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Exploring the Mediating Role of Physical Activity in the Relationship between Green Space Exposure and Well-being: Results from the AUGS Survey

Abstract

Although previous studies have shown that exposure to nature has a positive impact on physical and mental health, the factors that produce such benefits are still not well established, especially in high- and middle-income countries. In the present study, we implemented a mediation approach between green space exposure and psychological distress, body fat percentage and well-being index in Tirana (Albania), through the mediation of physical activity. The significant direct effects of green space on body fat percentage index (BFPI), psychological distress index (PDI) and well-being index, together with the relatively smaller mediating role of physical activity, offer insightful implications for the design and prioritisation of urban green spaces. The differential impact on health outcomes suggests a complex relationship that is not only mediated by physical activity, but also offers clear benefits by reducing psychological distress (as indicated by PDI scores) and significantly improving overall well-being. This dichotomy highlights the multifaceted role of green spaces in public health, requiring a broad lens that goes beyond physical health metrics to include mental health and subjective well-being. Our findings also confirm the intrinsic value of green spaces in improving well-being and reducing psychological distress, independent of the physical activities they may promote.

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1 Introduction

1.1 Motivation

People's health and well-being may be influenced by a lack of exposure to natural ecosystems in a rapidly urbanizing society (Hartig et al., 2014; Markevych et al., 2017). Over the past few decades, a developing discipline in environmental epidemiology has focused on the possibility of a causal relationship between population exposure to natural settings and favourable health outcomes (Astell-Burt & Feng, 2019, 2020; Chiabai et al., 2020). Air quality, exercise, social cohesion, stress reduction, and enhanced physical health are all topics that are currently receiving research focus (Astell-Burt et al., 2014; Astell-Burt & Feng, 2020; Beyer et al., 2014; Dzhambov et al., 2018; Johnson et al., 2018; Markevych et al., 2017; Orru et al., 2016). According to previous studies, exposure to nature is proven to have long-term effects on physical and mental well-being (Barton & Pretty, 2010; Chen et al., 2021; Chiabai et al., 2020; Dzhambov et al., 2018; Pretty et al., 2005, 2007). In the same vein, in high-income countries, existing evaluations and meta-analyses on residential greenness exposure or green spaces like parks, gardens, and forests are favourable for a variety of health indicators (Dzhambov et al., 2018; Escolà-Gascón & Houran, 2021; Gascon et al., 2015; Kondo et al., 2018; Taylor & Hochuli, 2017; White et al., 2019). The benefits of green space exposure remain unclear regarding the features that generate them. Consequently, it is a challenge to promote green spaces, especially in upper and middle-income countries, where scientific studies on the associations between green spaces and health are scarce.

1.2 Goals of the study

In this context, the aim of the present study is to explore the relationship between urban green spaces and health in a Mediterranean country examining the case of Albania, a Mediterranean country located in the Balkan peninsula. For that purpose, causal associations among green space exposure and psychological distress index (PDI), and body fat percentage index (BFPI) and well-being index will be explored via physical activity mediation.

It is likely that access to green space may have an effect on one's level of physical activity and, subsequently, weight status, as more exposure to green space can promote health by increasing possibilities and actual levels of physical activity (Jia et al., 2021). Previous studies have analysed the positive impact of different green settings on body fat percentage body index (BFPI) (Bai et al., 2013; Bird et al., 2016; Sander et al., 2017; Stark et al., 2014; Tsai et al., 2016). In this study, we assume that more green space exposure is connected to increased physical activity. The latter is associated with better BFPI. In that regard, two pathways will be explored. Firstly, if BFPI is directly associated to green exposure, and if BFPI is affected by green exposure through the mediation of physical activity. Therefore, the following hypotheses will be tested:

H1:1 BFPI is negatively associated with green exposure.

H1:2 BFPI is negatively associated with green exposure through the mediation of physical activity.

Considering that, natural settings have a tendency to alleviate perceived stress, green space has also drawn significant attention as a resource for psychological restoration (Ulrich, 1983; Ulrich et al., 1991; Hartig et al., 2014; Huang et al., 2020; Ward Thompson et al., 2012). A number of outcome measures related to mental health were utilized, including 1) the risk of psychological distress, (2) self-reported physician-diagnosed depression or anxiety, and (3) self-rated fair to poor general health (Furukawa et al., 2003). In the present study, we will test in the case of Tirana, Albania, if mental health through psychological distress is affected by green exposure and if the relationship between mental health (PDI)/ green spaces exposure is mediated by physical activity. We will also assume a positive relationship between green exposure and well-being index. In this context, the hypotheses to be tested are as follows:

H2.1: Psychological distress PDI is positively associated with green space exposure.

H2.2: Psychological distress PDI is positively associ-

ated with green space exposure through the mediation of physical activity.

H2.3: Well-being index is positively associated with green space exposure.

H2.4: Well-being index is positively associated with green space exposure through the mediation of physical activity.

The benefits generated from green spaces exposure in urban spaces are not uniform for all population segments (Richardson & Mitchell, 2010). Numerous studies analyse the socioeconomic variables that may have an impact on health and that limit the relationship between urban green space and health outcomes (Aerts et al., 2020; Astell-Burt et al., 2014; Astell-Burt & Feng, 2019, 2020; Gascon et al., 2015; Huang et al., 2020; Jia et al., 2021; Markevych et al., 2017; Richardson & Mitchell, 2010). Gender, income, education, employment status, etc., are some of the socio-demographics characteristics explored in the green spaces exposure-health relationship. We assume that gender, education and income will have a significant effect in the green space exposure → physical activity → BFPI, PDI and well-being index pathway.

2 Methods

This study presents results of a population-based online survey related to the Grand Park of Tirana, Albania. Health indicators such as body fat percentage index (BFPI), and mental health (psychological distress index (PDI), well-being index) are considered. The study area, research instrument and statistical approach are described below.

2.1 Study area

Albania has progressed from being one of the poorest countries in Europe to an upper-middle-income country (World Bank, 2022) and has been a NATO member since 2009. Tirana is the capital and the largest city in Albania, located in the Western Balkans, near to the Mediterranean Sea. The number of inhabitants in Tirana is forecasted to increase from 763,560 in 2011 to 909,252 in 2031 (up to 30%), (INSTAT, 2014). Despite Tirana's rapid population

Figure 1. Location of Grand Park of Tirana. Source: Author's elaboration.

growth over the years, very few research has been done on its urban parks. They manifest a pattern of increasing urbanization that suggests the need for studies on how this process may affect public health, as well as the need for evidence-based policies to develop eco-friendly solutions.

The Grand Park of Tirana is an area of about 250 ha of vegetation, within which is located the Tirana Artificial Lake, with an extension of 48 hectares (Figure 1). Many services are available in this area, as the Grand Park of Tirana is a popular leisure and sports destination in the city.

2.2 Research instrument

Following the validation and cleaning processes, 493 respondents who took part in the Albanian Urban Green Space (AUGS) survey were obtained as a representative sample (95% confidence level). This survey was designed for people over the age of 16 and was distributed to the public via social media platforms. The survey questionnaire included questions in four domains as follows: 1) Socio-demographic characteristics, 2) Life habits, 3) Health and well-being, and 4) Green space exposure (see Table 1).

This paper considers the variables used in the mediation analysis following the conceptual framework (see Figure 2).

The body fat percentage is a fitness measure that directly calculates a person's relative body composition without taking into account height or weight. In this study, we have used the Deurenberg formula to calculate the BFPI (Body fat % = (1.20 * BMI) + (0.23 * Age) - (10.8 * gender) - 5.4) (Deurenberg et al., 1991). The WHO provides the following ranges for body fat percentage for adults. On women, essential fat: 0-12 percent, athletes: 14-20 percent, fitness: 21-24 percent, acceptable: 25-31 percent, obese: 32 percent+. While for men essential Fat: 2-4 percent, athletes: 6-13 percent, fitness: 14-17 percent, acceptable: 18-25 percent, Obese: 26 percent+.

The World Health Organisation - Five Well-Being Index (WHO-5) consists of five statements: 1. "I have felt cheerful and in good spirits", 2. "I have felt calm and relaxed", 3. "I have felt active and vigorous" 4.

Table 1. Description of the variables included in the study.

Domains	Variables	Questions
1. Socio-demographic characteristics	Gender (Female/Male)	Gender
	Age (Years)	Year of birth
	Marital status (Married, Single, Divorced, Widowed, Prefer not to answer)	Marital status
	Education (Primary school, High school, University (completed), Following university studies)	Education
	Job status (Unemployed, Employee, Temporary sick leave, Permanently sick, Disabled, Retired Student)	Employment status (during the last month)? Please select only one
	Household income (less than 10,000 ALL, 10,001 to 20,000 ALL, 20,001 ALL to 40,000 ALL, 40,001 ALL to 60,000 ALL, 60,001 ALL to 80,000 ALL, 80,001 ALL to 100,000 ALL, 100,001 ALL to 120,000 ALL, 120,001 ALL to 140,000 ALL, 140,001 ALL to 160,000 ALL, 160,001 ALL to 180,000 ALL, 180,001 ALL to 200,000 ALL, Up to 200,001 ALL, Prefer not to answer)	Which of the following describes your household's total monthly income after tax and compulsory deductions, from all sources?
2. Life habits	Physical activity (in minutes) No. days * 30 minutes	During the last 4 weeks on how many days per week, have you done at least 30 minutes of physical activity?
3. Health and well-being	Body Fat Percentage Index (BFPI)	Underweight/Normal/Obese
	WHO-5 Well-Being Index (Range 0-50; poor well-being ≤ 50; good well-being < 50)	Please indicate for each of the five statements, which is closest to how you have been feeling over the last two weeks.
	Psychological Distress Index (PDI) (Range 10 – 50) Kessler Psychological Distress Scale K10	Please indicate for each of the five statements, which is closest to how you have been feeling over the last two weeks. 10- 19 Likely to be well 20- 24 Likely to have a mild disorder 25- 29 Likely to have a moderate disorder 30- 50 Likely to have a severe disorder
4. Green space exposure	Time of green spaces exposure (in minutes)	How much time (in minutes) did you spend during your visit?
	Quality of green space (Very good, Good, Neither good, nor bad, Bad, Very bad)	Overall, how would you describe the quality of Grand Park of Tirana?

"I woke up feeling fresh and rested" 5. "My daily life has been filled with things that interest me." Respondents rate according to the following scale: All of the time = 5; Most of the time = 4; More than half of the time = 3; Less than half of the time = 2; some of the time = 1; at no time = 0. WHO-5 values ≤50 are defined as poor well-being and >50 good well-being (Topp et al., 2015).

Exposure to the green space, in this case within the Grand Park of Tirana (green space exposure), was measured in minutes and coded for the data analysis as follows 1. 0-30 minutes, 2. 31-60 minutes, 3. 61-90 minutes, 4. 91-120 minutes, 5. 120-180 minutes, 6. Over 181 minutes.

Physical activity is coded for the data analysis as follows 1. 0-30, 2. 31-60, 3. 61-90, 4. 91-120, 5. 150, 6. Over 150 minutes.

Park's quality, is evaluated through a five Likert scale, 1=very good, 5=very bad.

2.3 Statistical analysis

Descriptive statistics were used to analyse (1) socio-demographic characteristics (age, gender, marital status, education level, job status and household income); (2) exposure time during the visit to green spaces; (3) the quality of urban green space, (4) physical activity; (5) self-reported health indicators (BFPI, PDI, well-being index). The statistical evaluations were conducted using the SPSS software platform. Data from the sample was calculated using frequency, percentage, mean, and standard deviation calculations.

In the present study, through a mediation model, we will test the relationship between BFPI, PDI and well-being index and green space exposure. Model four through the "PROCESS" macro was used for the mediation analysis (Hayes, 2013) in SPSS with bias-corrected 95% confidence intervals and bootstrapping will allow us to calculate the following pathways: Figure 2.

Model four tests the model with physical activity as a mediator, Through the model four we will test the following pathways: 1) Green space exposure → physical activity → PDI, 2) Green space exposure → physical activity → well-being index, 3) Green space exposure → physical BFPI.

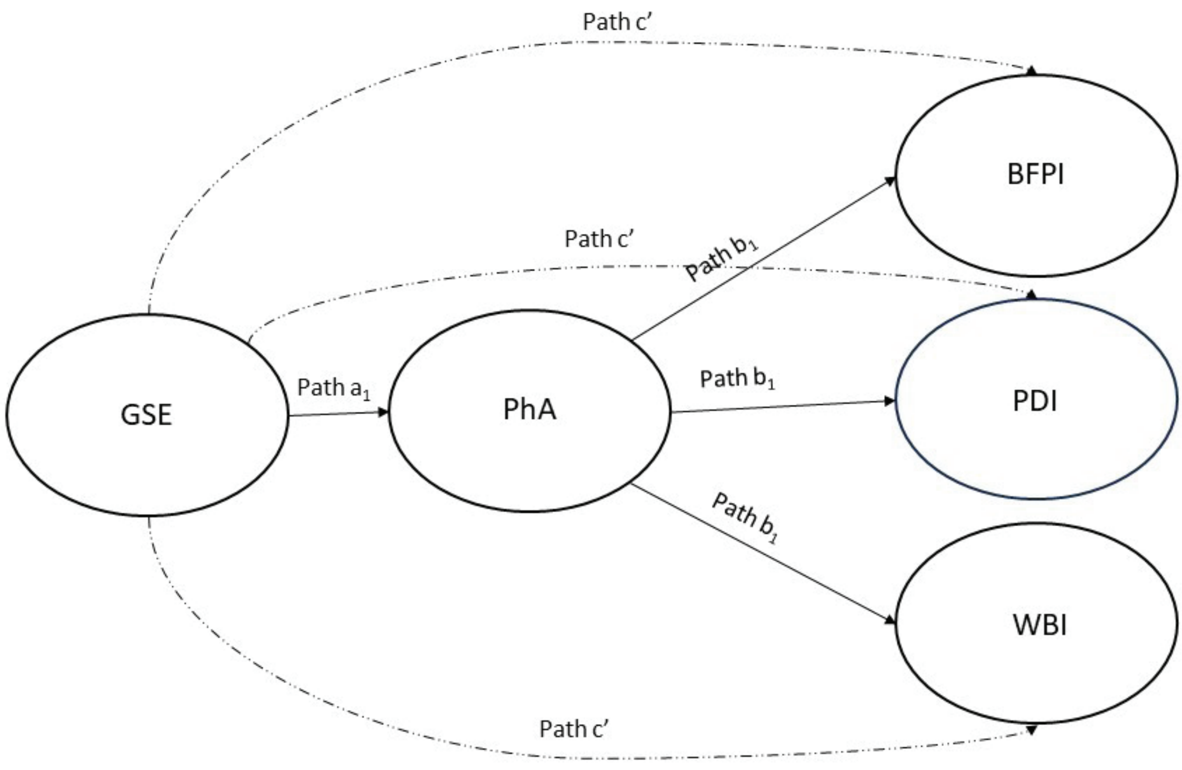

Figure 2. Conceptual and statistical model. GSE=Green Space Exposure; PhA=Physical Activity; PDI=Psychological Distress Index; BFPI=Body Fat Percentage Index, WBI=Well-being index. Source: adapted from Hayes, 2013. .

3 Results

The analysis of the socio-demographic characteristics revealed that the mean age of the respondents was 33.09 ± 10.976 as indicated in Table 1. It is clear that the population sample was young, with 58.4% of participants between the ages of 16 and 31; 28.4% between the ages of 32 and 45; and 7.5% between the ages of 46 and 54, and 5.7 % over 55 years old, including 69.2% of women and 30.8% of men. The vast majority of the participants in the survey are women (69%) showing again that women are more active in completing questionnaires in online platforms.

The mean BFPI for men over the age of 55 is 25.5%, 24.4% for men between the ages of 46 and 54, 18.6% for men between the ages of 32 and 45, and 13.3% for men between the ages of 16 and 31. This show that men, regardless age, their BFPI is considered acceptable to essential fat. On the other hand, women's BFPI is noted to be 34% over the age of 55, 32% between the ages of 46 and 54, 24.6% between the ages of 32 and 45, and 20.6% between the ages of 16 and 31. These results shows that older women and women in mid-age have a higher body fat percentage and considered obese. On the contrary, younger women seems to be healthier referring to lower levels of body fat percentage.

It is noteworthy to observe that respondents gave the quality of urban green space a low rating when discussing the visit's perceived benefit according to the scale and items used in the analysis. Approximately 86.4% of respondents said they were nei-

Table 2. Sociodemographic, green exposure and health-related variables (N: 493).

Sociodemographic variables	Frequency in N/%	Health-related variables	Frequency in N/%
Gender		**BFPI**	
Female	341 (69.2)	0-13	42 (8.6)
Male	152 (30.8)	14-20	203 (41.4)
Age group	33.09 ± 10.976	21-24	114 (23.3)
16-31	288 (58.4)	25 - 31	97 (19.8)
32-45	140 (28.4)	+32	34 (6.9)
46-54	37 (7.5)	**PDI**	
>55	28 (5.7)	Likely to be well (10 – 19)	179 (36.5)
Marital status		Likely to have a mild disorder (20 -24)	36 (27.5)
Married	168 (34.1)	Likely to have a moderate disorder (25 – 29)	69 (13.9)
Single	272 (55.2)	Likely to have a severe disorder (30 – 50)	109 (22.1)
Other	53 (10.7)	Well-being index	
Education level		Good well-being WHO-5 ≤50	270 (54.8)
Primary school	2 (0.4)	Poor well-being WHO-5 >50	223 (45.2)
High school	13 (2.6)	Green exposure	
Following university studies	105 (21.3)	**Time spent in the Tirana park (in minutes)**	
University (completed)	373 (75.7)	0-30	33 (9.3)
Job status		31-60	188 (53.1)
Unemployed	30 (6.1)	61-90	51 (14.4)
Employed	398 (80.7)	91-120	60 (16.9)
Students	59 (12.0)	121-180	16 (4.5)
Other	6 (1.2)	>181	6 (1.7)
Household income		**Physical activity (in minutes)**	
<200 USD	11 (2.2)	0-30	137 (27.5)
201 - 600 USD	67 (13.6)	31-60	83 (16.9)
601 - 1000 USD	102 (20.7)	61-90	89 (18.1)
1001 - 1400 USD	74 (15.0)	91-120	56 (11.4)
1401 - 1800 USD	31 (6.3)	150	56 (11.4)
< 1801 USD	82 (16.6)	>150	72 (14.7)
I do not prefer to answer	126 (25.6)		

GSE-Green Space Exposure; BFPI-Body Fat Percentage; WBI-Well-being Index; PDI-Psychological Distress Index. Source: Author's elaboration.

ther satisfied with their visit nor felt a part of nature (86.9%). They reported to be feeling insecure, the area being prone to vandalism, and the lack of adequate facilities.

Furthermore, nearly half of the participants (45.2%) reported poor well-being in our study. It also demonstrates that the majority of respondents are likely to have a psychological disorder. According to our findings, 36.5% are likely to be healthy, 27.5% to have a mild disorder, 22.1 % to have a severe disorder, and 13.9% to have a moderate disorder. In terms of the amount of time spent engaging in physical activity in green spaces during the visit, the results show that almost all respondents spent more than 30 minutes exercising in green spaces.

The analysis reveals a significant total effect of green space exposure on BFPI (a3 = .364; t = 2.263; p = .02). This means that, in general, an individuals' exposure to green space is positively associated with their body fat percentage index. The direct effect of green space on BFPI is significant even without considering the mediating role of physical activity (effect = .344; t = 2.117; p = .03). This means that space exposure influences BFPI independently of physical activity levels. The model also shows an indirect effect of green space exposure on BFPI through physical activity, although this effect is smaller (effect = .019). This suggests that part of the green space effect on BFPI is mediated by physical activity, but this pathway contributes less to the overall effect than the direct effect of green space exposure. The direct effect of green spaces on BFPI is greater than the indirect effect through physical activity. This suggests that although physical activity plays a role in the relationship between green spaces and BFPI, green spaces themselves have a greater direct effect on BFPI. The positive value of the relationship between green space exposure and BFPI (=.36) might initially be counterintuitive, as we expect green space exposure to lead to lower BFPI due to increased opportunities for physical activity. However, this finding suggests that other factors associated with green space exposure may be involved. Individuals with a higher BFPI may spend more time in green spaces for reasons unrelated to physical activity, such as relaxation or socialisation, which are not captured by the physical activity mediator. These findings highlight the complexity of the relationship between green space exposure and physical health outcomes. While it is generally assumed that green spaces promote health by encouraging physical activity, the direct relationship with the BFPI suggests that the benefits of green spaces may involve other mechanisms, or that the relationship may be influenced by other variables not included in this analysis, such as dietary habits, mental health or socio-economic factors. The computation of gender and age as covariates in the mediation model, show a significant effect of the gender (Effect=-6.784, F (value) = -16.120, p (value)= .000) and age Effect=4.581, F(value)= 20.361, p(value)= .000 (see Table 7 for BFPI sample comparison).Green exposure is related to lower BFPI in men, while its effects decrease with increasing age.

The overall effect of green space exposure on the Psychological Distress Index (PDI) is statistically significant, with a coefficient (a2) of 0.068, a t-value of 2.417, and a p-value of 0.01. This indicates that, overall, increased exposure to green space is associated with improvements in the PDI, suggesting less psychological distress among participants. However, the direct effect of green space exposure on PDI, excluding the mediating role of physical activity, also shows a positive effect with a coefficient (a2) of 0.058, a t-value of 2.056 and a p-value of 0.04 (see Table 4). This confirms that the positive relationship between exposure to green spaces and lower levels of psychological distress remains significant even when physical activity is not taken into account as a

Table 3. Sociodemographic, green exposure and health-related variables (N: 493).

Hypotheses to be tested	Causal relationship	Pathways	Results
H1:1 BFPI is negatively associated with green exposure	Green Space Exposure→ BFPI	The direct effect of green space exposure on BFPI = a3	R=0.10;F(value)=5.120 p(value)=0.02, a3 =.36
H1:2 BFPI is negatively associated with green exposure through the mediation of physical activity	Green Space Exposure → Physical Activity → BFPI	The indirect effect of green space exposure through physical activity =a1d31	R=0.10;F(value)=2.879; p(value)=0.02 a3 =.364; t (value) = 2.263; p (value) = .02

BFPI- Body Fat Percentage; PDI- Psychological Distress Index. Source: Author's elaboration.

Table 4. Green spaces exposure and mental health outcomes pathways H2.

Hypotheses to be tested	Causal relationship	Pathways	Results
H2.1:Psychological distress PDI is positively associated with green space exposure	Green Space Exposure → PDI	The direct effect of green space exposure on PDI=a2	R=0.23;F(value)=7.008 p(value)=0.01, a2 =.068
H2.2: The well-being index is positively associated with green space exposure	Green Space Exposure → Well-Being Index	The total effect of green space exposure on well-being index = c'	R=0.14;F(value)=9.024 p(value)=0.003, a3 =.36
H2:4 Well-being index is positively associated with green exposure through the mediation of physical activity	Green Space Exposure → Physical Activity → Well-Being Index	The indirect effect of green space exposure in well-being index through physical activity = c'	R=0.20;F(value)= 16.652 p(value)= .0001

BFPI- Body Fat Percentage; PDI- Psychological Distress Index. Source: Author's elaboration.

mediator. The indirect effect of green space exposure on PDI through physical activity is quantified with a coefficient (a2) of 0.010. This value, compared to the direct effect, suggests that although physical activity mediates the relationship between green space exposure and psychological distress, its role is less pronounced than the direct relationship. Furthermore, the indirect effect of physical activity in mediating the relationship between green space exposure and the Psychological Distress Index (PDI) is smaller than its role in mediating the relationship between green space exposure and the Body Fat Percentage Index (BFPI). This implies that although physical activity is a positive mediator in both cases, its mediating effect is stronger in the context of physical health (BFPI) than mental health (PDI).

The overall effect of exposure to green space on well-being, combining both direct and indirect effects, shows that the overall effect, before accounting for physical activity as a mediator, is -2.144, with a significant t-value of -3.884 and a p-value of 0.0001. This indicates a strong negative relationship, suggesting that greater exposure to green space is associated with improved well-being. The direct effect before considering physical activity as a mediator is -2.132, with a t-value of -3.858 and a p-value of 0.000. This is very close to the total effect, indicating that most of the effect of green space on well-being is direct. The total effect with physical activity as a mediator is -2.251, with a t-value of -4.080 and a p-value of 0.000. The direct effect with physical activity as a mediator is -2.093, with a t-value of -3.762 and a p-value of 0.000. This is slightly lower than the direct effect before taking physical activity into account, suggesting that a small part of the effect of green space on well-being is through the mediation of physical activity. The indirect effect through physical activity is therefore -.157. This suggests that physical activity accounts for some of the positive effects of green spaces on well-being, but is not the sole mediator. The small differences between the total and direct effects, both before and after accounting for physical activity, highlight the complex relationship between exposure to green space, physical activity and well-being.

In summary, comparing the total effects before and after considering physical activity as a mediator shows a slight increase in the total effect size (-2.144 to -2.251), indicating that physical activity enhances the overall positive impact of green spaces on well-being. The direct benefits are likely to arise from the intrinsic value of exposure to nature, while the indirect benefits are partly due to the promotion of physical activity. This dual pathway highlights the multifaceted value of green spaces in urban planning and public health strategies, emphasizing their role in improving physical and mental health.

To determine where the effect of green space is greater - whether on the Body Fat Percentage Index (BFPI), the Psychological Distress Index (PDI) or the Well-being Index - we compared the magnitude of the effects reported for each outcome. The direct effects of green space on BFPI (.344) and PDI (0.058) are significant, but the nature and implications of these effects differ. The effect on BFPI is positive, suggesting an increase in BFPI with exposure to green space, whereas the effect on PDI is negative, suggesting a reduction in psychological distress with more exposure to green space. The effects on the well-being index show strong negative associations, indicating a substantial improvement in well-being with increased exposure to green space. The magnitude of these effects (-2.144 to -2.251) suggests a significant impact of green spaces on overall well-being.

Table 5. Analysis of variance between health outcomes and demographics.

Variables	BMI	PDI	WELL-BEING INDEX	BFPI
Demographic variables				
Gender	F (value)=66.666***	F (value)=4.509**	ns	F (value)= 113.937***
Age	F (value)= 3.467***	F (value)= 2.352***	F (value)= 1.693**	F(value)= 7.605***
Income	ns	ns	ns	F(value)= 3.189***
Education	F (value)= 7.036***	F (value)= 6.383**	ns	F (value)= 18.167***

p<0.10 significant at p<0.05; ** significant at p<0.01; ***, not significant=ns.*

Across all outcomes, the direct effects of green space exposure are more significant than the indirect effects mediated by physical activity. Although physical activity makes a positive contribution, its mediating role is less significant than the direct influences of green spaces. This suggests that the benefits of green spaces go beyond simply promoting physical activity. The findings suggest that the presence of green spaces, rather than the physical activities they facilitate, is a significant contributor to health and well-being. Urban planning and natural resource management should prioritise the inclusion and maintenance of green spaces for their inherent value.

However, it is important to note that these effects are measured in different units and contexts, so a direct numerical comparison may not fully represent the relative importance or impact of these different outcomes. Nonetheless, we can make some general observations based on the statistical significance and implications of the findings.

The results of this study highlight the nuances of the relationship between demographics and health outcomes, with a particular focus on the Body Fat Percentage Index (BFPI), the Psychological Distress Index (PDI) and the Well-being Index. Data on education show that educational attainment is inversely correlated with the BFPI, with individuals with lower levels of education having a higher average BFPI (25.7) than those with higher levels of education (17). Conversely, higher education is associated with higher PDI scores, with more educated respondents averaging a PDI of 25.5, suggesting higher levels of psychological distress, possibly due to stress associated with higher life expectations, compared to their less educated counterparts (17). With regard to gender, the latter significantly influences the BFPI and the PDI, but not the well-being index. Women have a higher BFPI (mean=23) than men (mean=17). However, men have a higher body mass index, indicating differences in body composition and health outcomes between the sexes. Women also report higher levels of psychological distress (PDI mean=23) than men (PDI mean=21), but no significant gender differences were found in the well-being index. As people age, there is an observed increase in the BFPI and a decrease in well-being, along with an increase in the PDI. This suggests that older age groups may face greater physical health challenges and experience a decline in overall well-being and increased psychological distress. Finally, income level shows a direct relationship with the well-being index. Respondents in the lower income bracket (USD 100 to USD 800) report lower well-being scores (below 50), while those in the highest income bracket report significantly higher well-being scores (mean=63), highlighting the impact of socioeconomic status on health and happiness.

4 Discussion

The significant direct effects of green space exposure on the Body Fat Percentage Index (BFPI), the Psychological Distress Index (PDI) and the well-being Index, together with the relatively smaller mediating role of physical activity, offer insightful implications for the design and prioritisation of urban green spaces. The differential impact on health outcomes suggests a complex relationship that is not only mediated by physical activity, but also offers clear benefits by reducing psychological distress (as indicated by PDI scores) and significantly improving overall well-being. This dichotomy highlights the multifaceted role of green spaces in public health, requiring a broad lens that goes beyond physical health metrics to include mental health and subjective well-being. The findings also confirm the intrinsic value of green spaces in improving well-being and reducing psychological distress, regardless of the physical activities they may promote. This suggests that the mere presence of green spaces, possibly through their aesthetic, restorative and stress-reducing properties, plays a critical role in promoting health. The significant direct effects of green spaces on well-being and PDI, compared with the more complex relationship with BFPI, highlights the importance of designing urban green spaces that cater for a wide range of uses and user groups. This includes creating spaces that not only encourage physical activity, but also promote mental health through peaceful and restorative environments. While physical activity is a well-documented benefit of green spaces, this analysis highlights the need to consider additional mechanisms through which green spaces contribute to health. These could include social cohesion, environmental factors such as improved air quality, and the psychological effects such as stress reduction. Future research should explore these pathways in detail to fully understand the health benefits of green spaces. The different effects observed for different health outcomes suggest that individual and contextual factors, such as socio-demographic characteristics and the urban environment, may influence how exposure to green space affects health.

Analysis of the effect of demographics on the Body Fat Percentage Index (BFPI), the Psychological Distress Index (PDI) and the well-being Index reveals interesting findings. Education level has a significant effect on the BFPI and PDI, but not on the well-being index. Individuals with lower levels of education tend to have a higher BFPI, suggesting a possible link between educational attainment and physical health practices. In contrast, higher levels of education correlates with a higher PDI, suggesting that individuals with more education might experience greater mental health challenges, possibly due to increased stress. There are also notable gender differences, with women having a higher BFPI and PDI than men, suggesting gender-specific health and psychological trends. In the present study, age is another factor associated with increased body fat and worsening psychological well-being with age. Income level shows a clear association with the well-being index, with higher income levels reporting better well-being, highlighting the socio-economic factors that contribute to overall health and happiness. These findings highlight the complex interplay between demographics and health outcomes and suggest the need for targeted health interventions that take into account education, gender, age and socioeconomic status to improve physical and mental health outcomes. Also, the time exposed to green space and physical activity influences the results. According to WHO, 150 minutes of physical activity is required to have better health outcomes, and studies also show that spending at least 120 minutes a week in nature is associated with good health and well-being (White et al., 2019). In the present research, 31% of respondents spent 120 minutes in the urban park, and 31% exercised 150 minutes weekly, spending less of the required time in nature and making less physical activity required to be healthy.

The study's confirmation of the initial hypothesis that exposure to green space is positively associated with improved well-being underscores its methodological strength. This significant finding is in line with the existing literature and adds valuable empirical evidence to the urban planning and public health discourse. The robust statistical analysis demonstrating the direct and indirect effects of green spaces on various health indices provides a nuanced understanding of these relationships and contributes to a deeper understanding of the multiple benefits of green spaces. However, the reliance on a younger highly educated sample, predominantly female group of online respondents introduces a limitation to the generalisability of the study. The demographic bias towards younger individuals and women may reflect internet usage patterns and the propensity of women to participate in online surveys. This limitation suggests caution when extrapolating the findings to the wider population, particularly older adults who may have different experiences and benefits from exposure to green space. Also, the exclusion of dietary patterns from the analysis, based on the assumption of a healthy Mediterranean diet among the Albanian population, overlooks the potential confounding or mediating role of diet in the relationship between green space exposure and health outcomes. Given the sedentary nature of the study population, the inclusion of dietary habits may provide a more complete understanding of the lifestyle factors contributing to the observed health effects. In addition, the relatively low level of variance explained in the study indicates the complexity of the relationship between green space exposure and health outcomes and suggests the need to explore additional variables. In particular, understanding how different types of green spaces affect the five human senses could provide insights into the mechanisms by which green spaces exert their health benefits. This consideration is crucial for designing green spaces that maximise health and well-being outcomes. Expanding the study to include a wider range of demographic groups and exploring other factors such as lifestyle and technology use could improve understanding of the impact of green space exposure on health. This broader approach would allow a more detailed examination of how different aspects of green spaces interact with individual and societal factors to influence health outcomes.

The territorial reform undertaken by Albania in 2015, merging urban and rural areas into larger administrative units, presents a unique opportunity for enhancing green space exposure among the population. This reform provides an opportunity to rethink urban planning, prioritizing greening strategies that have not traditionally been central to political agendas, especially in low- and middle-income countries (LMICs). The integration of green spaces into urban and rural planning offers numerous health, social, and environmental benefits, highlighting the need for targeted research and policy initiatives in these regions. However, realizing these benefits requires concerted efforts from researchers, policymakers, and the public to prioritize greening strategies. Future studies should aim to fill the existing knowledge gaps, offering evidence-based recommendations for incorporating green spaces into urban planning, with a specific focus on enhancing access, quality, and public awareness in LMIC contexts.

5 Conclusion

In conclusion, the comprehensive analysis of the impact of green space exposure on well-being, the Body Fat Percentage Index (BFPI), and the Psychological Distress Index (PDI) offers significant insights into the multifaceted benefits of green spaces on public health in an urban setting. The findings demonstrate the importance of direct access to green spaces for improving physical and psychological well-being, beyond the benefits associated with physical activity alone. This research highlights the intrinsic value of green spaces in urban planning and public health strategies, emphasizing their role not only in enhancing physical and mental health but also in fostering social cohesion and environmental sustainability.

The methodological strengths of the study, including its confirmation of the hypothesis that green space exposure is positively associated with improved well-being, contribute valuable empirical evidence to the existing body of literature. However, the study's limitations, such as the demographic skew of the sample and the exclusion of dietary patterns, underscore the need for further research. Future studies should aim to address these limitations by incorporating a more diverse sample and exploring additional variables, such as dietary habits and the qualitative aspects of green space exposure, to provide a more comprehensive understanding of the health benefits of green spaces.

The results obtained provide an opportunity to prioritize green strategies in urban planning, especially in low- and middle-income countries (LMICs) such as Albania, where these considerations are often overlooked. The study's implications for LMICs highlight the need for targeted research and policy initiatives that recognize the health, social, and environmental benefits of green spaces. Addressing socioeconomic disparities and raising public awareness about the positive impacts of green space exposure are crucial steps toward promoting healthier lifestyles and fostering sustainable urban development.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Astell-Burt, T., & Feng, X. (2019). Association of Urban Green Space With Mental Health and General Health Among Adults in Australia. JAMA Network Open, 2(7), e198209. https://doi.org/10.1001/jamanetworkopen.2019.8209

Astell-Burt, T., & Feng, X. (2020). Urban green space, tree canopy and prevention of cardiometabolic diseases: A multilevel longitudinal study of 46 786 Australians. International Journal of Epidemiology, 49(3), 926–933. https://doi.org/10.1093/ije/dyz239

Astell-Burt, T., Mitchell, R., & Hartig, T. (2014). The association between green space and mental health varies across the lifecourse. A longitudinal study. Journal of Epidemiology and Community Health, 68(6), 578–583. https://doi.org/10.1136/jech-2013-203767

Bai, H., Wilhelm Stanis, S. A., Kaczynski, A. T., & Besenyi, G. M. (2013). Perceptions of Neighborhood Park this is not related to the foundingality: Associations with Physical Activity and Body Mass Index. Annals of Behavioral Medicine, 45(S1), 39–48. https://doi.org/10.1007/s12160-012-9448-4

Barton, J., & Pretty, J. (2010). What is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis. Environmental Science & Technology, 44(10), 3947–3955. https://doi.org/10.1021/es903183r

Bedimo-Rung, A. L., Mowen, A. J., & Cohen, D. A. (2005). The significance of parks to physical activity and public health. American Journal of Preventive Medicine, 28(2), 159–168. https://doi.org/10.1016/j.amepre.2004.10.024

Beyer, K., Kaltenbach, A., Szabo, A., Bogar, S., Nieto, F., & Malecki, K. (2014). Exposure to Neighborhood Green Space and Mental Health: Evidence from the Survey of the Health of Wisconsin. International Journal of Environmental Research and Public Health, 11(3), 3453–3472. https://doi.org/10.3390/ijerph110303453

Bird, M., Datta, G. D., van Hulst, A., Cloutier, M.-S., Henderson, M., & Barnett, T. A. (2016). A park typology in the QUALITY cohort: Implications for physical activity and truncal fat among youth at risk of obesity. Preventive Medicine, 90, 133–138. https://doi.org/10.1016/j.ypmed.2016.06.042

Chen, K., Zhang, T., Liu, F., Zhang, Y., & Song, Y. (2021). How Does Urban Green Space Impact Residents' Mental Health: A Literature Review of Mediators. International Journal of Environmental Research and Public Health, 18(22), 11746. https://doi.org/10.3390/ijerph182211746

Chiabai, A., Quiroga, S., Martinez-Juarez, P., Suárez, C., García de Jalón, S., & Taylor, T. (2020). Exposure to green areas: Modelling health benefits in a context of study heterogeneity. Ecological Economics, 167, 106401. https://doi.org/10.1016/j.ecolecon.2019.106401

Coutts, J. J., Hayes, A. F., & Jiang, T. (2019). Easy Statistical Mediation Analysis With Distinguishable Dyadic Data. Journal of Communication, 69(6), 612–649. https://doi.org/10.1093/joc/jqz034

Crum, A. J., & Langer, E. J. (2007). Mind-Set Matters: Exercise and the Placebo Effect. Psychological Science, 18(2), 165–171. https://doi.org/10.1111/j.1467-9280.2007.01867.x

Dempsey, S., Lyons, S., & Nolan, A. (2018). Urban green space and obesity in older adults: Evidence from Ireland. SSM - Population Health, 4, 206–215. https://doi.org/10.1016/j.ssmph.2018.01.002

Desharnais, R., Jobin, J., Côté, C., Lévesque, L., & Godin, G. (1993). Aerobic exercise and the placebo effect: A controlled study.: Psychosomatic Medicine, 55(2), 149–154. https://doi.org/10.1097/00006842-199303000-00003

Dzhambov, A., Hartig, T., Markevych, I., Tilov, B., & Dimitrova, D. (2018). Urban residential greenspace and mental health in youth: Different approaches to testing multiple pathways yield different conclusions. Environmental Research, 160, 47–59. https://doi.org/10.1016/j.envres.2017.09.015

Escolà-Gascón, Á., & Houran, J. (2021). Paradoxical effects of exposure to nature in "haunted" places: Implications for stress reduction theory. Landscape and Urban Planning, 214, 104183. https://doi.org/10.1016/j.landurbplan.2021.104183

Furukawa, T. A., Kessler, R. C., Slade, T., & Andrews, G. (2003). The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. Psychological Medicine, 33(2), 357–362. https://doi.org/10.1017/S0033291702006700

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Forns, J., Plasència, A., & Nieuwenhuijsen, M. (2015). Mental Health Benefits of Long-Term Exposure to Residential Green and Blue Spaces: A Systematic Review. International Journal of Environmental Research and Public Health, 12(4), 4354–4379. https://doi.org/10.3390/ijerph120404354

Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and Health. Annual Review of Public Health, 35(1), 207–228. https://doi.org/10.1146/annurev-publhealth-032013-182443

Hayes, A. F. (2018). Partial, conditional, and moderated moderated mediation: Quantification, inference, and interpretation. Communication Monographs, 85(1), 4–40. https://doi.org/10.1080/03637751.2017.1352100

Hayes, A. F., & Montoya, A. K. (2017). A Tutorial on Testing, Visualizing, and Probing an Interaction Involving a Multicategorical Variable in Linear Regression Analysis. Communication Methods and Measures, 11(1), 1–30. https://doi.org/10.1080/19312458.2016.1271116

Huang, Q., Yang, M., Jane, H., Li, S., & Bauer, N. (2020). Trees, grass, or concrete? The effects of different types of environments on stress reduction. Landscape and Urban Planning, 193, 103654. https://doi.org/10.1016/j.landurbplan.2019.103654

Jia, P., Cao, X., Yang, H., Dai, S., He, P., Huang, G., Wu, T., & Wang, Y. (2021). Green space access in the neighbourhood and childhood obesity. Obesity Reviews, 22(S1). https://doi.org/10.1111/obr.13100

Johnson, B. S., Malecki, K. M., Peppard, P. E., & Beyer, K. M. M. (2018). Exposure to neighborhood green space and sleep: Evidence from the Survey of the Health of Wisconsin. Sleep Health, 4(5), 413–419. https://doi.org/10.1016/j.sleh.2018.08.001

Kondo, M., Fluehr, J., McKeon, T., & Branas, C. (2018). Urban Green Space and Its Impact on Human Health. International Journal of Environmental Research and Public Health, 15(3), 445. https://doi.org/10.3390/ijerph15030445

Lavallee, K. L., Zhang, X. C., Schneider, S., & Margraf, J. (2021). Obesity and Mental Health: A Longitudinal, Cross-Cultural Examination in Germany and China. Frontiers in Psychology, 12, 712567. https://doi.org/10.3389/fpsyg.2021.712567

Markevych, I., Schoierer, J., Hartig, T., Chudnovsky, A., Hystad, P., Dzhambov, A. M., de Vries, S., Triguero-Mas, M., Brauer, M., Nieuwenhuijsen, M. J., Lupp, G., Richardson, E. A., Astell-Burt, T., Dimitrova, D., Feng, X., Sadeh, M., Standl, M., Heinrich, J., & Fuertes, E. (2017). Exploring pathways linking greenspace to health: Theoretical and methodological guidance. Environmental Research, 158, 301–317. https://doi.org/10.1016/j.envres.2017.06.028

Orru, K., Orru, H., Maasikmets, M., Hendrikson, R., & Ainsaar, M. (2016). Well-being and environmental quality: Does pollution affect life satisfaction? Quality of Life Research, 25(3), 699–705. https://doi.org/10.1007/s11136-015-1104-6

Pretty, J., Peacock, J., Hine, R., Sellens, M., South, N., & Griffin, M. (2007). Green exercise in the UK countryside: Effects on health and psychological well-being, and implications for policy and planning. Journal of Environmental Planning and Management, 50(2), 211–231. https://doi.org/10.1080/09640560601156466

Pretty, J., Peacock, J., Sellens, M., & Griffin, M. (2005). The mental and physical health outcomes of green exercise. International Journal of Environmental Health Research, 15(5), 319–337. https://doi.org/10.1080/09603120500155963

Rajan, T., & Menon, V. (2017). Psychiatric disorders and obesity: A review of association studies. Journal of Postgraduate Medicine, 63(3), 182. https://doi.org/10.4103/jpgm.JPGM_712_16

Richardson, E. A., & Mitchell, R. (2010). Gender differences in relationships between urban green space and health in the United Kingdom. Social Science & Medicine, 71(3), 568–575. https://doi.org/10.1016/j.socscimed.2010.04.015

Sander, H. A., Ghosh, D., & Hodson, C. B. (2017). Varying age-gender associations between body mass index and urban greenspace. Urban Forestry & Urban Greening, 26, 1–10. https://doi.org/10.1016/j.ufug.2017.05.016

Sarwer, D. B., & Polonsky, H. M. (2016). The Psychosocial Burden of Obesity. Endocrinology and Metabolism Clinics of North America, 45(3), 677–688. https://doi.org/10.1016/j.ecl.2016.04.016

Stark, J. H., Neckerman, K., Lovasi, G. S., Quinn, J., Weiss, C. C., Bader, M. D. M., Konty, K., Harris, T. G., & Rundle, A. (2014). The impact of neighborhood park access and quality on body mass index among adults in New York City. Preventive Medicine, 64, 63–68. https://doi.org/10.1016/j.ypmed.2014.03.026

Sugiyama, T., Leslie, E., Giles-Corti, B., & Owen, N. (2008). Associations of neighbourhood greenness with physical and mental health: Do walking, social coherence and local social interaction explain the relationships? Journal of Epidemiology & Community Health, 62(5), e9–e9. https://doi.org/10.1136/jech.2007.064287

Taylor, L., & Hochuli, D. F. (2017). Defining greenspace: Multiple uses across multiple disciplines. Landscape and Urban Planning, 158, 25–38. https://doi.org/10.1016/j.landurbplan.2016.09.024

Topp, C. W., Østergaard, S. D., Søndergaard, S., & Bech, P. (2015). The WHO-5 Well-Being Index: A Systematic Review of the Literature. Psychotherapy and Psychosomatics, 84(3), 167–176. https://doi.org/10.1159/000376585

Tsai, W.-L., Floyd, M. F., Leung, Y.-F., McHale, M. R., & Reich, B. J. (2016). Urban Vegetative Cover Fragmentation in the U.S. American Journal of Preventive Medicine, 50(4), 509–517. https://doi.org/10.1016/j.amepre.2015.09.022

Ulrich, R. S. (1983). Aesthetic and Affective Response to Natural Environment. In I. Altman & J. F. Wohlwill (Eds.), Behavior and the Natural Environment (pp. 85–125). Springer US. https://doi.org/10.1007/978-1-4613-3539-9_4

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. Journal of Environmental Psychology, 11(3), 201–230. https://doi.org/10.1016/S0272-4944(05)80184-7

Ward Thompson, C., Roe, J., Aspinall, P., Mitchell, R., Clow, A., & Miller, D. (2012). More green space is linked to less stress in deprived communities: Evidence from salivary cortisol patterns. Landscape and Urban Planning, 105(3), 221–229. https://doi.org/10.1016/j.landurbplan.2011.12.015

White, M. P., Alcock, I., Grellier, J., Wheeler, B. W., Hartig, T., Warber, S. L., Bone, A., Depledge, M. H., & Fleming, L. E. (2019). Spending at least 120 minutes a week in nature is associated with good health and wellbeing. Scientific Reports, 9(1), 7730. https://doi.org/10.1038/s41598-019-44097-3