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Impact of climate change on mental health Quantitative research

OBJECTIVE To examine the impact of weather and seasonality, as consequences of climate change, on mental health. **METHOD** The main hypothesis is that both weather and seasonality have significant effects on mental health. To investigate this hypothesis, the study employed a quantitative analysis using a questionnaire. The study investigated the impact of cold and hot weather on mental health in Greece through a quantitative survey. A sample of 120 citizens completed a questionnaire focusing on their mental health once during high temperatures and once during low temperatures. **RESULTS** During periods of high temperatures, respondents were more likely to report feeling unmotivated, while levels of stress, depression, and anxiety remained low. Additionally, they were more likely to agree that they had achieved the important things they wanted in life and that their life satisfaction was above average. Finally, the study found that participants exhibited statistically significant differences in stress, anxiety, and life satisfaction levels between the two temperature conditions. Specifically, they reported higher levels of stress and anxiety during high temperatures and higher levels of life satisfaction during low temperatures. **CONCLUSIONS** This study emphasized the urgent need for global leaders to accelerate action to reduce greenhouse gas emissions to avoid these unjust burdens on society while supporting communities to adapt.

Mental health disorders can lead to disability and morbidity and have significant negative social, occupational, personal, and economic consequences.¹ Both mental illness and environmental degradation seem to be global challenges nowadays and increasing research literature occupies the link between these two.

Despite the recent augmentation in interest, a relative deficiency of potent supporting data concerning the extent, nature, and severity of mental health effects and awareness of climate change remains. It is important to mention that strong emotional reactions and even anxiety can be considered a rational reaction to events and not a pathology. Supporting people to process the intense emotions

and losses caused by climate change can help protect their mental health and well-being. Specifically, evidence shows that both individual and collective action on climate change can support good mental health and reduce psychological distress and stress related to it.²

Both climate change and mental health are linked to social inequality. Available evidence points to a vicious cycle, where initial inequality disproportionately affects disadvantaged groups, resulting in greater subsequent inequality. Poor mental health is both a cause and consequence of social inequalities, where people with poor mental health are more likely to have insecure employment, and insecure housing and experience stigma, discrimination, and social

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Επίδραση της κλιματικής αλλαγής
στην ψυχική υγεία: Ποσοτική
έρευνα

Περίληψη στο τέλος του άρθρου

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isolation, while people facing social inequalities stemming from economic toughness, from racism and homophobia or other injustices are at greater risk of mental illness.

Already fragile systems will become even more vulnerable. Mental health services are already extremely extended and cannot provide the care people need. It is estimated that up to 50% of people with mental health disorders in high-resource settings and up to 90% of those in low-resource settings receive no treatment at all.³ Rates of effective coverage –good quality, accessible services that actually work– are even lower. Therefore, decision-makers need to be proactive in building resilience in mental health systems, including those in low-resource settings, already at risk from the effects of climate change, to continue providing care during extreme weather events or other disasters related to climate change and to respond to projected increases in mental health burden. Developing and implementing forceful evidence-based climate adaptation plans can mitigate the risk of short- and long-term mental health impacts, such as integrating community mental health support into the first response to extreme weather events.³

The above highlights the importance of investigating the link between the effects of climate change and mental health, which is attempted in this research. In particular, the main research question is to define not only the burden that the effects of climate change pose on mental health, but also the mental disorders that are generated consequently.

MATERIAL AND METHOD

In this study, the effect of cold and heat in the wider region of Greece on citizens' mental health was investigated. In more detail, the stress, anxiety, depression, and satisfaction of a sample of citizens were investigated both during high and during low temperatures, in order to investigate any statistically significant differences. Therefore, the research question was formulated as follows: "Does cold and heat influence the mental health of citizens in the wider area of Greece?"

To achieve the objectives of the research, a sample of 120 people was used in total. The sample consisted mainly of women aged 31 to 45 years old. In addition, respondents more often reported that they were owners of a master's degree, married without children, worked in the public sector, and lived in a city or small town.

The research tool was a three-section questionnaire. The first section investigates the demographic characteristics of the sample through the use of seven closed-ended questions. More specifically, the respondents' gender, age, educational level, marital status, the existence of children, work status, and area of residence are investigated. The second section contains the DASS-21⁴ tool

through which the anxiety, depression, and stress experienced by the participants are investigated via twenty-one Likert-type questions, given on a four-point scale, from 1 (did not apply to me at all), to 4 (applied to me very much or most of the time). The third and last section includes the satisfaction with life scale (Satisfaction with Life Scale-5)⁵ which through five Likert-type statements⁶ studies the participants' satisfaction with life. These statements are given on a seven-point scale from 0 (strongly disagree) to 6 (strongly agree). Likert-type statements are generally particularly useful for quantifying qualitative phenomena. The same questionnaire was administered both times, without any change, to produce reliable results.

Respondents were approached in two phases; the first was during summer, in the period from 22.7.2023 to 11.8.2023, and the second was during winter, in the period from 5.1.2024 to 25.1.2024.

The data analysis was carried out using the Statistical Package for Social Sciences (SPSS), version 25.0 program, while the Microsoft Excel program was also used as an aid. In more detail, percentages, frequencies, means (M), and standard deviations (SD) were calculated for the presentation of all variables of the questionnaire. Additionally, the paired-sample t-test⁷ was used, in order to answer the research question. The above are presented through appropriately formatted tables and graphics in the aforementioned programs.

RESULTS

Regarding the first demographic results, it appeared that 75.8% of the respondents were women and 24.2% were men. In addition, 20% were up to 30 years old, 12.5% were between 46 and 60 years old and 1.7% were over 60 years old. A total of 40.8% were owners of a Master's degree, 29.2% were graduates of post-secondary education, 19.2% were university: Higher or Technical Educational Institute, 9.2% were secondary education graduates and hardly 1.7% were Philosophy Doctorate (PhD) owners. Concerning the marital status of the respondents, 53.3% stated that they were married and 46.7% were celibate, while 78.3% of them stated that they did not have children, in contrast to 21.7% who had at least one.

Regarding the employment status of the participants, 44.2% declared that they were civil servants and 24.2% were private employees. Simultaneously, 17.5% were unemployed, 12.5% were self-employed and 1.7% were retired. As far as the residential area was concerned, 46.7% stated that they lived in some city or small town, 45.8% in Athens, Thessaloniki, or Patras, 5% in an island, and the remaining 2.5% reported that they lived in a village in Greece.

Continuing with the respondents' depression, stress, and anxiety scales during high temperatures, it appeared

that they answered on a scale from 1 to 4 (1: Did not apply to me at all; 2: Applied to me to a certain extent, or for a short time; 3: Applied to me to a certain extent, or for a long time; 4: Applied to me very much, or most of the time) and the higher the average, the more each statement applied to the respondents. Results are shown in table 1.

Based on the respondents' statements, three new variables-scores were created, which examine their total stress, anxiety, and depression. The three scores consist of an average of seven statements each and their reliability is acceptable with a value of 0.77 for stress, 0.82 for anxiety, and 0.84 for depression according to Cronbach's alpha reliability test. The specific indicator studies the reliability in groups of statements, while it is also used in the continuation of the research. Therefore, the scores reliably include information on the statements that make them up.⁸ Additionally, they accept values from 1 to 4 with an increase in the mean being identified with an increase in the level of stress, anxiety, and depression. In table 2, it is observed that stress ($M=1.4$, $s=0.45$), depression ($M=1.3$, $s=0.38$) and anxiety ($M=1.2$, $s=0.52$) level was low.

In table 3, people's life satisfaction during high temperatures was explored. Responses accept values from 0 to 6 (0: Strongly disagree; 1: Disagree; 2: Slightly disagree; 3: Neither agree or disagree; 4: Slightly agree; 5: Agree; 6: Strongly agree) and the higher the average, the more respondents agree with the given statement. It seems that between answers "Agree a little" and "Agree", with a tendency towards the second one, they were ranked in terms of having so far gotten the important things they wanted in life ($M=4.3$, $s=1.41$). Furthermore, they partially agreed that they were satisfied with their lives ($M=4.3$, $s=1.31$) and that their living conditions were excellent ($M=3.8$, $s=1.57$). At the same time, between neutrality and little agreement, with a tendency towards the second one, they were about to the fact that they would alternate nothing in their life if they could ($M=3.7$, $s=1.77$) and that their life was close to their ideal ($M=3.6$, $s=1.59$).

Additionally, from the average of the five variables presented in table 3, a new variable score was created, which studied the overall level of satisfaction with life. It is observed that life satisfaction was above average. The five

Table 1. Anxiety, depression and stress.

Answers – statements	Mean during high temperatures	Mean during low temperatures
I could not calm myself down	1.4 (0.69)	1.4 (0.66)
My mouth felt dry	1.2 (0.49)	1.3 (0.71)
I could not experience any positive emotion	1.5 (0.87)	1.4 (0.74)
I was having trouble breathing	1.2 (0.50)	1.4 (0.66)
I found it difficult to take the initiative to do some things	1.2 (0.52)	1.4 (0.76)
I tended to overreact to the situations I was faced with	1.3 (0.75)	1.2 (0.52)
I felt shaky	1.0 (0.21)	1.5 (0.62)
I often feel nervous	1.4 (0.75)	1.3 (0.48)
I worried about situations where I might panic and look foolish to others	1.3 (0.66)	1.2 (0.42)
I felt I had nothing to look forward to	1.3 (0.71)	1.1 (0.22)
I found myself feeling annoyed	1.5 (0.72)	1.2 (0.48)
It was hard for me to relax	1.5 (0.85)	1.1 (0.40)
I felt depressed and disappointed	1.2 (0.65)	1.2 (0.42)
I could not stand anything that kept me from continuing what I was doing	1.2 (0.50)	1.2 (0.49)
I felt very close to panic	1.1 (0.55)	1.5 (0.74)
Nothing could make me feel excited	1.6 (0.87)	1.3 (0.49)
I felt like I was not worth much as a person	1.2 (0.72)	1.3 (0.63)
I felt that I was quite irritable	1.5 (0.60)	1.2 (0.53)
I could feel my heart beating without any previous physical exercise	1.4 (0.64)	1.4 (0.65)
I felt scared for no reason	1.2 (0.53)	1.3 (0.58)
I felt that life had no meaning	1.2 (0.71)	1.4 (0.60)

Table 2. Total stress, anxiety and depression scores.

	Mean during high temperatures	Mean during low temperatures
Stress	1.4 (0.45)	1.3 (0.49)
Anxiety	1.2 (0.38)	1.1 (0.31)
Depression	1.3 (0.52)	1.3 (0.45)

Table 3. Satisfaction from life.

Answers – statements	Mean during high temperatures	Mean during low temperatures
In most ways my life is close to my ideal	3.6 (1.59)	3.9 (1.57)
My living conditions are excellent	3.8 (1.57)	4.1 (1.47)
I am satisfied with my life	4.3 (1.31)	4.5 (1.18)
So far I have gotten the important things I want in life	4.3 (1.41)	4.5 (1.31)
If I could live my life over again, I would change almost nothing	3.7 (1.77)	4.1 (1.63)

variables were also evaluated in terms of their reliability with Cronbach's alpha index, which turned out to be high, with a value of 0.87.

The research continued with the investigation of the symptoms of anxiety, depression, and stress experienced by the participants during the cold temperatures. As previously mentioned, the variables accepted values from 1 to 4 (1: Did not apply to me at all; 2: Applied to me to a certain extent, or for a short time; 3: Applied to me to a particular degree, or for a long time; 4: Applied to me very much, or most of the time) with an increase in the average, to be identified with a greater strength of participants' statements.

As before, three new scores were generated which

indicate total stress, anxiety, and depression experienced by the respondents during low temperatures. Each score consists of the average of seven statements, which were checked for their reliability with Cronbach's alpha index and were very high, as they had a value of 0.85 for stress, 0.85 for anxiety, and 0.86 for depression. This fact made it definite that the scores reliably store the information of the seven variables of which they are composed. Scores, also, accept values from 1 to 4, with an increase in the value being identified with an increase in stress, anxiety or depression. In more detail, results showed that stress level was unexpectedly low ($M=1.3$, $s=0.49$), followed by depression level ($M=1.3$, $s=0.45$), and anxiety level appeared to be even lower ($M=1.1$, $s=0.31$).

The present research studied respondents' satisfaction with life during cold temperatures. Response values ranged from 0 to 6 (0: Strongly disagree; 1: Disagree; 2: Slightly disagree; 3: Neither agree nor disagree; 4: Slightly agree; 5: Agree; 6: Strongly agree) with increasing of the mean, lead to an increase in agreement. It seems that between the answers "I agree a little" and "I agree", with a tendency towards the latter, respondents state to be satisfied with their lives ($M=4.5$, $s=1.18$) and have got the important things they wanted from life ($M=4.5$, $s=1.31$). In addition, they somewhat agreed that they would change almost nothing from their lives ($M=4.1$, $s=1.63$), that their life conditions were excellent ($M=4.1$, $s=1.47$), and that in most ways their lives were close to their ideal ($M=3.9$, $s=1.57$). It is worth noting that the reliability based on Cronbach's alpha was equal to 0.880; thus, the variable score reliably represented the information of the five statements that made it up. The level of satisfaction with respondents' lives seemed to be high.

To study the research question posed, the paired-sample t-test was used, the results of which are presented in table 4. The test is useful when examining whether there is a significant difference in the mean values of two conditions or time points for the same group of people. From the

Table 4. Paired samples test.

		Paired differences					t	df	Sig. (2-tailed)
		Mean	SD	SEM	95% CI of the difference				
					Lower	Upper			
Pair 1	Stress (heat) – Stress (cold)	0.06	0.41	0.03	-0.007	0.141	1.7	119	0.07
Pair 2	Anxiety (heat) – Anxiety (cold)	0.06	0.30	0.02	0.007	0.118	2.2	119	0.02
Pair 3	Depression (heat) – Depression (cold)	0.03	0.33	0.03	-0.030	0.092	1.0	119	0.31
Pair 4	Satisfaction with life (heat) – Satisfaction with life (cold)	-0.34	0.76	0.07	-0.483	-0.206	-4.9	119	0.00

SD: Standard deviation, SEM: Standard error mean, 95% CI: 95% Confidence interval

control results, it seemed that there were three statistically significant differences concerning stress ($p=0.07$), anxiety ($p=0.02$), and life satisfaction ($p=0.00$) in terms of temperature. Stress and anxiety seemed to be at a higher level during warmer temperatures, compared to colder ones. The opposite was true for life satisfaction, which was higher during cooler temperatures.

Results concerning the differences between high and low temperatures are given analytically in table 5.

DISCUSSION

In this research, the impact of cold and heat in the wider area of Greece on citizens' mental health was studied. In more detail, the sample included a total of 120 citizens, who answered a questionnaire focusing on their mental health, once in high and once in low temperatures. The sample consisted mainly of women, aged 31 to 45 years old and owners of a master's degree. Respondents were principally married without children, worked as civil servants, and lived in some city or small town in Greece. Through the present research, it declared that during high temperatures people mostly reported that nothing could make them excited, with the levels of stress, depression, and anxiety being placed at low levels. Simultaneously, they agreed more that so far they had gotten the important things they wanted in life and their satisfaction was above average. Regarding participants' responses concerning the low temperatures, they mostly reported that they felt quite irritable, or that they could not feel any positive emotion and the levels of stress, anxiety, and depression seemed to be low. Furthermore, they reported that they were more satisfied with their life during low temperatures than during high temperatures, with the overall satisfaction being of a high level. Investigating the research question posed, it was proved that respondents showed statistically significant differences in the levels of anxiety, stress, and life satisfaction between high and low temperatures. Specifically, they showed a higher level of stress and anxiety during high temperatures and a higher

level of life satisfaction during low temperatures. Evidence from several countries confirmed that high and extreme temperatures aggravated a range of mental health and well-being outcomes, including increased suicide rates, hospital attendance and admissions for mental disorders,⁹ and deteriorating population's mental health and emotional well-being. Nevertheless, the link between mental health and weather conditions, including temperature, is complex and dependent on context and mediating factors (for example humidity, season, local core temperatures).¹⁰ Negative mental health effects of increased temperatures have mainly been reported in Europe,¹¹ the USA,¹² and East Asia,¹³ but have also been observed in Mexico,¹⁴ Brazil,¹⁵ and Australia,¹⁰ with some studies reporting models using data from many countries.^{16,17} Temperature can modify mental illness symptoms or aggravate general mental health and well-being through a range of biological or cognitive and social pathways. These include psychological changes such as heat stress and changes in blood flow and central nervous system function, which can lead to cognitive and emotional changes, as well as social alterations, such as reduced economic output, increased distress, and violence. Higher or extreme temperatures can also disrupt sleep and reduce sleep quality, which is known to increase mental health risk.¹⁸

Generally, warmer temperatures have been globally associated with increased risk of emergency department attendance related to mental health, including bipolar disorder, schizophrenia, dementia, self-harm, and alcohol and substance abuse.¹⁹ Evidence for the effect of heat on more common mental disorders such as anxiety and depression is more mixed, although studies have shown an increase in depressive language in the general population with heat,¹⁴ and there is some evidence of worsening of anxiety symptoms.⁹ People taking psychotropic medications for mental health conditions may be at a heightened risk of heat-related illness and death due to impaired thermoregulation. Awareness of these risks among both patients and healthcare professionals is crucial to mitigate the impact of heat on vulnerable populations. Further research is needed to fully understand the mechanisms behind these associations and develop effective interventions to protect individuals at risk.²⁰

In conclusion, the research underscores the critical interplay between climate change and mental health, highlighting how environmental stressors can exacerbate mental health issues while emphasizing the need for resilient mental health systems and community support to mitigate these effects. Additionally, findings demonstrated that despite varying levels of stress, anxiety, and depression

Table 5. Stress, anxiety, depression and satisfaction with life comparably high and low temperatures.

	High temperatures	Low temperatures
Stress	1.4	1.3
Anxiety	1.2	1.1
Depression	1.3	1.3
Satisfaction from life	3.96	4.3

in response to temperature extremes, overall life satisfaction among participants remained relatively high. In particular, higher rates of anxiety, stress, and depression were observed in high temperatures, while in low temperatures the rates

of anxiety, stress and depression seemed to be lower. The rates concerning satisfaction with life alternate vice versa; they were higher in lower temperatures and lower in higher temperatures.

ΠΕΡΙΛΗΨΗ

Επίδραση της κλιματικής αλλαγής στην ψυχική υγεία: Ποσοτική έρευνα

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ΣΚΟΠΟΣ Να εξεταστεί η επίδραση του καιρού και της εποχικότητας, ως απόρροια της κλιματικής αλλαγής, στην ψυχική υγεία. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Η βασική υπόθεση είναι ότι τόσο ο καιρός όσο και η εποχικότητα έχουν σημαντικές επιδράσεις στην ψυχική υγεία. Για την εξαγωγή ευρημάτων, στην παρούσα μελέτη, υιοθετήθηκε η διαδικασία της ποσοτικής ανάλυσης με χρήση ερωτηματολογίου. Στην παρούσα εργασία μελετήθηκε ποσοτικά η επίδραση του κρύου και της ζέστης στην Ελλάδα, στην ψυχική υγεία των πολιτών. Πιο αναλυτικά, απαντήθηκε ένα ερωτηματολόγιο από δείγμα 120 πολιτών, που επικεντρώνεται στην ψυχική τους υγεία, μία φορά σε υψηλές και μία φορά σε χαμηλές θερμοκρασίες. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Κατά την περίοδο των υψηλών θερμοκρασιών οι ερωτώμενοι περισσότερο ανέφεραν ότι τίποτα δεν μπορούσε να τους κάνει να ενθουσιαστούν, με τα επίπεδα stress, κατάθλιψης και άγχους να βρίσκονται σε χαμηλά επίπεδα. Παράλληλα, συμφωνούσαν περισσότερο ότι μέχρι στιγμής είχαν λάβει τα σημαντικά πράγματα που θέλουν στη ζωή και η ικανοποίησή τους ήταν άνω του μετρίου. Τέλος, διερευνώντας το παραπάνω ερευνητικό ερώτημα, παρατηρήθηκε ότι οι συμμετέχοντες παρουσίαζαν στατιστικά σημαντικές διαφορές στα επίπεδα άγχους, stress και ικανοποίησης από τη ζωή ανάμεσα στις δύο θερμοκρασίες. Πιο αναλυτικά, υψηλότερο επίπεδο stress και άγχους παρουσιάζονταν κατά τις υψηλές θερμοκρασίες και υψηλότερο επίπεδο ικανοποίησης από τη ζωή κατά τις χαμηλές θερμοκρασίες. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Τα ευρήματα υπογραμμίζουν την επείγουσα ανάγκη με την οποία ειδικότερα οι παγκόσμιοι ηγέτες πρέπει να επιταχύνουν τη δράση για τη μείωση των εκπομπών αερίων του θερμοκηπίου, για να αποφευχθούν οι εν λόγω άδικες επιβαρύνσεις στην κοινωνία, υποστηρίζοντας παράλληλα τις κοινότητες να προσαρμοστούν.

Λέξεις ευρετηρίου: Άγχος, Εποχικότητα, Καιρικές συνθήκες, Κατάθλιψη, Κλιματική αλλαγή, Stress, Ψυχική υγεία

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