographic, behavioral, and clinical measures, and time in self-isolation were also obtained. Changes in MVPA and SB and their correlates were explored using generalized estimating equations (GEE). Models were adjusted for covariates.

Results: A total of 877 participants (72.7% women, 53.7% young adults [18-34 years]) were included. Overall, participants reported a 59.7% reduction (95%CI: 35.6 to 82.2) in time spent on MVPA during the pandemic, equivalent to 64.28 (95% CI: 36.06 to 83.33) minutes per day. Time spent in SB increased 42.0% (95%CI: 31.7 to 52.5), corresponding to an increase of 152.3 (95%CI: 111.9 to 192.7) minutes per day. Greater reductions in MVPA and increases in SB were seen in younger adults, those not married, those employed, and those with a self-reported previous diagnosis of a mental disorder.

Conclusions: People in self-isolation significantly reduced MVPA levels and increased SB. Public health strategies are needed to mitigate the impact of self-isolation on MVPA and SB.

Keywords: Physical activity, Sedentary behavior, COVID-19, Pandemic

Introduction

The coronavirus disease 2019 (COVID-19) pandemic, caused by the spread of the severe acute respiratory coronavirus 2 (SARS-CoV-2), has infected more than 13 million people in more than 200 countries around the world resulting in nearly 570 thousand deaths on the 14th of July 2020 according to the World Health Organization (WHO)[1]. As a response to reduce the virus spread, the WHO recommended national governments to adopt non-pharmacological strategies based on social and physical distancing, such as lockdown, quarantine, and self-isolation.

In Brazil, the epidemiological report number 05 of the Ministry of Health has recommended the adoption of social distancing measures, including self-isolation in areas with community transmission [2] . When self-isolating, people were advised to stay at home, and only go out in public for essential activities, such as going to the supermarket, to the pharmacy, or to use essential services, such as medical assistance. All other non-essential services, including gyms, parks, stadiums, and other places where people exercised were closed.

Self-isolation measures impose a drastic and sudden disruption of daily life routine, resulting in limited physical and social mobility, and fewer opportunities to be active [3]. Moreover, the emotional burden [4, 5] of the pandemic likely resulted in additional barriers to remain focused and motivated to be and/or stay physically active, potentially reducing the time spent in physical activity (PA), defined as any bodily movement produced by skeletal muscles that result in energy expenditure [6]. The negative impact of the pandemic and self-isolation measures on PA levels, both on light PA and moderate to vigorous PA (MVPA), defined as any activities that result in energy expenditure above 3 metabolic equivalents (METs) [7] noted in many countries including Australia [8, 9], Canada [10], Croatia [11], France [12], Italy [13], Spain [14], the UK [15, 16], and the USA [17-19]. However, some moderating factors on PA changes in this period were identified. For example, age [13, 15], sex [14], and the presence of chronic physical diseases or mental disorders moderated the pandemic impact on PA levels [15]. Further, increases in time spent in sedentary behavior (SB), defined as any waking behavior characterized by an energy expenditure ≤ 1.5 METs, while in a sitting, reclining or lying posture,[20] were noted during the pandemic in the US [18, 19], France and Sweden [21], and Spain [14]. In Spain, sex moderated the increase in time spent in SB [14].

104   To the best of our knowledge, no study has evaluated how the COVID-19 pandemic changed PA

105   and SB during self-isolating Brazilians. The present study aimed (i) to examine the changes (pre-versus

106   during COVID-19 pandemic) on PA and SB in self-isolating Brazilians, and (ii) to evaluate whether

107   sociodemographic (sex, age, ethnicity, marital status, employment, monthly household income),

108   behavioral (smoking, current alcohol consumption), clinical (presence of chronic physical diseases or

109   mental disorders), and contextual factors (i.e., number of days of self-isolation) moderated these changes.

110

111   **Methods**

112   This paper presents pre-planned interim analysis of data from a cross-sectional study. Data

113   collection was performed through an online survey (www.qualtrics.com). The study was launched on 11

114   April 2020 and data collection continued until 05 May. The study was approved by the Federal University

115   of Santa Maria Research Ethics Committee and by the National Commission of Ethics in Research

116   [CONEP] (30244620.1.0000.5346).

117

118   Participants and recruitment

119   Participants were recruited through social media (Facebook, Instagram, Twitter), and by

120   distributing an invitation to participate through existing researcher networks. The inclusion criteria were:

121   (1) Brazilians adults (18-65 years), (2) currently residing in Brazil, and (3) in self-isolation due to the

122   COVID-19 pandemic. Self-isolation was defined as staying-at-home and only leaving for essential

123   activities such as food shopping, visiting the pharmacist or other health professionals. Participants who

124   self-reported the presence of COVID-19 symptoms, assessed through a list of symptoms (fever, cough,

125   dry mouth, coriza, sore throat), were removed from this analysis.

126

127   Moderate to vigorous physical activity (MVPA) and sedentary behavior (SB) assessment

128   Participants were asked to recall the amount of time in vigorous and moderate physical activity,

129   and sedentary behavior they undertook on an average day, separately both pre- and during self-

130   isolation[16]. Participants were asked: (1) "How much time on an average day have you spent in vigorous

activity before/since social distancing?"; (2) "How much time on an average day have you spent in moderate activity since/before social distancing?" and (3) "How much time on an average day have you spent sitting since/before social distancing?" Responses were given in hours and minutes. MVPA and SB were analyzed as continuous variables (minutes per day). We also categorized PA levels (≥30 minutes/day or <30 minutes/day of MVPA), which is in accordance with the WHO recommendations. Next, four categories were derived to identify patterns of change: (1) persistent inactive (< 30 minutes/day of MVPA pre and during the pandemic), (2) decreased PA (≥30 minutes/day of MVPA pre and <30 minutes/day of MVPA during the pandemic), (3) increased PA (<30 minutes/day of MVPA pre and ≥30 minutes/day of MVPA during the pandemic) and (4) persistent active (≥30 minutes/day of MVPA pre and during the pandemic).

Covariates

Demographic data were collected, including sex (men or women), age (in 10-year age bands), ethnicity (Caucasian, Black, Asian, mixed, others), marital status (single, divorced, widowed or married), employment (employed, student, military, unemployed), monthly household income ≤R$1254, R$1255-R$2004, R$2005-R$8640, R$8641-R$11261 ≥R$11262). Health behaviors data included current smoking (y/n) or alcohol consumption (y/n). Clinical data included self-reported previous diagnosis of physical diseases or mental disorders, such as: obesity, hypertension, myocardial infarction, angina pectoris, and other coronary diseases, other cardiac diseases, varicose veins of lower extremities, osteoarthritis, chronic neck pain, chronic low back pain, chronic allergy (excluding allergic asthma), chronic bronchitis, emphysema or chronic obstructive pulmonary disease, type 1 diabetes, type 2 diabetes, diabetic retinopathy, cataract, peptic ulcer disease, urinary incontinence or urine control problems, hypercholesterolemia, chronic skin disease, chronic constipation, liver cirrhosis and other hepatic disorders, stroke, chronic migraine/others, depression, anxiety disorders, bipolar disorder and schizophrenia/others. Number of days (extension) in self-isolation was registered with a single question.

Statistical analyses

160   Data were analyzed using mean and standard deviation (SD) or 95% confidence interval

161   (95%CI) for continuous data and the raw numbers and % for categorical variables. Normality was

162   checked with the Kolmogorov-Smirnov test. Due to the non-normal distribution, the mean changes (pre-

163   versus during the pandemic) of MVPA levels and SB were evaluated using two generalized estimating

164   equations models (GEE), one with changes in MVPA and one with change in SB as the dependent

165   variable. The models were run testing the time effects (pre/during) and the interactions between time and

166   the factors included in the model. The factors included in the models were (sex [male versus female], age

167   [young adults {18-34 years} versus middle-age adults {35-54 years} versus older adults {55-65 years}],

168   ethnicity [Caucasian versus Asian/Black/mixed/others], marital status [married versus

169   single/divorced/widowed], employment [employed/students/military versus unemployed/retired], monthly

170   household income [<R$2,005 versus R$2,005-R$8,640 versus R$8,641-R$11,261 versus >R$11,261],

171   current smoking [yes versus no], alcohol consumption [yes versus no], self-reported previous diagnosis of

172   any chronic diseases [yes versus no] or any mental disorders [yes versus no]). When the interaction

173   between time and any factor was significant, the Bonferroni test was applied. The results of the models

174   are presented using estimated marginal means and 95%CI. We also calculated the delta% change (pre to

175   during), together with 95% CI as the effect size measure. The associations between the time (in days) in

176   self-isolation and the change in MVPA and SB were tested using linear regression models. Days in self-

177   isolation were collected as a continuous variable, and linear regression models were used to test the

178   association of time in self-isolation with changes in MVPA and SB. The level of statistical significance

179   was set at p-value < 0.05. All analyses were performed using SPSS (v. 21).

180

181   **Results**

182   A total of 1354 participants responded to the survey. Of these, 877 participants reported being in

183   self-isolation and provided complete data for the present analysis. The sample was predominantly

184   comprised of women (n=635, 72.7%), young adults ranging from 18-34 years (n=471, 53.7%),

185   Caucasians (n=669, 76.3%), singles (n=442, 50.9%), currently employed/students/military (n=723,

186   92.6%), with a monthly income ranging from R$2005 to R$8640 (n=364, 41.5%), non-smokers (n=836,

187   95.3%), currently consuming alcohol (n=605, 69.1%), with a self-reported previous diagnosis of a

188   physical chronic disease (n=824, 94%) and without a self-reported previous diagnosis of a mental

189   disorder (n=523, 59.6%). More than half of the participants were from the Rio Grande do Sul state (80%),

190   11% from the Rio de Janeiro, and about 6% from Ceará. Participants were on average 27.13 (6.57) days

191   in self-isolation. The full details of the sample can be seen at Table 1.

192

193   Mean changes in MVPA and SB (pre versus during pandemic)

194   A total of 432 (49.3%) of participants persisted to be active during the pandemic, 32 (3.6%)

195   increased MVPA levels during the pandemic, 306 (34.9%) reduced MVPA levels during the pandemic,

196   and 107 (12.2%) persisted to be inactive. We found an overall reduction of 64.28 (95%CI: 36.06 to 83.33)

197   minutes per day on time spent in MVPA, corresponding to a reduction of 59.7% (95%CI: 35.64 to 82.21,

198   p< 0.001). The average time spent in SB increased 42.0% (95%CI: 31.74 to 52.50, p< 0.001) during the

199   pandemic, corresponding to additional 152.3 (95%CI: 111.9 to 192.7) minutes per day in SB. The mean

200   time spent in MVPA and SB at baseline and during the pandemic can be found at figure 1.

201

202   Correlates of MVPA change

203   Significant interactions in MVPA change were found for age (p= 0.013), marital status (p=

204   0.006) and employment (p= 0.008). Bonferroni post hoc test found that young adults (mean change= -

205   71.37, 95%CI: -99.76.51 to -42.98) and middle age adults (mean change= -66.76, 95%CI: -94.50 to -

206   39.01) had greater decreases in time spent in MVPA when compared to older adults (mean change= -

207   54.70, 95%CI: -86.25 to -23.16). Also, those not married (single/divorced/widowed) had greater

208   reductions (mean change= -75.50, 95%CI:-102.00 to -49.00) when compared to those married (mean

209   change= -53.05, 95%CI: -79.36 to -26.75), and those with an occupation (employed/student/military) had

210   greater reductions (mean change= -78.69, 95%CI: -105.21 to -52.16) when compared to those without

211   occupation (unemployed/retired. Mean change= -49.87, 95%CI: -78.83 to -20.90). The detailed results of

212   the MVPA model with mean changes can be seen in Table 2. Those not married (mean difference= 22.08,

213   95%CI: 6.79 to 37.36, p= 0.005), and with no occupation (mean difference= 38.55, 95%CI: 14.08 to

214   63.03, p= 0.002) had greater MVPA levels at baseline (pre and during pandemic means are shown in

215 supplementary material 1). The number of days in self-isolation was not associated with changes in

216 MVPA (unstandardized beta coefficient= 0.234, 95%CI: -0.816 to 1.284, p= 0.662, R^2= 0.00).

217

218 Correlates of SB changes

219   The interactions found for the SB model were age (p<0.001), marital status (p= 0.024),

220 employment (p=0.03), and self-reported previous diagnosis of mental disorders (p= 0.003). Young adults

221 had greater increases (mean change= 190.48, 95%CI: 149.65 to 231.30) in time spent in SB when

222 compared to middle age (mean change= 143.35 95%CI: 99.48 to 187.21) or older adults (mean change=

223 136.71, 95%CI: 77.88 to 195.54). Also, greater increases in time spent in SB were found in those not

224 married (mean change= 176.15, 95%CI: 133.74 to 218.56) compared to those married (mean change=

225 137.96, 95%CI: 96.85 to 178.24), in those with an occupation (mean change= 179.85, 95%CI: 142.15 to

226 217.55) compared to those with no occupation (mean change= 133.84, 95%CI: 79.26 to 188.42), and in

227 those with a self-reported previous diagnosis of mental disorders (mean change= 173.16, 95%CI: 129.97

228 to 216.34) compared to those with no history of mental disorders (mean change= 140.53, 95%CI: 101.07

229 to 180.00). The detailed results of the SB model with interactions can be seen in Table 2. Younger adults

230 spent more time in SB than middle-age adults (mean difference= 39.99, 95%CI: 5.27 to 74.71, p=0.017),

231 but not more than older adults (mean difference= 43.28, 95%CI: -13.15 to 99.75, p= 0.20). Those with a

232 self-reported previous diagnosis of a mental disorder spent more time in SB at baseline (mean difference=

233 24.09, 95%CI: 0.41 to 48.66, p=0.046) than those without (pre and during pandemic means are shown in

234 supplementary material 2). The number of days in self-isolation was not associated with changes in SB

235 (unstandardized beta coefficient= 0.306, 95%CI: -1.732 to 2.345, p= 0.77, R^2= 0.00). The sample size

236 (n=1000) was calculated for evaluating the association of MVPA with mental health outcomes, published

237 elsewhere [22].

238

239 **Discussion**

240   The present study is, to the best of our knowledge, the first study demonstrating the impact of the

241 self-isolation during the COVID-19 pandemic on Brazilians for self-reported MVPA and SB.

242 Approximately 35.0% of the sample became insufficiently active during the self-isolation period. Only

243   3.6% became active with self-isolation. On average, there was a reduction of about 1 hour/day of time

244   spent in MVPA, which corresponds to a reduction of 60.0% of their MVPA pre-pandemic levels.

245   Participants reported spending 2.5 hours/day more in SB during the pandemic than before the pandemic,

246   corresponding to an increase of 40.0%.

247   The reduction in MVPA levels in Brazilians is consistent with the findings of previous studies in

248   other countries. For example, we found that roughly 35.0% of respondents became inactive during the

249   self-isolation period as did about 50.0% in similar studies collected in France [12], the USA [17], and

250   Australia [9]. Our results included reductions of 60.0% of the time spent in MVPA in Brazil, which is

251   comparable to the reductions found in the USA, where there was a decrease of 47.0% on time spent in

252   moderate PA [17]. Additionally, we observed an increase of about to 2.5 hours/day on time spent in SB,

253   which is consistent with other studies that have found an increase of about 2 to 3 hours/day of SB in

254   multiple countries [14, 23]. These findings highlight the urgent need for public health strategies to

255   mitigate the impact of self-isolation on MVPA and SB.

256   Greater reductions in MVPA and increases in SB were found among younger adults, which is

257   line with the findings from Italy and the UK [13, 15]. It is possible that this age group had fewer

258   resources and greater difficulty coping with emotional responses to this situation [24]. In addition, those

259   not married and currently working had higher MVPA levels at baseline, but decreased their MVPA to

260   similar levels to those not married and with no work during the pandemic. Of note, those currently

261   employed might have reduced their commuting-related PA and have likely increased their SB time due to

262   online meetings and activities. Lastly, those with a self-reported previous pandemic diagnosis of a mental

263   disorder spent more time in SB and reported the greatest increases in time spent in SB during the

264   pandemic. This finding is in accordance with a study in the UK [15] that found a greater reduction in

265   MVPA in people with depression. This finding is also consistent with previous studies showing that

266   people with mental disorders have higher SB levels than people without mental disorders [25-27] and

267   suggests that self-isolation during the pandemic might be specifically detrimental to people with a

268   previous diagnosis of a mental disorder.

269   There is ample evidence to justify making PA promotion a global public health priority during

270   the coronavirus pandemic [3]. The COVID-19 pandemic appears to have impacted mental health globally,

271   increasing rates of depression and anxiety symptoms and disorders [5]. On the other hand, physical

272   activity is a protective factor for mental disorders [28-30]. During the pandemic, cross-sectional and

273   longitudinal evidence suggests that those with higher PA or lower SB levels are less likely to present

274   depressive symptoms [22, 31]. Promoting MVPA and reducing SB during the pandemic is also essential

275   for physical health. Higher mortality due to COVID-19 is seen in those with clinical comorbidities such

276   as hypertension, diabetes, and coronary heart disease [32]. Increasing time spent in MVPA and reducing

277   time spent in SB seems to reduce the risk of developing multiple chronic diseases, including those

278   associated with a higher risk of COVID-19 mortality [33]. For example, people with higher PA levels

279   have 35% and 23% less risk of developing diabetes [34] and heart failure [35], respectively. In addition,

280   achieving the public health recommendations of 150 minutes of MVPA per week reduces the risk of all-

281   cause and cardiovascular mortality [36]. Lastly, initial evidence has suggested that physical inactivity

282   may be a risk factor for hospitalization due to COVID-19 [37], further underlining the potential

283   importance of promoting PA during the pandemic.

284   The present study has some limitations. First, MVPA and SB were assessed using self-reported

285   questionnaires. Self-reported questionnaires are commonly associated with overestimations of MVPA

286   [38] and underestimation of SB [39]. Second, pre-pandemic MVPA and SB were assessed

287   retrospectively, and both can be susceptible to memory bias. Third, the representativeness of the sample is

288   limited. However, participants were drawn from 24 of the 27 federative units of Brazil, with most

289   participants being from the Rio Grande do Sul state, Rio de Janeiro, and Ceará. Also, some groups such

290   as adults aging 55-64, Asian and Black people, and those with a household income lower than <R$1,254

291   are poorly represented. Fourth, we could not explore changes in light PA, such as walking. Also, we

292   could not explore the changes in time spent on MVPA across the different PA domains

293   (work/occupational, leisure, transportation, household). It is possible, for example, that some participants

294   reduced the time spent in leisure, transportation, or work/occupational activities, but increased the time

295   spent in household activities. This is important since we know that some mental health benefits are more

296   likely to be associated with time spent in leisure activities [40]. The strengths of the manuscript are the

297   large sample size of self-isolating Brazilians and the possibility to explore a variety of moderators.

298   Although the sample size was calculated for estimating the association of MVPA and mental health

299   outcomes, the large sample size is sufficiently powered for the present analyses.

300

301 **Conclusion**

302   Self-isolation during the pandemic significantly reduced time spent in MVPA and increased time

303 spent in SB in Brazilian adults, particularly in younger adults, those who were single, and those who were

304 employed. These findings highlight the urgent need of the adoption of public health strategies to address

305 the impact of self-isolation during the COVID-19 pandemic on MVPA and SB.

306

307

308

309

310

311

312

313

314

315

316

317

318

319

320

11

325 funding as Director of the Northern Ireland Public Health Research Network by the Research and
326 Development Division of the Public Health Agency (Northern Ireland).

327

328

329

330

331

332

333

334

335

336

337

338

339

340

341

342

343

344 **References**

345 1.   Organization, W.H., *Coronavirus disease 2019 (COVID-19): situation report, 179.* 2020.
346 2.   Saúde, M.d., *Boletim epidemiológico 05 - 20/03/2020*, M.d. Saúde, Editor. 2020:
347   http://maismedicos.gov.br/images/PDF/2020_03_13_Boletim-Epidemiologico-05.pdf.
348 3.   Sallis, J., et al., *An international physical activity and public health research agenda to*
349   *inform COVID-19 policies and practices.* Journal of Sport and Health Science, 2020.

12

350   4.   Ornell, F., et al., *Pandemic fear and COVID-19: mental health burden and strategies.*
351   Brazilian Journal of Psychiatry, 2020.
352   5.   Brooks, S.K., et al., *The psychological impact of quarantine and how to reduce it: rapid*
353   *review of the evidence.* The Lancet, 2020.
354   6.   Caspersen, C.J., K.E. Powell, and G.M. Christenson, *Physical activity, exercise, and*
355   *physical fitness: definitions and distinctions for health-related research.* Public Health
356   Rep, 1985. **100**(2): p. 126-31.
357   7.   AINSWORTH, B.E., et al., *2011 Compendium of Physical Activities: A Second Update of*
358   *Codes and MET Values.* Medicine & Science in Sports & Exercise, 2011. **43**(8): p. 1575-
359   1581.
360   8.   Gallo, L.A., et al., *The impact of isolation measures due to COVID-19 on energy intake*
361   *and physical activity levels in Australian university students.* medRxiv, 2020: p.
362   2020.05.10.20076414.
363   9.   Stanton, R., et al., *Depression, Anxiety and Stress during COVID-19: Associations with*
364   *Changes in Physical Activity, Sleep, Tobacco and Alcohol Use in Australian Adults.*
365   International Journal of Environmental Research and Public Health, 2020. **17**: p. 4065.
366   10.   Lesser, I. and C. Nienhuis, *The Impact of COVID-19 on Physical Activity Behavior and*
367   *Well-Being of Canadians.* International Journal of Environmental Research and Public
368   Health, 2020. **17**: p. 3899.
369   11.   Sekulic, D., et al., *Prospective Analysis of Levels and Correlates of Physical Activity*
370   *During COVID-19 Pandemic and Imposed Rules of Social Distancing; Gender Specific*
371   *Study Among Adolescents from Southern Croatia.* Sustainability, 2020. **12**(10): p. 4072.
372   12.   Deschasaux-Tanguy, M., et al., *Diet and physical activity during the COVID-19 lockdown*
373   *period (March-May 2020): results from the French NutriNet-Sante cohort study.*
374   medRxiv, 2020: p. 2020.06.04.20121855.
375   13.   Giustino, V., et al., *Physical Activity Levels and Related Energy Expenditure during*
376   *COVID-19 Quarantine among the Sicilian Active Population: A Cross-Sectional Online*
377   *Survey Study.* Sustainability, 2020. **12**: p. 4356.
378   14.   Castañeda, A., et al., *Impact of COVID-19 confinement on the time and intensity of*
379   *physical activity in the Spanish population*. 2020.
380   15.   Rogers, N., et al., *Behavioural change towards reduced intensity physical activity is*
381   *disproportionately prevalent among adults with serious health issues or self-perception*
382   *of high risk during the UK COVID-19 lockdown*. 2020.
383   16.   Lee Smith, J.M., Guillermo Felipe López-Sanchéz, Felipe Schuch, Igor Grabovac, Nicola
384   Veronese, Ahmad Abufaraj, Cristina Coperchiona, Mark Tully, *Prevalence and*
385   *Correlates of Physical activity in a sample of UK adults observing social distancing*
386   *during the COVID-19 pandemic.* BMJ Open Sport & Exercise Medicine, 2020. **in press**.
387   17.   Dunton, G., et al., *Early Effects of the COVID-19 Pandemic on Physical Activity in US*
388   *Adults.* 2020.
389   18.   Dunton, G., B. Do, and S. Wang, *Early Effects of the COVID-19 Pandemic on Physical*
390   *Activity and Sedentary Behavior in US Children.* 2020.
391   19.   Meyer, J., et al., *Changes in physical activity and sedentary behaviour due to the*
392   *COVID-19 outbreak and associations with mental health in 3,052 US adults*. 2020.
393   20.   Tremblay, M.S., et al., *Sedentary behavior research network (SBRN)–terminology*
394   *consensus project process and outcome.* International Journal of Behavioral Nutrition
395   and Physical Activity, 2017. **14**(1): p. 75.
396   21.   Cheval, B., et al., *Relationships between changes in self-reported physical activity,*
397   *sedentary behaviours and health during the coronavirus (COVID-19) pandemic in*
398   *France and Switzerland*. 2020.
399   22.   Schuch, F.B., et al., *Associations of moderate to vigorous physical activity and*
400   *sedentary behavior with depressive and anxiety symptoms in self-isolating people*

401   *during the COVID-19 pandemic: A cross-sectional survey in Brazil.* Psychiatry Res, 2020.
402   **292**: p. 113339.

403   23. Ammar, A., et al., *Effects of COVID-19 Home Confinement on Eating Behaviour and*
404   *Physical Activity: Results of the ECLB-COVID19 International Online Survey.* Nutrients,
405   2020. **12**.

406   24. Scott, S.B., M.J. Sliwinski, and F. Blanchard-Fields, *Age differences in emotional*
407   *responses to daily stress: the role of timing, severity, and global perceived stress.*
408   Psychol Aging, 2013. **28**(4): p. 1076-87.

409   25. Schuch, F., et al., *Physical activity and sedentary behavior in people with major*
410   *depressive disorder: a systematic review and meta-analysis.* Journal of affective
411   disorders, 2017. **210**: p. 139-150.

412   26. Vancampfort, D., et al., *Physical activity and sedentary behavior in people with bipolar*
413   *disorder: A systematic review and meta-analysis.* J Affect Disord, 2016. **201**: p. 145-52.

414   27. Vancampfort, D., et al., *Sedentary behavior and physical activity levels in people with*
415   *schizophrenia, bipolar disorder and major depressive disorder: a global systematic*
416   *review and meta-analysis.* World Psychiatry, 2017. **16**(3): p. 308-315.

417   28. Brokmeier, L.L., et al., *Does physical activity reduce the risk of psychosis? A systematic*
418   *review and meta-analysis of prospective studies.* Psychiatry Res, 2019: p. 112675.

419   29. Schuch, F.B., et al., *Physical Activity and Incident Depression: A Meta-Analysis of*
420   *Prospective Cohort Studies.* Am J Psychiatry, 2018. **175**(7): p. 631-648.

421   30. Schuch, F.B., et al., *Physical activity protects from incident anxiety: A meta-analysis of*
422   *prospective cohort studies.* Depress Anxiety, 2019. **36**(9): p. 846-858.

423   31. Wolf, S., et al., *Is Physical Activity Associated with Less Depression and Anxiety During*
424   *the COVID-19 Pandemic? A Rapid Systematic Review.* Sports medicine (Auckland, N.Z.),
425   2021.

426   32. Zhou, F., et al., *Clinical course and risk factors for mortality of adult inpatients with*
427   *COVID-19 in Wuhan, China: a retrospective cohort study.* The Lancet, 2020.
428   **395**(10229): p. 1054-1062.

429   33. Pedersen, B.K. and B. Saltin, *Exercise as medicine–evidence for prescribing exercise as*
430   *therapy in 26 different chronic diseases.* Scandinavian journal of medicine & science in
431   sports, 2015. **25**: p. 1-72.

432   34. Aune, D., et al., *Physical activity and the risk of type 2 diabetes: a systematic review*
433   *and dose-response meta-analysis.* Eur J Epidemiol, 2015. **30**(7): p. 529-42.

434   35. Aune, D., et al., *Physical activity and the risk of heart failure: a systematic review and*
435   *dose-response meta-analysis of prospective studies.* Eur J Epidemiol, 2021. **36**(4): p.
436   367-381.

437   36. Ekelund, U., et al., *Does physical activity attenuate, or even eliminate, the detrimental*
438   *association of sitting time with mortality? A harmonised meta-analysis of data from*
439   *more than 1 million men and women.* Lancet, 2016. **388**(10051): p. 1302-10.

440   37. Hamer, M., et al., *Lifestyle risk factors, inflammatory mechanisms, and COVID-19*
441   *hospitalization: A community-based cohort study of 387,109 adults in UK.* Brain Behav
442   Immun, 2020. **87**: p. 184-187.

443   38. Lee, P.H., et al., *Validity of the international physical activity questionnaire short form*
444   *(IPAQ-SF): A systematic review.* International Journal of Behavioral Nutrition and
445   Physical Activity, 2011. **8**(1): p. 115.

446   39. Prince, S., et al., *A comparison of self-reported and device measured sedentary*
447   *behaviour in adults: a systematic review and meta-analysis.* International Journal of
448   Behavioral Nutrition and Physical Activity, 2020. **17**: p. 1-17.

449   40. Teychenne, M., et al., *Do we need physical activity guidelines for mental health: What*
450   *does the evidence tell us?* Mental Health and Physical Activity, 2020. **18**: p. 100315.

451

452

453

454

455

456

457

458

459   **Table 1.** Sample characteristics

	Category/Mean (Standard deviation)	Overall N=877* (%)
Sex	Male	238 (27.3)
	Female	635 (72.7)
Age	18-24 years	131 (14.9)
	25-34 years	340 (38.8)
	35-44 years	220 (25.1)
	45-54 years	108 (12.3)
	55-64 years	78 (8.9)
Ethnicity	Asian	3 (0.3)
	Black	24 (2.7)
	Mixed	163 (18.6)
	Caucasian	669 (76.3)
	Others	16 (1.8)
Marital Status	Married	363 (41.4)
	Widowed	4 (0.5)
	Divorced	60 (6.9)
	Single	442 (50.9)
Employment	Employed	558 (63.6)
	Unemployed	43 (1.6)
	Student	235 (26.8)
	Military	19 (2.2)
	Retired	22 (2.5)
Monthly household income	<R$1254 ($232)	30 (3.4)
	R$1255 ($232)-R$2004 ($371)	94 (10.7)
	R$2005 ($371)-R$8640 ($1600)	364 (41.5)
	R$8641 ($1600)-R$11261 ($2085)	139 (15.8)
	>R$11262 ($2085)	250 (28.5)
Current smoking	No	836 (95.3)
	Yes	41 (4.7)
Current alcohol consumption	No	271 (30.9)
	Yes	605 (69.1)
Self-reported previous diagnoses of physical disease	No	53 (6)

15

Self-reported previous diagnoses of mental disorder	Yes	824 (94)
	No	523 (59.60)
	Yes	354 (40.4)
Days in self isolation	Mean (standard deviation)	27.07 (6.71)

460 * Total sample with available data. Number of cases can be different for each variable due to missing
461 cases (minimum=869)

Table 2. Moderate to vigorous physical activity change (pre-post pandemic) in self-isolated adults during the SARS-CoV-2 pandemic in 2020 in Brazil

| Characteristics	Category	Mean change in minutes	95% CI		Delta%	95% CI		Interaction p value
Sex	Male	-65.86	-92.26	-39.52	-61.24%	-85.79%	-36.75%	0.778
	Female	-62.71	-89.37	-36.05	-58.18%	-82.91%	-33.44%	
Age	Young adults (18-35 years)	**-71.37a**	**-99.76**	**-42.98**	**-72.68%**	**-101.51%**	**-43.77%**	**0.013**
	Middle age adults (36-55 years)	**-66.76a**	**-94.50**	**-39.01**	**-64.53%**	**-91.34%**	**-37.07%**	
	Older adults (55-64 years)	**-54.70b**	**-86.25**	**-23.16**	**-45.08%**	**-71.08%**	**-19.08%**	
Ethnicity	Black/Asian/Mixed/Others	-66.00	-95.52	-36.48	-62.67%	-90.70%	-34.64%	0.216
	White	-62.55	-86.72	-38.38	-56.59%	-78.87%	-34.98%	
Marital status	Single/divorced/widowed	**-75.50a**	**-102.00**	**-49.00**	**-63.60%**	**-85.93%**	**-41.28%**	**0.006**
	Married	**-53.05b**	**-79.36**	**-26.75**	**-54.91%**	**-82.14%**	**-27.68%**	
Employment	Employed/students/military	**-78.69a**	**-105.21**	**-52.16**	**-61.99%**	**-82.88%**	**-41.09%**	**0.008**
	Unemployed/retired	**-49.87b**	**-78.83**	**-20.90**	**-56.42%**	**-89.19%**	**-23.64%**	
Monthly household income	<R$2005 ($371)	-82.58	-114.49	-50.66	-63.52%	-88.15%	-39.00%	0.647
	R$2005 ($371) -R$8640 ($1600)	-57.53	-82.31	-32.75	-56.57%	-80.94%	-32.20%	
	R$8641 ($1600) - R$11261 ($2085)	-56.72	-89.26	-24.19	-58.06%	-91.38%	-24.76%	
	>R$11261	-60.28	-88.92	-31.63	-59.44%	-87.69%	-31.19%	
Current smoking	Yes	-70.76	-112.95	-28.57	-67.02%	-106.9%	-27.06%	0.090
	No	-57.80	-77.29	-38.30	-52.77%	-70.43%	-34.90%	
Current alcohol consumption	Yes	-58.39	-84.85	-31.93	-57.09%	-82.97%	-31.22%	0.378
	No	-70.16	-97.22	-43.10	-62.06%	-85.29%	-38.12%	
Self-reported previous diagnosis of mental disorders	Yes	-67.46	-95.88	-39.05	-63.37%	-90.07%	-36.68%	0.112
	No	-61.09	-85.60	-36.58	-56.11%	-78.63%	-33.60%	
Self-reported previous diagnosis of physical diseases	Yes	-67.42	-89.62	-45.23	-59.64%	-79.28%	-40.01%	0.803
	No	-61.13	-96.90	-25.63	-59.77%	-94.74%	-25.63%	

Different letters mean significant differences according the Bonferroni post-hoc test (p<0.05).

Table 3. Sedentary behavior change (pre-post pandemic) in self-isolated adults during the SARS-CoV-2 pandemic in 2020 in Brazil

Characteristics	Category	SB change (pre versus during)						
		Mean change in minutes	95% CI		Delta%	95% CI		Interaction p value
Sex	Male	161.41	119.48	203.35	42.51%	31.47%	53.56%	0.380
	Female	152.28	111.87	192.69	41.72%	30.61%	52.78%	
Age	Young adults (18-35 years)	**190.48a**	**149.65**	**231.30**	**47.62%**	**37.42%**	**57.81%**	**<0.001**
	Middle age adults (36-55 years)	**143.35b**	**99.48**	**187.21**	**39.87%**	**27.62%**	**51.99%**	
	Older adults (55-64 years)	**136.71b**	**77.88**	**195.54**	**38.34%**	**21.82%**	**54.80%**	
Ethnicity	Black/Asian/Mixed/Others	155.43	109.04	201.81	41.42%	29.07%	53.81%	0.940
	White	158.26	121.24	195.29	42.81%	32.80%	52.83%	
Marital status	Single/divorced/widowed	**176.15a**	**133.74**	**218.56**	**46.87%**	**35.58%**	**58.15%**	**0.024**
	Married	**137.54b**	**96.85**	**178.24**	**37.29%**	**26.18%**	**48.32%**	
Employment	Employed/students/military	**179.85a**	**142.15**	**217.55**	**45.58%**	**36.02%**	**55.14%**	**0.030**
	Unemployed/retired	**133.84b**	**79.26**	**188.42**	**38.22%**	**22.63%**	**53.81%**	
Monthly household income	<R$2005 ($371)	171.17	118.64	223.70	47.39%	32.85%	61.94%	0.632
	R$2005 ($371) -R$8640 ($1600)	166.74	125.52	207.95	45.81%	34.49%	57.14%	
	R$8641 ($1600) - R$11261 ($2085)	150.63	102.05	199.21	40.36%	27.34%	53.38%	
	<R$2005 ($371)	138.85	92.10	185.59	35.50%	23.54%	47.45%	
Current smoking	Yes	158.87	108.25	209.49	42.72%	29.10%	56.33%	0.984
	No	154.82	116.98	192.66	41.53%	31.38%	51.68%	
Current alcohol consumption	Yes	173.39	134.25	212.53	46.86%	36.28%	57.44%	0.091
	No	140.30	96.75	183.85	37.44%	25.82%	49.06%	
Self-reported previous diagnosis of mental disorders	Yes	**173.16a**	**129.97**	**216.34**	**45.02%**	**33.79%**	**56.25%**	**0.003**
	No	**140.53b**	**101.07**	**180.00**	**39.03%**	**28.07**	**49.99%**	
Self-reported previous diagnosis of physical diseases	Yes	139.60	107.20	172.00	37.85%	29.07%	46.64%	0.358
	No	174.09	117.49	230.69	46.31%	31.25%	61.37%	

Different letters mean significant differences according the Bonferroni post-hoc test (p<0.05).

Figure 1. Moderate to vigorous physical activity and sedentary behavior, pre and during COVID-19 pandemic in 2020 in Brazil
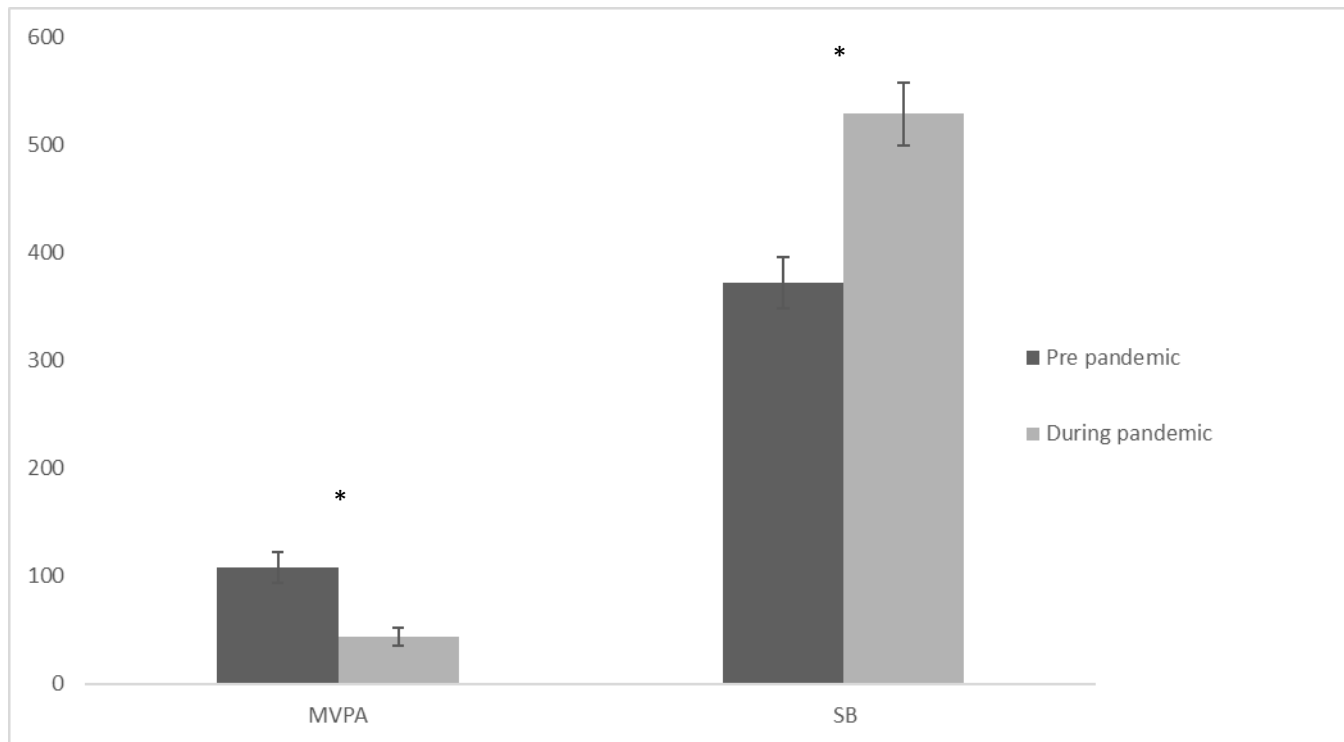
Values are shown as the estimated marginal means, in minutes per day, of moderate to vigorous physical activity (MVPA) and sedentary behavior (SB) together with their standard error. Significant changes across time were found for MVPA ($p<0.001$) and SB ($p<0.001$).