



ASSESSMENT OF NEUROLOGISTS' KNOWLEDGE, ATTITUDES, AND PRACTICES REGARDING THE IMPACT OF HEAT STRESS DURING HEATWAVES ON PATIENTS WITH NEUROLOGICAL DISORDERS: DEVELOPMENT AND VALIDATION OF THE SURVEY

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ABSTRACT

Introduction	In the context of accelerated climate change and the rising frequency of heatwaves, patients with neurological disorders represent a high-risk group. Heat stress can adversely affect their health, necessitating appropriate adaptations in medical practice. This study aimed to develop and validate a KAP (Knowledge, Attitudes, Practices) questionnaire to assess neurologists' perceptions and approaches regarding the impact of heat stress during heatwaves on patients with neurological disorders.
Material and methods	The study included a literature review phase to establish the theoretical foundation, followed by a practical phase for questionnaire development, content validation through expert consultation, and pre-testing on a sample of 104 neurologists. The clarity and relevance of the items, as well as the instrument's internal consistency, were evaluated (Cronbach's alpha coefficient = 0,82).
Results	An original 35-item questionnaire was developed and organized into three thematic sections. The pilot study confirmed the instrument's clarity and applicability, and preliminary psychometric analysis demonstrated satisfactory internal consistency.
Conclusions	The questionnaire is a valid tool, adapted to the climatic and professional context of the Republic of Moldova. Applying it to larger samples will enable more in-depth psychometric analysis and support the development of adaptive medical strategies for addressing heat stress.
Keywords	Questionnaire validation; knowledge, attitudes, and practices; heat stress impact; neurologists; neurological disorders; heatwave.

EVALUAREA CUNOȘTIINȚELOR, ATITUDINILOR ȘI PRACTICILOR MEDICILOR NEUROLOGI VIZÂND IMPACTUL STRESULUI TERMIC PE TIMP DE CANICULĂ ȘI CONDUITA PACIENȚILOR CU AFECȚIUNI NEUROLOGICE: STUDIU PILOT

Introducere	În contextul schimbărilor climatice accelerate și al intensificării frecvenței valurilor de căldură, pacienții cu afecțiuni neurologice reprezintă o categorie de risc sporit. Expunerea la stres termic poate agrava starea lor de sănătate, ceea ce impune o ajustare adecvată a practicilor medicale. Scopul cercetării a constat în elaborarea și validarea unui chestionar de tip KAP (cunoștințe, atitudini, practici) destinat evaluării percepției și conduitei medicilor neurologi față de impactul stresului termic în timpul episoadelor de caniculă asupra pacienților cu patologii neurologice.
Material și metode	Studiul a fost structurat în două etape: o etapă de analiză documentară pentru fundamentarea teoretică și o etapă practică de dezvoltare a chestionarului, urmată de validarea conținutului prin consultarea experților și pretestare pe un eșantion de 104 de medici neurologi. S-a evaluat claritatea itemilor, relevanța și consistența internă a instrumentului (coeficientul Cronbach $\alpha = 0,82$).
Rezultate	A fost elaborat un chestionar original cu 35 de itemi, structurat în trei compartimente tematice. Studiul pilot a confirmat claritatea și aplicabilitatea instrumentului, iar analiza preliminară a evidențiat o consistență internă satisfăcătoare.
Concluzii	Chestionarul este un instrument valid, adaptat contextului climatic și profesional din Republica Moldova. Aplicarea sa pe eșantioane extinse va permite aprofundarea analizei psihometrice și va contribui la dezvoltarea unor strategii medicale adaptative în fața stresului termic.
Cuvinte-cheie	Validarea chestionarului, cunoștințe atitudini și practici, impactul stresului termic, medici neurologici, afecțiuni neurologice, val de căldură.

INTRODUCTION

Heat stress is an underrecognized pathway through which climate change impacts human health, representing a major threat to human well-being. Each 1 °C increase in ambient temperature triggers a range of pathophysiological effects that can worsen pre-existing conditions and, in severe cases, lead to premature death (1).

Although the international community is striving to limit the rise in global average temperature to below 1.5 °C by 2100, irreversible environmental changes have already occurred, and as the planet continues to warm, these changes will persist and intensify (2).

The progressive increase in temperature, coupled with elevated levels of pollution, has a profound impact on population health, leading to a rise in both the frequency and severity of various neurological disorders (3). Extreme air temperatures can compromise the brain's resilience mechanisms, thereby exacerbating existing conditions or increasing susceptibility to neurological diseases (4). High ambient temperatures can cause disturbances in the nervous system, potentially resulting in strokes or even death. While climate change is not a direct cause of neurodegenerative diseases, it can aggravate their symptoms (3).

Patients with multiple sclerosis are particularly sensitive to elevated ambient temperatures, as heat is known to exacerbate symptoms and disrupt body temperature regulation (5).

The relationship between ambient temperature and the frequency and severity of stroke events remains inconclusive. Some studies suggest that certain stroke types are more likely to occur in extreme heat or cold, while others report seasonal variations in stroke incidence (1, 3).

Changes in ambient temperature have been shown to influence stroke-related mortality. In four Korean cities, data from 1992 to 2007 indicated that each 1 °C rise in mean ambient temperature was associated with an average 4% increase in stroke-related mortality (3).

A 1 °C increase in ambient temperature has been linked to a 23.1% rise in hospital admissions for Alzheimer's disease. Although there is no direct evidence that high ambient temperatures contribute to the development of Parkinson's disease, a study analyzing data from Spain (2001–2009) found that for each 1 °C increase above the threshold of 34 °C, hospital admissions for Parkinson's disease rose by 11.47%, while the mortality rate increased by 12.11% (3).

Scientific literature also indicates that climate change contributes to increased rates of depression, anxiety, substance abuse, and suicide (3, 6).

Individuals with chronic neurological disorders are particularly vulnerable to climate change and often have a reduced capacity to manage their illnesses. Neurological disorders rank among the most burdensome diseases, and regardless of whether climate change has direct effects on them, the reduced resilience of this population to environmental change requires specialists to remain aware of potential impacts and to take appropriate measures to address them (7).

The effects of climate change are pervasive. In 2021, a collective statement published simultaneously in over 220 medical journals worldwide raised serious concerns about the health and biodiversity impacts of heat stress, urging immediate action and calling on neurologists to educate themselves about climate change (2, 8). The accumulation of new knowledge, research on the effects of global warming, and the implementation of responses addressing neurological diseases are now integral responsibilities for those caring for neurological patients (9, 10).

The aim of this study was to develop and validate a questionnaire assessing neurologists' knowledge, attitudes, and practices regarding the impact of heat stress during heatwaves on patients with neurological disorders.

MATERIAL AND METHODS

In 2023, a study was conducted with the aim of developing and validating a KAP-type (Knowledge, Attitudes, Practices) questionnaire. The instrument was designed to assess neurologists' knowledge, attitudes, and practices regarding climate change, global warming, and the impact of heat stress during heatwaves on patients with neurological disorders.

The methodological approach followed the three-phase model proposed by Boateng et al. (2018), as outlined below:

The first phase – Item Development

Step 1: Conceptualization. A literature review was conducted to establish the conceptual framework for the questionnaire and to define the key dimensions of the KAP model in the context of heat-related health risks.

Step 2: Theoretical Analysis. Relevant scientific articles, existing instruments, and theoretical models were analyzed to determine the scope and structure of the questionnaire and ensure content representativeness.

A literature search was conducted using the open-access international database **PubMed**, social networking platform **ResearchGate**, and reference manager and academic social network **Mendeley** employing relevant search terms such as: “questionnaire validation,” “KAP survey,” “instrument development,” “heat stress,” “neurological disorders,” “heatwave,” “neurological patients,” “attitudes,” “practices,” “neurologists.” To highlight research conducted in the Republic of Moldova, the largest Open Access electronic library in the country – National Bibliometric Instrument (IBN) and the repository of the *Nicolae Testemițanu* State University of Medicine and Pharmacy were consulted, resulting in the selection of three articles. To enhance the relevance of the results and narrow the search scope, a Boolean operator AND, search field tags Title/Abstract [ti.ab] were applied.

A total of 25 relevant scientific sources were analyzed, which explicitly addressed:

- the current relevance of the studied problem;
- the importance of raising awareness about climate change;
- the standard stages of questionnaire development (including item formulation, section structuring, and content validation);
- the methods used for testing validity and reliability (e.g., internal consistency, factor analysis, test–retest);
- the application of KAP instruments in specific medical contexts, including neurology, public health, and climate-related risks.

Step 3: Item generation. Based on the theoretical analysis, an initial pool of items was developed and organized into three thematic sections: Knowledge, Attitudes, and Practices.

The second phase – Scale Development and Refinement

Step 4: Content validation through expert review. The preliminary version of the questionnaire was evaluated by four multidisciplinary experts (neurology, public health, environmental climatology, and sociology) for clarity, relevance, and comprehensiveness. Their feedback guided the revision and refinement of the items.

In parallel with this step, the study protocol, including the developed questionnaire, was evaluated and approved by the Research Ethics Committee of *Nicolae Testemițanu* State University of Medicine and Pharmacy, which issued positive opinion no. 1 on 26 May 2023.

Step 5: Pre-test (cognitive interviewing). A pilot study was conducted with a sample of 104 neurologists to evaluate the clarity and feasibility of the questionnaire. Based on participants' feedback, several items were reworded, redundant questions were removed, and the overall structure was refined to improve flow and comprehension.

Step 6: Assessment of internal consistency. As part of the instrument's refinement, internal consistency was assessed using Cronbach's alpha coefficient. A value of ≥ 0.70 was considered acceptable for reliability, in line with the specialized literature (11, 12). Internal consistency was evaluated separately for each of the three sections of the questionnaire (Knowledge, Attitudes, and Practices).

Table 1 presents the standardized interpretation of Cronbach's alpha values in relation to the instrument's level of internal consistency and reliability (13).

Table 1. Showing internal consistency value and significance (13).

	Cronbach's α value	Internal consistency/Reliability test
1	$\alpha \geq 0.9$	Excellent (high-stakes testing)
2	$0.7 \leq \alpha \leq 0.9$	Good (low-stakes testing)
3	$0.6 \leq \alpha < 0.7$	Acceptable
4	$0.5 \leq \alpha < 0.6$	Poor
5	$\alpha < 0.5$	Unacceptable

The *Cronbach's alpha* coefficient, used to evaluate the internal consistency of the questionnaire items, was calculated with licensed IBM SPSS Statistics software, version 27.0 (Software: **IBM Corp.** IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp.; 2020).

The third phase – Exploratory Factor Analysis

The first step in conducting the Exploratory Factor Analysis (EFA) was to test data adequacy. To verify the suitability of the dataset for EFA, two standard statistical tests were applied: the Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity.

The KMO index assesses the proportion of common variance among variables and determines whether factor analysis is statistically justified. Values close to 1 indicate a high degree of adequacy, whereas values below 0.60 are considered inadequate for EFA (14).

Bartlett's test evaluates the null hypothesis that the correlation matrix is an identity matrix, in which case factor analysis would not be appropriate. A significant result ($p < 0.05$) rejects the null hypothesis and confirms the suitability of the data for EFA (15).

For these tests, only the Likert scale items from the three questionnaire sections (Knowledge, Attitudes, and Practices) were included.

The dataset was analyzed using the Principal Component Analysis (PCA) extraction method to identify the latent structure of the questionnaire. Calculations were performed with IBM SPSS Statistics version 27 and Python (pandas, scikit-learn, and seaborn libraries).

For the interpretation of the factorial structure, the loadings of each item on the extracted factors were analyzed, with absolute loadings of ≥ 0.40 considered indicative of relevance for the corresponding factor.

Processing of dichotomous and multiple-choice questions

Dichotomous (Yes/No) and multiple-choice questions from the KAP questionnaire administered to neurologists were analyzed separately, given the nominal nature of these variables. Such items are not suitable for EFA, as it is not possible to apply Pearson correlation-based analysis between continuous variables.

Questions in this format were selected, and for each item absolute frequencies (number of responses) and relative frequencies (percentage of respondents) were calculated. For multiple-choice questions, each option was treated as a binary variable (selected/not selected) (16).

Data processing was performed using Microsoft Excel and Python (pandas and NumPy libraries). Descriptive analysis was applied in accordance with KAP study methodology for categorical variables.

RESULTS

Questionnaire development

The study began with an extensive literature review to identify existing instruments for assessing the knowledge, attitudes, and practices of healthcare professionals, particularly neurologists, in relation to heat stress during heatwaves. The search confirmed that no standardized, validated, and publicly available questionnaire aligned with the specific objectives of this study.

To address this gap, the first phase involved developing an original item pool, informed by the literature and adapted to the professional and climatic context of neurologists in the Republic of Moldova. This step corresponds to the "item development" stage (Phase 1) as described by Boateng et al. (2018), and laid the foundation for subsequent validation and refinement of the instrument.

This preparatory stage led to the identification of several thematic categories that structured the questionnaire. Specifically, the literature analysis highlighted key domains such as neurologists' awareness of heat-related health risks, clinical practices during heatwaves, attitudes toward climate adaptation, and patient guidance strategies. These domains formed the basis of the item pool, ensuring both clinical relevance and alignment with the KAP model.

Based on the preliminary analyses, the instrument entitled "Assessment of Neurologists' Knowledge, Attitudes, and Practices Regarding the Impact of Heat Stress During Heatwaves and the Behavior of Patients with Neurological Disorders" was developed.

The construction process followed six defined phases (steps), each generating concrete outcomes that contributed to the final structure of the questionnaire:

- Step 1* established clearly articulated research objectives and hypotheses directly aligned with the overarching aim of the study.
- Step 2* led to the formulation of precise research questions to operationalize those objectives.
- Step 3* delineated the key informational categories required to guide item development.
- Step 4* produced a draft questionnaire comprising 36 items, distributed across five structured sections aligned with the KAP model.
- Step 5* generated qualitative feedback from a panel of four multidisciplinary experts (neurology, hygiene, climatology, and sociology), which led to revisions in item clarity, language, and logical flow.
- Step 6* yielded internal consistency values (Cronbach's alpha) indicating good reliability of the instrument (see details below).

In developing the questionnaire, several key requirements for question formulation were observed, including:

- avoiding ambiguous wording,
- preventing double-barrelled questions,
- excluding leading questions or those containing implicit assumptions.

The questionnaire was subsequently reviewed and revised for linguistic, grammatical, and logical coherence, with ambiguities eliminated. Throughout the process, the principle of neutral and clear wording was maintained.

The initial version of the questionnaire included the three core components typical for KAP instruments: 1) neurologists' general knowledge of global warming and its impact on individuals with neurological disorders; 2) neurologists' attitudes toward heat stress associated with global warming and its influence on patients' neurological health; 3) practices applied by neurologists in supervising patients with neurological disorders during heatwaves.

In total, the questionnaire comprised 36 items in a mixed format (closed- and open-ended questions) and served as the basis for the subsequent pilot survey. It included five open-ended questions (items 9a and 9b from the *Knowledge* section, and items 34a, 35, and 36 from the *Practice* section). These were designed to capture nuanced perspectives, personal experiences, or examples not addressed by closed-ended items. Open-ended responses were excluded from the calculation of Cronbach's alpha, as internal consistency applies only to standardized response scales. Instead, they were analyzed qualitatively to supplement quantitative findings, identify emerging themes, and inform potential revisions to the instrument. Their role was exploratory and supportive rather than psychometric.

The questionnaire items employed different assessment formats depending on the KAP domain. In the *Knowledge* section, most questions were multiple-choice (5 items) or dichotomous ("Yes/No") (4 items), along with one item using a Likert-type 4-point ordinal scale (*Quite a lot / A lot / A little / Not at all*) to assess factual understanding. The *Attitudes* section included 9 dichotomous ("Yes/No") items and 4 Likert-type items: three on a 4-point ordinal scale (*Quite a lot / A lot / A little / Not at all*) and one on a scale ranging from *Very useful* to

Useless (Very useful/ Useful/ Neutral/ Useless). The *Practices* section comprised 7 dichotomous (“Yes/No”) items and 6 multiple-choice items.

Both the theoretical and practical construction of the instrument was informed by and adapted from international methodological recommendations, particularly those related to KAP model-based tool development (17, 18), sequential phases of item generation and pre-testing (19, 20), expert content validation (17–21), and the assessment of internal consistency using Cronbach’s alpha (19, 20).

Pilot study for questionnaire validation (pre-testing)

The developed questionnaire underwent a pre-testing phase to assess its clarity, comprehensibility, and content validity. This phase served as a pilot validation study, allowing for the refinement and adjustment of the instrument prior to its application in the main sample.

Pre-testing was conducted on a sample of 104 neurologists, selected through convenience sampling. Participants completed the questionnaire in paper format during face-to-face, interviewer-assisted sessions. This approach enabled the collection of quantitative data as well as valuable qualitative feedback, both of which were essential for improving the instrument.

Participants were invited to share their impressions of the wording and overall structure of the questionnaire by responding to three open-ended evaluation questions:

1. Which questions did you find unclear or difficult to understand?
2. Which questions were easy to understand?
3. What suggestions do you have for improving the wording of the items and the structure of the questionnaire?

By responding to these questions, participants provided constructive feedback that contributed to the improvement of the final version of the questionnaire. Most suggestions focused on rewording technical items to reduce ambiguity, standardizing response formats, and reorganizing questions to improve logical flow within their respective sections.

As part of the validation process, one question was excluded, four were revised, and two questions were transferred from one section to another.

All 20 completed questionnaires were validated for analysis, with no exclusions, as they fully met the criteria for completeness and consistency. The responses were verified and entered into an electronic database for subsequent analysis.

Preliminary evaluation

A preliminary analysis was conducted on the responses collected during the pre-testing phase. Its objective was to assess the content validity of the instrument and to verify its internal consistency.

1. **Content Validity.** The evaluation panel consisted of four experts from relevant fields (neurology, hygiene, climatology, and medical sociology). They assessed the items for clarity and lack of ambiguity, relevance to the targeted theoretical constructs, and suitability to the professional context of neurologists.

Qualitative feedback obtained from respondents during the pilot study was also taken into account. Based on their observations, several items were revised, and the questionnaire was restructured to improve logical clarity and terminology.

2. **Internal consistency** (reliability). To estimate internal consistency, Cronbach's alpha coefficient was calculated separately for each of the three main sections, Knowledge, Attitudes, and Practices, which comprised the final version of the questionnaire.

Although the sample size of 104 respondents was limited for robust statistical analysis, the Cronbach's alpha values obtained exceeded the minimum acceptable threshold of 0.70, indicating a satisfactory level of reliability for the instrument (tab. 2).

Table 2. Cronbach α coefficients.

Sections	Number of items	α Cronbach
Knowledge	10	0.82
Attitudes	12	0.84
Practices	14	0.79
Total	36	0.82

Thus, all values exceeded the minimum acceptable threshold of 0.70, indicating good internal consistency of the instrument and a satisfactory degree of item homogeneity within each section.

Factor analysis

As described in the *Materials and Methods* section, the first step of the exploratory factor analysis involved testing data adequacy using the Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity. The KMO index indicated a moderate to good level of adequacy, and Bartlett's test was statistically significant ($\chi^2 = 899.98$; $p < 0.001$), confirming that the correlation matrix differed from the identity matrix and justifying the application of EFA (tab. 3).

Table 3. Results of the adequacy tests for exploratory factor analysis.

Indicator	Value	Interpretation
KMO Index	0.674	Moderate to good adequacy; justifies the application of EFA
Bartlett's Test (Chi-Square)	899.98	High value, statistically significant
Bartlett's p-value	< 0.001	Statistically significant; rejects the null hypothesis (identity matrix excluded)

Note: Only Likert-scale items were included in the adequacy tests.

To identify the latent dimensions, principal component analysis (PCA) was conducted separately for each of the three KAP questionnaire domains – *Knowledge, Attitudes, and Practices* – including only Likert-scale items, in accordance with international methodological guidelines.

According to Kaiser's criterion (eigenvalues > 1), principal component analysis (PCA) identified three main factors in the "Knowledge" domain, which together explained 70.9% of the total response variance.

- Factor 1: General knowledge about climate change – items addressing the impact of global warming on neurological health and the concept of heat stress.
- Factor 2: Access to information and clinical protocols – items concerning the availability of guidelines, official strategies, and information sources for physicians.
- Factor 3: Knowledge of non-pharmacological interventions and preventive measures – items focused on practical methods to prevent heat stress.

All items demonstrated significant loadings (tab. 4).

The EFA conducted for the questions in the "Attitudes" domain highlighted three main factors, together explaining 76.3% of the total variance. The factor structure was interpreted as follows:

- Factor 1: Perceived risk to the population – physicians' beliefs about the impact of heat stress on both healthy and vulnerable individuals, as well as the importance of climate education.
- Factor 2: Support for organizational measures and policies – attitudes regarding the need for guidelines/protocols and interdisciplinary collaboration.
- Factor 3: Confidence in preventive measures – perceived usefulness of avoiding exposure and implementing preventive interventions.

This structure highlights neurologists' clear orientation toward protecting vulnerable patients and supporting organizational and educational interventions (tab. 4).

For the "Practices" domain, the identified factors accounted for 74.5% of the total variance. The extracted factors were:

- Factor 1: Patient education and professional involvement – items concerning patient information, the use of educational materials, and participation in specialized training.
- Factor 2: Thermal comfort and institutional infrastructure – perceptions of summer working conditions and their impact on clinical activity.
- Factor 3: Personal behavior and sources of information – the personal application of recommendations and the methods by which physicians stay informed about heatwaves.

The analysis suggests a practical approach centered on physicians' educational responsibilities and adaptation to both institutional and personal contexts (tab. 4).

This result indicates good internal consistency of the instrument and supports construct validity.

Table 4. Results of Exploratory Factor Analysis (EFA) by KAP domains and percentage of variance explained.

Factors	Explained Variance (%)	Interpretation
Knowledge Domain		
Factor 1	72.8	General knowledge about climate change
Factor 2	69.2	Access to information and clinical protocols
Factor 3	70.8	Knowledge of non-pharmacological interventions and preventive measures
Attitudes Domain		
Factor 1	72.8	Perceived risk to the population
Factor 2	74.7	Support for organizational measures and policies
Factor 3	81.4	Confidence in preventive measures
Practices Domain		
Factor 1	70.3	Patient education and professional involvement
Factor 2	78.3	Thermal comfort and institutional infrastructure
Factor 3	74.5	Personal behavior and sources of information

Correlations between the first factor scores from each domain (Knowledge, Attitudes, Practices) revealed a moderate positive association between *Knowledge* and *Practices*, suggesting that higher knowledge levels are linked to better-adapted practices for heat stress management. Correlations with *Attitudes* were weaker, indicating a potential gap between beliefs and actual behaviors, a phenomenon frequently reported in KAP studies (fig. 1).

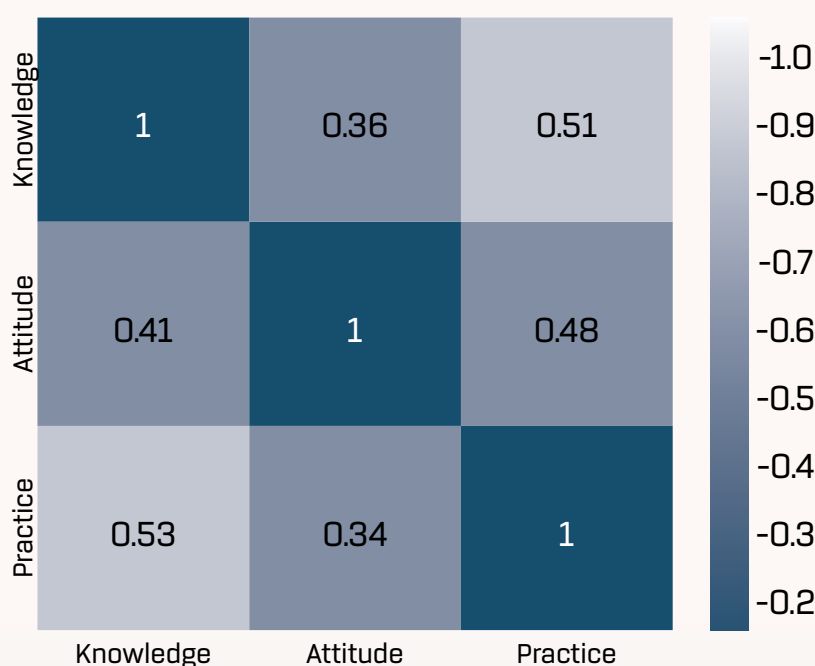


Figure 1. Correlations between KAP factor scores.

The questions analyzed in the EFA addressed medical infrastructure, professional education, sources of information about heatwaves, and the availability of informational materials within institutions. The data reflect real challenges in current medical practice and highlight the need for institutional interventions to support neurologists in adapting to the risks associated with heat stress.

Structure of the final questionnaire

The questionnaire begins with an introductory note to respondents, outlining the purpose and usefulness of the study, assurances of data confidentiality, and brief instructions for completing the form. To ensure consistent understanding of the items, a definition of the term “heatwave” was also provided, as it appears in several subsequent questions.

The final instrument was organized into three sections, corresponding to the three KAP model dimensions, and included a total of 35 items.

The first section, entitled *Global Warming and Its Impact on People with Neurological Disorders*, contains 9 questions addressing events that may contribute to global warming, the main effects of global warming, respondents’ understanding of the term “heat stress” associated with global warming, and general information about the treatment of neurological patients affected by heat stress. It also covers physicians’ knowledge of the existence of national clinical guidelines or protocols addressing the impact of global warming on patients with neurological disorders, non-pharmacological techniques or treatments for preventing the impact of global warming on neurological health, the existence of medications that may mitigate the effects of heat stress on neurological patients, whether strategies approved by competent authorities exist to reduce the risk of heat stress among neurological patients, and whether respondents consider the information they currently possess to be sufficient regarding upcoming heatwaves, behavior during heat events, assistance to be provided to patients, and preventive measures related to heat stress (tab. 5).

The next section, entitled *The Heat Stress Problem Associated with Global Warming and Its Impact on the Health of Neurological Patients (as Perceived by Physicians)*, includes 12 questions focusing on neurologists’ attitudes. These address their beliefs about the current existence of global warming, their views on environmental news, whether heat stress affects the healthy population in the Republic of Moldova, and whether vulnerable groups, particularly those with certain pathologies, including neurological disorders, are impacted. The section also explores physicians’ opinions on whether the population should be educated about climate change and heat stress, whether patients with neurological disorders should avoid exposure to high temperatures, and how useful preventive measures are for mitigating the effects of heat stress. Further questions examine whether managing neurological patients during heatwaves is a shared responsibility across medical specialties, whether time should be allocated during consultations to inform patients about the impact of heatwaves, and whether guidance should be provided to patients on how to behave during such events. Finally, the section assesses physicians’ views on the need for a national guideline for managing neurological patients affected by heatwaves in the Republic of Moldova and their evaluation of working conditions in terms of thermal comfort during the warm season (tab. 5).

The third section of the questionnaire, entitled *Surveillance of Patients with Neurological Disorders During Heatwaves, Activity Conditions, and Climate*

Education, includes 14 questions and focuses on the practices of neurologists in patient management, as well as their personal working conditions and education. The questions address physicians' clinical activity during consultations with patients whose neurological disorders are aggravated by high air temperatures, the most frequent symptoms reported by such patients, the challenges encountered in managing them during heatwaves, the non-pharmacological techniques or treatments recommended, and whether physicians provide information to patients about health risks related to heatwaves. To better understand working conditions, neurologists were asked whether high temperatures had affected their professional activity during summer in the past five years, whether their consulting rooms were equipped with air conditioning, and whether their institutions provided access to a drinking water dispenser (cooler). Another set of questions explored how physicians receive information about heatwaves, including how they learn about upcoming events and appropriate patient care recommendations, whether healthcare institutions provide guides, brochures, leaflets, or other educational materials for patients on the effects of and behavior during heatwaves, whether they have received continuing medical education or training related to patient behavior during heatwaves, what type of information on health and heatwaves they feel they need to better support their work with patients, and through which channels such information should ideally be communicated. Finally, physicians were asked how the general population could best gain access to information about appropriate behavior during heatwaves, from the perspective of healthcare providers (tab. 5).

The questionnaire concluded with a professional identification item, asking respondents to indicate their number of years of experience in the field of neurology. Finally, participants were presented with a thank-you message acknowledging their contribution to the study.

Table 5. Final structure of the KAP questionnaire applied to neurologists.

Thematic compartment	Number of items	Type of questions
Knowledge about the phenomenon of global warming and its impact on patients with neurological disorders	9	8 closed, 1 open
Attitudes towards heat stress and its influence on the health of neurological patients	12	12 closed
Practices regarding patient supervision, working conditions and climate education	14	12 closed, 2 open
Total	35	32 closed, 3 open

DISCUSSION

Against the backdrop of increasingly frequent and intense heatwaves, and growing evidence of the vulnerability of patients with neurological diseases to heat stress, the role of neurologists has become essential. However, the scientific literature on the preparedness of medical professionals for such challenges remains limited, and existing questionnaires are either designed for the general public (7) or targeted at other medical specialties (22).

The development and validation of a KAP (Knowledge, Attitudes, Practices) questionnaire specifically targeting neurologists in the context of heat stress during heatwaves represents an innovative initiative, given the absence of

standardized instruments tailored to this field. The development process followed methodological steps recommended in the literature (18, 20, 21), including literature review, expert consultation, pre-testing, and preliminary evaluation.

The information extracted from the selected bibliographic sources formed the basis for the theoretical and structural design of the proposed questionnaire, enabling a rigorous approach to developing a valid and reliable instrument tailored to the professional context of neurologists in the face of climate change and heat stress.

Regarding content validity, the involvement of a multidisciplinary panel of experts ensured a comprehensive evaluation of item clarity, relevance, and coherence, in line with previous recommendations for the development of KAP instruments in healthcare. Pre-testing the questionnaire on a sample of 20 neurologists allowed for the identification and correction of potential ambiguities, thereby enhancing its clarity and feasibility. Its modular structure (36 items grouped into three thematic sections) ensured multidimensional coverage of the research domain.

The evaluation of internal consistency, performed by calculating Cronbach's alpha for each of the three main sections (Knowledge, Attitudes, Practices), yielded values exceeding the minimum acceptable threshold of 0.70, within the range considered satisfactory for behavioral research instruments (11, 12, 13). This finding supports the conclusion that the included items are coherent and relevant to the targeted constructs. These results are consistent with previous studies that reported similar Cronbach's alpha values in the validation of KAP-type questionnaires (11, 17, 18, 21, 22).

Therefore, the instrument developed in this study addresses an urgent need for applied research in the field of climate and health and may contribute to the development of educational interventions, public policies, and professional standards.

The questionnaire development methodology adhered to international guidelines on the creation of standardized tools for psychosocial evaluation in healthcare (10, 11). The steps followed – literature review, item generation, expert review, pre-testing, and internal consistency evaluation – are supported by multiple recent sources on KAP questionnaire validation in various domains (10, 17, 19, 21, 23, 24, 25, 26), including the medical field in the Republic of Moldova.

Feedback from experts in four domains (neurology, hygiene, climatology, and medical sociology) strengthened content validity, while the involvement of neurologists in the pre-testing phase enabled item adjustment and clarification, consistent with other methodological approaches described in the literature (17, 18, 25).

Nevertheless, studies focused on neurology and climate remain scarce, which makes the proposed instrument a novel contribution to interdisciplinary research in the field of climate-related health.

Study limitations

Moreover, the questionnaire was administered in the Republic of Moldova, which may limit the generalizability of the results to other geographical and cultural contexts. However, the flexible structure of the instrument allows its adaptation to other categories of healthcare professionals or regions with only minor adjustments.

Practical implications and future directions

The results suggest that the proposed instrument may serve as a foundation for:

- conducting large-scale national surveys;
- identifying training gaps among neurologists;
- supporting the development of educational interventions for managing vulnerable patients under heat stress conditions;
- contributing to the creation of climate-sensitive clinical guidelines.

In the next phase, it is recommended that the questionnaire be applied to a larger sample and that exploratory factor analysis be conducted to confirm the instrument's latent structure and validate the proposed dimensions.

CONCLUSIONS

1. An original KAP-type questionnaire was developed in accordance with methodological standards and adapted to the professional context of neurologists in the Republic of Moldova, in light of current climate-related risks.
2. Pre-testing confirmed the clarity of items, the relevance of content, and the feasibility of implementation in real-world clinical settings.
3. Findings from the development, pre-testing, and preliminary validation phases demonstrated that the instrument adequately captures the key constructs of the study – neurologists' knowledge, attitudes, and practices regarding heat stress during heatwaves. The questionnaire is coherent, relevant, and demonstrates satisfactory internal reliability.

CONFLICT OF INTEREST The authors declare no conflicts of interest.

ETHICAL APPROVAL The study was approved by the Research Ethics Committee of *Nicolae Testemițanu* State University of Medicine and Pharmacy (approval no. 1, May 26, 2023).

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