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A study on the physical and psychological effects of indoor plants in the workplace

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Abstract

Indoor plants not only improve the physical environment but also offer significant psychological benefits. Based on this importance, a randomized study was conducted with academic and administrative staff working at Zonguldak Bülent Ecevit University, Çaycuma Vocational School, to examine the effects of indoor plants on individuals' physical health and psychological state. The study involved 11 participants. Data collected from the participants were analyzed using SPSS 22. The results indicated that issues such as headaches, difficulty concentrating, and eye itching or burning were not dependent on the presence of plants in the work environment. However, symptoms including a feeling of heaviness in the head, nausea/dizziness, nasal irritation, congestion and discharge, hoarseness, dry throat, coughing, facial skin dryness or redness, scalp or ear itching, and dryness or itching of the hands were associated with the presence or absence of plants. When the average severity of these problems was compared between environments with and without plants, it was observed that working in a plant-rich environment reduced these issues. Therefore, it can be concluded that indoor plants contribute to reducing physical and psychological problems in the workplace.

Keywords: Academic staff, Administrative staff, Indoor plants, Physical and psychological effects.

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1. Introduction

It is known that certain environments provide physical and psychological relaxation for people, and that natural environments in particular have these healing effects [1]. For this reason, plants began to be used indoors in very ancient times [2]. Written evidence shows that the Egyptians brought plants indoors in the 3rd century BC, and the Pompeii ruins reveal that indoor plants were used there more than 2,000 years ago [3]. Many new indoor plants were discovered in the 15th century when Europeans began to explore the New World. When explorers returned to Europe, they often brought new plants with them to present to kings and queens. Since these brought plants were of tropical origin, they designed plant houses called "Orangeries" at that time, which we now refer to as "winter gardens or orangeries," to provide suitable climatic conditions

for these plants. They started to grow many species, such as palm trees, fig trees, and citrus fruits, in them. House plants and their cultivation became quite popular, especially during the Victorian period, becoming a hobby. This period is considered the beginning of indoor plant cultivation [4]. In the second half of the 20th century, the practice became more widespread across latitudes and social classes. The reasons for this progress included lower transportation and production costs for tropical and subtropical plants, changes in interior design practices, and the transition to higher indoor temperatures that made it possible to keep plants indoors at higher latitudes [3]. The positive benefits of plants in indoor and outdoor physical environments have been recognized since the early 1970s, and the benefits they provide to individuals and society have been supported by scientific research since the early 1980s [5]. Today, people all over the world use plants in their homes, workplaces, waiting areas, shopping malls, restaurants, hotels, schools, and other environments of daily life [3]. Indoor plants are plants that are removed from their natural ecological environments and are artificially provided in pots or various containers. They can survive in indoor spaces similar to their own growth and development environments and have flowers, leaves, or both features [6, 7]. These plants, with their showy flowers, fruits, branches, and leaves, exhibit unique aesthetic and functional features in the environment they inhabit [8, 9]. Plants are considered a vital and indispensable part of any healthy environment, including offices, hotels, waiting rooms, restaurants, classrooms, or certain indoor areas [10]. With the transfer of plants from the outdoors to the indoors, the positive energy of nature began to be reflected in the interior spaces, allowing people to feel more peaceful and comfortable in these environments [7]. Therefore, contact with plants offers many benefits, including improvements in physical, cognitive, psychological, and social functions [11, 12]. Therefore, when designing plants for interior spaces, the plants should be suitable for the characteristics of the space in terms of size, shape, color, and texture. The plants should be selected in accordance with the size and shape of the space, as well as the color and texture of the elements that make up the space, to achieve harmony between them. Otherwise, an arrangement that lacks aesthetics and appears very unattractive, which can disturb people physically and psychologically, will be created [6]. It is observed that the studies conducted in our country focus on the effects of one or a few environmental variables and limit other independent variables [13]. Studies on the effects of indoor plants are limited in particular. The studies conducted have mostly focused on which indoor plants are preferred, the effects of indoor plants on user satisfaction, and purchasing preferences [4, 6-8]. No studies have been found on the physical and psychological effects of indoor plants. Based on this deficiency, this research examines the physical and psychological effects of indoor plants used in offices on individuals.

2. Physical and Psychological Effects of Indoor Plants

Throughout history, people have pondered the health benefits of contact with nature [14]. For this reason, they shape the environment they live in according to their own wishes and needs. However, these created environments can also affect people physically and psychologically [13]. Despite the use of new building materials and energy savings to improve the indoor climate, especially in offices, office workers continue to experience various health and discomfort problems. Common complaints include cough, irritation of the nose, upper respiratory tract, throat, skin, and eyes, as well as neurological symptoms such as numbness, nausea, dizziness, headache, and loss of concentration [15]. Faced with such questions, people have believed that nature possesses healing potential for centuries. For this reason, they used plants, sunlight, and other natural elements as therapeutic aids to improve the environments they inhabit [12]. Plants have different leaf, flower, and stem features according to the seasons and species. Due to these features, they are suitable for creating various combinations in spaces [16]. In addition to these features, plants are aesthetically pleasing, absorb toxins in their environment, and provide oxygen [17]. In this respect, indoor plants are considered important design elements that can directly affect human health and performance [7]. Plants in indoor spaces improve the aesthetics of homes and work environments, while allowing people to live in greener spaces. Even looking at a blooming flower or any tree can make people happy [8, 9]. Plants clear the mind, stimulate the senses, arouse curiosity in people, and motivate the soul. Plants with functional qualities can be used to help individuals develop or improve some physical or cognitive skills in their daily lives [18]. Plants not only purify the environment and potentially reduce air pollution but also decrease noise pollution, dust, and the accumulation of particles in the air. Due to their ability to minimize dust accumulation in indoor spaces and reduce pollutants, plants are known to mitigate harmful effects [5]. It is reported that indoor plants improve mood, reduce stress, increase productivity, enhance individuals' reaction speed, improve attention span, enhance the air quality of the environment they are in, reduce blood pressure, and decrease fatigue and headaches [1, 10, 19]. For example, in their study, Fjeld et al. [15] found that the total score of symptoms was 23% lower when the subjects had plants in their offices compared to the control period. When there were plants in the offices, complaints about cough and fatigue decreased by 37% and 30%, respectively. Self-reported levels of dryness/hoarseness and dry/itchy facial skin decreased by approximately 23% when plants were present. Lohr and Pearson-Mims [2] found that spaces with plants were more cheerful, pleasant, and inviting than spaces with other aesthetic amenities. Brand and Millot [20] stated that women are more likely to be affected by different plants, so they can better distinguish the smells and tastes of the plants in question. Chang and Chen [21] found in their studies that observing nature and working in an area with indoor plants reduces tension and anxiety. Kellert [22] states that indoor plants promote physical capacity, material comfort, emotional maturation, creative ability, moral beliefs, spiritual meaning, and intellectual development. Bringslimark et al. [23] estimated the relationships between plants and perceived stress, sick leave, and productivity, and found that indoor plants near an employee's desk positively affected the employee's level of illness and productivity. Raanaas et al. [24] found in their studies using plants that patients had an increase in their personal well-being after the application. Yildirim et al. [7] found in their study that 81.3% of the participants believed that plants had a positive effect on people's mental health. Han et al. [14] also conducted a study in which indoor plants improved the physical functions of the participants, especially relaxed physiology and improved cognitive functions.

3. Material and Method

Study Area: Çaycuma Vocational School, where the study was conducted, is a higher education institution established in 2001 to train technical intermediate staff affiliated with Zonguldak Bülent Ecevit University. Çaycuma Vocational School continues its educational and training activities with 8 departments, 13 associate degree programs, and over 2000 registered students. The school provides theoretical education reinforced with practical opportunities in various programs such as office services, mining, forestry, design, transportation services, and foreign languages. The school conducts its work with an approach based on application and is open to cooperation with the sector.

Work Office and Plant Layout: The dimensions of the work offices for academic and administrative personnel vary between 5.60x3.20 m and 5.70x3.30 m. The office in question has an interior space with a single wide window or double windows, where natural lighting is intense. The windows are positioned to receive direct sunlight, allowing the environment to be illuminated with natural light. The desks are also positioned to receive light at the back. The floor covering used in the space consists of light-colored ceramic tiles, which support the spacious atmosphere of the interior. The office furniture is preferred in dark tones, and there is a desk, an office chair, a bookcase, two guest chairs, a desktop computer, and a telephone.

Figure 1.
A view of the offices with and without plants.

A total of 17 indoor plants were used in the study offices: *Dracaena marginata, Dracaena reflexa, Aglaonema* sp., *Epipremnum aureum, Dypsis lutescens, Chlorophytum comosum, Spathiphyllum wallisii, Dracaena trifasciata, Monstera deliciosa, Ficus benjamina, Chlorophytum comosum, Epipremnum aureum, Chamaedorea seifrizii, Ficus elastica, Syngonium podophyllum, Nephrolepis exaltata,* ve *Calathea* sp.

Study Group: This study involves academic and administrative staff working at Zonguldak Bülent Ecevit University, Çaycuma Vocational School. A total of 26 individuals are employed at the institution, including 17 academic staff and 9 administrative staff. Twenty-two subjects participated in the pre-test. Among these, 11 individuals who experienced the most physical and psychological problems, which they attributed to the work environment, were identified as the experimental group (Figure 1).

Research Process: Since the research is a randomized controlled study, a survey was conducted on people who did not have indoor plants in their study rooms to determine the control and experimental groups. The survey included a scale developed by Andersson [25] that measures the physical and psychological effects of the work environment. The scale included statements aimed at determining whether individuals experienced problems such as fatigue, a feeling of a heavy head, headache, nausea/dizziness, concentration difficulties, itching, burning or irritation in the eyes, nasal irritation, congestion or discharge, hoarseness, dry throat, cough, dry or red facial skin, flaking/itching, scalp or ears, dry hands, itching, and red skin. The questions were scored as 3=often, 2=sometimes, 1=never. Based on the scoring, individuals experiencing the most physical and psychological problems, and attributing these issues to the work environment, were identified as the experimental group. Subsequently, indoor plants with positive psychological and physical effects were placed in the rooms of the individuals in the experimental group. The plants remained in the offices of these individuals for at least two months. After this period, the same survey was administered again to the experimental group. Data analysis was conducted using SPSS 22. Initially, the demographic characteristics of the participants were determined. Descriptive statistics were then used to assess the physical and psychological problems experienced by participants in environments without plants and with plants. Next, the differences in these problems between the two environments were analyzed using the Independent Sample T-test. Various inferences were made based on the scores obtained from the pre- and post-tests.

Table 1.
General characteristics of the staff.

Features	**Variables**	**n**	**%**
Gender	Male	4	36.4
	Woman	7	63.6
Age	Age 40 and Under	4	36.4
	41-44 Years Old	3	27.2
	Ages 45 and Above	4	36.4
Marital status	Married	8	72.7
	Single	3	27.3
Task Type	Academic Staff	7	63.6
	Administrative Staff	4	36.4
Duration of Service in the Institution	10 Years and Under	4	36.4
	11-15 Years	3	27.2
	16 Years and Above	4	36.4
Grand Total		11	100

4. Results and Discussion

4.1. General Characteristics of Personnel Participating in the Research

Frequency analysis was conducted to determine the general characteristics of the personnel participating in the research. The findings regarding the general characteristics of the personnel are provided in Table 1.

The application was conducted on a total of 11 personnel. Four of the subjects were male and seven were female. Four of the subjects were 40 years old or younger, three were between 41 and 44 years old, and four were 45 years old or older. Eight of the subjects were married, and three were single. Seven of the participants were academic staff, and four were administrative staff. Four of the subjects had been working in the institution for 10 years or less, three for 11-15 years, and four for 16 years or more.

4.2. Findings Regarding the Physical and Psychological Disorders of the Staff

In this part of the study, the physical and psychological problems experienced by staff in offices without plants and with plants were analyzed. The problems identified were determined through descriptive analysis. To assess the physical and psychological issues faced by staff, the following value ranges were used: 1.00-1.66 = never, 1.67-2.33 = partly, 2.34-3.00 = often. The findings related to the pre-test and post-test scores are presented in Table 2 and Table 3. The data from these tables are summarized in Figure 2.

Table 2.
Physical and psychological problems experienced by staff in a plant-free environment (pre-test).

Physical and Psychological Problems		None	Sometimes	Often	$\bar{X} \pm SS$
Burnout	n	1	7	3	2.18 ±0.60
	%	9.1	63.6	27.3	
Feeling Heaviness in the Head	n	-	8	3	2.27 ±0.46
	%	-	72.7	27.3	
Headache	n	-	8	3	2.27 ±0.46
	%	-	72.7	27.3	
Nausea/Dizziness	n	4	6	1	1.72 ±0.64
	%	36.4	54.5	9.1	
Inability to Concentrate	n	-	9	2	2.18 ±0.40
	%	-	81.8	18.2	
Itching, Burning in the Eyes, etc.	n	4	5	2	1.81 ±0.75
	%	36.4	45.5	18.2	
Irritated, Stuffy and Runny Nose	n	1	7	3	2.18 ±0.60
	%	9.1	63.6	27.3	
Hoarseness, Dry Throat	n	1	6	4	2.27 ±0.64
	%	9.1	54.5	36.4	
Cough	n	-	6	5	2.45 ±0.52
	%	-	54.5	45.5	
Dry or Reddened Facial Skin	n	1	6	4	2.27 ±0.64
	%	9.1	54.5	36.4	
Itching in the Scalp or Ears	n	1	7	3	2.18 ±0.60
	%	9.1	63.6	27.3	
Dry, Itchy, Red Skin on Hands	n	4	4	3	1.90 ±0.83
	%	36.4	36.4	27.2	

In a plant-free environment, staff sometimes experience burnout ($\bar{X}$=2.18), feeling heaviness in the head ($\bar{X}$=2.27), It was determined that the patient experienced headache ($\bar{X}$=2.27), nausea/dizziness ($\bar{X}$=1.72), inability to concentrate ($\bar{X}$=2.18), itching, burning, etc. in the eyes ($\bar{X}$=1.81), irritation, congestion and discharge in the nose ($\bar{X}$=2.18), hoarseness and dry throat ($\bar{X}$=2.27), dry or reddened facial skin ($\bar{X}$=2.27), itching in the scalp or ears ($\bar{X}$=2.18), dryness and itching in the hands ($\bar{X}$=1.90). It was also revealed that he coughed frequently ($\bar{X}$=2.45).

Table 3.
Physical and psychological problems experienced by staff in a planted environment (post-test).

Physical and Psychological Problems		None	Sometimes	Often	$\bar{X} \pm SS$
Burnout	n	5	6	-	1.54 ±0.52
	%	45.5	54.5	-	
Feeling Heaviness in the Head	n	3	8	-	1.72 ±0.46
	%	27.3	72.7	-	
Headache	n	2	8	1	1.90 ±0.53
	%	18.2	72.7	9.1	
Nausea/Dizziness	n	10	1	-	1.09 ±0.30
	%	90.9	9.1	-	
Inability to Concentrate	n	3	6	2	1.90 ±0.70
	%	27.3	54.5	18.2	
Itching, Burning in the Eyes, etc.	n	8	3	-	1.27 ±0.46
	%	72.7	27.3	-	
Irritated, Stuffy and Runny Nose	n	6	5	-	1.45 ±0.52
	%	54.5	45.5	-	
Hoarseness, Dry Throat	n	3	8	-	1.72 ±0.46
	%	27.3	72.7	-	
Cough	n	8	3	-	1.27 ±0.46
	%	72.7	27.3	-	
Dry or Reddened Facial Skin	n	11	-	-	1.00 ±0.00

	%	100	-	-	
Itching in the Scalp or Ears	n	8	3	-	1.27 ±0.46
	%	72.7	27.3	-	
Dry, Itchy, Red Skin on Hands	n	8	3	-	1.27 ±0.46
	%	72.7	27.3	-	

In a plant environment, personnel did not experience burnout ($\bar{X}$=1.54), did not experience nausea/dizziness ($\bar{X}$=1.09), It was determined that the personnel did not experience itching, burning, etc. in the eyes ($\bar{X}$=1.27), did not experience irritation, blockage, or discharge in the nose ($\bar{X}$=1.45), did not cough ($\bar{X}$ = 1.27), did not have dry or red facial skin ($\bar{X}$=1.00), did not experience itching in the scalp or ears ($\bar{X}$=1.27), did not experience dryness or itching in the hands ($\bar{X}$=1.27). On the other hand, it was determined that the personnel sometimes felt heaviness in the head ($\bar{X}$=1.72) in the planted environment. It was determined that he had a headache ($\bar{X}$=1.90), could not concentrate ($\bar{X}$=1.90), and suffered from hoarseness and dry throat ($\bar{X}$=1.72).

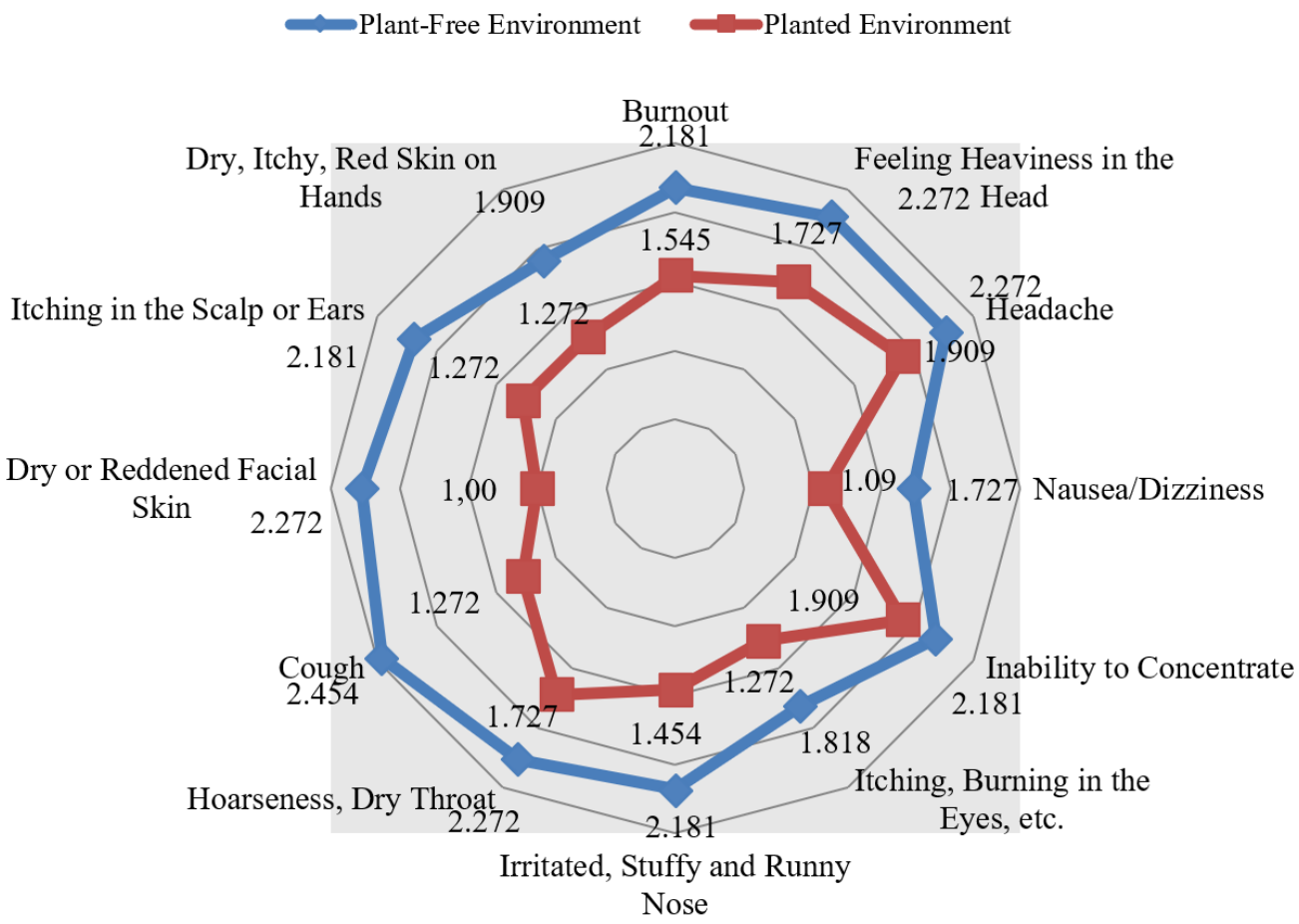

Figure 2.
Physical and psychological problems experienced in a plant-free and plant-enriched environment.

Table 4.
Comparison of physical and psychological problems experienced by staff in plant-free and planted environments.

Physical and Psychological Problems	Working Environment	n	$\bar{X} \pm SS$	t	p
Burnout	Plant-free Environment	11	2.18±0.60	2.646	0.016 *
	Planted Environment	11	1.54±0.52		
Feeling Heaviness in the Head	Plant-free Environment	11	2.27±0.46	2.739	0.013 *
	Planted Environment	11	1.72±0.46		
Headache	Plant-free Environment	11	2.27±0.46	1.690	0.106
	Planted Environment	11	1.90±0.53		
Nausea/Dizziness	Plant-free Environment	11	1.72±0.64	2.958	0.010 *
	Planted Environment	11	1.09±0.30		
Inability to Concentrate	Plant-free Environment	11	2.18±0.40	1.118	0.277
	Planted Environment	11	1.90±0.70		
Itching, Burning in the Eyes, etc.	Plant-free Environment	11	1.81±0.75	2.046	0.054
	Planted Environment	11	1.27±0.46		
Irritated, Stuffy and Runny Nose	Plant-free Environment	11	2.18±0.60	3.024	0.007 *
	Planted Environment	11	1.45±0.52		
Hoarseness, Dry Throat	Plant-free Environment	11	2.27±0.64	2.268	0.035 *
	Planted Environment	11	1.72±0.46		
Cough	Plant-free Environment	11	2.45±0.52	5.594	0.000 *
	Planted Environment	11	1.27±0.46		
Dry or Reddened Facial Skin	Plant-free Environment	11	2.27±0.64	6.528	0.000 *
	Planted Environment	11	1.00±0.00		
Itching in the Scalp or Ears	Plant-free Environment	11	2.18±0.60	3.953	0.001 *
	Planted Environment	11	1.27±0.46		
Dry, Itchy, Red Skin on Hands	Plant-free Environment	11	1.90±0.83	2.214	0.039 *
	Planted Environment	11	1.27±0.46		

It was determined that the problems experienced by the subjects, such as headache, inability to concentrate, itching, and burning in the eyes, were not related to whether the working environment was planted or not ($p>0.05$). On the other hand, the feeling of heaviness in the head (head); it has been determined that the following conditions can be experienced depending on whether the working environment is planted or not ($p<0.05$). When the arithmetic means of the problems experienced in the plant-free and planted environments are examined, it can be seen that working in a planted environment causes a decrease in these problems. In other words, it can be said that working in a planted environment reduces physical and psychological problems (Table 4).

5. Conclusion and Recommendations

Plants are considered a vital and indispensable part of any healthy environment, including offices, hotels, waiting rooms, restaurants, classrooms, or certain indoor areas [10]. Contact with plants has many benefits, including improvements in physical, cognitive, psychological, and social functions [11, 12]. It is reported that indoor plants improve mood, reduce stress, increase productivity, enhance individuals' reaction speed, improve attention span, enhance the air quality of the environment they are in, reduce blood pressure, and decrease fatigue and headaches [1, 10, 19].

In this study conducted on academic and administrative staff working at Çaycuma Vocational School, it was determined that in a plant-free environment, staff sometimes experience burnout, heaviness in the head, headaches, nausea/dizziness, difficulty concentrating, itching, burning, etc., in the eyes, irritation, blockage, and discharge in the nose, hoarseness, dry throat, dry or reddened facial skin, itching in the scalp or ears, and dryness and itching in the hands. It was also revealed that they cough frequently. In a plant-based environment, it was determined that staff do not experience burnout, nausea/dizziness, itching, burning, etc., in the eyes, irritation, blockage, and discharge in the nose, and do not cough. They have dry or reddened facial skin, do not experience itching in the scalp or ears, and experience dryness and itching in the hands. On the other hand, it was found that staff sometimes feel heaviness in the head, experience headaches, cannot concentrate, and experience hoarseness and a dry throat.

It has been determined that the problems experienced by subjects working in planted and non-planted environments, such as headaches, inability to concentrate, itching, and burning in the eyes, are not related to the type of environment. However, it has been observed that personnel may experience heaviness in the head; nausea/dizziness; nasal irritation, blockage, and discharge; hoarseness and dry throat; cough; facial skin dryness or redness; itching in the scalp or ears; and

dryness and itching in the hands, depending on the environment. When the arithmetic averages of these problems are examined, it appears that working in a planted environment reduces these issues. In other words, working in a planted environment can decrease physical and psychological problems. These findings have been found to be parallel to the mists obtained by Fjeld et al. [15], Lohr and Pearson-Mims [2], Chang and Chen [21], Bringslimark et al. [23], Raanaas et al. [24], Yildirim et al. [7] and Han et al. [14].

The research results indicate that using plants in work offices can reduce physical and psychological problems among individuals. Therefore, it is recommended that personnel place indoor plants in their offices to support mental health, reduce stress, enhance attention spans, lower blood pressure, decrease fatigue and headaches, and mitigate issues such as skin dryness. Since some respiratory symptoms may persist even in environments with plants, proper ventilation should be maintained; particularly, carbon dioxide levels and humidity should be monitored regularly. Complaints such as headaches and concentration difficulties could be due to inadequate lighting or screen use. Increasing natural light, maintaining appropriate screen brightness, and implementing ergonomic arrangements are advisable. Symptoms like a dry throat and hoarseness may result from insufficient fluid intake or dry air. Employees should be encouraged to drink adequate water, and humidifiers can be used if necessary. To reduce concentration issues and headaches, employees should take short breaks at regular intervals and perform eye exercises. Each individual reacts differently to environmental factors; therefore, symptoms should be monitored regularly, and personalized remedial measures should be implemented.

This study examined the effects of working in planted and non-planted environments on the physical and psychological states of individuals. In future studies, which plants contribute more to physical and mental health can be analyzed, and the most suitable species can be integrated into work environments. Since headaches and similar complaints continue even in a planted environment, studies can be conducted by taking into account air quality parameters such as volatile organic compounds, carbon dioxide, oxygen, and humidity. Although physical symptoms decreased in this study, since mental fatigue symptoms were observed, the effects of natural elements on cognitive performance can be evaluated with neuropsychological tests, and interventions can be developed in this direction. In addition, to ensure the findings are generalizable, larger samples from different age groups, genders, and fields of duty can be studied.

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