# Cambiamenti climatici ed emicrania

Nono congresso nazionale

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# Cambiamenti climatici ed emicrania

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9° CONGRESSO NAZIONALE
Inquinamento e cambiamenti climatici:
l'impatto sulla salute in ottica di genere

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# OUTLINE
## Titolo

**Introduzione**
**Fattori scatenanti**
**Emicrania e variazioni metereologiche**
**Emicrania e inquinamento ambientale**
**Emicrania e riscaldamento globale**
**Emicrania e migranti climatici**
**Percezione da parte del neurologo**
**Domande aperte**

# Titolo

**Introduzione**
**Fattori scatenanti**
**Emicrania e variazioni metereologiche**
**Emicrania e inquinamento ambientale**
**Emicrania e riscaldamento globale**
**Emicrania e migranti climatici**
**Percezione da parte del neurologo**
**Domande aperte**

# Cos'è l'emicrania

## Titolo

L'emicrania è un disordine neurologico complesso delle funzioni superiori e dei meccanismi di controllo del dolore **senza alcuna anormalità strutturale rilevabile**


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# Non è «solo» un mal di testa

Titolo

# Patologia altamente disabilitante

Titolo

Steiner *et al. The Journal of Headache and Pain* (2020) 21:137
https://doi.org/10.1186/s10194-020-01208-0

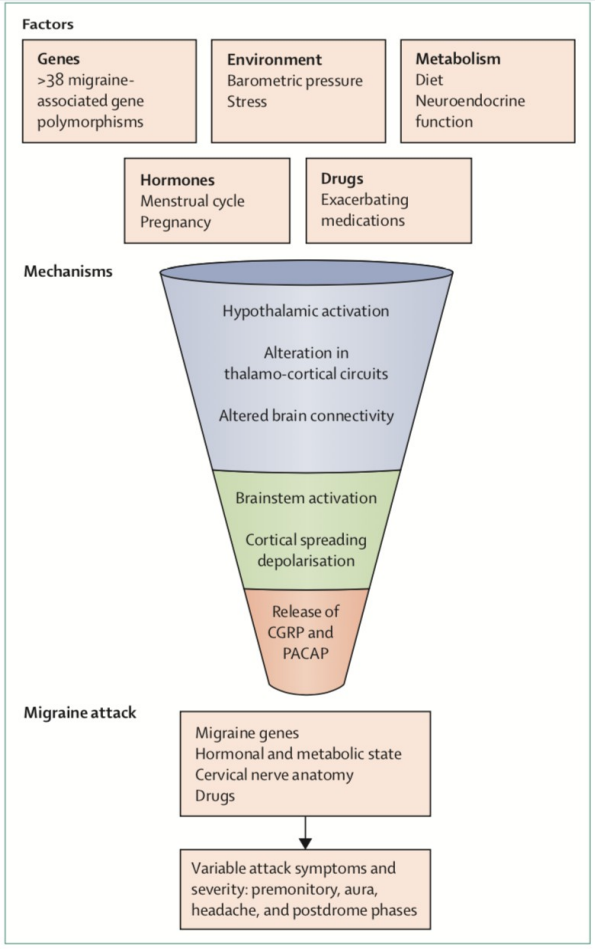
The Journal of Headache and Pain

**EDITORIAL** **Open Access**

## Migraine remains second among the world's causes of disability, and first among young women: findings from GBD2019

T. J. Steiner[1,2*], L. J. Stovner[1,3], R. Jensen[4], D. Uluduz[5], Z. Katsarava[6,7,8,9] on behalf of Lifting The Burden: the Global Campaign against Headache

# Il cervello emicranico




- ✓ Neuroimmagini e neurofisiologia
- ✓ Biochimica
- ✓ Metabolismo mitocondriale
- ✓ Genetica

*Lancet Neurol* 2018; 17: 174–82

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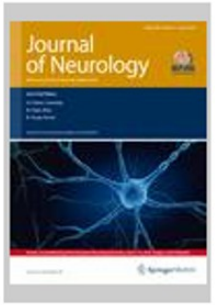
# Emicrania e deficit energetico cerebrale?

1989

JOURNAL OF NEUROLOGY
Volume 236, Number 2, 124-125, DOI: 10.1007/BF00314412




LETTERS TO THE EDITORS

Migraine as a defect of brain oxidative metabolism: a hypothesis

P. Montagna, T. Sacquegna, P. Cortelli and E. Lugaresi

**Migraine as a defect of brain oxidative metabolism: a hypothesis**

**P. Montagna, T. Sacquegna, P. Cortelli, and E. Lugaresi**

Neurological Institute, University of Bologna,
Via U. Foscolo 7, I-40123 Bologna, Italy

# Emicrania e deficit energetico cerebrale?

- Studi hanno prodotto evidenze di un deficit di produzione energetica e di un incremento di consumo energetico nelle persone emicraniche.

- Il difetto metabolico mitocondriale è una caratteristica intrinseca degli emicranici e rappresenta un fattore predisponente agli attacchi in caso di aumentata richiesta energetica o di ridotto apporto energetico

- Maggiore difficoltà ad adattarsi ai cambiamenti di vario genere?

# Introduzione
# Fattori scatenanti

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# Emicrania e fattori scatenanti

Titolo

Migraine and tension-type headache in Croatia: a population-based survey of precipitating factors

Cephalalgia 2003; 23:336–343.

**Table 2** Frequencies of lifetime precipitant-dependent attacks in migraine and tension-type headache and odds ratios (OR) associated with each precipitating factor

| Precipitating factor | Migraine (720) *n* (%) | Tension-type headache (1319) *n* (%) | OR | 95% CI |
|---|---|---|---|---|
| *Mental factors* | | | | |
| Stress | 416 (57.8) | 651 (49.4) | 1.4 | (1.17, 1.69) |
| Sleep disturbances | 289 (40.1) | 475 (36) | 1.19 | (0.99, 1.44) |
| Eating habits | 231 (32.1) | 397 (30.1) | 1.09 | (0.91, 1.33) |
| *Endogenous factors* | | | | |
| Menstrual cycle* | 223 (49.4) | 334 (45.7) | 1.16 | (0.91, 1.47) |
| Oral contraceptives* | 142 (31.5) | 216 (29.5) | 1.09 | (0.85, 1.41) |
| *Absorbed factors* | | | | |
| Various food items | 90 (12.5) | 155 (11.8) | 1.07 | (0.81, 1.42) |
| *Other factors* | | | | |
| Afferent stimulation | 280 (38.9) | 458 (34.7) | 1.2 | (0.99, 1.44) |
| Changes in weather conditions and temperature | 353 (49) | 590 (44.7) | 1.19 | (0.99, 1.43) |
| Frequent travelling | 393 (54.6) | 692 (52.5) | 1.09 | (0.91, 1.31) |
| Physical activity | 212 (29.4) | 485 (36.7) | 0.72 | (0.59, 0.87) |

*Results relate to female gender.

The comparison between groups was performed using the $\chi^2$ test. Odds ratios (OR) and 95% confidence intervals (CI) are given.

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# Fattori scatenanti
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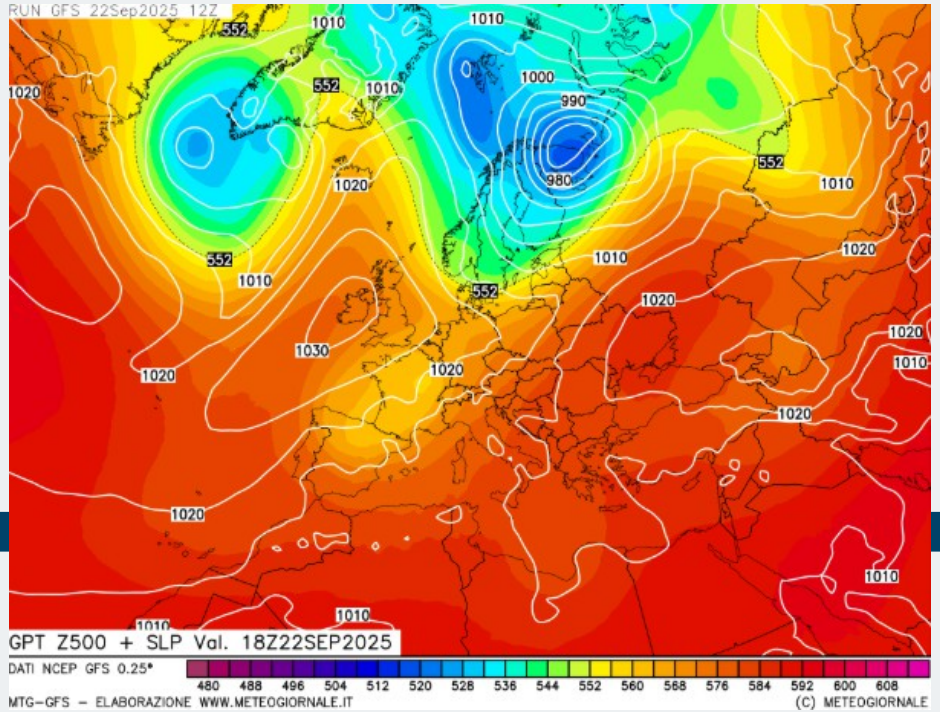
## Titolo

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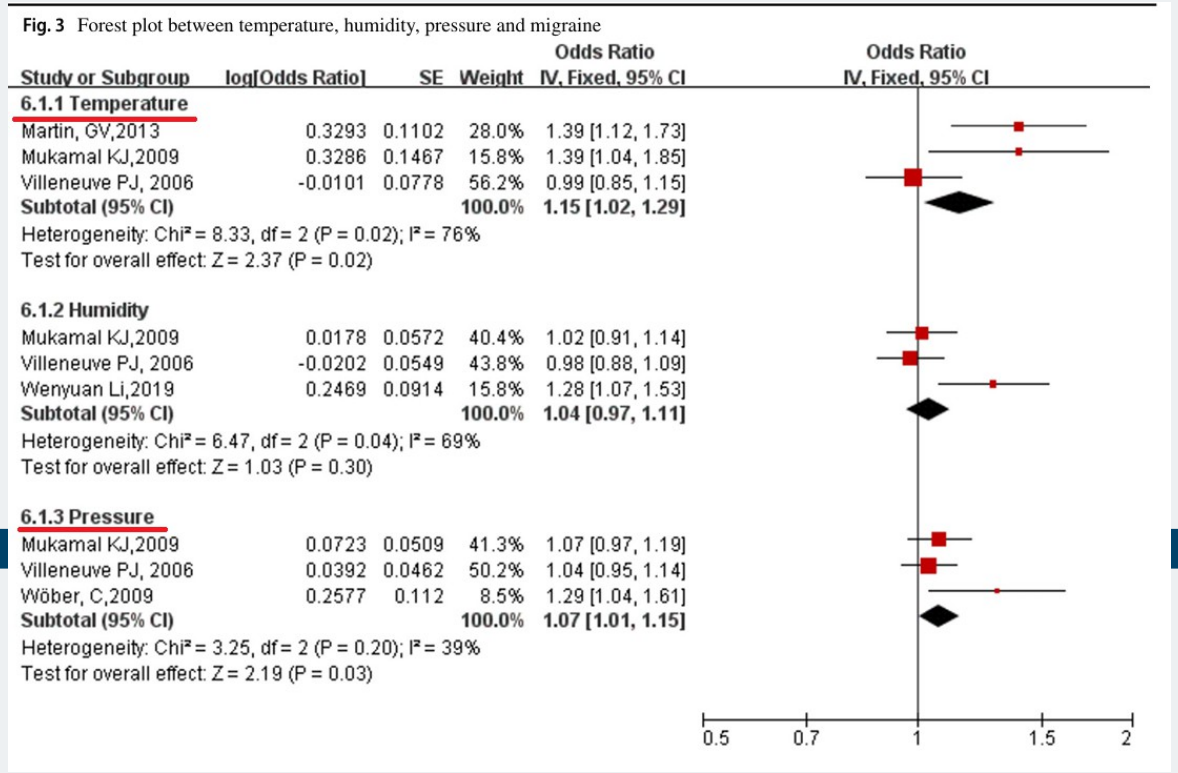
# Emicrania e variazioni metereologiche

## Association between weather conditions and migraine: a systematic review and meta-analysis

Journal of Neurology (2025) 272:346

Shiqin Li[1] · Qian Liu[1] · Mengmeng Ma[1] · Jinghuan Fang[1] · Li He[1]

**Fig. 3** Forest plot between temperature, humidity, pressure and migraine




31 studies were included in the meta-analysis

Our primary outcome was the frequency of reported weather changes as migraine triggers

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# Introduzione
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# Emicrania e inquinamento ambientale

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# Emicrania e inquinamento ambientale

## The association between ambient air pollution and migraine: a systematic review

Environ Monit Assess (2024) 196:271

**Abstract** Some studies have shown the effect of air pollution on migraine. However, it needs to be confirmed in larger-scale studies, as scientific evidence is scarce regarding the association between air pollution and migraine. Therefore, this systematic review aims to determine whether there are associations between outdoor air pollution and migraine.

- "Outcome": Migraine headache (diagnosis of a disease; visit due to migraine headache; referral to a physician due to migraine headache; complaint of migraine headache; hospitalization due to migraine headache; etc.)

Fourteen out of 1417 identified articles met the inclusion criteria and entered the study. Among the gaseous air pollutants, there was a correlation between exposure to nitrogen dioxide ($NO_2$) (78.3% of detrimental relationships) and carbon monoxide (CO) (68.0% of detrimental relationships) and migraine, but no apparent correlation has been found for sulfur dioxide ($SO_2$) (21.2% of detrimental relationships) and ozone ($O_3$) (55.2% of detrimental relationships). In the case of particulate air pollutants, particulate matter with a diameter of 10 μm or less ($PM_{10}$) (76.0% of detrimental relationships) and particulate matter with a diameter of 2.5 μm or less ($PM_{2.5}$) (61.3% of detrimental relationships) had relationships with migraine. In conclusion, exposure to $NO_2$, CO, $PM_{10}$, and $PM_{2.5}$ is associated with migraine headaches, while no

# Emicrania e inquinamento ambientale

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## Association between weather conditions and migraine: a systematic review and meta-analysis

Journal of Neurology (2025) 272:346

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31 studies were included in the meta-analysis

Our primary outcome was the frequency of reported weather changes as migraine triggers

Moreover, increased levels of air pollutants, including PM10 (OR = 1.07, 95% CI = 1.03–1.11), PM2.5 (OR = 1.04, 95% CI = 1.01–1.06), $NO_2$ (OR = 1.08, 95% CI = 1.03–1.14), CO (OR = 1.08, 95% CI = 1.01–1.16), and $O_3$ (OR = 1.12, 95% CI = 1.03–1.21), were significantly associated with an increased risk of migraine clinical visits, whereas $SO_2$ (OR = 1.02, 95% CI = 1.00–1.04) was not.

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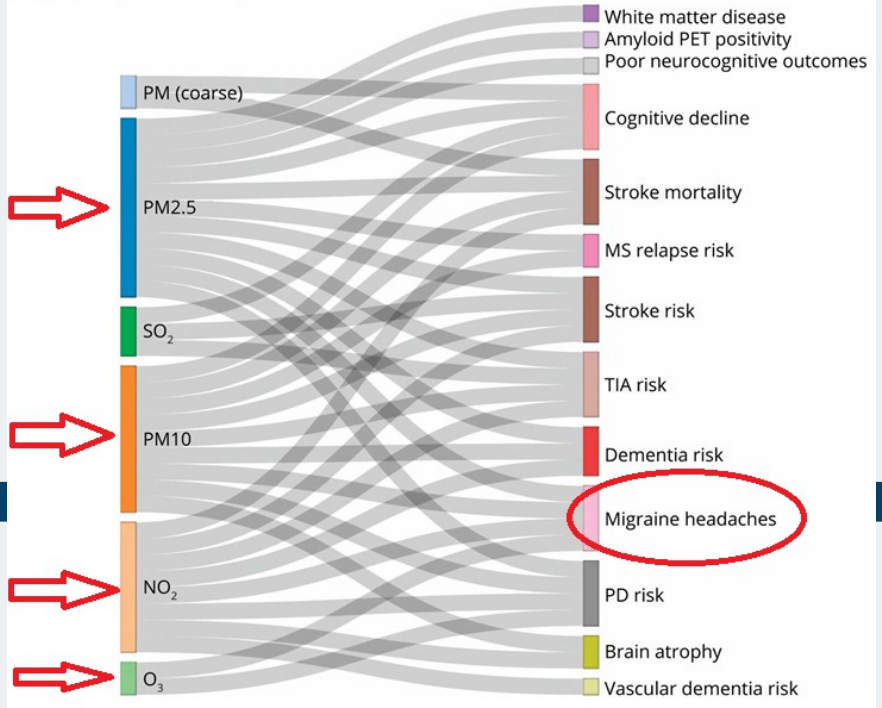
# Emicrania e inquinamento ambientale

## Impacts of Climate Change and Air Pollution on Neurologic Health, Disease, and Practice

A Scoping Review *Neurology*® 2023;100:474-483.

**Figure 3** Relationships Between Pollutants and Identified Neurologic Links

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# Emicrania e inquinamento ambientale

## Ambient air pollution exposure and risk of migraine: Synergistic effect with high temperature

Environment International 121 (2018) 383–391

*Background:* Migraine is a chronic and agonizing neurological disorder prevalent worldwide. Although its pathogenesis remains unclear, limited evidence exists on the role of air pollution.

*Objective:* We aimed to assess the association of short-term air pollution exposure with migraine in conjunction with the synergistic effect of temperature.

*Methods:* We identified 18,921 patients who visited emergency departments (EDs) for migraine as a primary disease in Seoul from the national emergency database between 2008 and 2014. We conducted a time-stratified, case-crossover analysis to compare levels of particles < 2.5 μm ($PM_{2.5}$), particles < 10 μm ($PM_{10}$), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), ozone ($O_3$), and carbon monoxide (CO) on ED visit days and those on the control days matched to day of the week, month, and year. We evaluated the synergistic effects of air pollution and temperature using an interaction term.

*Results:* Higher air pollution levels were significantly associated with risk of migraine over various lag structures. In the best fitting lags, the odds ratio (OR) associated with an interquartile range increase of $PM_{2.5}$, $PM_{10}$, $NO_2$, $O_3$, and CO was 1.031 (95% CI: 1.010–1.053), 1.032 (95% CI: 1.007–1.057), 1.053 (95% CI: 1.022–1.085), 1.034 (95% CI: 1.001–1.067), and 1.029 (95% CI: 1.005–1.053), respectively. The $SO_2$ effect was positive but not significant (OR 1.019 [95% CI: 0.991–1.047]). The PM effect was significantly stronger on high-temperature days (above the 75th percentile) than on low-temperature days ($PM_{2.5}$, high: OR 1.068, low: OR 1.021, $P_{interact} = 0.03$; $PM_{10}$, high: OR 1.066, low: OR 1.014, $P_{interact} = 0.02$).

*Conclusion:* Our study provides new evidence that air pollution exposure may trigger migraine especially on high-temperature days, and this finding may contribute in establishing preventive measures against migraine.

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# Emicrania e riscaldamento globale

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## Global warming and neurological practice: systematic review

Amiri et al. (2021), *PeerJ*, DOI 10.7717/peerj.11941

### *Headache and migraine*

Two studies from two countries including $N = 7{,}156$ cases reported on the effects of high temperatures on headache (33% migraines) (*Mukamal et al., 2009*; *Neut et al., 2012*). The largest study by Mukamal et al. analyzed data from 7,054 patients seen in an emergency department between 2000–2007 (*Mukamal et al., 2009*). In this study, higher ambient temperatures in the 24 h preceding hospital presentation increased the risk of acute headache requiring emergency evaluation with 7.5% for each 5 °C increment in temperature. Neut et al. interviewed 102 children and adolescents with migraine and/or their parents about triggering factors precipitating migraine attacks. 70% stated warm climate could trigger their migraine, and 24% reported warm climate was often or very often a trigger factor for migraine attacks (*Neut et al., 2012*).

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# Emicrania e riscaldamento globale

## Impacts of Climate Change and Air Pollution on Neurologic Health, Disease, and Practice

A Scoping Review *Neurology*® 2023;100:474-483.

**Headache**

Two studies examined headache in association with meteorologic variables. A study of over 22,000 headache visits to the emergency department (ED) showed that an increase in temperature by 5°C was associated with a relative risk of headache presentation of 1.042 (95% CI 1.009–1.076), but did not specify International Classification of Headache Disorders diagnosis.[39] Mukamal et al.[40] examined headache incidence at a single center using a case-crossover design, examining temperature, barometric pressure, relative humidity, and pollutant levels in the 24–72 hours preceding presentation. In this study, higher temperatures and lower barometric pressure were associated with greater risk of presentation with any headache, especially nonmigraine headache.[40]

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# Emicrania e migranti climatici

## Titolo

MARCOMANFREDINI

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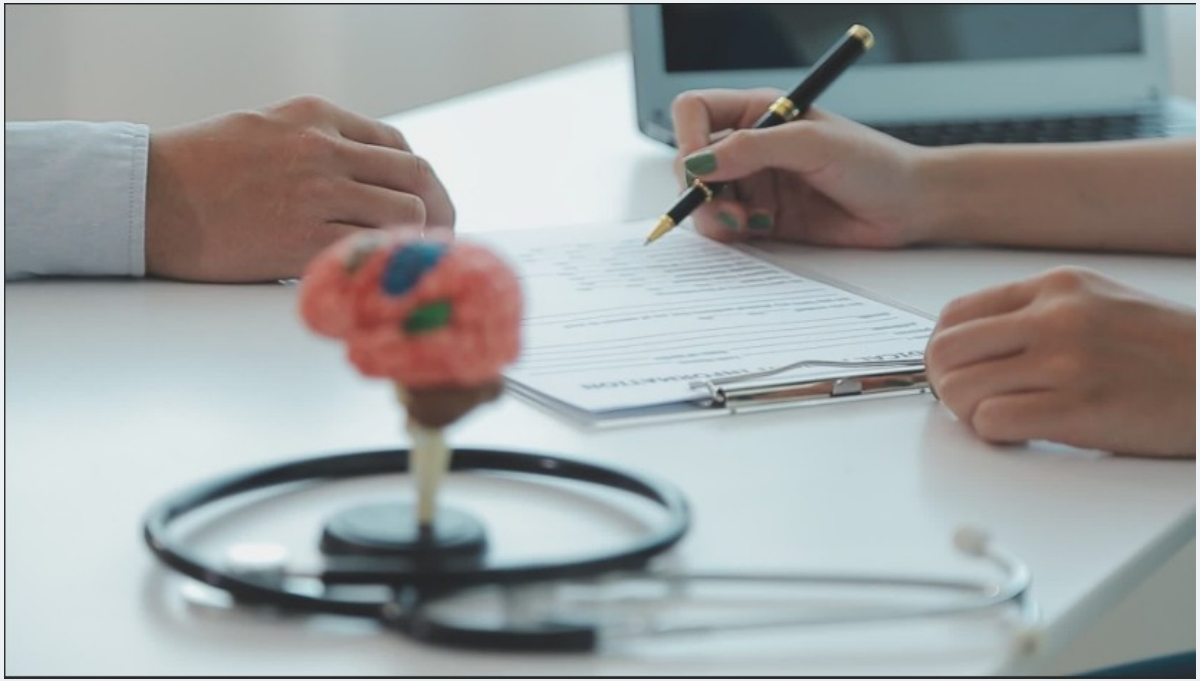
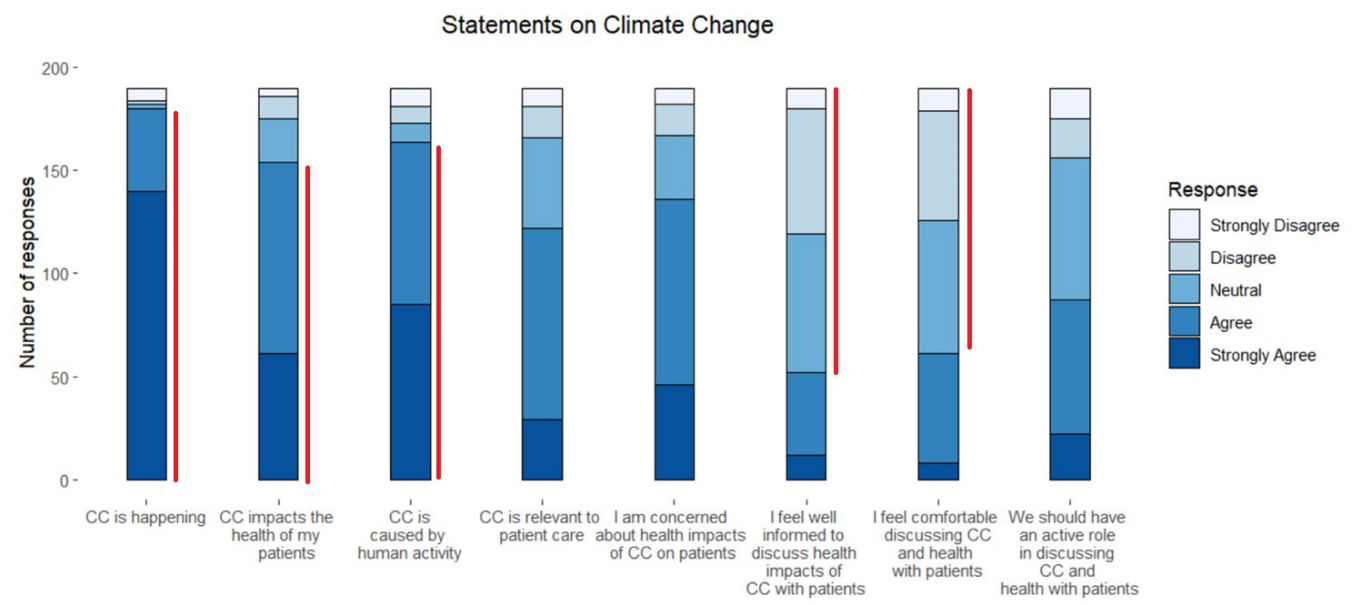


# Percezione da parte del neurologo
# Domande aperte

# Percezione da parte del neurologo

Climate change and neurology: A survey of neurologists in Australia and New Zealand☆ Journal of the Neurological Sciences 472 (2025) 123481

Survey participant characteristics (n = 190/994 – 19.1%)



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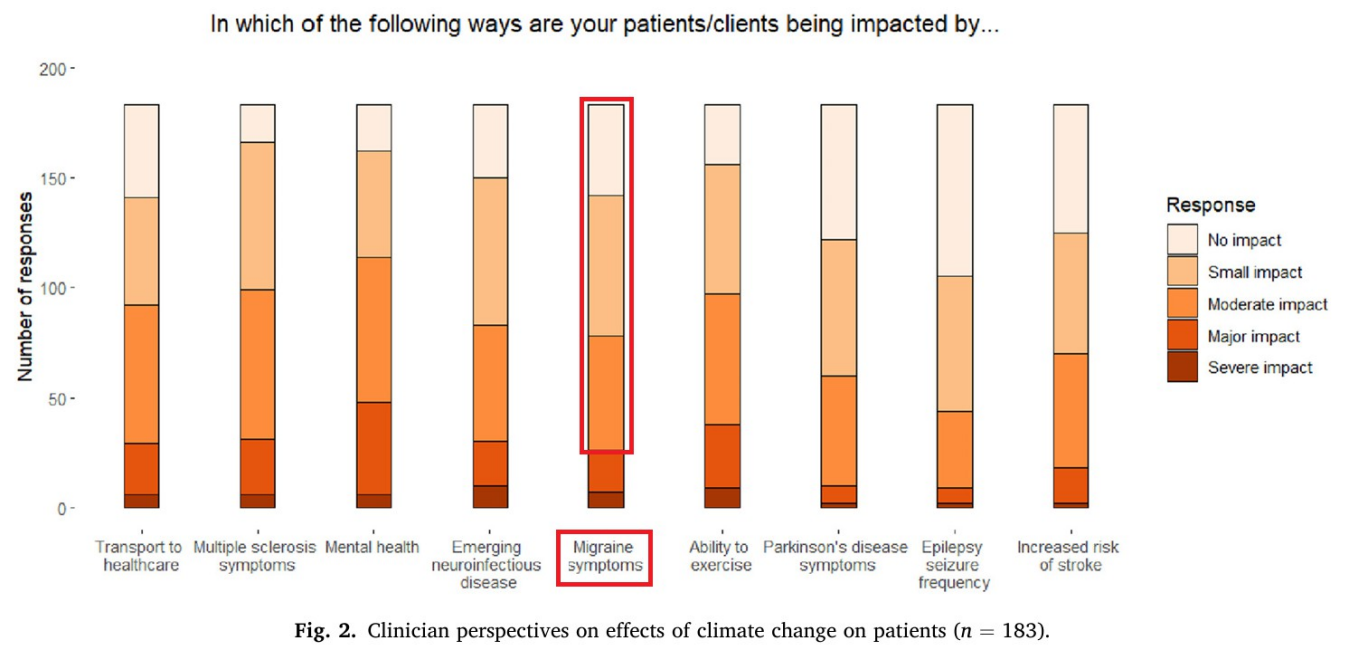


**Fig. 2.** Clinician perspectives on effects of climate change on patients ($n$ = 183).

# Domande aperte

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# Meccanismo d’azione?

Titolo

## Elevation in body temperature may increase susceptibility to cortical spreading depression in a rat model

Neuroscience Research 206 (2024) 30–34

One characteristic of migraine is recurrent headache attacks, which are known to be induced by changes in climatic variables such as atmospheric pressure, humidity, and outside temperature. However, the relationship between temperature changes and migraine remains unclear. Therefore, we investigated the relationship between body temperature changes and cortical spreading depression (CSD) using KCl-induced rat models of CSD. We initially induced CSD under controlled conditions at a room temperature of 28°C on an operating table maintained at 37°C. Subsequently, we controlled the operating table temperature to induce a second round of CSD under conditions of either a 10 ± 1 % increase or decrease in body temperature. We ensured 1 h rest period between the first and second inductions of CSD. The results indicated that the number of CSDs significantly increased after body temperature elevation (before, 8.8 ± 1.2 times vs. after, 13.4 ± 1.3 times; $p = 0.0003$). The mean percentage change in cerebral blood flow decreased after body temperature increased (before, 33.1 ± 2.4 % vs. after, 18.2 ± 1.4 %; $p = 0.006$). There were no significant changes in CSD after body temperature decreased. The susceptibility of the cortex to CSD may increase under conditions of elevated body temperature.

# Cambiamenti climatici e:

Titolo

**Variazioni dell’incidenza dell’emicrania?**
**Variazioni della clinica dell’emicrania?**
**Variazioni nella risposta alle terapie?**
**Modalità di prevezione «clima-specifiche»?**

# GRAZIE PER L'ATTENZIONE