PSYCHOLOGY

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Impact of COVID-19 lockdown on physical activity and psychological well-being in taekwondo athletes

Abstract

Background. Coronavirus disease 2019" (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

Problem and Aim. investigate the effects of lockdown on the physical activity and psychological well-being of Colombian taekwondo athletes during the COVID-19 outbreak.

Methods. A total of 114 athletes (male = 78; female = 36) were surveyed. Athletes responded to an online survey – the International Physical Activity (PA) Questionnaire and the psychological General Well-Being Index, considering "before" and "during" the pandemic.

Results. Lockdown had a negative effect on total PA levels (MET-min/week) (F = 20.16; p < 0.01), with females displaying the greatest decrease (from 5.420 to 3.403; p < 0.05). In the total sample, a greater change in PA behavior between before and during confinement was observed in highly active participants (n = 93 vs n = 63) as total MET-min/week (6.121vs 5.556; p < 0.05). Assessment of psychological well-being revealed significant differences by gender, with females being more affected by lockdown in perceived anxiety (p < 0.05), vitality (p < 0.01) and general health (p<0.01). However, no differences were found at technical level. PA levels during lockdown revealed significant inter-group differences between the moderate and high-activity male groups for anxiety (p<0.01) and vitality (p < 0.05), while the moderate and high-active female groups showed differences in the self-control (p < 0.05) and well-being (p < 0.05) dimensions.

Conclusions. while COVID-19-associated restrictions were essential to preserve public health, PA and psychological well-being were compromised, affecting mainly female taekwondo practitioners.

Introduction

"Coronavirus disease 2019" (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was first detected in December 2019 in Wuhan City, China. COVID-19 was declared a pandemic by the World Health Organization [Pan *et al.* 2020]. Particularly, Colombia was one of the countries with the longest lockdown period in Latin America during the pandemic. Preventive measures were taken to reduce the risk of contagion, including social distancing and the closure of commercial activities to avoid social gatherings. Also, physical activity (PA) and highly competitive physical training were prohibited (Colombian Government, 2020). Consequently, this may contribute to anxiety, depression, mental health distress and anger [Hakansson, Jonsson, Kentta, 2020; Fuentes-García *et al.* 2020]. Indeed, in a sample of 102 Estonian athletes, Parm *et al.* [2021] indicated that two-thirds of the participants had some indication of distress. In the same way, Donmez *et al.* [2021] found that most of the professional football players (66%) had post-traumatic stress disorder symptoms that were caused by lockdown, while Mon-Lopez *et al.*[2020] reported that social isolation affected psychological components in Spanish handball players.

Before this pandemic, insufficient physical inactivity was already described as a global public health problem [Guthold *et al.* 2018]. According to the National Nutrition *Survey (ENSIN, 2015)*, approximately half of the Colombians between 18 and 64 years old are physically inactive according to WHO recommendations. In addition, both physical inactivity and lockdown have been reported to have a negative impact on mood in general population and athletes [di Fronso *et al.* 2020; Melendez *et al.* 2020].

PA and long-term exercise showed to have a positive impact on both physical health and psychological well-being [Chekroud *et al.* 2018; Corpas *et al.* 2019; De la Rosa *et al.* 2019]. Neurobiological effects of PA seem to influence several neural mechanisms related to depression, anger, cynical distrust, stress, anxiety, and other psychological disorders [Hassmen, Koivula, Uutela 2000; Strohle *et al.* 2009]. Although there is evidence that the benefits of moderate PA (60% VO_2max) on different psychological health parameters can be achieved after 20 min, there is not yet an ideal dose of exercise to improve psychological health [Hansen, Stevens, Coast 2001]. However, the literature indicates that any PA is still better than none in order to fight against psychological disorders [Harris 2018].

Sports practice, including martial arts, provides psychological benefits. In this regard, previous evidence indicates that martial arts training is able to reduce symptoms of psychological disorders such as anxiety, depression, and aggression [Milligan *et al.* 2016; Moore, Dudley, Woodcock 2019], and have a positive influence on personality traits such as higher self-esteem, confidence, and optimism [Fuller 1988; Vertonghen, Theeboom 2010]. Indeed, martial arts athletes reported improvements in areas such as respect, self-confidence, moral development, spirit and energy [Lantz 2002]. In fact, a recent meta-analysis found that martial arts training improved psychological well-being and reduced symptoms associated with anxiety and depression [Moore, Dudley, Woodcock 2020].

According to taekwondo field research, some studies evaluated its effect on psychological health. In the late 1980's, Finkenberg [1990] and Trulson [1986] reported positive higher self-concept, self-esteem and lower levels of anxiety in taekwondo athletes compared to the control group. More recently, literature reported positive outcomes in psychological health such as cognitive and affective self-regulation, social behavior, and improvements in mood state in children and adults who practiced taekwondo [Harwood, Lavidor, Rassovsky 2017; Yang, Ko, Roh 2018].

With lockdown due to the COVID-19 pandemic, athletes were forced to interrupt their specific training activities and were in mandatory home isolation following government Colombian guidelines. The only opportunity for taekwondo athletes to maintain their physical performance level was to undertake home-based training programs individually provided by coaches.

However, the effects caused by stopping training during the lockdown, in martial arts and/or combat sports has received less attention in the scientific literature.

Based on the aforementioned considerations, we hypothesized that total PA levels would decrease during lockdown, and this would be associated with higher levels of different psychological symptoms such as anxiety, stress and depression, specifically in female and non-black belt athletes overall. Thus, the aims of this study were two. First, to analyse changes in PA levels and sedentary behaviors in Colombian taekwondo athletes before and during lockdown period. Secondly, to examine lockdown impacts on psychological well-being during COVID-19 pandemic in taekwondo athletes, with a special focus on gender and expertise level.

Materials and methods

Design and participants

The present study is an exploratory and retrospective design to examine the impact of lockdown on PA levels and psychological well-being in Colombian taekwondo athletes, due to COVID-19 pandemic. The sample comprised 114 participants: male *n* = 78 (age: 35.4 ±14.7 years; body mass: 72.0 ±11.3 kg, height: 174 ± 6.3 cm, body mass index (BMI): 23.8 ± 3.6 kg·m^{-2}) and female athletes

n = 36 (age: 26.5 ± 9.6 years; body mass: 62.4 ± 10.6 kg; height: 163 ± 87 cm; BMI: 23.3 ± 3.9 kg·m^{-2}). Participants were distributed according to life cycle [Maugeri et al. 2020] (for details see **table 1**) and belonged to clubs associated with the Colombian Taekwondo Federation. Participants' eligibility was based on the following inclusion criteria: i) be a member of a club associated with the Colombian Taekwondo Federation; ii) athletes aged 18 or more; iii) taekwondo practice systematically at least three times a week before the pandemic. Those who had previously reported having COVID-19 symptoms were excluded from the study. All participants were previously informed via email and before starting the survey in order to know the purpose of the study and the benefits associated with the research. Participants were asked to sign an informed consent form electronically. The study was approved by the Ethics Committee of the Catholic University of East, and it was conducted in accordance with the Declaration of Helsinki.

Table 1. General characteristics of the participants

	Male (n= 78)	Female (n= 36)
Age (years)	35.0 ± 14.6	26.5 ± 9.6
Body mass (kg)	71.8 ± 11.4	62.4 ± 10.6
Height (cm)	174 ± 6.4	163.6 ± 8.7
BMI (mass/height²)	23.7 ± 3.6	23.3 ± 3.9
	(n=20) Young (n=14)	
Age (years)	18.2± 2.0	18.5 ±1.0
Body mass (kg)	64.9 ± 9.6	57.7 ± 10.0
Height (cm)	175.9 ± 5.4	164.2 ± 9.8
BMI (mass/height²)	20.9 ± 2.7	22.2 ±2.7
	(n=28) Young Adults (n=17)	
Age (years)	30.1 ± 5.7	27.4 ± 4.7
Body mass (kg)	73.8 ±12.3	64.4 ± 11.2
Height (cm)	176.3 ± 6.2	164.2 ± 7.3
BMI (mass/height²)	23.7 ± 3.6	24.0 ± 5.0
	(n=30) Adults (n = 5)	
Age (years)	50.8 ±7.9	46 ± 3.7
Body mass (kg)	74.5 ± 10	68 ± 4.5
Height (cm)	170.7 ± 5.8	169.6 ± 8
BMI (kg·m^{-2})	25.5 ± 3.1	23.9 ± 2

Descriptive results are expressed as mean standard deviation (SD); BMI: Body mass index.

Measures

Physical Activity levels

To evaluate PA levels of taekwondo athletes, the short form of the International Physical Activity Questionnaire survey (IPAQ-SF) was used as a valid measure for estimating PA and recommended by the World Health Organization [Van Poppel et al. 2010]. The questions allowed the assessment of PA levels of the participants by providing information on minutes per day or days per week, at any time of the day, spent in activity prior to the lockdown and the last four weeks during the lockdown. Participants reported the frequency and duration of different types of activity: vigorous (i.e., heavy lifting, intense aerobic exercise, cycling or treadmill use); moderate (i.e., carrying light loads and cycling at a regular pace, gardening); walking activities; as well as the average time spent sitting on a weekday, including sitting at work [Maugeri et al. 2020]. Results were calculated as the weekly metabolic equivalent of a task in minutes (MET-min/week). Based on the IPAQ recommendations for the scoring protocol, participants were classified according to PA level: low active (<600 MET-min/week), moderate active (>600 MET-min/week) and high active (>3000 MET-min/week) (http://www.ipaq.ki.se).

Psychological Well-being Measure

To assess the self-perceived psychological well-being of taekwondo athletes during lockdown, the short form of PGWBI (PGWBI-S) was adopted [Grossi et al. 2006]. Briefly, this version consists of six dimensions of the original PGWB and a subset of six items which are rated on a six-point scale from 0 to 5, reaching a maximum of 30 points. Total score was obtained from the sum of the scores of the six dimensions (Anxiety, Vitality, Depression, Self-Control, Well-Being and General Health) by multiplying the overall score by 3.66 (to make it comparable to the original PGWBI version). Subsequently, athletes were rated based on a six-step scale: values below 60 indicated strong distress; values between 60 and 69 indicated distress; values between 70 and 89 indicated a state of no distress; values of 90 and above indicated a state of positive well-being [Grossi et al., 2006]. In our study, Cronbach's alpha for reliability was 0.87 indicating good reliability and content validity [Saalim et al. 2020].

Procedures

Data were collected in 2020 from 8 to 22 July, during lockdown period, via an online survey. After having signed informed consent, participants completed a web-based survey which was launched online *https://tinyurl.com/ybsrz9z5*. The survey remained online 14 days and took around from 10 to 15 min to complete being self-administered. It included the IPAQ-SF and PGWBI-S, together with questions related to demographic and socioeconomic data.

Athletes were initially recruited by phone, email, WhatsApp, or using our informal and professional networks being informed on the study purpose and methodology. Before starting the survey, it was reiterated that it would be completely anonymous and not traceable to the identity of the participants. In addition, the athletes received an induction on the assessments performed to avoid the learning effect.

Subsequently, the results of the analysed athletes were classified according to their level of expertise (novice, advanced and expert), sociodemographic level (high school, professional and postgraduate education), age-category and PA level.

Statistical analysis

All statistical analyses were performed using SPSS software version 25.0 (SPSS/IBM, Chicago, IL USA). Continuous results are presented as mean ± standard deviation. Categorical results are expressed in absolute and percentage terms. The normality of distribution was checked with the Shapiro-Wilk test, and homogeneity of variance was tested by Levene's statistics. The interaction of gender and age (between-subjects factor) in the changes of PA levels before and during the lockdown (within-subjects factor) were analysed by a mixed design ANOVA (gender × age × time). A multivariate analysis of variance (MANOVA) test was performed to evaluate the PGWBI-score and all six dimensions in PGWBI-S test (anxiety, vitality, depression, self-control, well-being, and general health). Pearson's correlation was calculated when data followed a normal distribution. Otherwise, we used a Spearman correlation. Partial correlations were performed for controlling for the effect of additional variables.

The internal consistency of the PGWB-S test applied to the population of our study was examined by Cronbach's alpha (α) that should be at least 0.7 as an indicator of the satisfactory homogeneity of the items within the total scale [Taber 2018].

A critical value for significance of $p < 0.05$ with a 95% confidence interval (95% CI) was used throughout the study.

Results

Descriptive data of study sample.

Table 2 shows descriptive data of the sample. Overall, the study sample (n = 114) comprised 68.4 % of males and 31.6% of females.

Considering the level belt, both males and females documented a proportion of expert and novice athletes of 64.1% vs 35.8% and 18 (50%) vs 18 (50%), respectively. *Total physical activity is modified by lockdown: ¿Are age and technical level influential factors?*

As shown in **Figure 1A**, the examination of the whole sample revealed significant differences (F = 18.43; p < 0.01) between before and during lockdown for high active participants (6121vs 5556 MET–min/week). Moreover, total physical activity significantly decreased during lockdown (F = 20.16; p<0.01) in both female (5.420 vs 3.403 MET–min/wk; p < 0.05) and male (5.345 vs 3.877 MET–min/w k; p < 0.01). Likewise, mixed ANOVA showed a no significant time × sex effect (F = 0.498; p> 0.05) (**Fig. 1B**).

No significant differences in variation in total physical activity between females and males were found (**Fig. 1C**).

As shown in **Fig. 1D**, lockdown modified total PA levels in both males and females, according to age-category. ANOVA test showed an effect of time (F = 33.53;

p < 0.01) in the young male and adult groups (p < 0.01 and p < 0.05, respectively). Total PA levels decreased in young adult group respect to the before lockdown period (5073. 75 vs 4.063 MET–min/wk) but achieved no significant threshold (the p value was >0.05).

Table 2. Description of categorical results according to sex, technical level and sociodemographic parameters.

Results	Male (n =78)		Female (n = 36)	
	n	%	n	%
Age category				
-19 years	20	25.6	14	38.8
20-40 years	28	35.8	17	47.2
41-60 years	30	38.4	5	13.8
Technical level				
Colours	28	35.8	18	50
Black belt	50	64.1	18	50
Schooling				
High School	18	23	6	16.6
University	46	58.9	25	69.4
Postgraduate	14	17.9	5	13.8
Nutritional status				
Underweight	5	6.4	-	-
Normal weight	42	53.8	28	77.7
Overweight	31	39.7	8	22.2
Physical Activity Level (pre)				
Low	1	1.2	-	-
Moderate	12	15.3	8	22.2
High	65	83.3	28	77.7
Physical activity level (during)				
Low	8	10.2	4	11.1
Moderate	21	26.9	18	50
High	49	62.8	14	38.8
Score PGWBI-S (during)				
Strong distress	24	30.7	14	38.8
Distress	31	39.7	7	19.4
No distress	5	6.4	12	33.3
Positive well-being	18	23.0	3	8.3

PGWBI-S: psychological General Well-Being Index Short.

Likewise, analysis revealed an effect time in the young and young adult female groups (p < 0.01 and p<0.05 respectively), but no significant time × sex effect (F = 0.56; p > 0.05), time × age category (F = 2.05; p > 0.05) or time × sex ×age category (F = 0.007; p > 0.05) were found.

Mixed ANOVA analysis revealed an effect of time factor in both males and females (F = 39.29; p < 0.01), independent of technical level. No significant time × sex effect (F = 0.78; p > 0.05), time × technical level (F = 0.24; p>0.05) or time × gender ×technical level (F = 0.58; p > 0.05) were found, as shown **Figure 1E**.

Psychological wellbeing is strongly influenced by gender

PGWBI scores of six health domains comprising anxiety, vitality, depression, self-control, well-being and general health and PGWBI score of participants divided by gender, technical level, and levels of physical activity, are shown in **Figure 2** and **Table 3**.

The MANOVA test showed statistically significant differences in PGWBI-score (F = 7.43; p < 0.05; η²p = 0.063) and anxiety (F = 5.19; p < 0.05), vitality (F = 11.10;
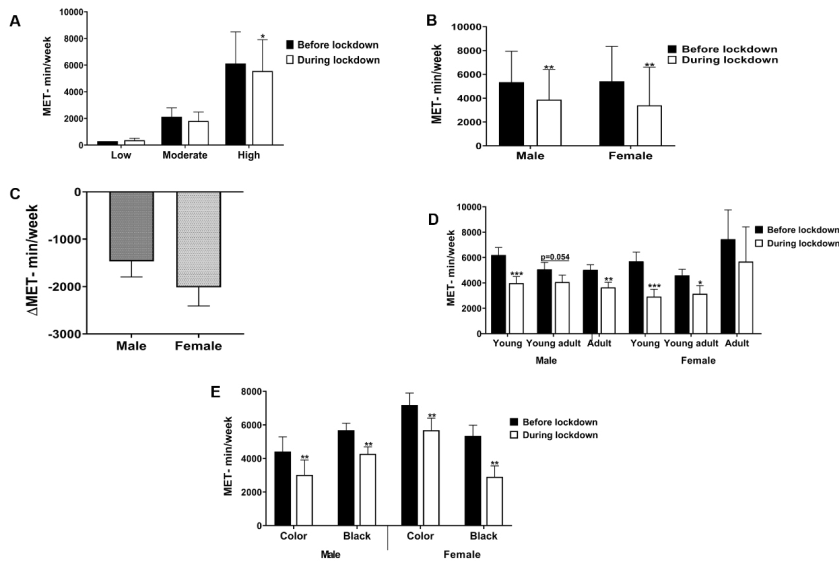
Figure 1.

Changes in total physical activity in MET- minutes/week before and during lockdown. (**A**) Effects of lockdown in whole sample according to PA levels. (**B**) Effects of lockdown in male and female athletes (**C**)Variation of total physical activity between before and during lockdown. (**D**) Effects of lockdown according to age-category. (**E**) Effects of lockdown according to technical level. Bars represent mean ± SD. */**/*** denotes p < 0.05/0.01/0.001, respectively vs before lockdown.
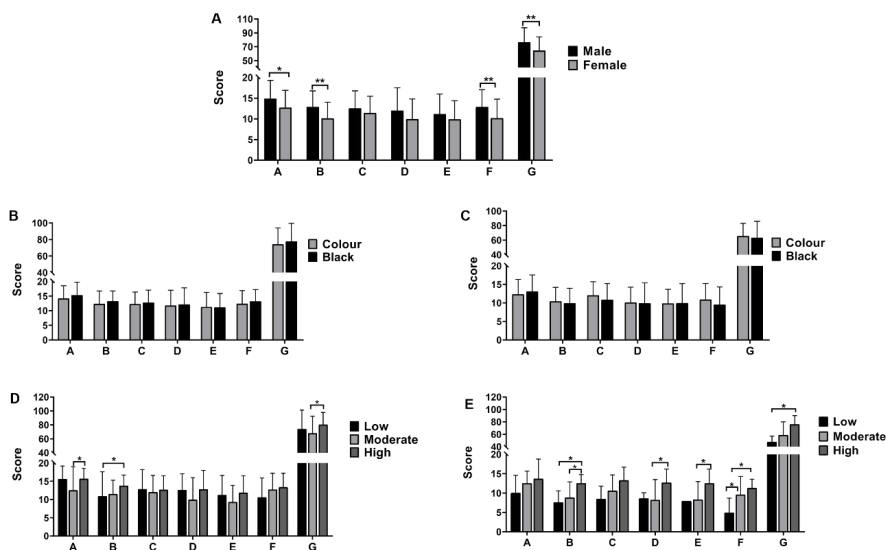

Figure 2.

Score in PGWBI-S test (PGWBI-score and all six dimensions) in male and female athletes of taekwondo, during lockdown. (**A**) According to technical level in males. (**B**) According to technical level in females. (**C**) According to PA levels during lockdown in male and (**D**) According to PA levels during lockdown in female. Bars represent mean ± SD. A: anxiety; B: vitality; C: depression; D: self-control; E: well-being; F: general health; G: PGWBI-score. */** denotes p < 0.05/0.01, respectively.
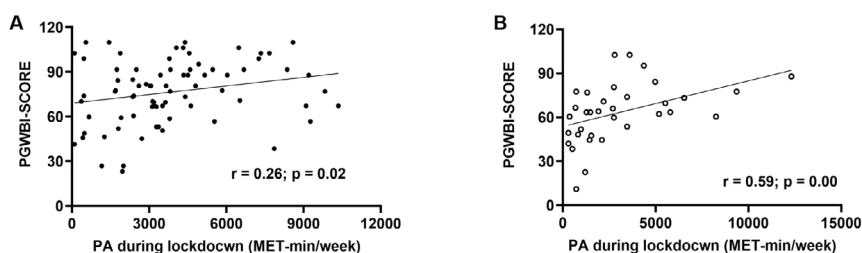

Figure 3.

Pearson's correlation test between total physical activity during lockdown and PGWBI score in male (**A**) and female (**B**). For both, values inside the graph indicate the p value of the correlation.

p < 0.01) and general health (F = 8.79; p < 0.05) dimensions (**Fig**. **2A**). Comparing colour and black belts, the MANOVA procedure showed no significant differences in any parameter of PGWBI-S test in either male or female (**Fig. 2B-C,** respectively). According to PA levels during lockdown and sex, MANOVA showed significant differences for PA levels during lockdown in PGWBI-score (F = 7.08; p < 0.05), vitality (F = 9.35; p < 0.01), self-control (F = 5.39; p < 0.05), well-being (F = 5.85; p < 0.05) and general health (F = 5.15; p < 0.05) dimensions. For sex, the MANOVA procedure showed significant differences in PGWBI-score (F = 7.09; p < 0.05) and anxiety (F = 5.87; p < 0.05), vitality (F = 7.07; p < 0.05) and general health (F = 10.07; p < 0.05) dimensions, but no for PA levels × sex interaction. Multiple pairwise *comparisons* revealed significant intra-group differences between moderate and high active male groups in PGWBI-score (p<0.05), anxiety (p < 0.05) and vitality (p < 0.05).

In females, pairwise *comparisons showed* significant intra-group differences between low and high active groups in PGWBI-score (p < 0.05); the final score slightly decreased in the moderate active compared to high active group (58.9 vs 76) but achieved no significant threshold (the p =0.052). Significant differences were also found between moderate and high active female groups in the self-control (p < 0.05) and well-being (p < 0.05) dimensions. Likewise, pairwise *comparisons showed statistical differences between low* and high active groups in general health (p < 0.05); the general health score slightly decreased in the low compared to moderate active group (4.9 vs 9.6) but achieved no significant threshold (p > 0.05).

According to schooling and sex, MANOVA only showed significant differences for schooling in depression dimension (F = 3.09; p < 0.05). For sex, the MANOVA procedure only showed significant differences in the vitality dimension (F = 7.66; p < 0.05), but no for schooling × sex interaction.

Multiple pairwise *comparisons* revealed significant intra-group differences only between university and postgraduate female groups (p < 0.05).

According to nutritional status and sex, MANOVA revealed no significant differences for nutritional status in any dimension or PGWBI-score (p > 0.05). Nevertheless, according to sex variable, analysis revealed significant differences in PGWBI-score (F = 7.65; p < 0.05) and the anxiety (F=6.58; p < 0.05), vitality (F = 13.51; p < 0.01) and general health (F = 6.28; p < 0.05) dimensions.

Comparing by age-category and sex, MANOVA procedure showed no significant differences for age-category in any dimension or PGWBI-score (p > 0.05). However, according to sex variable, analysis showed significant differences in PGWBI-score (F = 4.03; p < 0.05) and vitality (F = 9.26; p < 0.05) and general health (F=6.86; p < 0.01) dimensions, but no for schooling × sex interaction.

The between-group MANOVA results for PGWBI-score and all six dimensions according to technical level, schooling, nutritional status, PA levels during lockdown and age-category are presented in **Table 3.**

In addition, we found positive correlations between total physical activity (MET-min/week) during lockdown and PGWBI score in males (r = 0.26, p = 0.02; Sup. Fig. **3A**) and females (r = 0.59, p = 0.00; Sup. Fig. **3B**) taekwondo practitioners. These positive correlations were maintained when adjusted for sex, nutritional status, age-category, schooling and technical level, indicating that the relationship between physical activity and PGWBI score was not dependent of categorical variables. All the subjects from male and female groups were included in the correlation study.

Discussion

This study investigated PA levels before and during the lockdown caused by the COVID-19 pandemic and assessed the relationship with the psychological well-being of 114 participants practicing taekwondo. We consider that this is the first study carried out with taekwondo athletes, where psychological well-being and PA levels are evaluated analysing the effects of COVID-19 related-lockdown on these parameters.

Physical Activity and Lockdown
Results of the present study support the first hypothesis that PA levels were negatively impacted by lockdown. Thus, among the main findings, it was reported that lockdown affected total PA levels in the whole sample **(Table 2** and **Fig. 1A)**. This is consistent with recent evidence describing an overall reduction in PA levels in children and adolescents [Xiang, Zhang, Kuwahara, 2020], young adults [Karuc *et al.* 2020] and in the athlete population [Markovic, Mišigoj-Durakovic, Trninic 2005] due to lockdown. Furthermore, these results are similar to those reported in the literature in the general Croatian and Italian population [Giustino *et al.* 2020; Sekulic *et al.* 2020] and in the athlete population [Mon-Lopez *et al.* 2020].

However, when considering sex as a factor, no significant differences were reported between males and females **(Figs. 1B-C)**. In this respect, some reports showed that women spend less time in outdoor activities at different ages than men [Van Uffelen, Khan, Burton 2017; Godtman Kling, Margaryan, Fuchs 2020]. It is possible that the characteristics of the sample, i.e., regular taekwondo athletes, have thus eliminated sex-related differences. These findings are similar to those reported by Toskovic *et al.* [2004] in male and female taekwondo athletes after analysing physical fitness.

Similarly, no significant effect on age was reported **(fig. 2D)**. Thus, lockdown negatively affected both males and females regardless of age. In contrast to males, female adult groups did not reach statistical differences. Here it

Table 3. Outcomes in PGWBI-score and dimensions

	Males							Females						
	Anxiety	Vitality	Depression	Self-control	Well-being	General Health	PGWBI score	Anxiety	Vitality	Depression	Self-control	Well-being	General health	PGWBI score
Technical level														
Colours	14.1±4.3	12.3±4.4	12.2±4.1	11.7±5.2	11.2±5.6	12.3±4.7	74.1±19.8 (ND)	12.3±4.0	10.4±3.7	12.0±3.6	10.0±4.1	9.8±3.8	10.8±4.3	65.5±17.4 (D)
Black belt	15.2±4.4	13.±3.5	12.7±4.3	12.1±5.6	11.1±4.7	13.2±4.0	77.7±21.7 (ND)	13.1±4.4	9.8±4.1	10.8±4.3	9.8±5.5	9.9±5.2	9.4±4.8	63.1±22.8** (D)
Schooling														
Secondary school	13.6±5.2	12.3±4.2	12.3±4.2	11.0±5.2	9.7±4.9	12.3±4.9	71.3±21.3 (ND)	13.0±4.7	10.4±4.7	11.1±3.7	8.3±3.5	8.3±5.8	12.5±5.1	63.8±21.3 (D)
University	15.2±4.1	12.9±4.0	12.5±4.3	12.1±5.7	11.3±4.8	12.9±3.7	77.1±20.8 (ND)	11.8±3.8	10±3.3	10.5±3.6	9.8±5.0	10.0±4.5	9.1±4.5	61.3±19.5 (D)
Postgraduate	15.4±4.1	13.6±2.5	12.8±4.1	12.8±5.2	12.3±4.4	13.6±4.7	80.7±21.7 (ND)	16.8±3.2	10.2±6.0	16.1±3.2	13.2±3.9	11.1±2.3	12.4±2.0	80.0±16.9 (ND)
Nutritional status														
Underweight	15.4±4.5	13.4±5.2	13.2±4.7	13.1±7.5	12.4±5.5	14.7±4.9	82.5±26.3 (ND)	-	-	-	-	-	-	-
Normal weight	14.5±4.5	13.3±3.9	13.0±4.2	12.7±5.2	11.4±5.2	13.1±4.0	78.2±20.9 (ND)	13.0±4.2	10.6±3.7	11.6±4.2	10.3±5.0	10.0±4.8	10.1±4.7	65.9±20.7* (D)
Overweight	15.2±4.3	12.2±3.6	11.7±4.1	10.8±5.4	10.6 4.2	12.3±4.2	73.0±20.5 (ND)	11.5±4.0	8.3±4.2	10.5±3.0	8.5±4.2	9.3±3.2	10.2±4.1	58.4±17.2 (D)
Physical activity Level during														
Low	12.5±6.5	13.8±2.9	12.8±5.4	12.5±4.4	11.2±5.3	10.5±5.2	73.8±27.3 (ND)	12.2±2.1	6.5±2.4	7.5±3.6	8.9±1.7	7.9±0.00	3.8±3.9	46.9±11.7$ (SD)
Moderate	12.5±6.5	15.7±3.6	11.9±4.6	9.9±6.1	9.3±5.7	12.7±4.5	67.9±24.5# (D)	11.7±3.2	7.4±4.4	9.2±3.9	6.6±4.7	7.1±5.0	9.6±4.7	51.8±19.6 (D)
High	15.7±2.9	13.8±2.9	12.7±3.8	12.8±5.2	11.9±4.6	10.5±5.2	80.5±17.4 (ND)	13.3±5.1	12.1±1.7	12.9±3.2	12.5±3.6	12.0±3.4	11.0±2.9	73.9±12.3 (ND)
Age category														
-19 years	14.6±4.4	12.4±4.4	13.4±4.7	12.8±5.7	12.5±5.1	12.7±4.4	78.7±25.3 (ND)	12.1±4.8	9.5±4.8	11.2±4.5	9.9±5.2	9.9±4.1	10.8±4.5	63.5±22.4 (D)
20-40 years	14.8±4.6	12.8±4.1	11.4±4.1	11.9±5.6	9.9±4.6	12.9±4.4	73.9±16.7 (ND)	12.4±3.5	10.8±3.2	10.5±3.0	8.8±4.8	9.4±5.6	9.0±5.0	61.1±18.6* (D)
41-60 years	15.1±3.6	13.3±3.1	12.4±3.6	11.2±5.2	10.6±4.5	12.0±3.8	75.9±19.7 (ND)	15.3±3.0	10.8±3.2	14.6±3.6	13.1±2.0	11.1±2.3	11.2±3.3	75.8±12.5 (ND)

Abbreviations psychological dimensions: SD: Strong distress; D: Distress; ND: No distress; */** denotes $p < 0.05/0.01$ vs male; ** $p < 0.01$ vs male; $p < 0.05$ vs high active female; #p=0.05 vs high active male. All values are expressed as the means±SD.

is possible that this result may be biased by the presence of fewer female in the older group (14%) compared to the number in the adult male group (38%).

On the other hand, when considering the technical level, the analyses revealed no statistical differences **(Fig. 2E)**. In this respect, previous studies show discrepancy as they indicate that a higher technical level is related to a better physical condition in taekwondo athletes [Toskovic N N; Blessing, Williford 2004; Formalioni et al. 2020]. However, the results obtained could be explained, in part, by the fact that both black and colours belts had similar limitations in terms of access to physical, material and human resources to carry out their training. Thus, under the same conditions of confinement, technical level does not seem to be a protective variable against the decrease in PA levels.

The period of lockdown contributed significantly to lower PA levels in the general population and in athletes [Guessogo et al. 2021; Stockwell et al. 2021]. This is an element of concern considering that physical inactivity has been established as a primary cause of most chronic diseases [Booth, Roberts, Laye 2012] and could lead to impaired performance and increased risk of injury in athletes [Sarto et al. 2020]. During lockdown, a large part of taekwondo training sessions, particularly the loading components, have been affected by the results showing a decrease in weekly energy expenditure in athletes. Thus, our results show that the absence of organized and controlled training and competition, exposure to inefficient training environments and lack of interaction with teammates, could drastically modify the quality and intensity of training compared to before the lockout, regardless of age, gender and technical level factors, and therefore PA levels would be affected.

Psychological Well-being and Lockdown
Another aim of this study was to examine the impact of lockdown on the psychological well-being of athletes, paying special attention to differences in sex, technical level and PA levels. For this purpose, the PGWBI-score was used as an overall score to determine the participants' state of psychological well-being. In addition, each dimension of the psychological test was analysed independently.

Among the results, several significant differences in anxiety, vitality, general health and PGWBI-score were found in relation to gender.

When analysing the whole sample, the results show that lockdown affects mainly female taekwondo athletes over males (PGWBI score: 64.32 vs 76.45, respectively), being classified in the distressed range, while males were classified as non-distressed **(Figure 2A** and **table 3).** Significant differences were also found between male and female for anxiety, vitality and general health dimensions. These results are consistent with previous findings showing sex-related differences in perceived stress, emotions

and avoidance in women versus men athletes [Junge, Feddermann-Demont 2016; Di Cagno et al. 2020; di Fronso et al. 2020; Fiorilli et al. 2021] and in the general population [Lowe et al. 2008], by using another different psychological test to PGWBI. In this regard, Hakansson et al [2020] reported higher anxiety and depression measured by the the Generalized Anxiety Disorder scale (GAD-7) in female athletes. Similarly, Pillay and colleagues (2020), assessing the impact of lockdown in South African athletes, reported that women were more likely to report depressive feelings, loss of energy and lack of motivation than male athletes. In a similar vein, in Olympic and Paralympic athletes, Clemente-Suarez et al.[2020] found higher levels of inflexibility and negative feelings in male compared to their male counterparts during lockdown.

In addition, the impact of lockdown on different psychological variables was explored according to technical level (defined by colour and black belt). Interestingly, it was reported that a higher technical level was not a protective factor against the different psychological symptoms tested during lockdown. However, these results are in agreement with previous evidence, where it was reported no significant differences between elite Italian athletes and novices in total score, intrusion and avoidance symptoms during lockout using the Event Scale-Revised (IES-R) [Di Cagno et al. 2020]. However, in other studies, competitive level was found to be protective against psychological symptoms during lockdown, i.e. elite or high-level athletes reported lower perceived stress and hyperactivity, and higher scores on functional psychobiosocial states than novice athletes [di Fronso et al. 2020; Fiorilli et al. 2021]. This discrepancy has recently been well documented by two meta-analyses [Gorczynski, Coyle, Gibson 2017; Rice et al. 2019], which informed that elite athletes reported similar levels of depression and anxiety compared to non-athletes. Similarly, was informed that elite athletes had rates of psychological illness comparable to the prevalence in the general population [Balcombe, de Leo 2020].

It is worth mentioning that the different method used to assess psychological symptoms in our study may partly explain differences with other researchers. These results should be interpreted with caution because an extrapolation should not be made to other sports.

Further research is needed in order to outline the technical level-specific effects of the lockdown in athletes.

However, both males and females who were classified as high active in terms of PA levels during lockdown, experienced higher levels of vitality, self-control, well-being, general health and higher PGWBI-score than the low and/or moderate active groups **(Figures 2D-E)**. This is not surprising because the impact of physical exercise on the mood of individuals and athletes is recognized, so it is logical to note that lockdown may have had an impact on increasing both positive and negative

emotions in those who maintained or decreased their PA levels, respectively, and thus affect psychological well-being [Peluso, Guerra de Andrade 2005; Chang *et al.* 2020]. This idea is reinforced by the correlations between PGWBI-score and total PA levels in both male and female groups **(Figure 3A-B)**.

Consistent with the above approach, several studies reported an increase in psychological symptoms such as anxiety, stress and depression in general [Wang *et al.* 2020; Knolle, Ronan, Murray. 2021] and in the athlete population [Pillay *et al.* 2020; Uroh, Adewunmi 2021] as well as an increase in chronic diseases [Ammar *et al.* 2020; Schuch *et al.* 2020; Hermassi *et al.* 2021] during COVID-19 lockdown. Furthermore, it is associated with increased affect and negative feelings and is likely to increase susceptibility to undesirable states of anxiety and stress [Lades *et al.* 2020].

Moreover, it was reported that other factors such as domestic violence increased during lockdown with deleterious psychological consequences for families [Das, Das, Mandal 2020; Evans, Lindauer, Farrell 2020]. In addition, economic hardship may also influence the decline in psychological well-being, especially in women [PRC 2020]. Consequently, this condition may have had a negative emotional impact [Xiang *et al.* 2020], as lockdown and situations of uncertainty are associated with increased affect and feelings of anxiety, depression and chronic illness.

Conclusions

The main purpose of our study was to provide an insight on Colombian taekwondo athletes PA levels and mental well-being during COVID-19 lockdown.

Our findings showed that lockdown negatively affected both total physical activity levels and psychological well-being in Colombian taekwondo athletes. Additionally, our results suggest that both sex and PA levels, but not technical level or age, may influence psychological well-being during lockdown, specifically with women being more affected.

These observations may be used to design physical activity and psychological recommendations during prolonged home lockdown in taekwondo athletes, but also in athletes and general population.

Limitations of the study

Some limitations are inherent in the present study. First, the sample of female volunteers was limited and may have introduced bias. However, our subjects are of valuable as avowed frequent taekwondo athletes. Secondly, the cross-sectional design of the study introduces some weakness because it may preclude the detection of possible bias in the measures of physical activity (pre vs during lockdown). Although the volume of physical exercise of each participant in the study was obtained from standardized questionnaire, in the absence of physiological measures of fitness we cannot discard some inaccuracies in the time or the intensity of the exercise performed. However, the results clearly showed the influence of lockdown on the reduction of physical activity levels in both males and females.

References

1. Ammar A., Chtouro, H. Boukhris, O., Trabelsi K., Masmoudi L., Brach M. (2020), *Covid-19 home confinement negatively impacts social participation and life satisfaction: A worldwide multicenter study*, "International Journal of Environmental Research and Public Health. MDPI AG" vol. 17, no. 17, pp. 1–17; doi: 10.3390/ijerph17176237.

2. Balcombe L., de Leo D. (2020), *Psychological screening and tracking of athletes and digital mental health solutions in a hybrid model of care: Mini review*, "JMIR Formative Research. JMIR Publications Inc", p. e22755; doi: 10.2196/22755.

3. Booth F.W., Roberts C.K., Laye M.J. (2012), *Lack of exercise is a major cause of chronic diseases*, *Comprehensive Physiology*, "American Cancer Society", vol. 2, no. 2, pp. 1143–1211; doi: 10.1002/cphy.c110025.

4. Chang Y.K., Hung C.L., Timme S., Nosrat S., Chu C.H. (2020), *Exercise behavior and mood during the COVID-19 pandemic in Taiwan: Lessons for the future*, "International Journal of Environmental Research and Public Health. MDPI AG", vol. 17, no. 19, pp. 1–17; doi: 10.3390/ijerph17197092.

5. Chekroud S.R., Gueorguieva R., Zheutlin A.B., Paulus M., Krumholz H.M., Krystal J.H., Chekround A.M. (2018), *Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: a cross-sectional study*, "The Lancet Psychiatry. Elsevier Ltd", vol. 5, no. 9, pp. 739–746; doi: 10.1016/S2215-0366(18)30227-X.

6. Clemente-Suarez V., Fuentes-Garcia J., de la Vega Marcos R., Martinez Patino M. (2020), *Modulators of the Personal*

and Professional Threat Perception of Olympic Athletes in the Actual COVID-19 Crisis, "Frontiers in Psychology", vol. 11; doi: 10.3389/FPSYG.2020.01985.

7. Colombian Government. Presidency of the republic, Ministry of the interior. *Decreto número 457 de 2020.* Available at: https://id.presidencia.gov.co/Documents/200323-Decreto-457.pdf (Accessed: 19 February 2021).

8. Corpas R., Solana E., De la Rosa A., Sarroca S., Grinan-ferre C., Oriol M., Sanfeliu C. (2019), *Peripheral Maintenance of the Axis SIRT1-SIRT3 at Youth Level May Contribute to Brain Resilience in Middle-Aged Amateur Rugby Players,* "Frontiers in Aging Neuroscience", vol. 11; doi: 10.3389/fnagi.2019.00352.

9. Das M., Das A., Mandal A. (2020), *Examining the impact of lockdown (due to COVID-19) on Domestic Violence (DV): An evidences from India,* "Asian Journal of Psychiatry. Elsevier B.V", p. 102335; doi: 10.1016/j.ajp.2020.102335.

10. De la Rosa A., Solana E., Corpas R., Bartes-Faz D., Pallas M., Vina J., Gomez-Cabrera M.C. (2019), *Long-term exercise training improves memory in middle-aged men and modulates peripheral levels of BDNF and Cathepsin B,* "Scientific reports. Nature Publishing Group", vol. 9, no. 1, p. 3337; doi: 10.1038/s41598-019-40040-8.

11. Di Cagno A., Bousenso A., Baralla F., Grazioli E., Di martino G., Lecce E., Fiorilli G. (2020), *Psychological impact of the quarantine-induced stress during the coronavirus (COVID-19) outbreak among Italian athletes,* "International Journal of Environmental Research and Public Health. MDPI AG", vol. 17, no. 23, pp. 1–13; doi: 10.3390/ijerph17238867.

12. di Fronso S., Costa S., Montesano C., Di Gruttola F., Ciofi E., Morgilli L., Bertollo M. (2020), *The effects of COVID-19 pandemic on perceived stress and psychobiosocial states in Italian athletes,* "International Journal of Sport and Exercise Psychology. Taylor and Francis Inc", pp. 1–13; doi: 10.1080/1612197X.2020.1802612.

13. Donmez Gurhan, Ozkan Omer, Menderes Yigitcan, Torgutalp Serife, Karacoban Levend, Denerel Nevzad, Kudas Savas (2021), *The effects of home confinement on physical activity level and mental status in professional football players during COVID-19 outbreak, "* The Physician and Sportsmedicine. Taylor and Francis", doi: 10.1080/00913847.2021.1888630.

14. *ENSIN: Encuesta Nacional de la Situacion Nutricional en Colombia (ENSIN).2015* [in Spanish].

15. Evans M.L., Lindauer M., Farrel M.E. (2020), *A Pandemic within a Pandemic — Intimate Partner Violence during Covid-19,* "New England Journal of Medicine. Massachusetts Medical Society", vol. 383, no. 24, pp. 2302–2304; doi: 10.1056/nejmp2024046.

16. Finkenberg M.E. (1990), *Effect of Participation in Taekwondo on College Women's Self-Concept', Perceptual and Motor Skills,* "SAGE PublicationsSage CA: Los Angeles, CA", vol. 71, no. 3, pp. 891–894; doi: 10.2466/pms.1990.71.3.891.

17. Fiorilli G., Grazioli E., Bousenso A., Di Martino G., Despina T., Calcagno G., Di Cagno A. (2021), *A national COVID-19 quarantine survey and its impact on the Italian sports community: Implications and recommendation',* "PLoS ONE, Public Library of Science", vol. 16, no. 3 March, p. e0248345; doi: 10.1371/journal.pone.0248345.

18. Formalioni A., Antunez B.F., Vecchio F.B.D., Cabistany L.D., Coswig V.S., Letieri R.V., Fukuda D.H. (2020), *Anthropometric characteristics and physical performance of taekwondo athletes,* "Revista Brasileira de Cineantropometria e Desempenho Humano. Universidade Federal de Santa Catarina", vol. 22, pp. 1–13; doi: 10.1590/1980-0037.2020v22e55697 [in Portuguese].

19. Fuentes-Garcia J. (2020), Martinez Patiño M., Villafania S., Clemente-suarez V. (2020) *The Effect of COVID-19 Confinement in Behavioral, Psychological, and Training,* "Frontiers in Psychology", vol. 11; doi: 10.3389/FPSYG.2020.01812.

20. Fuller J.R. (1988), *Martial arts and psychological health,* "British Journal of Medical Psychology. John Wiley & Sons, Ltd", vol. 61 no. 4, pp. 317–328; doi: 10.1111/j.2044-8341.1988.tb02794.x.

21. Giustino V., Parraco A.M., Gennaro A., Musumeci G., Palma A., Battaglia G. (2020), *Physical Activity Levels and Related Energy Expenditure during COVID-19 Quarantine among the Sicilian Active Population: A Cross-Sectional Online Survey Study', Sustainability,* "MDPI, Open Access Journal", vol. 12, no. 11, pp. 1–19.

22. Godtman Kling K., Margaryan L., Fuchs M. (2020), *(In)equality in the outdoors: gender perspective on recreation and tourism media in the Swedish mountains, Current Issues in Tourism,* "Routledge", vol. 23, no. 2, pp. 233–247; doi: 10.1080/13683500.2018.1495698.

23. Gorczynski P.F., Coyle M., Gibson K. (2017), *Depressive symptoms in high-performance athletes and non-athletes: A comparative meta-analysis,* "British Journal of Sports Medicine. BMJ Publishing Group", pp. 1348–1354; doi: 10.1136/bjsports-2016-096455.

24. Grossi E., Groth N., Mosconi P., Cerutti R., Pace F., Compare A., Apolone G. (2006), *Development and validation of the short version of the Psychological General Well-Being Index (PGWB-S),* "Health and Quality of Life Outcomes. BioMed Central", vol. 4, no. 1, p. 88; doi: 10.1186/1477-7525-4-88.

25. Guessogo W.R., Bika-Lele E.C., Mban-Bian W., Mandjek. Audrey R.D., Temfemo A., Mandengue S.H., Assomon-demba P.B. (2021), *Impact of Covid-19 Semi-lockdown on Sports and Physical Activity Behaviors of Cameroonian Elite Volleyball Players: A Cross-sectional Study, Electronic Physician;* doi: 10.19082/7813.

26. Guthold R., Stevens G.A., Riley L.M., Bull F.C. (2018), *Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants,* "The Lancet Global Health. Elsevier Ltd", vol. 6, no. 10, pp. e1077–e1086; doi: 10.1016/S2214-109X(18)30357-7.

27. Hakansson A., Jonsson C., Kentta G. (2020), *Psychological distress and problem gambling in elite athletes during covid-19 restrictions—a web survey in top leagues of three sports during the pandemic,* "International Journal of Environ-

mental Research and Public Health. MDPI AG", vol. 17, no. 18, pp. 1–17; doi: 10.3390/ijerph17186693.

28. Hansen C.J., Stevens L.C., Coast J.R. (2001), *Exercise duration and mood state: How much is enough to feel better?*, "Health Psychology. American Psychological Association Inc", vol. 20, no. 4, pp. 267–275; doi: 10.1037/0278-6133.20.4.267.

29. Harris M.A. (2018), *The relationship between physical inactivity and mental wellbeing: Findings from a gamification-based community-wide physical activity intervention*, "Health Psychology Open. SAGE Publications Inc", vol. 5, no. 1; doi: 10.1177/2055102917753853.

30. Harwood A., Lavido M., Rassovsky Y. (2017), *Reducing aggression with martial arts: A meta-analysis of child and youth studies, Aggression and Violent Behavior*, "Elsevier Ltd", pp. 96–101; doi: 10.1016/j.avb.2017.03.001.

31. Hassmen P., Koivula N., Uutela A. (2000), *Physical exercise and psychological well-being: A population study in Finland*, "Preventive Medicine. Academic Press", vol. 30, no. 1, pp. 17–25; doi: 10.1006/pmed.1999.0597.

32. Hermassi S., Sellami M., Salman A., Al-Mohammadi A.S., Bouhafs E.G., Hayes L.D., Schewesig R. (2021), *Effects of covid-19 lockdown on physical activity, sedentary behavior, and satisfaction with life in Qatar: A preliminary study*, "International Journal of Environmental Research and Public Health. MDPI AG", vol. 18, no. 6, pp. 1–14; doi: 10.3390/ijerph18063093.

33. Junge A., Feddermann-Demont N. (2016), *Prevalence of depression and anxiety in top-level male and female football players*, "BMJ Open Sport & Exercise Medicine. BMJ", vol. 2, no. 1, p. e000087; doi: 10.1136/bmjsem-2015-000087.

34. Karuc J., Soric M., Radman, I., Misigij-Durakovic M. (2020), *Moderators of change in physical activity levels during restrictions due to COVID-19 pandemic in young urban adults, Sustainability (Switzerland)*, "MDPI AG", vol. 12, no. 16; doi: 10.3390/SU12166392.

35. Knolle F., Ronan L., Murray G.K. (2021), *The impact of the COVID-19 pandemic on mental health in the general population: a comparison between Germany and the UK*, "BMC Psychology. BioMed Central Ltd", vol. 9, no. 1, pp. 1–17; doi: 10.1186/s40359-021-00565-y.

36. Lades L.K., Laffan K., Daly M., Delaney L. (2020), *Daily emotional well-being during the COVID-19 pandemic*, "British Journal of Health Psychology. John Wiley and Sons Ltd", vol. 25, no. 4, pp. 902–911; doi: 10.1111/bjhp.12450.

37. Lantz J. (2002), *Family development and the martial arts: A phenomenological study', Contemporary Family Therapy*, "Springer", vol. 24, no. 4, pp. 565–580; doi: 10.1023/A:1021221112826.

38. Lowe B., Decker O., Muller S., Brahler E., Schellberg D., Herzog W., Herzberg P.Y. (2008), *Validation and standardization of the generalized anxiety disorder screener (GAD-7) in the general population*, "Medical Care", vol. 46, no. 3, pp. 266–274; doi: 10.1097/MLR.0b013e318160d093.

39. Markovic G., Misigoj-Durakovic M., Trninic S. (2005), *Fitness profile of elite croatian female taekwondo athletes*, "Collegium Antropologicum", vol. 29, no. 1, pp. 93–99.

40. Maugeri G., Castrogiovanni P., Battaglia G., Pippi R., D'Agata V., Palma A., Musumeci G. (2020), *The impact of physical activity on psychological health during Covid-19 pandemic in Italy*, "Heliyon, Elsevier Ltd", vol. 6, no. 6, p. e04315; doi: 10.1016/j.heliyon.2020.e04315.

41. Meleandndez J.C., Satorres E., Reyes-Olmedo M., Delhom I., Real E., Lora Y. (2020), *Emotion recognition changes in a confinement situation due to COVID-19*, "Journal of Environmental Psychology, Academic Press", vol. 72, p. 101518; doi: 10.1016/j.jenvp.2020.101518.

42. Milligan K., Irwin A., Wolfe-Misco M., Hamilton L., Mintz L., Cox M., Phillips M. (2016), *Mindfulness Enhances Use of Secondary Control Strategies in High School Students at Risk for Mental Health Challenges, Mindfulness*, "Springer New York LLC", vol. 7, no. 1, pp. 219–227; doi: 10.1007/s12671-015-0466-8.

43. Mon-Lopez D., de la Rubiela Riaza A., Honotoria Galan M., Refoyo Roman I. (2020), *The impact of covid-19 and the effect of psychological factors on training conditions of handball players*, "International Journal of Environmental Research and Public Health, MDPI AG", vol. 17, no. 18, pp. 1–14; doi: 10.3390/ijerph17186471.

44. Moore B., Dudley D., Woodcock S. (2019), *The effects of martial arts participation on mental and psychosocial health outcomes: A randomised controlled trial of a secondary school-based mental health promotion program*, "BMC Psychology. BioMed Central Ltd", vol. 7, no. 1, p. 60; doi: 10.1186/s40359-019-0329-5.

45. Moore B., Dudley D, Woodcock S. (2020), *The effect of martial arts training on mental health outcomes: A systematic review and meta-analysis*, "Journal of Bodywork and Movement Therapies" Churchill Livingstone, vol. 24, no. 4, pp. 402–412; doi: 10.1016/j.jbmt.2020.06.017.

46. Pan A., Liu L., Wang C., Guo H., Hao X., Wang Q., Wu T. (2020), *Association of Public Health Interventions With the Epidemiology of the COVID-19 Outbreak in Wuhan, China*, "JAMA. American Medical Association", vol. 323, no. 19, p. 1915; doi: 10.1001/jama.2020.6130.

47. Parm Ulle, Aluoja Anu, Tomingas Tuuli (2021), *Impact of the COVID-19 Pandemic on Estonian Elite Athletes: Survey on Mental Health Characteristics, Training Conditions, Competition Possibilities, and Perception of Supportiveness*, "International Journal of Environmental Research and Public Health", vol. 18, no. 8, 4317; doi: 10.3390/ijerph18084317.

48. Tamm A.-L., Pan A., Liu L., Wang C., Guo H., Hao X., Wang Q., Wu T. (2020), *Association of Public Health Interventions With the Epidemiology of the COVID-19 Outbreak in Wuhan, China*, "JAMA. American Medical Association", vol. 323, no. 19, p. 1915; doi: 10.1001/jama.2020.6130.

49. Peluso M.A.M., Guerra de Andrade L.H.S. (2005), *Physical activity and mental health: the association between exercise and mood*, "Clinics (Sao Paulo, Brazil). Faculdade de Medicina / USP", pp. 61–70; doi: 10.1590/S1807-59322005000100012.

50. Pillay L., van Resburg D.C.C.J., van Resburg A.J., Ramagole D.A., Holtzhausen L., Dijkstra H.O., Cronje T. (2020),

Nowhere to hide: The significant impact of coronavirus disease 2019 (COVID-19) measures on elite and semi-elite South African athletes, "Journal of Science and Medicine in Sport". Elsevier Ltd. vol. 23, no. 7, pp. 670–679; doi: 10.1016/j.jsams.2020.05.016.

51. Rice S.M., Gwyther K., Santeseban-Echarri O., Baron D., Gorczynski P., Gottebarge V., Purcell R. (2019), *Determinants of anxiety in elite athletes: a systematic review and meta-analysis*, "British journal of sports medicine. NLM (Medline)", vol. 53, no. 11, pp. 722–730; doi: 10.1136/bjsports-2019-100620.

52. Saalim M., Sansare K., Karjodkar F.R., Ali I.K., Sharma S.R., Kapoor R., Rahman B. (2020), *Oral submucous fibrosis and its impact on psychological stress: a case-control study*, "Psychology, Health and Medicine. Routledge", pp. 1–11; doi: 10.1080/13548506.2020.1826545.

53. Sarto F., Impellizeri F.M., Sporri J., Porcelli S., Olmo J., Requena B., Franchi M.V. (2020), *Impact of Potential Physiological Changes due to COVID-19 Home Confinement on Athlete Health Protection in Elite Sports: a Call for Awareness in Sports Programming*, "Sports Medicine. Springer", pp. 1417–1419; doi: 10.1007/s40279-020-01297-6.

54. Schinke R., Papaioannou A., Henriksen K., Si G., Zhang L., Haberl P. (2020), *Sport psychology services to high performance athletes during COVID-19*, "International Journal of Sport and Exercise Psychology. Taylor and Francis Inc", pp. 269–272; doi: 10.1080/1612197X.2020.1754616.

55. Schuch F.B., Bulzing R.A., Vancampfort D., Firth J., Stubbs B., Smith L. (2020), *Associations of moderate to vigorous physical activity and sedentary behavior with depressive and anxiety symptoms in self-isolating people during the COVID-19 pandemic: A cross-sectional survey in Brazil*, "Psychiatry Research. Elsevier Ireland Ltd", vol. 292, p. 113339; doi: 10.1016/j.psychres.2020.113339.

56. Sekulic D., Blazevic M., Gilic B., Kvesic I., Zenic N. (2020) *Prospective analysis of levels and correlates of physical activity during COVID-19 pandemic and imposed rules of social distancing; gender specific study among adolescents from Southern Croatia*, "Sustainability (Switzerland). MDPI AG", vol. 12, no. 10; doi: 10.3390/SU12104072.

57. Stockwell S., Trott M., Tully M., Shin Y., Butler L., Smith L. (2021), *Changes in physical activity and sedentary behaviours from before to during the COVID-19 pandemic lockdown: A systematic review*, "BMJ Open Sport and Exercise Medicine. BMJ Publishing Group", p. 960; doi: 10.1136/bmjsem-2020-000960.

58. Strohle A., Graetz B., Scheel M., Wittmann A., Feller C., Heinz A., Dimeo F. (2009), *The acute antipanic and anxiolytic activity of aerobic exercise in patients with panic disorder and healthy control subjects*, "Journal of Psychiatric Research. Pergamon", vol. 43 no. 12, pp. 1013–1017; doi: 10.1016/j.jpsychires.2009.02.004.

59. Taber K.S. (2018), *The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education*, "Research in Science Education. Springer Netherlands", vol. 48, no. 6, pp. 1273–1296; doi: 10.1007/s11165-016-9602-2.

60. Toskovic N.N., Blessing D., Williford H.N. (2004), *Physiologic profile of recreational male and female novice and experienced Tae Kwon Do athletes*, "PubMed, Journal of Sports Medicine and Physical Fitness", vol. 44, no. 2, pp. 164.

61. Trulson M.E. (1986), *Martial Arts Training: A Novel "Cure" for Juvenile Delinquency*, *Human Relations,* "Sage Publications Sage CA: Thousand Oaks, CA", vol. 39, no. 12, pp. 1131–1140; doi: 10.1177/001872678603901204.

62. Uroh C.C., Adewunmi C.M. (2021), *Psychological Impact of the COVID-19 Pandemic on Athletes*, "Frontiers in Sports and Active Living. Frontiers Media SA", vol. 3, p. 603415; doi: 10.3389/fspor.2021.603415.

63. Van Poppel M.N.M., van Rensburg D.C.C.J., van Rensburg A.J., Ramagole D.A., Holtzhausen L., Dijkstra H.P., Cronje T. (2010), *Physical activity questionnaires for adults: A systematic review of measurement properties*, "Sports Medicine. Springer", pp. 565–600; doi: 10.2165/11531930-000000000-00000.

64. Van Uffelen J.G.Z., Khan A., Burton N.W. (2017), *Gender differences in physical activity motivators and context preferences: A population-based study in people in their sixties*, "BMC Public Health. BioMed Central Ltd", vol. 17, no. 1; doi: 10.1186/s12889-017-4540-0.

65. Vertonghen J., Theeboom M. (2010), *The Social-Psychological Outcomes of Martial Arts Practise Among Youth: A Review*, "Journal of Sports Science & Medicine. Dept. of Sports Medicine, Medical Faculty of Uludag University", vol. 9, no. 4, p. 528.

66. Wang C. Pan R., Wan X., Tan Y., Xu L., Mclntyre R.S., Ho C. (2020), *A longitudinal study on the mental health of general population during the COVID-19 epidemic in China*, *Brain, Behavior, and Immunity.* Academic Press Inc., 87, pp. 40–48; doi: 10.1016/j.bbi.2020.04.028.

67. Xiang M., Zhang Z., Kuwahara K. (2020), *Impact of COVID-19 pandemic on children and adolescents' lifestyle behavior larger than expected*, "Progress in Cardiovascular Diseases. W.B. Saunders", pp. 531–532; doi: 10.1016/j.pcad.2020.04.013.

68. Xiang Y.T., Yang Y., Li W., Zhang, L., Zhang Q., Cheung T., Ng C.H. (2020), *Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed*, "The Lancet Psychiatry. Elsevier Ltd", pp. 228–229; doi: 10.1016/S2215-0366(20)30046-8.

69. Yang J.S., Ko J.M., Roh H.T. (2018), *Effects of regular Taekwondo exercise on mood changes in children from multicultural families in South Korea: a pilot study*, "Journal of Physical Therapy Science. Society of Physical Therapy Science", vol. 30, no. 4, pp. 496–499; doi: 10.1589/jpts.30.496.

PA levels during lockdown revealed significant inter-group differences between the moderate and high male groups for anxiety ($p<0.01$) and vitality ($p < 0.05$), while the moderate and high active female groups showed differences in the self-control ($p < 0.05$) and well-being ($p < 0.05$) dimensions.

Wpływ lockdownu w czasie epeidemii COVID-19 na aktywność fizyczną i samopoczucie psychiczne u zawodników taekwondo

Streszczenie

Tło. Choroba koronawirusowa z roku 2019 (COVID-19) jest chorobą zakaźną wywołaną przez koronawirusa (SARS-CoV-2) wywołującego ciężki ostry zespół oddechowy.

Problem i cel. Celem badania było zbadanie wpływu lockdownu na aktywność fizyczną i samopoczucie psychiczne kolumbijskich sportowców taekwondo podczas epidemii COVID-19.

Metody. Przebadano łącznie 114 sportowców (mężczyźni = 78; kobiety = 36). Sportowcy odpowiedzieli na ankietę online Międzynarodowego Kwestionariusza Aktywności Fizycznej (PA) i psychologicznego Indeksu Ogólnego Dobrostanu, biorąc pod uwagę sutuację „przed" i „w trakcie" pandemii.

Wyniki. Lockdown miał negatywny wpływ na całkowity poziom PA (MET-min/tydzień) (F = 20,16; p < 0,01), przy czym największy spadek odnotowano u kobiet (z 5,420 do 3,403; p < 0,05). W całej próbie większa zmiana w zachowaniu PA pomiędzy okresem "przed" i "w trakcie" pobytu w szpitalu została zaobserwowana u uczestników o wysokiej aktywności (n = 93 vs n = 63) jako całkowita MET-min/tydzień (6,121vs 5,556; p < 0,05). Ocena dobrostanu psychicznego wykazała istotne różnice w zależności od płci, przy czym kobiety były bardziej dotknięte lockdownem w odczuwanym niepokoju (p < 0,05), witalności (p < 0,01) i ogólnym stanie zdrowia (p <0,01). Nie stwierdzono natomiast różnic w zależności od poziomu technicznego. Poziomy PA podczas lockdownu ujawniły istotne różnice międzygrupowe pomiędzy mężczyznami o umiarkowanym i wysokim poziomie aktywności, w kategorii lęku (p <0,01) i witalności (p < 0,05), podczas gdy w umiarkowanie i wysoko aktywnych grupach kobiet wykazano różnice w kategorii samokontroli (p < 0,05) i samopoczucia (p < 0,05).

Wnioski. Podczas gdy ograniczenia związane z COVID-19 były niezbędne dla zachowania zdrowia publicznego, PA i dobrostan psychologiczny były zagrożone, co dotyczy głównie kobiet uprawiających taekwondo.