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Analysis of Body Composition and Dynamic and Static Balance in Individuals Previously Infected with COVID-19

COVİD-19 Enfeksiyonu Geçirmiş Bireylerde Vücut Kompozisyonu ile Dinamik ve Statik Dengenin İncelenmesi

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ABSTRACT

Objective: This study examines body composition and the parameters of dynamic and statistic balance in individuals previously infected with coronavirus disease-2019 (COVID-19) and to compare these individuals with the control group.

Methods: A total of 112 volunteering individuals, 56 individuals previously diagnosed with COVID-19 via polymerase chain reaction test (COVID-19 group), and 56 healthy individuals (control group), between the ages of 18 and 26 participated in the study. Sociodemographic characteristics of the individuals in both groups and their COVID-19 related information were recorded. While Tanita BC 418 (Tokyo, Japan, 2015) operating with bioelectrical impedance was used for body composition measurement, the flamingo balance test and Y balance test were used respectively for static and dynamic balance measurements.

Results: Because of the statistical analysis conducted, it was found that the COVID-19 group had a statistically significant lower balance level than the control group according to the Y balance test anterior, posterolateral, posteromedial, total reach values and flamingo balance test values in terms of balance performance ($p<0.05$).

Conclusion: Because of the study, no significant difference was found in the body composition of individuals aged 18-26 previously infected with COVID-19 compared with healthy individuals of the same age. In terms of static and dynamic balance parameters, it was found that those who were previously infected with COVID-19 were more negatively affected than the control group. We think that determining these balance disorders seen after the COVID-19 infection will be a guide in planning rehabilitation programs for actual needs.

Keywords: COVID-19, dynamic balance, static balance, body composition

ÖZ

Amaç: Koronavirüs hastalığı-2019 (COVİD-19) enfeksiyonu geçirmiş bireylerde vücut kompozisyonu, dinamik-statik denge parametrelerini incelemek ve bu bireyleri kontrol grubu ile karşılaştırmaktır.

Yöntemler: Çalışmaya 18-26 yaş aralığında, daha önce polimeraz zincir reaksiyonu testi ile COVİD-19 tanısı almış 56 birey (COVİD-19 grubu) ile sağlıklı 56 birey (kontrol grubu) olmak üzere toplam 112 gönüllü birey katıldı. Her iki gruptaki bireylerin sosyodemografik özellikleri ve COVİD-19 ile ilişkili bilgileri araştırmacılar tarafından hazırlanan bir form ile kaydedildi. Vücut kompozisyonu ölçümü için biyoelektriksel empedans yöntemi ile çalışan Tanita BC 418 markalı cihaz (Tokyo, Japonya, 2015) kullanılırken statik ve dinamik denge ölçümü için sırasıyla flamingo denge testi ve Y denge testi kullanıldı.

Bulgular: Yapılan istatistiksel analiz sonucunda, denge performansı bakımından Y denge testi anterior, posterolateral, posteromedial, total uzanma değerleri ve flamingo denge testi değerlerine göre COVİD-19 grubunun kontrol grubuna göre istatistiksel olarak anlamlı seviyede daha düşük denge seviyesine sahip olduğu belirlendi ($p<0,05$).

Sonuç: Çalışma sonucunda 18-26 yaş aralığındaki COVİD-19 enfeksiyonu geçiren bireylerin aynı yaştaki sağlıklı bireylere göre vücut kompozisyonunda belirgin bir farklılığın olmadığı görüldü. Statik ve dinamik denge parametreleri bakımından ise COVİD-19 enfeksiyonu geçirenlerin kontrol grubuna göre daha olumsuz etkilendiği tespit edildi. COVİD-19 enfeksiyonu sonrası görülen bu denge bozuklukların belirlenmesi, gerçek ihtiyaçlara göre rehabilitasyon programlarının planlanmasında yol gösterici olacağını düşünmekteyiz.

Anahtar kelimeler: COVİD-19, dinamik denge, statik denge, vücut kompozisyonu

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INTRODUCTION

Coronavirus disease-2019 (COVID-19) is defined as the clinical condition caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) from the coronavirus family, which causes a large number of deaths worldwide (1). The disease can be transmitted from person to person in a variety ways most commonly combined-droplet transmission (2). Studies conducted have reported that the symptoms of coronavirus differ from person to person and symptoms commonly include fever, cough, shortness of breath, muscle aches, loss of sense of smell and taste and gastrointestinal findings (1,3). While these symptoms have commonly appeared 2-14 days later, reportedly some symptoms continued after the resolution of the acute illness (4-6).

Balance is defined as an individual's ability to maintain the line of gravity within the base of support. It is central to taking the necessary position of the body in the formation of movement (7). Somatosensorial/proprioceptive, vestibular system, and visual system provide balance-related input to the central nervous system (CNS). Notifications sent to the CNS about balance orientation are integrated by these three systems. Balance is then achieved by selectively activating the muscles to maintain balance, producing a corrective, stabilizing torque (7).

It is thought that the effect of SARS-CoV-2 infection on balance systems may be due to the virus's access to the CNS through the olfactory bulb (8). This may cause neurological problems such as headache, facial paralysis, loss of consciousness, dizziness, vestibular disorders, and even paralysis (9). Some studies even concluded that SARS-CoV-2 may damage the auditory-vestibular system through direct infection or vascular damage, and balance problems such as sensorineural hearing, tinnitus, and vertigo may occur during or after infection (10). According to another study conducted simultaneously, dizziness appears to be one of the main balance problems in almost one-third of the patients. Despite these reports, balance has been evaluated in COVID-19 patients by using surveys rather than objective measurements. In other words, a comprehensive assessment that guarantees an objective assessment of balance-related systems is still limited (11).

Body composition is defined as the proportional amount of muscle, bone, fat, and other important parts of the body (12). The important point in the evaluation of body composition is calculating the body fat percentage by finding the body density. For a healthy life, a certain amount of fat is required because too low a or too high body fat may cause some serious health problems (13).

Considering the relationship between body composition and COVID-19, it has been shown that obesity defined by high body mass index (BMI) in patients with COVID-19 may be associated with poor outcomes such as intensive care unit admission, severe COVID-19, use of mechanical ventilation, and even death (14,15). The fact that the prevalence of obesity being approximately one-third of the world population causes COVID-19 infection to have a higher effect on society. Here, it is stated that creating a healthy lifestyle and especially reaching the ideal body weight is a critical approach in preventing and reducing some bad consequences, including death, in case of getting infected with COVID-19 (14).

When the literature is reviewed, it can be seen that there are few studies evaluating the balance and body composition of individuals previously infected with COVID-19. Although there is a statistically significant relationship between balance and body composition (16), no studies were found evaluating these parameters together in individuals previously infected with COVID-19. Considering this information, our study aimed to examine the body composition, static, and dynamic balance levels of individuals previously infected with COVID-19 and to compare these with the healthy control group in terms of these parameters.

METHODS

This study was designed as a descriptive and cross-sectional study examining the balance and body composition parameters of individuals previously infected with COVID-19. The study was conducted at Zonguldak Bülent Ecevit University Faculty of Medicine, Department of Anatomy, Anatomy Practice Laboratory between January 2022 and May 2022. Before the study, necessary permission (decision no: 2022/06, date: 23.03.2022) was obtained from Zonguldak Bülent Ecevit University Non-interventional Clinical Research Ethics Committee.

The population of the study consisted of 112 students (56 females and 56 males) who continued their undergraduate education at Zonguldak Bülent Ecevit University Faculty of Medicine and Faculty of Dentistry, who met the inclusion criteria and who signed the informed consent form. Two groups were included in the study as a patient group of 56 individuals previously infected with COVID-19 and a control group of 56 individuals. Inclusion criteria for the patient group were being between the ages of 18 and 30, having been diagnosed with COVID-19 in the last +12 months, having a negative polymerase chain reaction (PCR) test, or having completed an isolation period of 14 days. Inclusion criteria for the control group were 18-30 years of age, not having been diagnosed with COVID-19 (+), diagnosed as COVID-19 (-) by PCR test, and not having any symptoms of COVID-19 infection. Exclusion criteria were having any orthopedic or neurological problems that may cause especially balance problems, the presence of chronic pain that has been continuing at least for 4 months, having a positive Romberg and Fuduka Step test, using sleeping pills or psychiatric drugs. The demographic information form prepared by the researchers was filled in and static balance was evaluated with the flamingo balance test (FBT), dynamic balance was evaluated with the Y balance test (YBT), and body composition was evaluated with the Bioelectrical Impedance Method.

Demographic Information Form

Demographic information form prepared by the researchers included questions about the individuals' gender, age, height, the data of having been diagnosed with COVID-19 (+), PCR test

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results (via E-nabız), the ending date of the isolation period and the symptoms that occurred in this process, cigarette and alcohol use, history of surgery, presence of chronic disease, presence of pain, and drugs used.

Flamingo Balance Test

FBT, the validity and reliability of which was found to be 0.71 (intraclass correlation coefficient) by Tsigilis et al. (17), was used to evaluate static balance. The participants were asked to stand on a 50 cm long, 4 cm high, and 3 cm-wide wooden flamingo balance board. They were asked to hold their free leg by bending back with their hand on the same side after getting on the balance board, and they were told that they could use their free arm to keep their balance. They were then asked to stand on the balance board for a minute. The test was conducted on both the right and left legs. The total number of times when the balance was disturbed in 1 min was noted (18).

Y Balance Test

The reliability of the test was conducted by Türkeri et al. (19) in 2020. While preparing the test environment, a fixed point was determined and 3 different tape measures with 120° in-between were fixed to the ground in a Y shape with one end coming to a fixed point. Before starting the test, the leg length of each participant was recorded in cm by measuring the distance from the anterior superior point of the iliac spine to the medial distal part of the medial malleolus from both sides. The participants were placed on the centre of the test setup with bare feet and were asked to reach the anterior, posterolateral, and posteromedial directions with both feet and touch lightly to the farthest point with the tip of their toes. These distances they reached were recorded in cm (20). After the data were collected, the best reaching distance in each direction was divided by length and multiplied by 100 and the scores obtained were normalized to rule out the leg advantage (21).

Bioelectrical Impedance Analysis

Tanita BC 418 (Tokyo, Japan, 2015) operating with the bioelectrical impedance method was used to determine the body composition of the participants. Before the measurement, the students were asked to have spent at least 2 h after having a meal, not to have consumed alcohol within the past week, and female students were asked to have measurements outside their menstrual cycle. When the process was completed, the participants body weight, BMI, basal metabolic rate (kJ, kcal), muscle resistance (IMPEDANCE; Ω), body fat ratio (FAT %), body fat mass (FAT MASS; kg), fat free mass in the body (kg), total body fluid (TBW; kg), arm fat ratio (AFAT; %), leg fat ratio (LFAT; %), and total muscle ratio (%) values measured by the device were reported (22).

Statistical Analysis

Before starting the study, the sample size was calculated with the G Power Version 3.1.9.2 program. While calculating the sample size, since the researcher did not have any predictions about the parameters to be used in the study and because there were no reference studies in the literature that could be used to obtain the parameters, "medium effect size" described by Cohen was used during the calculations (23). The required sample size for the study was found as minimum 82, with an effect size of 0.30 for independent samples t-test to meet 80% of the test power at a confidence interval of 95%.

SPSS 20.0 (Statistical Package for Social Science) was used for the statistical analysis of the study. The normality distribution of the data was examined with the Shapiro-Wilk test. Mann-Whitney U test and chi-square test continuity correction were used respectively to analyse the quantitative and qualitative variables. While the quantitative variables were expressed as mean, standard deviation, median, minimum, and maximum values, qualitative variables were expressed as number-percentage (n %). The Mann-Whitney U test was used to compare the groups. $P<0.05$ was considered a significant level because of statistical analysis. The data were taken from the thesis entitled "Analysis of balance, reaction time, and concentration parameters of individuals previously infected with COVID-19" and they were analysed again for this study.

RESULTS

Out study was completed with 112 individuals, 56 (28 female, 28 male) individuals previously infected with COVID-19 and 56 (28 female, 28 male) individuals who were not previously infected with COVID-19, attending Zonguldak Bülent Ecevit University between January 2022 and May 2022. Table 1 shows the age, gender, height, cigarette-alcohol use, and chronic disease data of the COVID-19 group and control groups. No statistically significant difference was found between the groups in terms of these data according to the results of Mann-Whitney U test and chi-square test ($p<0.05$) (Table 1).

Table 2 shows the static and dynamic balance results of the participants. According to Mann-Whitney U test results, a statistically significant difference was found between the static and dynamic balance scores of the groups ($p<0.05$). Dynamic balance values of the groups are shown in Figure 1 with a radar graph, while static balance values are shown in Figure 2 with a bar graph.

Table 3 shows the body composition results of the participants. According to Mann-Whitney U test results, no statistically significant difference was found between the groups in terms of body composition parameters ($p>0.05$).

DISCUSSION

Although respiratory symptoms disappear after COVID-19 infection, significant deficiencies in daily living activities are observed in patients who are discharged. This condition is not only specific to elderly patients; it may also affect young individuals (24). Especially in patients with a chronic disease, there are long-term major sequelae called "post-intensive care syndrome", which cause many physical disorders such as balance problems and muscle weakness (25). Many studies resulting from this condition

emphasize the importance of rehabilitation problems to improve the quality of life after COVID-19 infection, to return to daily activities, and to eliminate post COVID-19 sequelae (26). In this study, when individuals previously infected with COVID-19 were compared with healthy controls, while no difference was found in terms of body composition values, it was found that individuals previously infected with COVID-19 had worse balance in terms of dynamic and static balance. In a study by Doğan (27) on 59 individuals between the ages of 20 and 30 who had been infected with COVID-19 at least three months ago and who had received home isolation and medication therapy, dynamic and static balance was evaluated with functional reach test and a single-leg standing test. According to the results of the evaluation, it was found that eyes open dynamic and static balance was affected significantly negatively in individuals previously infected with COVID-19, compared with the control group (27). Our study was conducted in the same age group, and although different balance evaluation methods were used, the same conclusions were reached. In this respect, it can be seen that our study supports this study.

In a study by Giardini et al. (26), which included 25 individuals with COVID-19 infection, 25 patients with acute exacerbation of chronic obstructive pulmonary disease, and 25 healthy individuals, static balance was evaluated with a stabilometric platform, while dynamic balance was evaluated with Mini-BESTest and Timed Up and Go test. Because of the study, it was found that both the static balance and dynamic balance performance of the group with previous COVID-19 infection were significantly worse compared

Table 1. Sociodemographic characteristics of the participants and statistical analysis results between groups

Sociodemographic characteristics	COVID-19 group n=56	Control group n=56	p-value
Age (years) $\bar{x}$ ± s min-max	20.50±1.695 18-26	20.54±1.501 18-26	0.898**
Body weight (kg) $\bar{x}$ ± s min-max	68.59±14.56 47.60-111	65.32±13.91 44-107.20	0.259**
Height (cm) $\bar{x}$ ± s min-max	171.38±9.65 153-191	170.82±10.12 155-193	0.612**
Gender n (%) female/male	28 (50%)/28 (50%)	28 (50%)/28 (50%)	1.000*
Cigarette use, n (%) yes/no	12 (21.4%)/44 (78.6%)	9 (16.1%)/47(83.9%)	0.628*
Alcohol use, n (%) yes/no	15 (26.8%)/41 (73.2%)	10 (17.9%)/46 (82.1%)	0.364*
Chronic disease, n (%) yes/no	5 (8.9%)/51 (91.1%)	4 (7.2%)/52 (92.8%)	1.000*

*chi-square test continuity correction, **Mann-Whitney U test, $\bar{x}$ ± s: mean ± standard deviation, n: number, %: percentage, min: minimum value, max: maximum value, COVID-19: coronavirus disease-2019, p<0.05

Table 2. Static and dynamic balance results of the participants and statistical analysis results between the groups

	COVID-19 group (n=56) median (min-max)	Control group (n=56) median (min-max)	p-value
YBT-A (%) Reaching with the right foot Reaching with the left foot	 82.91 (58.82-106.94) 80.96 (52.32-111.11)	 86.97 (86.97-62.06) 86.09 (60-114.73)	 0.012* 0.032*
YBT-PL (%) Reaching with the right foot Reaching with the left foot	 91.29 (65.38-119.84) 87.82 (65.38-124.41)	 102.41 (65.85-134.95) 100.55 (68.29-136.84)	 0.001* 0.001*
YBT-PM (%) Reaching with the right foot Reaching with the left foot	 73.73 (46.05-102.38) 71.64 (51.31-97.75)	 84.36 (11.87-113.75) 81.25 (52.63-114.28)	 0.022* 0.001*
YBT total (%) Reaching with the right foot Reaching with the left foot	 79.95 (64.95-107.48) 80.42 (62.39-104.48)	 90.68 (64.63-115.80) 88.59 (65.44-121.40)	 0.025* 0.001*
FBT (score) Reaching with the right foot Reaching with the left foot	 7 (2-15) 8 (2-20)	 4 (0-9) 4 (0-11)	 <0.001* <0.001*

YBT: Y balance test, A: anterior, PL: posterolateral, PM: posteromedial, FBT: flamingo balance test, n: number, min: minimum value, max: maximum value, COVID-19: coronavirus disease-2019, p<0.05, *Mann-Whitney U test

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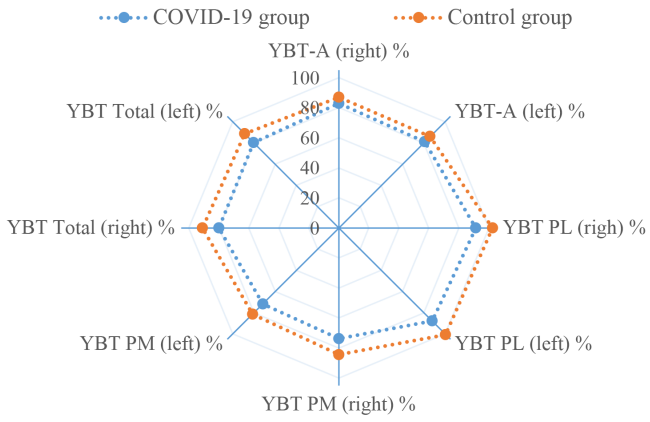

Figure 1. Comparison of Y balance test results of COVID-19 and control group with radar graph

YBT: Y balance test, A: anterior, PL: posterolateral, PM: posteromedial, COVID-19: coronavirus disease-2019

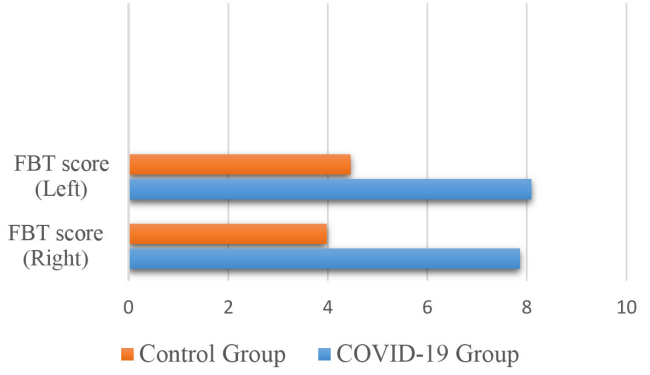

Figure 2. Comparison of flamingo balance test results of COVID-19 and control group with bar graph

FBT: flamingo balance test, COVID-19: coronavirus disease-2019

with the other groups (26). Unlike our study, static and dynamic balance values were measured in individuals approximately 69.5 years old with a mean of 25.4 BMI. Additionally, although different evaluation methods were used, the results were found to be parallel to the results of our study.

In a study they evaluated whether there was a difference in post-COVID-19 syndrome-related balance and proprioception, Gervasoni et al. (28) analyzed the data of 66 post-COVID-19 patients prospectively. The dynamic balance of the participants was evaluated both eyes open and eyes closed with the innovative robotic device Hunova. Because of the study, it was stated that when vision, somatosensorial information, and vestibular information were integrated, post-COVID syndrome affected dynamic balance test performance negatively, regardless of the disease severity (28). In another study conducted, Sharpendromberg and Time Up and Go tests were used to evaluate static and dynamic balance and knee joint position sense in 15 women infected with COVID-19 and 15 healthy women. Because of the tests conducted, a significant difference was found between the static and dynamic balances of the two groups (COVID-19 and healthy group) ($p<0.05$) (29). In our study, dynamic and static balance levels of 56 individuals previously infected with COVID-19 were evaluated using the YBT and the FBT. Because of the evaluations, it was found that the COVID-19 group had worse static and dynamic balance performance compared with the control group. Although our methods for evaluating balance were different from studies in the literature, results similar to those in the literature were obtained.

Measures such as quarantine, isolation and social distance caused decreased physical activity, deterioration in muscle mass and function and increase in body fat. These changes in the body composition are associated with a series of chronic conditions, including cardiovascular disease, diabetes, vulnerability, cognitive decline, and balance problems (30). Therefore, we think that the

Table 3. Body composition results of the participants and statistical analysis results between the groups

	COVID-19 group (n=56) median (min-max)	Control group (n=56) median (min-max)	p-value
BMR (kcal)	1474 (1156-2660)	1508 (1150-2312)	0.275*
BMI (kg/m²)	22.70 (16.70-31.90)	21.85 (17.20-30.30)	0.101*
IMPD (Ω)	655.50 (469-875)	640 (459-894)	0.272*
FAT (%)	22.20 (6.60-36.60)	18.85 (2.70-37)	0.268*
FFM (kg)	48.15 (35.40-86.70)	48.40 (36.50-76.70)	0.263*
TBW (kg)	35.25 (25.90-63.50)	35.45 (26.70-56.10)	0.256*
AFAT (%)	24.27 (9.50-40.20)	23.02 (8.60-40.95)	0.412*
LFAT (%)	25.75 (3.15-61)	22.20 (4.60-65.80)	0.330*
Trunk FAT (%)	20.15 (4.50-36.70)	18.85 (3-36.30)	0.222*
Muscle rate (%)	74.32 (60.17-89.26)	77.41 (59.97-92.79)	0.256*

BMR: basal metabolism rate, IMP: muscle resistance, FAT: body fat ratio, FFM: fat free mass in the body, TBW: total body fluid, AFAT: arm fat ratio, LFAT: leg fat ratio, n: number, min: minimum value, max: maximum value, COVID-19: coronavirus disease-2019, p<0,05, *Mann-Whitney U test

evaluation of body composition is an important issue to identify possible risk factors before and after COVID-19 infection.

When the literature was reviewed, it was found that a limited number of studies examining body composition in individuals previously infected with COVID-19 and studies were mostly conducted during the COVID-19 pandemic. In a study by Lemos et al. (31), the body composition of 171 volunteering individuals between the ages of 19 and 65 were measured with the bioelectrical method. The participants were grouped into three according to the severity of COVID-19 symptoms as non-hospitalized individuals with mild symptoms (n=61), those hospitalized (n=58) and those hospitalized in the intensive care (n=52). Because of the study, it was found that individuals who were hospitalized had significantly higher fat mass and body fat percentage values compared with individuals who were not hospitalized (31). In our study, when individuals previously infected with COVID-19 were compared with healthy controls in terms of body composition, no statistical difference was found. We believe that this difference may be because the participants were young and the fact that the individuals previously infected with COVID-19 had mild or moderate disease according to the guide prepared by the Turkish Republic Ministry of Health.

Study Limitations

Since the YBT ignores parameters such as sensor organization, motor adaptation, and rhythmic weight shifting, balance evaluations of the participants could be made in more detail by using technology-supported systems. While this situation was a limitation of our study, technology -assisted balance systems could not be used due to their high cost. Another limitation of our study is that the body composition gave indirect information about the physical activity levels of the participants, and the physical activity levels of the participants were not evaluated.

CONCLUSION

We found that although approximately 7-8 months had passed since the infection, young adults who had mild or moderate level of COVID-19 infection had worse static and dynamic balance levels than healthy individuals in the same age group. No significant difference was found between the groups in terms of body composition parameters. In line with these results, the fact that post - COVID-19 balance disorders were found even in individuals who had mild-moderate level of COVID-19 infection shows that providing balance training to individuals to prevent injuries and complications that may occur due to post-COVID-19 falls is an important topic in rehabilitation programs.

Ethics Committee Approval: Before the study, necessary permission (decision no: 2022/06, date: 23.03.2022) was obtained from Zonguldak Bülent Ecevit University Non-interventional Clinical Research Ethics Committee.

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REFERENCES

1. Park M, Cook AR, Lim JT, Sun Y, Dickens BL. A Systematic Review of COVID-19 Epidemiology Based on Current Evidence. J Clin Med 2020; 9: 967.
2. Xu X, Yu C, Zhang L, Luo L, Liu J. Imaging features of 2019 novel coronavirus pneumonia. Eur J Nucl Med Mol Imaging 2020; 47: 1022-3.
3. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. Lancet 2020; 395: 470-3. Erratum in: Lancet 2020.
4. Xiang YT, Yang Y, Li W, Zhang L, Zhang Q, Cheung T, et al. Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. Lancet Psychiatry 2020; 7: 228-9.
5. Carfì A, Bernabei R, Landi F; Gemelli Against COVID-19 Post-Acute Care Study Group. Persistent Symptoms in Patients After Acute COVID-19. JAMA 2020; 324: 603-5.
6. Fancello V, Hatzopoulos S, Corazzi V, Bianchini C, Skarżyńska MB, Pelucchi S, et al. SARS-CoV-2 (COVID-19) and audio-vestibular disorders. Int J Immunopathol Pharmacol 2021; 35: 20587384211027373.
7. Peterka RJ. Sensorimotor integration in human postural control. J Neurophysiol 2002; 88: 1097-118.
8. Carod-Artal FJ. Neurological complications of coronavirus and COVID-19. Rev Neurol 2020; 70: 311-22.
9. Ahmad I, Rathore FA. Neurological manifestations and complications of COVID-19: A literature review. J Clin Neurosci 2020; 77: 8-12.
10. Jafari Z, Baguley D, Kolb BE, Mohajerani MH. A Systematic Review and Meta-Analysis of Extended High-Frequency Hearing Thresholds in Tinnitus With a Normal Audiogram. Ear Hear 2022; 43: 1643-52.
11. Yılmaz O, Mutlu BÖ, Yaman H, Bayazıt D, Demirhan H, Bayazıt YA. Assessment of balance after recovery from Covid-19 disease. Auris Nasus Larynx 2022; 49: 291-8.
12. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. Lippincott Williams & Wilkins. 2013.
13. Kocahan T, Kabak B. Evaluation of Body Composition in Athletes. In: Kocahan T, editor. Health and performance measurement and evaluation in athletes. 1st Edition. Ankara: Türkiye Klinikleri; 2021. p.29-35.
14. Soeroto AY, Soetedjo NN, Purwiga A, Santoso P, Kulsum ID, Suryadinata H, et al. Effect of increased BMI and obesity on the outcome of COVID-19 adult patients: A systematic review and meta-analysis. Diabetes Metab Syndr 2020; 14: 1897-904.
15. Freuer D, Linseisen J, Meisinger C. Impact of body composition on COVID-19 susceptibility and severity: A two-sample multivariable Mendelian randomization study. Metabolism. 2021; 118: 154732.
16. Rusek W, Adamczyk M, Baran J, Leszczak J, Inglot G, Baran R, et al. Is There a Link between Balance and Body Mass Composition in Children and Adolescents? Int J Environ Res Public Health. 2021; 18: 10449.

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17. Tsigilis N, Douda H, Tokmakidis SP. Test-retest reliability of the Eurofit test battery administered to university students. Percept Mot Skills 2002; 95: 1295-300.
18. Haksever B, Düzgün I, Yüce D, Baltacı G. Effects of Balance Board Training on Dynamic, Static Balance and Functionality On Healthy Subjects. Gazi Üniversitesi Sağlık Bilimleri Dergisi 2017; 2: 40-9.
19. Türkeri C, Büyüktaş B, Öztürk B. The Study on the Reliability of Lower Extremity Y Dynamic Balance Test. Turkish Studies 2020; 15: 1439-51.
20. Engquist KD, Smith CA, Chimera NJ, Warren M. Performance Comparison of Student-Athletes and General College Students on the Functional Movement Screen and the Y Balance Test. J Strength Cond Res 2015; 29: 2296-303.
21. Gribble PA, Hertel J. Effect of lower-extremity muscle fatigue on postural control. Arch Phys Med Rehabil 2004; 85: 589-92.
22. Kelly JS, Metcalfe J. Validity and reliability of body composition analysis using the tanita BC 418-MA. Journal of Exercise Physiology Online 2012; 15: 74-83.
23. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. New York: LAWRENCE ERLBAUM ASSOCIATES, Publishers; 1988.
24. Belli S, Balbi B, Prince I, Cattaneo D, Masocco F, Zaccaria S, et al. Low physical functioning and impaired performance of activities of daily life in COVID-19 patients who survived hospitalisation. Eur Respir J 2020; 56: 2002096.
25. Jaffri A, Jaffri UA. Post-Intensive care syndrome and COVID-19: crisis after a crisis? Heart Lung 2020; 49: 883-4.
26. Giardini M, Arcolin I, Guglielmetti S, Godi M, Capelli A, Corna S. Balance performance in patients with post-acute COVID-19 compared to patients with an acute exacerbation of chronic obstructive pulmonary disease and healthy subjects. Int J Rehabil Res 2022; 45: 47-52.
27. Doğan AS. Evaluation of muscle strength, muscle endurance, flexibility and balance in individuals after COVID-19 infection (dissertation). Baskent University Institute of Health Sciences. 2021.
28. Gervasoni F, LoMauro A, Ricci V, Salce G, Andreoli A, Visconti A, et al. Balance and visual reliance in post-COVID syndrome patients assessed with a robotic system: a multi-sensory integration deficit. Neurol Sci 2022; 43: 85-8.
29. Negarestani S, Amirseyfaddini M, Daneshjoo A, Karimzadeh M, Shourabadi S. Comparison of Static, Dynamic Balance, Knee Joint Position Among Healthy Women and Those Infected with COVID-19. The Scientific Journal of Rehabilitation Medicine 2021; 10: 1066-79.
30. Kirwan R, McCullough D, Butler T, Perez de Heredia F, Davies IG, et al. Sarcopenia during COVID-19 lockdown restrictions: long-term health effects of short-term muscle loss. Geroscience 2020; 42: 1547-78.
31. Lemos MM, Cavalini GR, Pugliese Henrique CR, Perli VAS, de Moraes Marchiori G, Marchiori LLM, et al. Body composition and cardiorespiratory fitness in overweight or obese people post COVID-19: A comparative study. Front Physiol 2022; 13: 949351.