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Exploring the Relationship between Physical Activity and Segmental Body Composition Parameters in Office Workers: A Multi-Frequency Bioelectrical Impedance Analysis Approach

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Abstract

This research aimed to determine the relationship between physical activity levels and body composition parameters in office workers. The study was carried out with 60 individuals who agreed to participate in the study and met the inclusion criteria, among the office workers who had sedentary jobs, at the Rector's Office of a university in the Eastern Region of the Republic of Turkey between June 2021 and January 2022. Informed Voluntary Consent Forms and the International Physical Activity Questionnaire were administered to participants. Body compositions were measured with the TANITA MC-780 Bioelectrical impedance device. The study found a positive relationship between lean body mass (kg), muscle mass in the right leg (kg), muscle mass in the left leg (kg), muscle mass in the right arm (kg), muscle mass in the left arm (kg), and trunk muscle (kg) with all Phase Angle (PhA) measures (p<0.05). Moreover, the study determined a correlation between lean mass in the right leg (kg), lean mass in the left leg (kg), lean mass in the right arm (kg), and lean mass in the left arm (kg) with vigorous activity scores (p<0.05). The study's results add to the existing literature on segmental body composition values in individuals with prolonged sedentary behavior.
Keywords: Bioelectrical impedance, Body composition, Physical activity, Sedentary behavior, Office worker

Ofis Çalışanlarında Fiziksel Aktivite ve Segmental Vücut Kompozisyonu Parametreleri Arasındaki İlişkinin İncelenmesi: Çok Frekanslı Biyoelektrik Empedans Analizi Yaklaşımı

Öz

Bu araştırmanın amacı, ofis çalışanlarında fiziksel aktivite düzeyleri ile vücut kompozisyonu parametreleri arasındaki ilişkiyi belirlemektir. Çalışma, Haziran 2021- Ocak 2022 tarihleri arasında Türkiye Cumhuriyeti Doğu Anadolu Bölgesinde bulunan bir üniversitenin Rektörlüğünde sedanter işlerde çalışan büro personellerinden araştırmaya katılmayı kabul eden ve dahil edilme kriterlerini karşılayan 60 kişi ile gerçekleştirilmiştir. Katılımcılara Bilgilendirilmiş Gönüllü Olur Formları ve Uluslararası Fiziksel Aktivite Anketi uygulanmıştır. Vücut kompozisyonları, TANITA MC-780 Biyoelektrik empedans cihazı ile ölçülmüştür. Çalışma sonucunda faz Açısı (PhA) ölçümleriyle yağsız vücut kütlesi (kg), sağ bacak kas kütlesi (kg), sol bacak kas kütlesi (kg), sağ kol kas kütlesi (kg), sol kol kas kütlesi (kg), gövde kası (kg) arasında pozitif bir ilişki bulunmuştur (p<0.05). Ayrıca, çalışma sonucunda, şiddetli egzersizle sağ bacak yağsız kütle (kg), sol bacak yağsız kütle (kg), sağ kol yağsız kütle (kg) ve sol kol yağsız kütle (kg) arasında bir korelasyon belirlenmiştir (p<0.05). Çalışmanın sonuçları, segmental faz açısı kullanımıyla uzun süreli hareketsiz davranışı olan bireylerde vücut kompozisyonu değerlerine ilişkin mevcut literatüre katkıda bulunmaktadır.
Anahtar Kelimeler: Biyoelektrik empedans, Vücut kompozisyonu, Fiziksel aktivite, Sedanter davranış, Ofis çalışanı

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INTRODUCTION

Physical activity is an activity that occurs when individuals use their muscles and joints in their daily work to generate energy, which is done at different intensities and increases the heart and respiratory rate as the intensity increases (Kenney et al., 2021). In studies examining the health attitudes of individuals, it is stated that physical activity is the parameter most likely to be given up by people and that the lack of physical activity in society is increasing gradually (Haseler & Haseler, 2022; Oja et al., 2010). Nowadays, the fact that the work produced by physical activity in the working environment or daily life is now done using technological tools has been the leading factor in the transition of people to a sedentary lifestyle. The modern lifestyle of our age, spending more sedentary time in front of the computer and the use of technology in the workplace bring about the fact that the work is carried out with less physical activity and energy, and the body accumulates the energy that cannot be used as fat (Ozer & Baltaci, 2008). Despite the overwhelming evidence that adequate physical activity is associated with comprehensive health benefits and plays a role in reducing morbidity and mortality rates, it is stated in the literature that very few people do regular physical activity (Hallal et al., 2012; Ozemek et al., 2019). In a global context, a lack of physical activity is evident in 17% of the adult population (Kohl et al., 2012).

Body composition refers to the makeup of the body, including components such as body fat, lean mass, intra/extracellular fluids, bone, muscle tissue, and other organic matter. Body composition can be divided into fat and lean mass. Lean mass includes subcutaneous (storage) fats and essential oils, while fatty mass includes water, nerves, bone, muscle tissue, veins, and other organic substances. Body composition measurements are useful in assessing the effectiveness of nutritional and health interventions and in monitoring changes associated with growth and disease states (Kuriyan, 2018). Measurements made using a reliable technique provide us with a lot of information about an individual's health outcomes. Bioelectrical instrumentation used to assess body composition, such as impedance analysis (BIA), is a frequently used method in the evaluation of body composition of patients in clinics due to its safety, speed, non-invasive nature, low cost, and effectiveness as an evaluation method (Kyle et al., 2004). BIA is based on the principle of detecting body composition by giving a very low level and different frequencies (800 μA; 50 Khz) electric current to the human body. With the biological parameters obtained from BIA analysis results, the body composition, disease course, and general health status of individuals can be evaluated. In recent years, the PhA (PhA) has started to be included in these parameters. Studies have shown that PhA is influenced by many factors such as disease, physical activity level, and nutritional status.

It is widely accepted that regular physical activity is associated with a range of health benefits, including the prevention and management of chronic diseases such as obesity, hypertension, diabetes, ischemic stroke, breast cancer, and osteoporosis. One of the ways to evaluate the effectiveness of physical activity in these diseases is to examine the relationship between physical activity level and body composition. This may involve measuring changes in body fat, muscle mass, and other body composition parameters in response to physical activity interventions and comparing these changes to those seen in inactive individuals or individuals with the disease in question. By understanding the relationship between physical activity and body composition, healthcare professionals and researchers can develop more effective strategies for preventing and treating these chronic diseases.

In line with these considerations, the aim of this research was to determine the relationship between physical activity levels and body composition changes among office workers who were required to sit for extended periods due to their job demands. We aimed to test the following hypotheses:

H0: There was no significant relationship between physical activity levels and changes in body composition among office workers.

H1: There was a significant relationship between physical activity levels and changes in body composition among office workers.

METHOD

Research Model

This research is an experimental study to determine and correlate body compositions and physical activity levels of office workers.

Participants

The study, conducted between June 2021 and January 2022, took place in the rectorate of a state university located in Agri, Turkey. The population of the research consisted of the rectorate staff who have been working at a state university in Agri for at least 1 year. In this evaluation study, it is planned to reach all the staff of the rectorate. Therefore, no sampling study was conducted. Adults between the ages of 30-65, who declared that they worked mostly sitting in the university rectorate for at least one year, and whose body mass index is above 18.5 kg/m² were included in the study. The study comprised a total of 60 participants.

Ethical Approval

Written consent was obtained from the Eskişehir Osmangazi University Scientific Research Ethics Committee (number: E-25403353-050.99-180726), the Ağrı İbrahim Çeçen University Rectorate where the research was conducted, and from the volunteers participating in the research. This ensures that the research was conducted ethically and in accordance with the principles of informed consent, protection of human subjects, and confidentiality.

Data Collection Tools

Study data, long form of International Physical Activity Questionnaire to evaluate the exercise status of individuals who signed the informed consent form for participation in the voluntary study, TANITA MC-780 Black Bioimpedance Device to measure body compositions collected using impedance analysis (BIA).

International Physical Activity Questionnaire (IPAQ): The international validity and reliability studies of this questionnaire were carried out by Craig et al., and the validity and reliability studies in Turkey were carried out by Öztürk to university students (Öztürk, 2005). This questionnaire provides information on sitting, walking, moderately vigorous activities, and time spent in vigorous activities. A score is obtained as "MET-minutes/week" by multiplying the minute, day and MET value (multiples of resting oxygen consumption). Physical activity levels include those who are not physically active (<600 MET-min/week), low physical activity level (600 – 3000 MET-min/week), and adequate physical activity level (beneficial for health) (>3000 MET-minutes/week) (Kayapinar, 2012).

TANITA MC-780 Bioimpedance Device: TANITA MC-780 Bioimpedance Device is a bioelectrical impedance analysis device that is used to determine the segmental and functional body compositions of the participants in the study. The body composition parameters measured by this method include weight, Body Mass Index (BMI), Basal Metabolic Rate, Body Fat, Body Fat Mass, Muscle Mass, Body Fluid, Adipose area around internal organs cm² (Visceral Fat Area), Total Body Fluid Mass (TBW) (0.1 kg and 0.1 %), Extracellular Fluid (ECW) (0.1 kg), Intracellular Fluid (ICW) (0.1 kg), Edema (ECW/TBW), Bone Mineral (kg), Metabolism Age, Target Weight Control, Difference Analysis, Waist and Hip Ratio, Obesity Degree, Soft Muscle Tissue (kg) (Body Composition Analyzer MC-780MA Instruction Manual, 2018).

In a study conducted on adults, TANITA MC-780 bioelectrical impedance device was compared with DEXA and reliable fat mass and lean mass measurements were reached (Verney et al., 2015). In another study, it was stated that it gave reliable results except for 3rd degree obese individuals (Verney et al., 2016). This device is considered as a reliable method to measure body composition in adults.

Analysis of Data

The data acquired during this research underwent thorough analysis using the IBM SPSS Statistics 25 software. Statistical assessments were conducted on categorical variables pertinent to the study's scope within the SPSS platform. Chi-square analyses were executed to make comparisons among categorical variables, leading to the creation of contingency tables. Parametric tests, specifically the Independent Sample T Test and Pearson Correlation, were employed to evaluate relationships and differences as needed. Furthermore, descriptive statistics were incorporated to provide a comprehensive overview of the data. The significance level for all analyses was predetermined at $p<0.05$. Prior to conducting the analyses involving scales, an initial assessment for normal distribution was carried out. Subsequently, parametric tests were chosen for those scales that met the criteria for normal distribution.

FINDINGS

The study included 60 individuals, of which 39 (65%) were male and 21 (35%) were female. The general mean age of the individuals was 34.25±9.36. The age range of participants was between 22 and 53 years. The mean age of male individuals was 37 years, while the mean age of female individuals was 29.14 years. The mean height of the participants was 170.2±8.16 cm. The height range was between 153 cm and 185 cm. The mean height of the male participants was 174.33 cm, while the mean height of the female participants was 162.52 cm. The overall mean weight of the participants was 71.05±8.16 kg. The weight range was between

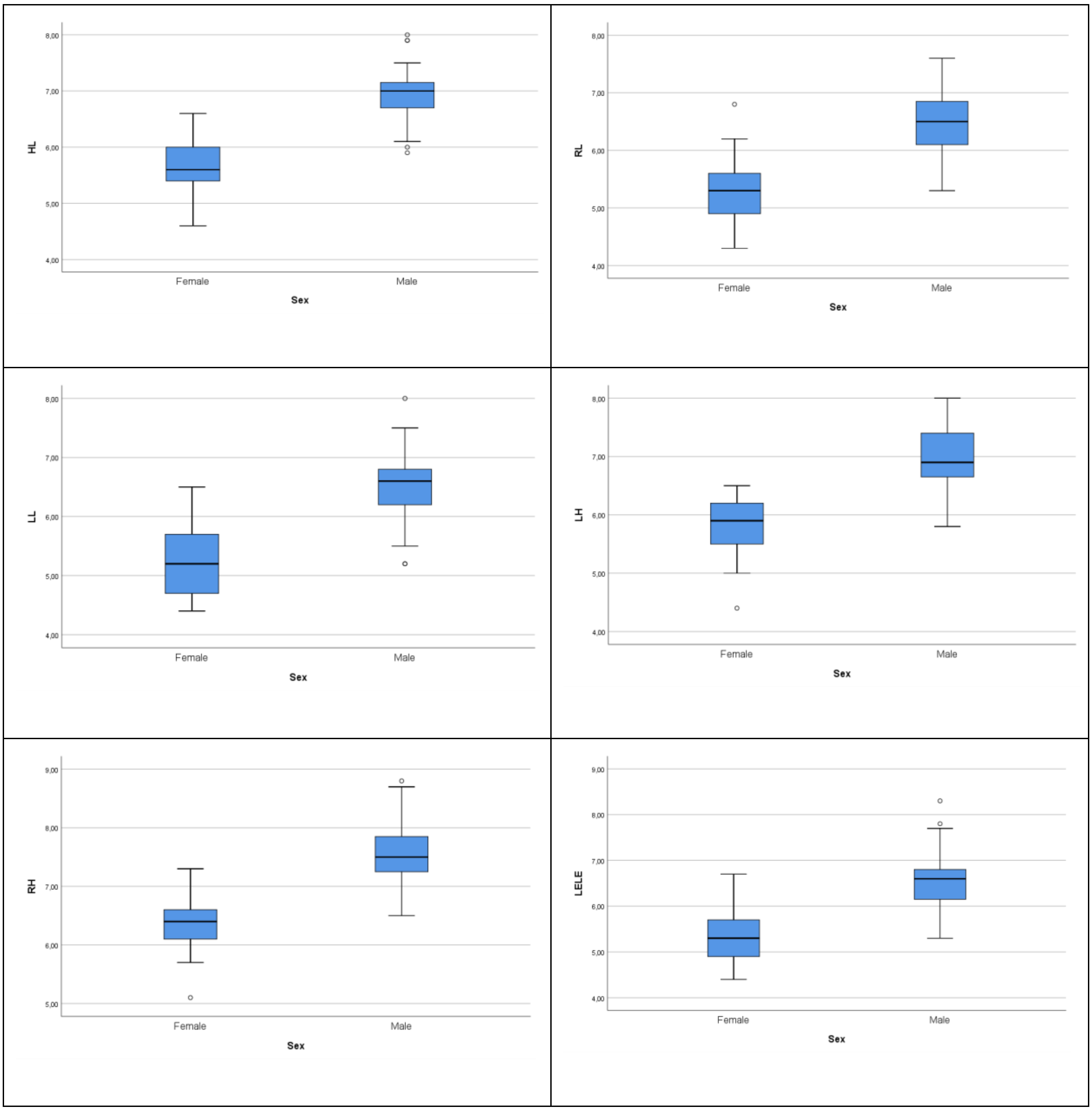
42.3 and 100.3 kg. The mean weight of the male participants was 78.49 kg, while the mean weight of the female participants was 57.21 kg. The general mean of BMI values was 24.39±19.31 kg/m². The mean BMI value of male individuals was 25.86 kg/m² and the mean BMI value of female individuals was 21.66 kg/m². Body composition analysis of individuals is given in Table 1,2 and Graphic 1.

Table 1. Body composition analysis

		N	Mean	Std.	Minimum	Maximum
Protein (Kg)	Male	39	13.39	1.46	7.46	16.28
	Female	21	8.87	0.76		
Lean Mass (Kg)	Male	39	63.26	5.75	35.9	72.5
	Female	21	42.51	3.76		
Mineral (Kg)	Male	39	4.51	0.50	2.62	5.29
	Female	21	3.10	0.27		
Muscle Mass (Kg)	Male	39	59.03	6.95	34.1	68.9
	Female	21	40.35	3.57		
Metabolic Age	Male	39	36.51	11.81	15	68
	Female	21	27.43	4.86		
Fat Mass (Kg)	Male	39	15.99	5.78	4.6	28.3
	Female	21	14.70	4.82		
Fat Percentage (%)	Male	39	19.70	5.52	7.07	34.43
	Female	21	25.05	5.44		
Basal metabolic rate (Kcal)	Male	39	1848.87	178.29	1110	2161
	Female	21	1295.81	109.53		
Total Body Water Mass (L)	Male	39	45.35	4.17	25.9	53.5
	Female	21	30.56	2.69		
Body Density (g/cc)	Male	39	1.06	0.07	1.01	1.50
	Female	21	1.04	0.01		
Intracellular Water (L)	Male	39	26.97	2.89	15.4	32.6
	Female	21	17.66	1.56		
Extracellular Water (L)	Male	39	18.38	1.39	10.5	21.1
	Female	21	12.80	1.27		
Obesity Degree (%)	Male	39	12.62	14.53	-30.14	44.49
	Female	21	-2.33	14.21		
Visceral Fat Score (1-59)	Male	39	7.05	3.53	1	15
	Female	21	2.14	1.10		
Visceral Fat Area (cm²)	Male	39	64.08	23.37	20	110
	Female	21	28.95	8.90		
Soft Lean Mass (Kg)	Male	39	58.74	5.32	33.28	67.54
	Female	21	39.41	3.48		
Skeletal Muscles (Kg)	Male	39	35.81	3.26	20	41
	Female	21	24.07	2.12		
Organ Muscles (Kg)	Male	39	21.49	2.13	12.14	25.93
	Female	21	14.41	1.27		
BMR/Weight	Male	39	23.49	1.52	20	27
	Female	21	22.86	1.59		
Waist (cm)	Male	39	90.49	8.73	60	109
	Female	21	73.14	7.39		
Waist/ Height	Male	39	0.52	0.05	0.37	0.63
	Female	21	0.46	0.05		
Edema Percent (%)	Male	39	40.61	1.32	37.9	45
	Female	21	41.84	1.07		
Hand-Leg PhA °	Male	39	6.94	0.47	4.60	8
	Female	21	5.68	0.46		
	Male	39	6.50	0.55		
Right Leg PhA °	Female	21	5.30	0.60	4.30	7.60
	Female	21	5.33	0.57		

Table 1. Body composition analysis **(**Continued)

		N	Mean	Std. Deviation	Minimum	Maximum
	Female	21	2.14	1.10		
	Female	21	5.30	0.60		
Left Leg PhA °	Male	39	6.49	0.56	4.40	7.20
	Female	21	5.26	0.61		
Left Hand PhA °	Male	39	6.95	0.54	4.70	8.0
	Female	21	5.80	0.51		
Right Hand PhA °	Male	39	7.53	0.52	5.70	8.0
	Female	21	6.37	0.49		
Leg - Leg PhA °	Male	39	6.55	0.62	4.40	8.80
	Female	21	5.33	0.57		



*HL PhA: Hand Leg (Whole body) PhA, RL PhA: Right leg PhA, LL PhA: Left leg PhA, RH PhA: Right hand PhA, LH PhA: Left hand PhA, LELE PhA: leg to leg PhA

Graphic 1. PhA values of individuals by gender*

Table 2. Body composition segmental fat ratio analysis

	N	Woman	Male	Mean	Std. Deviation	Minimum	Maximum
Right Leg Fat Ratio (%)	60	31.78	16.81	22.05	8.62	6.30	38.70
Left Leg Fat Ratio (%)	60	31.68	16.82	22.02	8.41	7.90	37.80
Right Arm Fat Ratio (%)	60	27.72	18.37	21.65	7.11	10.50	37.90
Left Arm Fat Ratio (%)	60	27.98	18.85	22.04	7.11	10.30	38.40
Body Fat Ratio	60	19.97	21.56	21.00	6.51	5.80	33.00

The data provided in the table suggests that, on mean, the right leg fat ratio of the individuals was 22.05±8.62% and the left leg fat ratio was 22.02±8.41%. The right arm fat rate was 21.65±7.11% and the left arm fat rate was 22.04±7.11%. The table also indicates that the right and left leg fat ratio is higher in women, while the mean body fat ratio is 21.00±6.51%. It is also stated that body fat mean is higher in men.

Table 3. Analysis of the relationship between body composition, segmental fat ratio and muscle values and PhA's

		HL PhA	RL PhA	LL PhA	RH PhA	LH PhA	LELE PhA
Right Leg Fat Ratio (%)	Pearson Correlation	-0.191	-.449 **	-.472 **	-.467 **	-.457 **	-.448 **
	Sig. (2-tailed)	0.143	0.000	0.000	0.000	0.000	0.000
	N	60	60	60	60	60	60
Left Leg Fat Ratio (%)	Pearson Correlation	-0.182	-.465 **	-.476 **	-.472 **	-.472 **	-.454 **
	Sig. (2-tailed)	0.164	0.000	0.000	0.000	0.000	0.000
	N	60	60	60	60	60	60
Right Arm Fat Ratio (%)	Pearson Correlation	-0.149	-.271 *	-.257 *	-0.227	-0.227	-.260 *
	Sig. (2-tailed)	0.255	0.036	0.048	0.081	0.081	0.045
	N	60	60	60	60	60	60
Left Arm Fat Ratio (%)	Pearson Correlation	-0.148	-0.227	-0.212	-0.169	-0.196	-0.217
	Sig. (2-tailed)	0.259	0.081	0.105	0.197	0.132	0.096
	N	60	60	60	60	60	60
Body Fat Ratio (%)	Pearson Correlation	0.016	0.253	.293 *	.366 **	.332 **	.265 *
	Sig. (2-tailed)	0.901	0.051	0.023	0.004	0.010	0.040
	N	60	60	60	60	60	60

** $p < 0.01$, * $p < 0.05$

Table 3. Analysis of the relationship between body composition, segmental fat ratio and muscle values and PhA's (Continued)

		HL PhA	RL PhA	LL PhA	RH PhA	LH PhA	LELE PhA
Right Leg Muscle Mass (kg)	Pearson Correlation	.941 **	.500 **	.410 **	.383 **	.458 **	.607 **
	Sig. (2-tailed)	0.000	0.000	0.001	0.003	0,000	0,000
	N	60	60	60	60	60	60
Left Leg Muscle Mass (kg)	Pearson Correlation	.352 **	.710 **	.728 **	.773 **	.759 **	.725 **
	Sig. (2-tailed)	0.006	0.000	0.000	0.000	0.000	0.000
	N	60	60	60	60	60	60
Right Arm Muscle Mass (kg)	Pearson Correlation	.878 **	.581 **	.500 **	.481 **	.547 **	.671 **
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000
	N	60	60	60	60	60	60
Left Arm Muscle Mass (kg)	Pearson Correlation	.340 **	.704 **	.713 **	.744 **	.746 **	.712 **
	Sig. (2-tailed)	0.008	0.000	0.000	0.000	0.000	0.000
	N	60	60	60	60	60	60
Body Muscle Mass (kg)	Pearson Correlation	-.404 **	.457 **	.546 **	.628 **	.558 **	.370 **
	Sig. (2-tailed)	0.001	0.000	0.000	0.000	0.000	0.004
	N	60	60	60	60	60	60
** p < 0.01 , * p < 0.05							

When the relationship between the segmental PhA's of the fat and muscle values of the individuals is examined; It was determined that right leg fat ratio and left leg fat ratio were negatively correlated with RL PhA, LL PhA, RH PhA, LH PhA and LELE PhA (p<0.01). While there was a negative significant relationship between RL PhA, LL PhA and LELE PhA in right arm fat ratio, no significant relationship was found between left arm and PhA's (p>0.05). In addition, it was concluded that there was a positive and significant relationship between right leg muscle, left leg muscle, right arm muscle, left arm muscle and trunk muscle and all PhAs (p<0.01).

Table 4. Physical activity category scores

Physical Activity Category (MET-min/Week)	IPAQ Rating Range		Mean	SD
	Minimum	Maximum		
Vigorous Activity Score	66	2880	520.4167	±746.57
Moderate Activity Score	60	4200	903.2167	± 1174.34
Walking Activity Score	49.5	2772	445,225	± 580.48
Sitting Score	180	2100	1007.1667	± 495.10
Total	720	6852	2876.025	± 1547.95

The data obtained from the International Physical Activity Questionnaire shows that the mean vigorous activity score of individuals is 520.42 ±746.57 MET-min/week, the mean activity score is 903.22±1174.34 MET-min/week, the mean walking score is 445.23 ±580.48

MET-min/week, and the mean sitting score is 1007.17 ±495.1. The overall mean International Physical Activity score is 2876.03± 1547.95 MET-min/week, which indicates that individuals are not active enough as the total score is less than 3000.

Table 5. Relationship between physical activity levels and PhA's

		Vigorous Activity Score	Moderate Activity Score	Walking Activity Score	Sitting Score	Total Physical Activity Score
HL PhA	Pearson correlation	.328 *	-0.102	0.055	-0.174	0.045
	p	0.011	0.436	0.677	0.183	0.731
RL PhA	Pearson correlation	0.204	-0.222	0.062	-0.003	-0.048
	p	0.119	0088	0.638	0.980	0.714
LL PhA	Pearson correlation	0.166	-0.126	0.009	0.073	-0.091
	p	0.206	0.448	0.946	0.577	0.491
RH PhA	Pearson correlation	0.175	-0.102	-0.005	0.013	0.010
	p	0.180	0.439	0.973	0.924	0.942
LH PhA	Pearson correlation	0.180	-0.070	-0.023	0.006	0.027
	p	0.169	0594	0.863	0.965	0.839
LELE PhA	Pearson correlation	0.229	-0.078	0.038	0.007	-0.071
	p	0.078	0.336	0.774	0.955	0.592

The results of the relationship analysis between individuals' physical activity levels and PhA's indicate that there is a significant positive correlation between HL PhA and vigorous activity level ($p<0.05$). This means that as the vigorous physical activity score increases, the HL PhA of the individuals also increases.

DISCUSSION AND CONCLUSION

Health promotion in the workplace can improve individuals' health outcomes and productivity (Goetzel & Ozminkowski, 2008). Sedentary behavior is a significant risk factor in the workplace and can lead to many structural and functional changes in the body including low cardiorespiratory fitness, low vascular and skeletal muscle function, and increased fatigue. The cross-sectional analyses conducted in this study found that physical activity is associated with lower adiposity, similar to most other cross-sectional studies in adults that have found an inverse relationship between physical activity and adiposity, although their findings are based solely on self-reported data (DiPietro, 1995; LaMonte & Blair, 2006; Williams et al., 2022).

An increase of 30 minutes of moderate-intensity physical activity per day is associated with a lower Body Mass Index (BMI) of 0.5 kg/m2, lower fat mass index, and a lower waist circumference of 1.3 cm (WHO, 2020). A systematic review found that increasing the duration of sedentary behavior increases the risk of all-cause mortality, and there is a positive relationship between sedentary behavior and metabolic syndrome, waist circumference, and overweight/obesity (de Rezende et al., 2014). Furthermore, studies have found that sitting time and physical activity are independently associated with obesity (Gianoudis et al., 2015).

Brunani et al., (2021) found a negative correlation between Physical Activity (PhA) and Body Mass Index (BMI) in obese individuals. In a large cohort of mild to severely obese patients, current body composition analysis using bioelectrical impedance analysis (BIA) revealed decreased resistance and reactance values with a significant reduction in PhA in a BMI-dependent manner. The results suggest that new equations adapted for patients suffering from obesity need to be developed (Brunani et al., 2021).

It was concluded that there is a positive relationship between lean body (kg), right leg muscle (kg), left leg muscle (kg), right arm muscle (kg), left arm muscle (kg) and trunk muscle (kg) and all PhA's reached ($p<0.05$). This suggests that the PhA's of the individuals participating in the study are associated with a lower fat ratio, which indicates positive cellular health. Langer et al. in a study conducted in 2021, he found that there is a relationship between PhA and hand grip strength in healthy young men and confirmed that this relationship is due to body components. 163 healthy male students (18.8 ± 0.6 years old) participated in the study. PhA was determined by BIA, hand grip strength was evaluated by hydraulic dynamometer, and fat mass (FM), bone mineral ratio and lean soft tissue (kg) were determined by dual-energy X-ray absorptiometry. Participants were divided into three groups according to their PhA's (first triad: PhA < 7.14°, second triad: 7.14° ≤ PhA < 7.83°, and third triad: PhA ≥ 7.83°). The bone mineral ratio of the youth was determined as (2.8 kg, 3.0 kg, 3.1 kg) and lean soft tissue (kg) (51.7 kg, 53.8 kg, 57.6 kg) respectively according to the PhA groups. In addition, lower grip strength was detected in the first tertile (83.0 kg vs. 93.1 kg) compared to the third in the PhA group ($p < 0.01$) (Langer et al., 2022). A high PhA may be an indication of high muscle strength.

Siddiqui et al., in a study conducted in 2016 found that the average amount of fat in the experimental group was determined as 22%, which is similar to the findings of the current study, and in the study findings, the PhA was higher. It was stated that it can be estimated by the rate of visceral adiposity (Siddiqui et al., 2016). The results of the current study show that PhA is significantly correlated with body fat percentage.

PhA studies with individuals who are not athletes and spend most of the time sedentary constitute the minority in the literature. Streb et al., (2020) found that PhA was associated with physical fitness variables in adults with obesity. Body fat and maximum strength were evaluated as determinants of PhA and no relationship was found between flexibility and PhA. Additionally, there was no correlation found between physical activity and sedentary behavior in the study (Streb et al., 2020).

It was determined that there is a correlation between right leg lean (kg), left leg lean (kg), right arm lean (kg) and left arm lean (kg) and vigorous activity scores ($p<0.05$). As the level of intense activity of the individuals increases, the fat ratios of these segments decreases. The same relationship is observed between the right leg muscle (kg), left leg muscle (kg), right arm muscle (kg) and left arm muscle (kg) values of individuals and their intense activity level score. As the level of vigorous activity of individuals increases, muscle sizes also increase. It is known that planned and regular physical activity is effective in reducing body fat and improves muscle function (Hughes et al., 2001; Kay & Fiatarone Singh, 2006).

According to the data obtained from the International Physical Activity Questionnaire in this study, the mean vigorous activity score of individuals was 520.42±746.57 MET-min/week, the mean activity score is 903.22±1174.34 MET-min/week, the mean walking score is 445.23±580.48 MET-min/week, and the mean sitting score is 1007.17±495.1' MET-min/week. The overall mean International Physical Activity score was found to be 2876.03±1547.95 MET-min/week. Olcucu et al., (2015) in a study of middle-aged individuals, the walking scores of individuals were found to be 1428.20±1907.08 MET-min/week. In the same study, the moderate activity scores of the individuals were determined as 1960.41±3959.39 MET-min/week, the severe activity scores as 1578.80±4144.08 MET-min/week, and the total physical activity scores as 5188.84 MET-min/week (Olcucu et al., 2015). In Tural's study examining the Physical Activity levels of individuals in home isolation during the pandemic process and their quality of life during this isolation period, the walking scores of individuals were found to be 528 MET-min/week in total, moderate activity scores of 720 MET-min/week, and severe activity scores of 480 MET-min/week, total physical activity scores were found to be 1728 MET-min/week (Tural, 2020). The high difference between the studies shows that with the pandemic process, changes in community habits and people spend more sedentary time by reducing their physical activity levels.

The majority of the respondents in the study are between the ages of 26 and 39, and while 50% of these individuals have sufficient physical activity level, 27% have low activity level, and 22% of the individuals were not active. The study found that 16 of the participants are 40 years or older, and while 50% of them have low physical activity level, 43.8% have sufficient physical activity level. The study also found that, for the participants under the age of 25, 50% have low activity level, and the rate of those with sufficient physical activity level is 50%. According to the UFAA scores of individuals in Tural's study, it was determined that 51.2% (133) had physical activity at an inactive level, 45.7% (119) had low physical activity level, and only 3.1% (8) of these individuals were physically active (Tural, 2020). Kadioglu et al.'s study conducted by female students receiving undergraduate health education in 2017, it was determined that 7.2% of the 235 female students participating in the study had low physical activity, 80.4% had moderate physical activity, and the remaining 12.3% had a high level of physical activity. (Kadioglu & Fatos, 2017). The study suggests that only 50% of the individuals participating in the study have sufficient physical activity due to the quarantine practices applied during the COVID-19 pandemic process.

This finding suggests that individuals who engage in more vigorous physical activity have higher HL PhA, which is consistent with previous studies in the literature. HL PhA, or hand-to-foot bioelectrical impedance analysis, is a method for measuring body composition and can be used to estimate body fat percentage and muscle mass. This study adds to the existing literature by showing a correlation between HL PhA and vigorous physical activity levels, which highlights the importance of regular vigorous physical activity for maintaining a healthy body composition.

The findings of the study contribute to the literature on body composition values in individuals with intense sedentary behavior, and it is a pioneering study on the relationship of segmental phase angles with body fat ratio and physical activity levels. It is recommended that further studies be conducted in larger populations and in different workgroups to further validate these findings and explore the relationship in depth.

Limitations of the study

Within the limitations of the study, the data obtained from individuals were taken from the employees of a single institution, the pandemic restrictions were applied during the period of the research, and the use of self-report scales was based on the self-reports of the participants. Although it is accepted that the participants provided accurate statements in the research, there is a possibility that the participants presented themselves differently on the self-report scales.

Conflict of Interest: The authors have no conflicts of interest to declare.

Researchers' Statement of Contribution Rate: Research Design, DAY, KU; Statistical analysis, DAY; Preparation of the article, DAY, KU; Data Collection was carried out by DAY.

Ethical Approval

Board Name: Ethics Committee of Eskişehir Osmangazi University, Turkey.

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