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When climate crisis hits home: mental health of elderly with type 2 diabetes amidst floods in Brazil

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Abstract

Background Climate change has increased the frequency of natural disasters, challenging society in various aspects. Individuals living with chronic diseases are particularly vulnerable due to their constant need for medical care. This study aimed to investigate the impact of the unprecedented floods that hit Brazil in 2024 on the mental health of elderly with diabetes.

Methods This is a cross-sectional study involving outpatient elderly individuals with type 2 diabetes in Southern Brazil. Participants were stratified into two groups according to the impact their residences suffered from the floods (directly vs. non-directly impacted). The study outcome was mental distress, assessed using the Self-Report Questionnaire-20 (SRQ-20). Analyses of covariance and multivariable logistic regression were used for between-group comparisons.

Results A total of 80 elderly individuals were included, with a mean age of 72.5 ± 5.5 years old. Among the participants, 67.5% were women, and 57.5% were white. Fifty individuals were directly affected by the floods, while 30 were non-directly impacted. When compared, SRQ-20 scores were significantly higher in the directly impacted group, with an adjusted mean difference of 2.56 (95% CI: 0.42–4.70; $p = 0.020$), indicating higher mental distress among those directly impacted. Additionally, the prevalence of positive screening for mental distress was higher among those directly impacted by the floods (58% vs. 30%; adjusted OR = 4.16 [95% CI = 1.40-12.31], $p = 0.010$).

Conclusions Our findings highlight the significant prevalence of mental distress among those directly impacted by climate disasters, underscoring the need for public policies and strategies focused on mental health during and after such disasters.

Keywords Mental distress, Older adults, Climate change, Natural disasters, Self-care

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Background

Climate change has significantly increased the frequency of natural disasters, presenting unprecedented challenges for society. Over the last year, Brazil recorded 1,161 natural disasters, equivalent to more than three per day, and in 2024 experienced one of the most severe floods ever recorded [1, 2] he climatic disaster began at the end of April in Rio Grande do Sul, a state in the southern region of the country, and with a population of nearly 11 million [3, 4] After nearly ten consecutive days of intense rainfall, Lake Guaíba, located on the outskirts of the state capital, reached a historic height of 5.33 m, and a state of public calamity was declared due to massive flooding, affecting more than 3 million people and causing the evacuation of 538,000 residents from their homes [5, 6]. Over 470 of the 497 cities in the state were severely affected and parts of the state capital were submerged for over a month [7]. The consequences associated with the floods are expected to be enduring, exacerbating the damage to roads, bridges, airports, and transmission lines [8, 9].

During crisis situations, people living with chronic diseases face numerous challenges in continuing their treatments. Those with type 2 diabetes, which affects more than 10.5% of the Brazilian population, were particularly vulnerable, as their treatment depends on various factors such as access to medication and proper storage conditions (e.g., insulin), access to multidisciplinary medical care, glycemic control, medical assistance, and the availability of healthy food and opportunities for physical activity [1, 10, 11]. Moreover, extreme weather events may exacerbate diabetes-related complications, such as infections and metabolic decompensation, although evidence on the direct impacts of these events on individuals living with type 2 diabetes remains limited.

In addition to treatment barriers, the psychological impact of climate disasters is a significant public health concern. A systematic review evaluating the impact of extreme weather events on health outcomes found an association between flooding and an increased burden of mental distress, including high levels of depression and anxiety in the European population [12]. This is particularly relevant in the context of diabetes, as previous studies have shown that the prevalence of psychological disorders, such as anxiety and depression, is up to two times higher in people living with diabetes compared to the general population [13, 14]. Furthermore, individuals with diabetes and psychiatric disorders face a greater risk of functional impairment, diabetes complications, decreased quality of life, and poorer self-care markers compared to those with diabetes alone [15]. Elderly individuals with diabetes may be particularly vulnerable to the effects of natural disasters, as studies have shown that they are more than twice as likely to experience symptoms of post-traumatic stress disorder compared to younger adults following such events [16].

Given the lack of evidence regarding the psychological impact of floods on elderly individuals with type 2 diabetes in Brazil, our study aims to investigate the mental health effects of the 2024 floods in Rio Grande do Sul on this population. We also evaluated its impact on perceived stress, adherence to diabetes-related self-care behaviors, and described how elderly individuals with type 2 diabetes were affected by the disaster.

Methods

Study design

This is a secondary and exploratory cross-sectional study designed to assess the prevalence of mental distress in a previously established cohort of elderly patients living with type 2 diabetes during the acute phase of the massive flooding that hit Southern Brazil in May 2024. The study was conducted at the Center for Clinical Research Facility at Hospital São Lucas, with data collected through phone interviews during the acute phase of the flooding. The Declaration of Helsinki, 2004, was followed when designing this study, and it was approved by the institutional review board before data collection. Results are reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [17].

Participants and sample size

Elderly patients with type 2 diabetes from a previously established cohort following a randomized clinical trial were invited to participate. For the primary study, eligibility criteria included being 65 years or older, having a previous diagnosis of type 2 diabetes, and not having significant cognitive impairment. The study protocol of the original trial, which includes a detailed description of the eligibility criteria, was published elsewhere [18]. For this secondary study, all individuals from the original cohort were contacted to receive an explanation about the study and an invitation to participate. Initial contact was made via phone calls. Every potential participant received at least nine phone call attempts, distributed across three different days. If participants did not respond to these calls, a follow-up message was sent via WhatsApp® as an additional attempt to reach them. Participants who expressed interest in the study during these contacts were included, and their outcome data were collected. Individuals who failed to respond to phone call attempts and the WhatsApp® message were considered unreachable and, therefore, ineligible for the study. This approach aimed to maximize participation while ensuring consistent efforts to reach potential participants.

The decision to use a previously established cohort of patients was made due to the need to conduct the study

promptly in order to capture mental distress during the acute phase of the floods. We chose to focus on the acute phase to better understand the immediate disruptions caused by the disaster, such as damage to infrastructure, disruption in daily routines, and the emotional and practical challenges faced by participants.

Study groups

For contrast, included participants were divided into two groups: the directly impacted group and the non-directly impacted group. Participants were classified as part of the directly impacted group if their home was directly impacted by the floods, based on self-reports of any of the following conditions: (1) their home was flooded, (2) they needed to evacuate their home, or (3) they were without water or electricity in their home for more than 72 h. All other participants were classified as part of the non-affected group.

Outcomes

The study outcome was mental distress. The Brazilian version of the Self-Report Questionnaire-20 (SRQ-20) was used to assess the presence of depression, anxiety, and other psychoemotional symptoms. The 20-item questionnaire evaluates symptoms that may have been present in the past 30 days, with a score ranging from 0 to 20, higher scores indicating higher mental distress, and demonstrating good internal consistency (Cronbach's alpha = 0.86) [19]. The outcome was reported as the total mean score across study groups, and as positive screening for mental distress (score ≥ 7 using the SRQ-20 questionnaire). The cut-off was selected based on previous studies in the Brazilian population, which identified 7/8 as the optimal threshold for screening mental distress, with a sensitivity of 86% and a specificity of 89% [19] Additional outcomes evaluated include perception of stress, reported as the total score on the Brazilian version of the Perceived Stress Scale (PSS), and diabetes self-care behaviors, reported as the total score on the Brazilian version of the Self-Care Inventory-Revised (SCI-R) questionnaire for patients with type 2 diabetes. The PSS score ranges from 0 to 56, with higher scores indicating higher perception of stress (Cronbach's alpha = 0.82) [20], while the SCI-R score ranges from 11 to 55, with higher scores indicating a higher level of self-care (Cronbach's alpha = 0.63) [21]. All study outcomes were assessed through a phone call by a trained member of the research team who had no previous relationship with the participants. All surveys were previously translated into Brazilian Portuguese and validated for use in the Brazilian population [19–21].

Statistical analysis

Demographic and clinical data are presented as mean ± standard deviation (SD) or frequencies (percentages). Differences between groups for sociodemographic data were evaluated by the chi-square test for categorical variables and unpaired Student's t-test for continuous variables.

For the study outcomes, between-group differences in scores on the SRQ-20, PSS, and SCI-R questionnaires were evaluated using analysis of covariance (ANCOVA). Unadjusted and adjusted mean differences, along with their respective 95% confidence intervals (95% CI), were obtained. Age, sex, education, race, and income were included as covariates in the adjusted model. Covariates were included based on their clinical relevance and known predictors of psychosocial outcomes. Income, race, and education were included due to findings from the National Institute of Science and Technology in Brazil, which reported that areas most affected by floods have a higher proportion of low-income individuals and significant concentrations of non-white populations [22]. Age was included because older adults are more prone to geriatric syndromes and may face greater disruptions in care following floods, while sex was included because women consistently show higher rates of depression and anxiety symptoms [23, 24].

Additionally, the association between having the home affected with positive screening for mental distress was evaluated using a multivariable logistic regression model. Both crude and adjusted odds ratios (OR), along with their respective 95% CI, were reported. The same covariates used in the adjusted model for continuous variables - age, sex, education, race, and income - were also included as confounders in the logistic regression model. All statistical analysis was performed using SPSS® version 27.0 software (SPSS Inc., Chicago, IL), with p values reported to three decimal places. An α level of ≤ 0.05 was used to determine statistical significance.

Results

Between May 24, 2024, and June 05, 2024, a total of 95 elderly patients with type 2 diabetes were invited to participate. Of these, 11 could not be reached after nine phone call attempts, three declined to participate, one was deceased, and 80 consented to participate and were included in the study. Those not included ($n = 15$) were similar to those included with respect to age, sex, race, education, income, and diabetes duration. Out of the 80 patients evaluated, 50 were categorized into the directly impacted group and 30 into the non-directly impacted group.

Overall, participants had a mean age of 72.5 ± 5.5 years old, 67.5% were female and 57.5% were white. Their mean duration of diabetes was 17.7 ± 10.9 years, and the

Table 1 Demographics and clinical characteristics of the included participants

	Overall (*n* = 80)	Non-directly impacted (*n* = 30)	Directly impacted (*n* = 50)	*p* value
Age (years)	72.52 ± 5.5	73.70 ± 5.9	71.80 ± 5.2	0.090
BMI	30.78 ± 6.1	30.38 ± 6.8	31.02 ± - 5.8	0.659
Sex (female)	54 (67.5)	22 (73.3)	32 (64.0)	0.388
Race and ethnicity (white)	46 (57.5)	16 (53.3)	30 (60.0)	0.559
Education[a]	7.09 ± 4.2	6.87 ± 3.9	7.24 ± 4.4	0.704
Income[b]	2.30 ± 2.4	2.30 ± 2.1	2.33 ± 2.6	0.962
HbA1c (%)	7.87 ± 1.5	7.77 ± 1.4	7.89 ± 1.6	0.719
HbA1c (mmol/mol)[c]	62.60 ± 16.1	61.39 ± 14.9	62.76 ± 17.3	0.719
Metformin use	64 (80.0)	25 (83.3)	39 (78.0)	0.564
Insulin use	42 (52.5)	16 (53.3)	26 (52.0)	0.908
Diabetes duration (years)	17.68 ± 10.9	18.03 ± 10.8	17.32 ± 11.0	0.778

Data are presented as mean ± standard deviation (SD) or frequencies (%). Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); HbA1c, glycated hemoglobin. [a]Number of complete years of study. [b]Number of minimum wage in Brazil (defined as an income of R$1320.00 per month, equivalent to USD 257.35 or EUR 237.86) per month. [c]To convert HbA1c from percentage to mmol/mol, the equation recommended by the National Glycohemoglobin Standardization Program (NGSP) was used: HbA1c [mmol/mol] = (10.93×HbA1c[%]) − 23.50. *P* values indicate a between-group comparisons using Student's t-test or Chi-squared test. Statistical significance was considered when $p < 0.05$

Table 2 Descriptive data on home damage, Diabetes Care disruptions, and behavioral changes among individuals directly affected by the floods

	Directly impacted (*n* = 50)
Home evacuation	14 (28.0)
Home flooding	13 (26.0)
Need for shelter	2 (4.0)
Home electricity lack	30 (60.0)
Home electricity lack (days)	6.43 ± 6.2
Home water lack	43 (86.0)
Home water lack (days)	8.50 ± 5.7
Diabetes medication lack	11 (22.0)
Insulin lack	6 (12.0)
Difficulty accessing medical services	15 (30.0)
Worsening dietary patterns	19 (38.0)
Reduced physical activity	27 (54.0)

Data are presented as mean ± standard deviation (SD) or frequencies (%). Abbreviation: SD, standard deviation. All data presented in Table 2 are self-reported and reflect changes as a direct consequence of the flooding

mean glycated hemoglobin (HbA1c) level was 7.9 ± 1.5% (62.6 ± 16.1 mmol/mol). The mean income among the included participants was 2.3 ± 2.4 Brazilian minimum wages, and the average education level was 7.1 ± 4.2 years of completed study, with no significant differences between groups (see Table 1).

Among the participants directly impacted by the floods, 28% ($n = 14$) had to evacuate their homes, 26% ($n = 13$) experienced home flooding, and 4% ($n = 2$) sought shelter. Additionally, 60% ($n = 30$) faced a lack of electricity for more than 72 h, and 86% ($n = 43$) experienced a lack of water for more than 72 h. Moreover, among those directly impacted by the floods, many individuals reported a lack of diabetes medication (22%), difficulty accessing medical services (30%), and behavioral changes, such as worsening dietary patterns (38%) and reduced physical activity (54%), as direct consequences of the flooding (see Table 2).

Study outcomes

Regarding the study outcomes, there was a significant difference in the total SRQ-20 score between the study groups. The mean score was higher in the directly impacted group compared to the non-directly impacted group, with an unadjusted mean difference of 2.56 (95% CI: 0.42 to 4.70; $p = 0.020$), indicating higher levels of mental distress among those directly impacted. This difference remained significant after adjusting for age, sex, education, race, and income, with an adjusted mean difference of 2.64 (95% CI: 0.56 to 4.73; $p = 0.014$) (see Table 3).

When assessing the number of patients with positive screening for mental distress, participants in the directly impacted group had a higher prevalence of positive screening based on the SRQ-20 scores (58% vs. 30%). They were more than 4.0 times as likely to have a positive screening for mental distress when compared to similar subjects that were not directly impacted by the floods, with an adjusted odds ratio (OR) of 4.16 (95% CI: 1.40 to 12.31; $p = 0.010$).

Secondary outcomes included perception of stress, assessed using the PSS, and adherence to diabetes self-care behavior, assessed by the SCI-R questionnaire. The findings suggested that self-perception of stress was higher in the directly impacted group, with borderline significance (adjusted mean difference = 5.14 [95% CI: 0.06 to 10.34]; $p = 0.053$). For the SCI-R score, no significant differences were observed between study groups (adjusted mean difference = -1.73 [95% CI: -4.40 to 0.93]; $p = 0.198$) (see Table 3).

Discussion

The aim of this study was to investigate the acute impact of a climate disaster on the mental health of elderly individuals with diabetes, specifically among those whose homes were directly affected. Our study found that over 60% of participants experienced direct impact from the floods. These individuals exhibited higher scores on SRQ-20 and a higher prevalence of positive screening for mental distress compared to a similar population not directly affected. Previous studies suggest that small differences in SRQ-20 scores are clinically significant, and

Table 3 Comparison of SRQ-20, SCI-R, and PSS scores between those directly impacted and those non-directly impacted by the floods

	Non-directly impacted ($n=30$)	Directly impacted ($n=50$)	Mean difference (95% CI)	*p* value[e]
SRQ-20 score[a]				
Unadjusted mean (SD)	5.50 (4.59)	8.06 (4.68)	2.56 (0.42 to 4.70)	0.020
Adjusted mean (95% CI)[b]	5.45 (3.82 to 7.08)	8.09 (6.84 to 9.34)	2.64 (0.56 to 4.73)	0.014
Secondary outcomes				
SCI-R score[c]				
Unadjusted mean (SD)	37.47 (5.85)	36.06 (5.38)	-1.41 (-3.96 to 1.15)	0.276
Adjusted mean (95% CI)[b]	37.67 (35.59 to 39.75)	35.94 (34.34 to 37.53)	-1.73 (-4.40 to 0.93)	0.198
PSS score[d]				
Unadjusted mean (SD)	18.40 (9.98)	22.20 (11.91)	3.80 (-1.37 to 8.97)	0.147
Adjusted mean (95% CI)[b]	17.57 (13.50 to 21.63)	22.70 (19.58 to 25.82)	5.14 (0.06 to 10.34)	0.053

Abbreviation: SRQ, self-report questionnaire; SD, standard deviation; CI, confidence interval, SCI-R, self-care inventory-revised (version for type 2 diabetes); PSS, perceived stress scale. [a]Total score ranging from 0 to 20 points, with lower scores indicating less mental distress. [b]Variables included in the adjusted model: age, sex, education, race and income. [c]Total scoreranging from 11 to 55 points, with higher scores indicating a higher level of care related to diabetes. [d]Total score ranging from 0 to 56 points, with lower scores indicating a reduced level of stress. [e]Between-group pairwise comparisons using analysis of covariance. Statistical significance was considered when $p<0.05$

even minor changes of 1–2 points can indicate shifts in mental health status [25, 26]. In our study, we found a mean difference of 2.64 points in SRQ-20 scores between the groups, suggesting that the disaster's impact on mental health was clinically significant in the short term and for this population. Additionally, individuals whose homes were directly affected reported significant disruptions in diabetes treatment, including a lack of medication (such as insulin), difficulties in accessing medical care, and changes in diet and physical activity.

Comparisons with other crisis periods and environmental disasters further underscore the mental health challenges observed in our study. A study on patients with diabetes during the COVID-19 pandemic found a 53% prevalence of positive mental distress screening using the SRQ-20 among older adults (mean age of 62.3 years) with type 2 diabetes in Brazil [27]. Another study in China, on populations affected by earthquakes, reported SRQ-20 positive screening rates of 52% among adults [28]. In contrast, the 58% prevalence of positive screening for mental distress observed in our study suggests a similar rate of mental distress among those directly impacted by the floods compared to what has been observed in other crisis situations.

Psychological distress is a common emotional response to adverse stressors among patients with chronic illnesses and is closely associated with reduced well-being and impaired social functioning [29]. This is particularly relevant in the context of diabetes, given that depressive disorders have consistently been linked to non-adherence to diabetes treatment in multiple studies [30–32] Additionally, psychiatric disorders are linked to poor dietary habits, inadequate foot care, physical inactivity, reduced adherence to glucose monitoring, and worse glycemic control [30, 31, 33–36]. As a result, patients already vulnerable to disruptions in diabetes care due to the floodings may face even greater barriers due to mental distress.

Several factors could have contributed to these findings, as individuals whose homes were affected were likely living in socially vulnerable situations or with poorer financial conditions. However, our study population was similar across groups regarding all sociodemographic variables, and the difference in SRQ-20 scores and positive screening for mental distress remained significant after controlling for confounders such as income and education.

The novelty of our study lies in its focus on assessing the acute impacts of a natural disaster of this magnitude on the mental health and self-care of older adults with diabetes, a context that, to our knowledge, has not been previously addressed in the literature. Despite that, our study has limitations, including its cross-sectional design and the potential for selection bias, as the study population was drawn from a convenience sample of a previous study, and individuals who could not be reached were excluded. This limitation is particularly relevant because participants who were severely affected may have missed calls due to power outages or lack of access to mobile phones, potentially leading to their exclusion. To mitigate bias related to the exclusion of unreached individuals, we attempted to contact potential participants at least nine times across three different days before excluding them. Additionally, the low number of unreachable individuals ($n=11$) and the similar characteristics of these individuals compared to those included suggest that the impact of this issue was minimal.

Recall bias may also have influenced participants' reports on how the flood impacted their lives and diabetes self-care (descriptive data presented in Table 2), potentially affecting the distribution of patients across our study groups. Furthermore, our population consisted

of elderly patients, many of whom experienced isolation due to the severe weather conditions, making this group particularly vulnerable to mental distress. These findings may have implications for understanding mental health impacts in other populations affected by similar environmental disasters, though caution should be taken when generalizing these results to younger or less vulnerable groups. Finally, while we assessed the impact on mental health during the acute phase of the climate disaster, it remains uncertain whether these factors will persist in the medium and long term and how they might influence diabetes care.

Conclusion

Brazil experienced one of the greatest environmental catastrophes in its history, and we are now beginning to understand the impacts these floods have had on those living with chronic diseases. To our knowledge, this is the first study to evaluate the impact of the climate disaster on the mental health of elderly individuals with type 2 diabetes, specifically those whose homes were directly affected by the disaster. Our results not only provide data on the impacts on personal lives and the barriers to the continuity of type 2 diabetes treatment but can also possibly be extended to the treatment of other prevalent chronic diseases. The data from this study provide evidence of a significant prevalence of psychiatric symptoms among patients with type 2 diabetes who were directly affected by the floods, serving as a warning for the mental health impact on this population during and after the disaster. These findings highlight the importance of optimizing strategies and public policies focused on mental health promotion during crisis situations. Future research should evaluate the impact of natural disasters on other chronic diseases and across different age groups, as well as assess whether the observed changes in mental health persist in the long term and how they may affect diabetes care in longitudinal studies.

Author contributions

M.M.C: Conceptualization, Methodology, Data curation, Writing- Original draft preparation. L.S.M: Conceptualization, Methodology, Data curation, Writing- Original draft preparation, Formal Analysis. L.G.B.B, A.G.R.H, M.K.P, H.T.U, B.G.C, V.G: Methodology, Writing- Original draft preparation. F.L.C, G.H.T.: Conceptualization, Supervision, Writing- Reviewing and Editing. All authors have reviewed the final version of the manuscript and agree with the publication of the results presented. M.M.C is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Data availability

The data collected for the study will be available for one year after publication of the article upon justified request to the email address of the main researcher and with a signed data access agreement.

Declarations

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of Pontifícia Universidade Católica do Rio Grande do Sul (number 5274307). Written, informed consent to participate was obtained from all included participants before data collection. All authors signed the confidentiality document for data usage.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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