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Protective role of physical activity patterns prior to COVID-19 confinement with the severity/duration of respiratory pathologies consistent with COVID-19 symptoms in Spanish populations

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ABSTRACT

The main purpose of the present study was to determine the association of physical activity (PA) patterns prior to COVID-19 confinement with severe respiratory distress consistent with COVID-19 symptoms. Participants were recruited by sending a survey through various social network channels via the snowball method. A voluntary sample of 420 individuals consisting of 199 men and 221 women from the Spanish national territory participated in this study. Some factors, such as being overweight and obese were related to the presence of a greater number of symptoms associated with COVID-19. Interestingly, it was observed that not performing moderate or vigorous PA increased the risk of COVID-19 symptoms. Consequently, when the effect of the practise of PA was evaluated in terms of the number of practises per week and in minutes per practise per week, a protective effect was observed, where moderate PA >150 min per week reported an inverse association with hospitalization for respiratory symptoms (RR: 95%CI: 0.24, 0.05–1.04, P = 0.05). Likewise, overweight (RR: 16.3, 95%CI: 1.93–137.9, P = 0.01), obesity (RR: 19.1, 95%CI: 1.63–222.5, P = 0.019) and non-performance of moderate PA (RR: 4.12, 95%CI; 0.95–17.76, P = 0.05) reported positive associations with hospitalization for respiratory symptoms. Thus, the practise of moderate PA (>150 min per week) is a protective factor against hospitalization for respiratory symptoms consistent withCOVID-19 symptoms.

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Introduction

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), originated in Wuhan, China in December 2019, and on

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11 March 2020, the World Health Organization (WHO) (World Health Organisation, 2020) declared the outbreak a pandemic. Most people infected with the SARS-CoV-2 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems such as cardiovascular disease, diabetes, chronic respiratory disease and cancer, however, are more likely to develop serious illnesses. The most common symptoms of COVID-19 are fever, dry cough and fatigue. Other, less common symptoms that may affect patients include aches and pains, nasal congestion, headache, conjunctivitis, sore throat, diarrhoea, loss of taste or smell, skin rash and discoloration of the fingers or toes.

The first transmission recorded in Spain was on 31 January 2020, on the island of La Gomera (Canary Island). On March 15, the government declared a state of emergency and lockdown. According to information from the Red Nacional de Vigilancia Epidemielógica (España, 2020), 769,351 cases of COVID-19 have been identified in Spain as of October 21. Of these cases, 5.4% have been hospitalized, 0.4% have been admitted to the ICU and 0.8% have died. The highest proportion of COVID-19 cases occur in the 15-59 age group (68% of the total), with the 15-29 age group being the most represented, with 22% of the cases. Regarding the distribution by sex and age of the Spanish population, the cases of COVID-19 are overrepresented in men aged 15–39 years and in women aged 15–49 years and over 89 years. Approximately 51.6% of the cases present with symptoms.

The COVID-19 pandemic has affected many countries in terms of labour, the economy, production, health and, consequently, lifestyle. This pandemic has led to the implementation of strict quarantines and state plans around the world to attempt to control the chain of virus transmission, the primary prevention measures being physical distancing and a significant reduction in mobility. The WHO has also called on nations to provide plans that promote teleworking to prevent and control COVID-19, affecting physical and mental health (Adhikari et al., 2020; Rajkumar, 2020). During the 99 days of confinement implemented by Spanish officials to prevent and control the COVID-19 pandemic, restrictions on the movement of people reduced physical activity (PA), thus increasing sedentary behaviour among the population (Castañeda-Babarro et al., 2020; López-Bueno et al., 2020; Sánchez-Sánchez et al., 2020). Failure to comply with PA recommendations of a minimum of 150 minutes of activity at a moderate intensity per week can decrease physical fitness, worsen metabolic and cardiovascular parameters, change body composition (decreasing muscle mass and increasing mass adipose), increase depressive symptoms, decrease general well-being and have other adverse effects (Goethals et al., 2020; Mattioli & Ballerini Puviani, 2020). In this sense, obesity increases the risk of infection and mortality with viral diseases, so it is advisable to avoid weight gain by exercising regularly (Luzi & Radaelli, 2020). Additionally, physical inactivity due to a sustained quarantine period can decrease the ability of organ systems to resist viral infection and increase the risk of damage to the immune, respiratory, cardiovascular and musculoskeletal systems, as well as the brain (Woods et al., 2020). Moreover, sedentary behaviour during COVID-19 confinement has been reported to have a positive association with weight increase and different cardiometabolic risk factors (Reyes-Olavarría et al., 2020; Zachary et al., 2020).

On the other hand, although susceptibility to infection is multifactorial, epigenetic and environmental/behavioural factors all impact or contribute to immunity in the early stages of the infection (Zbinden-Foncea et al., 2020). Primary data suggest that the severity of symptoms associated with COVID-19 and the chances of being infected by the virus are associated with people's health status and lifestyles prior to infection (Zbinden-Foncea et al., 2020). The factors linked to an increased risk of hospitalization and mortality include becoming overweight/obese and developing insulin resistance or diabetes. These diseases are related to sedentary behaviour, poor dietary habits and a lack of physical exercise and are further characterized by chronic, low-grade inflammation (Zbinden-Foncea et al., 2020). Therefore, PA represents the first line of defence against metabolic diseases and infections like COVID-19, mediating several crucial functions, such as inflammation and the immune response, and may even counteract or mitigate viral adverse effects (Nigro et al., 2020). In this regard, prior exercise training and high levels of cardiorespiratory fitness are likely to act as immunoprotective agents in patients who contract SARS-CoV-2 (Zbinden-Foncea et al., 2020).

As early as 2005, it was highlighted that PA is a key component of successful recovery from SARS (Lau et al., 2005). Recently, it was found that regular bouts of short (up to 45 minutes) and moderate-intensity exercise is beneficial for host immune defence, especially among older people and adults with chronic diseases (Simpson et al., 2020). However, immune function can be compromised at the high-performance end of the spectrum of PA and place an individual at increased risk of infection, which is associated with periods of intense training (Simpson et al., 2020). Therefore, it appears that moderate-to-vigorous exercise may be beneficial in reducing or alleviating the severity of respiratory pathologies consistent with COVID-19. Actually, in a recent review, authors concluded that PA has been proven an effective therapy for most chronic diseases, including COVID-19. Consequently, PA could be helpful to regulate physiological systems, such as the inflammatory response and antioxidant defence (Fernández-Lázaro et al., 2020). Indeed, following a respiratory pathology such as COVID-19, there is a drastic reduction in physical strength and fitness, and physical rehabilitation interventions are required to promote recovery post infection (Rooney et al., 2020).

To date, little is known regarding how PA might interact as a protective agent against respiratory pathologies such a SARS-CoV-2 infectivity and susceptibility to COVID-19 disease. As the pandemic proceeds, it will be important to perform retrospective studies to determine whether PA status had any bearing on the infection or symptoms of COVID-19 (Woods et al., 2020). Taking into account the previous literature, the main purpose of the present study is to delineate the association of PA patterns in individuals prior to COVID-19 confinement with severe respiratory symptoms consistent with COVID-19 symptoms.

Methods

Participants

Participants were recruited by using a survey sent through various social network channels via the snowball method. Therefore, this cross-sectional study was based on a voluntary sample of 420 individuals from the Spanish population, which consisted of 199 men and 221 women. To be included in the study, individuals had to (i) be at least 18 years old, (ii) be residents of Spain (Spanish citizens or foreigners residing in Spain) and (iii) have reliable internet access. Individuals were excluded if they (i) were unable to give consent, (ii) had intellectual limitations or (iii) had no or limited internet access. After receiving detailed information on the objectives and procedure of the study, each participant signed an informed consent form for participation that complied with the ethical standards of the World Medical Association Declaration of Helsinki (2013). The local Ethics Committee of University of Jaén (DIC.20/5.TES) approved the study.

Materials and testing

An online questionnaire was developed to collect the information validated by researchers from multidisciplinary groups. The questionnaire was distributed through different social networks and emails (e.g., email, WhatsApp, Twitter, Instagram and Facebook) via a nonprobability snowball sampling strategy focused on recruiting people 18 years of age or older living in Spain during the COVID-19 outbreak (Jans et al., 2015). It has been shown that online snowball surveys are very effective for contacting participants from different places, typically producing a higher response rate than that of other strategies (Baltar & Brunet, 2012).

Once the literature review was completed, 30 items were included in the questionnaire. The items were sent to five experts (experienced sports science researchers) for their evaluation, who then recommended the removal of four items. The data were collected via Google Drive. A pilot study with 20 participants was performed to check the operation of the test and analyse the psychometric properties of the items. Finally, the remaining 26 items were analysed in the final group of 420 individuals. The study was carried out through non-probability sampling. The participants were able to respond to the questionnaire via a link, which was shared through institutional emails, Facebook, Instagram, WhatsApp and Twitter, in May and June 2020; in other words, the questionnaire was available for eight weeks. The study was divided into three sections: informed consent, sociodemographic data and PA patterns.

Study presentation and informed consent

The first part of the survey mentioned the background of the study, supervisor responsible and terms of informed consent. Participants were asked to be as honest as possible and to answer all questions completely and accurately. The answers were private and anonymous; participants were told to refrain from reporting their names or any personal information at any point. The questionnaire could be interrupted at any time before the submission process. An analysis was performed on only the responses from participants who answered all of the questions and clicked "submit" at the end of the survey.

Personal history

The personal history obtained through the questionnaire was focused on the personal background of the participants, which included their email, sex (female, male), age (years), body weight (kg), height (cm), race (Caucasian, Berbers, Indian, African American), autonomous community location, education level (primary, secondary, university, technical education, postgraduate), number of people who lived in the same household during quarantine, current occupation (student, unemployed, active worker [construction, warehouse worker, maintenance, etc.], passive worker [office worker, driver, telemarketer, etc.], tobacco consumption (never, daily, occasional, ex-smoker) and alcohol consumption (never, moderate, excessive, ex-drinker). Additionally, the participants were asked if they had suffered the characteristic symptoms of COVID-19 according to the World Health Organisation (2020).

Physical activity patterns and anthropometric characteristics

PA before quarantine was measured by a short version of the international PA questionnaire (IPAQ), Spanish version (Cancela et al., 2019). This measure assesses the types of intensities of PA and the amount of time that people spend sitting as part of their daily lives, considered in metabolic equivalent of task (MET)-min/week. According to the IPAQ, PA is defined as the level of self-reported engagement in moderate or vigorous activity in a typical week, measured in days per week and hours per week, as well as how many days per week the individual walks for 10 minutes. Moderate PA is defined as an activity that causes heavier than normal breathing and may include carrying light weights, riding a bicycle at normal speed and engaging in sports, but does not include walking. Vigorous physical activities refer to those that require hard, physical effort and cause much harder than normal breathing. In addition to questions about their PA, the participants were asked if they were infected with SARS-CoV-2.

Finally, participants were asked about their body weight and height, in order to calculate BMI (weight (kg)/height (cm)^2). BMI is categorized according to the WHO criteria

Table 1. Comparison of anthropometric and physical activity parameters according to sex.

Variables	Total n = 420	Women n = 221 (52.6)	Men n = 199 (47.4)	p value
Age (years)[a]	33 (20–54)	30 (19–54)	36 (21–54)	**<0.001**
		Anthropometric parameters		
Weight (k)[a]	70 (50–95)	60 (47–85)	77 (62–100)	**<0.001**
Height (m)[a]	1.70 (1.56–1.85)	1.63 (1.54–1.74)	1.78 (1.67–1.87)	**<0.001**
BMI (kg/m2)[a]	23.5 (19.2–30.9)	22.6 (18.3–30.4)	24.3 (20.1–31.6)	**<0.001**
Category, BMI [b]				**0.007**
Normal (<24.9)	287 (68.3)	166 (75.1)	121 (60.8)	
Overweight (25–29.9)	105 (25.0)	43 (19.5)	62 (31.2)	
Obese (≥30)	28 (6.7)	12 (5.4)	16 (8.0)	
		Physical parameters		
Exercise time				
Walk				
Walk (times per week)	2 (0–7)	2 (0–7)	2 (0–7)	0.64
Walk (min per day)	60 (20–240)	60 (20–180)	60 (20–300)	0.87
Walk (min per week)	85 (0–840)	90 (0–630)	60 (0–1,260)	0.64
Moderate physical activity				
Moderate PA (times per week)	3 (0–7)	3 (0–7)	3 (0–7)	0.80
Moderate PA (min per day)	60 (30–480)	60 (30–480)	60 (30–480)	0.14
Moderate PA (min per week)	180 (0–1440)	180 (0–540)	135 (0–1680)	0.99
Intense physical activity				
Vigorous PA (times per week)	3.1 (0–7)	2.9 (0–7)	3.4 (0–7)	**0.02**
Vigorous PA (min per day)	60 (30–150)	60 (30–120)	60 (30–240)	**0.003**
Vigorous PA (min per week)	180 (0–720)	160 (0–540)	225 (0–840)	**0.003**
Seat time				
Inactivity time (min per day)	420 (180–900)	420 (120–900)	480 (180–900)	0.14

Data show number (percent), and [a]median and 5 and 95th percentile as follows: less than 18.5 kg/m^2 is underweight; 18.5–24.9 kg/m^2 is normal; 25.0–29.9 kg/m^2 is overweight and greater than 30 kg/m^2 is obese (World Health Organization, 2003).

Statistical analysis

Statistical analysis was performed using STATA V.13.0. (StataCorp, College Station, TX, USA). The data were tested for the normal distribution using the Kolmogorov–Smirnov test. For continuous variables, values are presented as median and 5th–95th percentiles. Differences between sex were determined using the Mann–Witney U test. Qualitative variables are shown as proportions and compared using a chi-square test. To determine the association between weight status and physical parameters, a model of logistic regression adjusted by sex and age was used and reported as relative risk (RR; with 95% CI). Values of $P< 0.05$ were considered statistically significant.

Results

The analysis was carried out in a Spanish population of 420 people from 18 to 68 years of age. From the total sample, 68.3% exhibited normal weight, 75.9% did not smoke tobacco, and 23.8% did not drink alcohol. Table 1 shows a comparison of anthropometric and PA parameters according to sex. There were significant differences between the sexes in number of sessions per week (P = 0.02), minutes per day (P = 0.003) and minutes per

Table 2. Comparison of physical activity parameters and respiratory symptoms according to sex.

Variables	Total n = 420	Female n = 221 (52.6)	Male n = 199 (47.4)	p value
Hike/Walk (min per week)				0.92
None	161 (38.3)	88 (39.8)	73 (36.7)	
150	100 (23.8)	52 (23.5)	48 (24.1)	
151–300	83 (19.8)	42 (19.0)	41 (20.6)	
>300	76 (18.1)	39 (17.7)	37 (18.6)	
Moderate PA (min per week)				**0.033**
None	84 (20.0)	40 (18.1)	44 (22.1)	
150	124 (29.5)	66 (29.9)	58 (29.1)	
151–300	94 (22.4)	61 (27.6)	33 (16.6)	
>300	118 (28.1)	54 (24.4)	64 (32.2)	
Vigorous PA (min per week)				**0.038**
None	87 (20.7)	47 (21.3)	40 (20.1)	
75	42 (10.0)	30 (13.6)	12 (6.0)	
76–150	59 (14.1)	33 (14.9)	26 (13.1)	
>150	232 (55.2)	111 (50.2)	121 (60.8)	
Sitting time				0.55
< 4 hours	90 (21.4)	49 (22.2)	41 (20.6)	
4–8 hours	187 (44.5)	102 (46.1)	85 (42.7)	
>8 hours	143 (34.1)	70 (31.7)	73 (36.7)	
Respiratory symptoms				
Fever	204 (48.6)	103 (46.6)	101 (50.7)	0.39
Cough	315 (75.0)	159 (71.9)	156 (78.4)	0.12
Respiratory distress	139 (33.1)	72 (32.6)	67 (33.7)	0.81
Loss of smell	123 (29.3)	67 (30.3)	56 (28.1)	0.65
Loss of taste	109 (26.0)	59 (26.7)	50 (25.1)	0.71

Data show number and (percent).

Table 3. Variables associated with the severity of the respiratory symptoms compatible with COVID-19.

Respiratory symptoms	Variable associated	RR (95%IC) P value
Fever		
Fever >1 week	None PA Vigorous	2.48 (1.02–6.01), 0.04
Fever >1 week	None PA Moderate	3.13 (1.2–8.1), 0.019
Fever >1 week	PA Moderate, >150 min per week	0.31 (0.12–0.83), 0.019
Fever >1 week	PA Vigorous, 3–5 days per week	0.27 (0.08–0.92), 0.037
Fever >1 week	PA Vigorous, >75 min per week	0.40 (0.16–0.97), 0.04
Cough		
Cough >1 week	Obesity	4.23 (1.36–13.1), 0.012
Cough >1 week	Hike, 1–2 days per week	0.45 (0.17–1.13), 0.08
Cough <48 hours	PA Moderate, >150 min per week	3.16 (0.99–10.0), 0.05
Respiratory distress		
Respiratory distress >1 week	Obesity	3.78 (1.07–13.3), 0.038
Respiratory distress 3–6 days	None PA Vigorous	3.43 (1.15–10.1), 0.02
Respiratory distress 3–6 days	PA Vigorous, >75 min per week	0.45 (0.22–0.90), 0.02
Loss of smell		
Loss of smell 3–6 days	None PA Vigorous	2.67 (0.83–8.5), 0.09
Loss of smell 3–6 days	PA Vigorous, >75 min per week	0.37 (0.11–1.19), 0.09
Loss of smell >1 week	PA Vigorous, 3–5 days per week	0.38 (0.18–0.80), 0.011
Loss of taste		
Loss of taste 3–6 days	Sitting time >8 hours	1.66 (1.04–2.62), 0.03

All values are age adjusted, RR; Relative risk ($CI_{95\%}$), p value

Table 4. Variables associated with hospitalization by respiratory symptoms compatible with COVID-19.

Variable associated	RR (95%IC) P value
Overweight	16.3 (1.93–137.9), 0.01
Obesity	19.1 (1.63–222.5), 0.019
None Moderate PA	4.12 (0.95–17.76), 0.05
Moderate PA, >150 min per week	0.24 (0.05–1.04), 0.05
Moderate PA, 30–150 min per week	0.13 (0.01–1.17), 0.07

All values are age adjusted, RR; Relative risk ($CI_{95\%}$), p value

week (P = 0.003) spent on vigorous PA. Moreover, men reported a higher prevalence of overweight than women (P = 0.007).

Regarding PA, the frequency of and time dedicated to hiking/walking in minutes per week and sitting time in hours per day were similar in both sexes, whereas men presented higher values of moderate (P = 0.033) and vigorous PA (P = 0.038) in minutes per week than women. Regarding respiratory symptoms, the most frequent symptom from the analysis was the presence of cough, followed by fever and respiratory distress. Loss of smell and taste was reported in about a quarter of the population (Table 2).

Table 3 shows the variables associated with the severity of respiratory symptoms compatible with COVID-19. Interestingly, it was observed that not performing moderate or vigorous PA was also a risk factor regarding the presence of symptoms and their degree of severity. In this case, fever >1 week was positively associated with not performing PA relative to performing vigorous (RR: 2.48, 95%CI: 1.02–6.01, P = 0.04) and moderate (RR: 3.13, 95%CI: 1.2–8.1, P = 0.019) PA. By contrast, moderate PA, >150 min per week reported an inverse association with fever (RR: 0.31, 95%CI: 0.12–0.83, P = 0.019) and cough <48 hours (RR: 3.16, 95%CI: 0.99–10.0, P = 0.05). On the other hand, obesity was associated with respiratory distress >1 week (RR: 3.78, 95%CI: 1.07–13.3, P = 0.038) and cough (RR:

4.23, 95%CI: 1.36–13.1, P = 0.012). Loss of smell >1 week was inversely associated with vigorous PA, 3–5 days per week (RR: 0.38, 95%CI: 0.18–0.80, P = 0.011). Finally, sitting time >8 h presented a positive association with loss of taste 3–6 days (RR: 1.66, 95%CI: 1.04–2.62, P = 0.03).

Table 4 shows the variables associated with hospitalization for respiratory symptoms compatible with COVID-19. In this sense, overweight (RR: 16.3, 95%CI: 1.93–137.9, P = 0.01), obesity (RR: 19.1, 95%CI: 1.63–222.5, P = 0.019) and non-performance of moderate PA (RR: 4.12, 95%CI; 0.95–17.76, P = 0.05) reported positive associations with hospitalization for respiratory symptoms. By contrast, performance of moderate PA >150 min per week reported an inverse association with hospitalization for respiratory symptoms (RR: 95%CI: 0.24, 0.05–1.04, P = 0.05).

Discussion

The main purpose of the present study was to delineate the association of PA patterns prior to COVID-19 confinement with the severity of respiratory symptoms consistent with COVID-19. The main findings of this study were i) performing moderate PA (>150 min per week) is a protective factor against hospitalization for respiratory symptoms, ii) not performing moderate or vigorous PA is a risk factor regarding the presence of symptoms and their degree of severity and iii) obesity and overweight are associated with an increased risk of hospitalization for respiratory symptoms. Consequently, when the practise of PA was evaluated in minutes per week and number of practices per week, a protective factor was observed.

The severity of symptoms associated with COVID-19 and the subsequent outcomes from the infection are associated with the health status of individuals prior to infection (Zbinden-Foncea et al., 2020). Previous research showed that various indicators, such as obesity, physical inactivity, tobacco smoking and physical exercise, among others, are related to the clinical worsening of COVID-19 patients (Hamer et al., 2020; Magdy Beshbishy et al., 2020; Sanchis-Gomar et al., 2020; Vardavas & Nikitara, 2020). Indeed, Sallis et al., found that being inactive was a stronger risk factor for severe COVID-19 outcomes (Sallis et al., 2021). Common to these conditions is a state of chronic low-grade inflammation (Zbinden-Foncea et al., 2020).

In accordance with the present results, a recent study demonstrated that a protective association of PA with COVID-19 was observed even at relatively low levels of exercise below the international recommendations (i.e. less than 150 minutes of moderate-to-vigorous activity), whereas higher levels did not produce a dose-response effect (Hamer et al., 2020). Furthermore, it should be noted that maximal exercise capacity was independently and inversely associated with the likelihood of hospitalization due to COVID-19. In additions, Salgado-Aranda et al., reported that a baseline sedentary lifestyle represents an important finding and suggests the utility of exercise in prevention of severe COVID-19 presentations. (Salgado-Aranda et al., 2021). Thus, one MET higher of exercise capacity was associated with 13% lower odds of hospitalization (Brawner et al., 2020).

While it is difficult to determine conclusively, these results might be related to the levels of cytokines and chemokines in the body, which play significant roles in immunity and immunopathology (Zbinden-Foncea et al., 2020). During and after PA, pro- and anti-inflammatory cytokines are released, and lymphocyte circulation and cell recruitment increase, all of which could have an effect on the existence of a viral infection, the intensity of its symptoms, and the possibility of mortality as a consequence of the infection in individuals who practice exercise habitually (Da Silveira et al., 2020).

Given the positive effects of moderate doses of exercise on select immune markers associated with many disease states, it seems that prior exercise training and high levels of cardiorespiratory fitness are likely to act as immunoprotective agents in patients who contract SARS-CoV-2 (Zbinden-Foncea et al., 2020). Additionally, physical exercise may be a useful adjuvant in a COVID-19 management or rehabilitation setting due to its effects on the peroxisome proliferator-activated receptor alpha and vascular endothelial function (Heffernan et al., 2020).

PA is a very promising non-pharmacological method for the promotion of health and is available to all people (World Health Organization, 2010). Indeed, there is irrefutable evidence of the effectiveness of regular PA in the primary and secondary prevention of several chronic diseases, including cardiovascular disease, diabetes, cancer, hypertension, obesity, depression and osteoporosis, as well as premature death (Warburton et al., 2006). Therefore, contemporary evidence from epidemiological studies shows that leading a physically active lifestyle reduces the possibility of contracting communicable (e.g., bacterial and viral infections) and non-communicable (e.g., cancer) diseases, thus implying that immune competency is enhanced by regular exercise (Campbell & Turner, 2018). It can then be deduced that PA has a similar effect on viral transmissible diseases (Da Silveira et al., 2020), which could influence the severity of SARS-CoV-2 infection (Woods et al., 2020).

Although there is no direct evidence that PA can prevent or treat COVID-19 (Damiot et al., 2020), regular PA of adequate intensity is recommended as a complementary tool to reinforce and prepare the immune system for COVID-19 (Da Silveira et al., 2020). Conversely, a disruption of PA and a decrease in physical fitness levels may intensify susceptibility to infection and increase several comorbidities related to poor COVID-19 outcomes (Woods et al., 2020).

The main limitation of this study was its cross-sectional design; the authors recommend that the factors also be measured in a longitudinal study in the future in order to further clarify the direction of the associations. Another limitation was that body weight and PA levels were self-reported, which could mean that these data were underestimated or overestimated. The main strength of the study was that people from all over the Spanish national territory participated. Additionally, it produced novel results applicable to periods of confinement and included several covariates that are currently suspected of increasing the risks related to COVID-19.

Although possible links between the risk of viral infections and changes in fitness or PA levels are outside the boundaries of the present study, in accordance with Brawner et al. (Brawner et al., 2020), these results support important public health recommendations. It can therefore be surmised that both the volume and the intensity of PA are inversely related to the risk of infection.

Conclusion

The current study reported that a healthy lifestyle that includes PA and the maintenance of a healthy weight are particularly important because they may be protective factors against COVID-19. Moreover, performing moderate PA (>150 min per week) is a protective factor against hospitalization for respiratory symptoms. The current study provided different relevant aspects that must be considered during times of confinement and as measures to better prepare the immune system against COVID-19.

Disclosure of potential conflicts of interest

No potential conflict of interest was reported by the author(s).

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