ORIGINAL PAPER
ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

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The heat wave knowledge, awareness, practice and behavior scale
Translation and validation in Greek

OBJECTIVE **To translate and validate the heat wave knowledge, awareness, practice and behavior scale (HWKAPBS) in Greek.** METHOD **We conducted a cross-sectional study in Greece with a convenience sample of 147 individuals. We assessed test-retest reliability, internal reliability, face validity and construct validity. We calculated intraclass correlation coefficients, the Kuder-Richardson Formula 20, and Cronbach's coefficient alpha. Moreover, we performed confirmatory factor analysis to assess the construct validity of the HWKAPBS.** RESULTS **Intraclass correlation coefficients for the four constructs (knowledge, awareness, practice, behavior) ranged from 0.918 to 0.993 (p<0.001 in all cases). All model fit indices in the confirmatory factor analysis were acceptable. Thus, confirmatory factor analysis confirmed the structure of the original version of the HWKAPBS with the four structures: knowledge, awareness, practice and behavior. Correlations between awareness, practice and behavior constructs were very high and statistically significant (p<0.001 in all cases). Kuder-Richardson Formula 20 for the knowledge construct was 0.611. Moreover, Cronbach's coefficients alpha for the awareness, practice and behavior constructs were 0.929, 0.866, and 0.766, respectively.** CONCLUSIONS **The HWKAPBS is a brief, reliable and valid tool to measure knowledge, attitudes and practice of the general public about heat waves.**

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Κλίμακα εκτίμησης της γνώσης, της ετοιμότητας, των πρακτικών και της συμπεριφοράς απέναντι στους καύσωνες: Μετάφραση και στάθμιση στα Ελληνικά

Περίληψη στο τέλος του άρθρου

Key words

Awareness
Behavior
Heat waves
Knowledge
Practice

Climate change is one of the most significant threats of our century, endangering the lives and well-being of people.[1] The last seven years have been the warmest years in the earth's history. Climate change is expected to increase the intensity, frequency, duration and severity of extreme weather events such as heat waves,[2] in which the maximum temperature is above 39 °C for at least three days.

Heat waves are a major public health problem, as they are associated with an increased number of emergency department visits, increased morbidity and mortality.[3,4] The

negative effects of a heat wave range from burns to heat strokes, kidney failures, heart attacks and even deaths.[5] Over the past 30 years, several studies have found that an increased number of deaths occur during a heat wave beyond the expected deaths under normal temperature conditions.[6–11]

The impact of a heat wave on morbidity and mortality is influenced by several factors, e.g. the quality of health services, living conditions and the preparedness of a country to deal with extreme weather events.[12,13] Livelihood conditions include the quality of houses, the socio-economic level of people and personal ability to manage difficult situations. In this context, several countries have developed national action plans to prevent and address the negative effects that heat waves can have on people's health.

Recently, scholars in Turkey and Malaysia have developed two valid instruments to assess the knowledge and attitudes of the general population towards heat waves.[14,15] We decided to use the instrument that has been developed in Turkey since it is a Mediterranean country with similar temperatures as Greece.

Thus, our aim was to translate and validate the heat wave knowledge, awareness, practice and behavior scale (HWKAPBS)[15] in Greek. To the best of our knowledge, this is the first study that evaluates psychometric properties of the HWKAPBS in a language other than that the developers of the tool have validated it.

MATERIAL AND METHOD

Study design

We collected our data during September 2023. We obtained our data through several ways: social media campaigns, e-mail campaigns, and face-to-face interviews. Thus, we conducted a cross-sectional study in Greece with a convenience sample. Adults that understand the Greek language can participate in our study.

The heat wave knowledge, awareness, practice and behavior scale comprises 28 items and the following four constructs: knowledge (15 items), awareness (5 items), practice (5 items) and behavior (3 items).[15] Total score is calculated for each construct. Higher scores are indicative of higher knowledge, awareness, practice and behavior towards heat waves.

First, we obtained a license from the HWKAPBS developers to translate and validate the tool in the Greek language. Then, we applied the forward-backward translation method[16] to obtain a valid Greek version of the HWKAPBS.

Afterwards, we performed cognitive interviews with 10 individuals from the general population to assess the face validity of the KAPBS. All the participants understood the items and the answers and so on we did not make changes to the HWKAPBS. Thus, the face validity of the HWKAPBS was excellent.

Then, we performed a test-retest study[17] to estimate the reliability of the HWKAPBS. In that case, we used a sample with 50 participants from the general public. These individuals filled the KAPBS two times with an interval of one week.

Finally, we collected data from 147 individuals to perform confirmatory factor analysis (CFA).[17] In that case, we assessed the construct validity of the scale for the awareness, practice and behavior constructs (13 items). Moreover, we calculated the Kuder-Richardson Formula 20 for the knowledge construct, and Cronbach's coefficient alpha for the other three constructs to assess the internal reliability of the KAPBS. Values greater than 0.6 for Kuder-Richardson Formula 20 and Cronbach's coefficient alpha are acceptable.

Ethical issues

We informed participants about the aim and design of our study and those who gave their written consent could fill the study questionnaire. Moreover, the Ethics Committee of Faculty of Nursing, National and Kapodistrian University of Athens (reference number: 459, September 2023) approved our study protocol. Our study was performed following the Declaration of Helsinki.

Statistical analysis

We used numbers and percentages to present categorical variables, as well as mean and standard deviation (SD) to present continuous variables. We calculated the intraclass correlation coefficients and 95% confidence intervals (CI) for the constructs scores between the two measurements in test-retest study. In CFA, we examined the goodness of fit indices by calculating the following indices: Chi-square/degree of freedom (x^2/df); root mean square error of approximation (RMSEA); goodness of fit index (GFI); adjusted goodness of fit index (AGFI); Tucker-Lewis index (TLI); incremental fit index (IFI); normed fit index (NFI); comparative fit index (CFI). Acceptable value for x^2/df is <5, for RMSEA is <0.10, and for all other measures in the CFA >0.90.[18,19] CFA was performed with AMOS version 21 (Amos Development Corporation, 2018). All other analyses were performed with the Statistical Package for Social Sciences (IBM SPSS), version 21.0 (IBM Corp, released 2012. IBM SPSS Statistics for Windows, version 21.0; IBM Corp, Armonk, NY). P-values <0.05 were considered as statistically significant.

RESULTS

Study population included 147 participants. Among them, 81% (n=119) were females, while 19% (n=28) were males. Among our participants, 10.2% (n=15) finished high school, 31.3% (n=46) possessed a University degree, and

58.5% (n=86) possessed a MSc/PhD diploma. Mean age was 35.5 years (SD: 10.7). Test-retest study revealed an excellent reliability of the HWKAPBS (tab. 1). Intraclass correlation coefficients for the four constructs ranged from 0.918 to 0.993 (p<0.001 in all cases).

Our CFA confirmed the structure of the original version of the HWKAPBS (fig. 1). All model fit indices were excel-lent, as table 2 shows. In particular, x^2/df was <5, RMSEA was <0.10, and GFI, AGFI, TLI, IFI, NFI and CFI were >0.90. Correlations between awareness, practice and behav-ior constructs were very high and statistically significant (p<0.001 in all cases). In particular, correlation coefficient between awareness and practice was 0.68, between aware-ness and behavior was 0.65, and between practice and behavior was 0.82.

Kuder-Richardson Formula 20 for the knowledge con-struct was 0.611. Moreover, Cronbach's coefficients alpha for the awareness, practice and behavior constructs were 0.929, 0.866, and 0.766, respectively. Corrected item-total correlations between the items and the constructs were moderate to high ranging from 0.508 to 0.889 (tab. 3). Also, Cronbach's alpha when a single item was deleted was increased only for an item in the awareness construct. Therefore, the reliability of the HWKAPBS was excellent.

Table 1. Intraclass correlation coefficients for the heat wave knowledge, awareness, practice and behavior scale in test-retest study.

Construct	Intraclass correlation coefficient	95% confidence interval	p-value
Knowledge	0.918	0.855 to 0.953	<0.001
Awareness	0.979	0.963 to 0.988	<0.001
Practice	0.993	0.988 to 0.996	<0.001
Behavior	0.958	0.926 to 0.976	<0.001

DISCUSSION

To the best of our knowledge this is the first study that assesses the psychometric properties of the heat wave knowledge, awareness, practice and behavior scale. We found that the HWKAPBS is a brief, reliable and valid tool to measure knowledge, attitudes and practice of the general public about heat waves. Thus, a valid and reliable version of the HWKAPBS is now available in the Greek language. The HWKAPBS comprises only 28 items and it is simple for individuals to fill it. Moreover, it measures four dimensions (i.e., knowledge, awareness, practice and behavior) and thus, totally covers the issue of heat waves.

Climate change and especially heat waves are creating more and more problems for individuals and countries alike. It is therefore necessary to increase people's knowl-edge so that they can formulate a better attitude towards heat waves.[20,21] Following the 2003 heat waves in France, public awareness programmes were implemented, which allowed people to react better to the 2006 heat waves.[22] Individuals' awareness is an important factor in shaping health education behaviors that can reduce the risks of heat waves.[23] For example, individuals who have heard instructions on how to cope with a heat wave are more likely to implement appropriate heat wave precautions more often and more effectively.[24] In this context, several
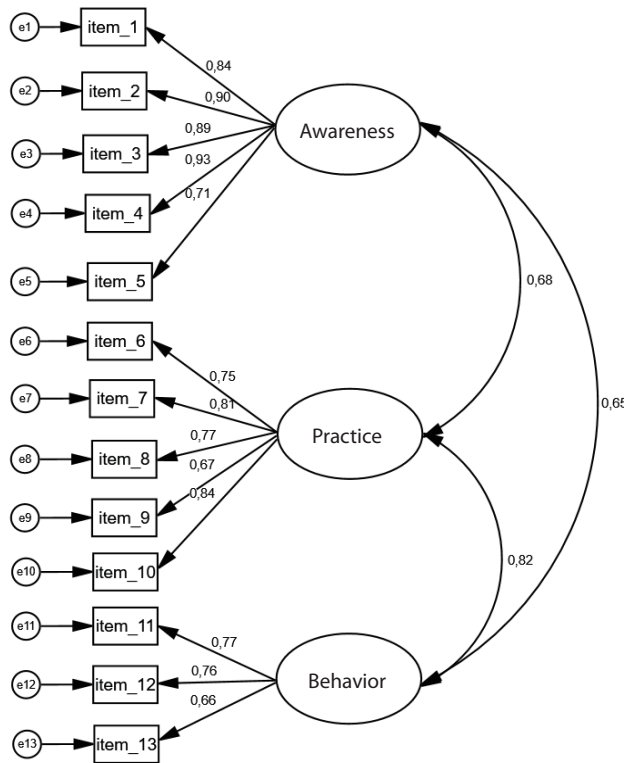

Figure 1. Confirmatory factor analysis of the heat wave knowledge, awareness, practice and behavior scale.

Table 2. Confirmatory factor analysis for the heat wave knowledge, awareness, practice and behavior scale.

Model	x^2	df	x^2/df	RMSEA	GFI	AGFI	TLI	IFI	NFI	CFI
13 items	61.16	46	1.330	0.048	0.943	0.901	0.981	0.989	0.958	0.989

Table 3. Corrected item-total correlation and Cronbach's alpha when a single item was deleted for the awareness, practice and behavior constructs (13 items).

Item	Corrected item-total correlation	Cronbach's alpha if item deleted
Awareness construct		
The frequency of extreme temperature events has been increasing globally	0.802	0.915
I am concerned that there will be more heat waves in the coming years	0.865	0.902
Heat waves with severe effects on health can occur in the area where I reside	0.842	0.907
If adequate measures are not taken, serious health consequences will occur due to heat waves in the near future	0.889	0.897
Measures to inform the community are required during heat waves	0.671	0.938
Practice construct		
During a heat wave, I avoid going out, especially at noon (11:00–15:00 hours)	0.686	0.838
I avoid physically demanding tasks during a heat wave	0.748	0.827
I drink a lot of water during heat waves	0.649	0.849
I avoid alcohol and caffeinated beverages during a heat wave	0.628	0.866
One should eat light meals and avoid foods with protein during heat waves	0.802	0.808
Behavior construct		
I keep track of the weather when there is a heat wave	0.640	0.639
I regularly keep an eye on weather reports	0.655	0.619
If I am warned about heat waves, I will take the precautions I know	0.508	0.780

countries have created national action plans to inform and prepare the public to successfully cope with a heat wave. These plans have proven effective in reducing mortality.[21,25]

The general population is showing deficiencies in its preparedness for the climate change that is taking place. Media campaigns are the most effective strategy to inform people.[26] Individual preparedness for a natural disaster requires knowledge of how to deal with it in order to protect oneself.[27] Literature suggests a significant correlation between heat wave knowledge, awareness, practice and behavior.[15,20]

Our study had a few limitations. First, we conducted a cross-sectional study with a convenience sample. Thus, our sample could be representative of the general population in Greece. Further studies with samples from different countries and cultures should be conducted to assess the psychometric properties of the HWKAPBS. Second, we collected our data using a self-reported questionnaire. Thus, information bias could be arising in our study. Finally, further validation analyses could be done. For example, we did not investigate concurrent and convergent validity of the scale.

In conclusion, the Greek version of the HWKAPBS showed excellent psychometric properties. Thus, the scale is a reliable and valid tool to measure knowledge and attitudes of the general public about heat waves. However, since it is the first study that validates the scale, further studies should be conducted to support our findings.

ΠΕΡΙΛΗΨΗ

Κλίμακα εκτίμησης της γνώσης, της ετοιμότητας, των πρακτικών και της συμπεριφοράς απέναντι στους καύσωνες: Μετάφραση και στάθμιση στα Ελληνικά

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ΣΚΟΠΟΣ Η μετάφραση και η στάθμιση στα Ελληνικά της κλίμακας εκτίμησης της γνώσης, της ετοιμότητας, των πρακτικών και της συμπεριφοράς απέναντι στους καύσωνες. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Διεξήχθη μια συγχρονική μελέτη στην Ελλάδα με ένα δείγμα ευκολίας 147 συμμετεχόντων. Εκτιμήσαμε την αξιοπιστία ελέγχου-επανελέγχου, την εσωτερική αξιοπιστία, την εγκυρότητα όψης και την εγκυρότητα κατασκευής. Υπολογίσαμε τους συντελεστές ενδοταξικής συσχέτισης, τον Kuder-Richardson Formula 20 και τον συντελεστή αξιοπιστίας Cronbach's alpha. Επί πλέον, διενεργήσαμε επιβεβαιωτική ανάλυση παραγόντων για την εκτίμηση της εγκυρότητας κατασκευής της κλίμακας. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Ο συντελεστής ενδοταξικής συσχέτισης για τις τέσσερις διαστάσεις της κλίμακας (γνώση, ευαισθητοποίηση, πρακτική και συμπεριφορά) κυμαινόταν από 0,918–0,993 (p<0,001 σε όλες τις περιπτώσεις). Όλοι οι δείκτες στην επιβεβαιωτική ανάλυση παραγόντων είχαν αποδεκτές τιμές. Έτσι, η επιβεβαιωτική ανάλυση παραγόντων επικύρωσε τη δομή της πρωτότυπης κλίμακας με τις τέσσερις διαστάσεις: γνώση, ευαισθητοποίηση, πρακτική και συμπεριφορά. Οι συσχετίσεις ανάμεσα στην ευαισθητοποίηση, στην πρακτική και στη συμπεριφορά ήταν αρκετά υψηλές και στατιστικά σημαντικές (p<0,001 σε όλες τις περιπτώσεις). Ο συντελεστής Kuder-Richardson Formula 20 για τις γνώσεις ήταν 0,611. Ο συντελεστής Cronbach's alpha για την ευαισθητοποίηση, την πρακτική και τη συμπεριφορά ήταν 0,929, 0,866 και 0,766, αντίστοιχα. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Διαπιστώθηκε ότι η κλίμακα είναι ένα σύντομο, αξιόπιστο και έγκυρο εργαλείο για τη μέτρηση της γνώσης, της συμπεριφοράς και των πρακτικών του γενικού πληθυσμού απέναντι στους καύσωνες.

Λέξεις ευρετηρίου: Γνώση, Ετοιμότητα, Καύσωνες, Πρακτική, Συμπεριφορά

References

1. CAMPBELL S, REMENYI TA, WHITE CJ, JOHNSTON FH. Heatwave and health impact research: A global review. *Health Place* 2018, 53:210–218

2. HUANG L, YANG Q, LI J, CHEN J, HE R, ZHANG C ET AL. Risk perception of heat waves and its spatial variation in Nanjing, China. *Int J Biometeorol* 2018, 62:783–794

3. AKOMPAB DA, BI P, WILLIAMS S, GRANT J, WALKER IA, AUGOUSTINOS M. Heat waves and climate change: Applying the health belief model to identify predictors of risk perception and adaptive behaviours in Adelaide, Australia. *Int J Environ Res Public Health* 2013, 10:2164–2184

4. ORAY NC, ORAY D, AKSAY E, ATILLA R, BAYRAM B. The impact of a heat wave on mortality in the emergency department. *Medicine (Baltimore)* 2018, 97:e13815

5. ZUO J, PULLEN S, PALMER J, BENNETTS H, CHILESHE N, MA T. Impacts of heat waves and corresponding measures: A review. *J Clean Prod* 2015, 92:1–12

6. SEMENZA JC, RUBIN CH, FALTER KH, SELANIKIO JD, FLANDERS WD, HOWE HL ET AL. Heat-related deaths during the July 1995 heat wave in Chicago. *N Engl J Med* 1996, 335:84–90

7. ROBINE JM, CHEUNG SLK, LE ROY S, VAN OYEN H, GRIFFITHS C, MICHEL JP ET AL. Death toll exceeded 70,000 in Europe during the summer of 2003. *C R Biol* 2008, 331:171–178

8. SHAPOSHNIKOV D, REVICH B, BELLANDER T, BEDADA GB, BOTTAI M, KHARKOVA T ET AL. Mortality related to air pollution with the Moscow heat wave and wildfire of 2010. *Epidemiology* 2014, 25:359–364

9. HENDERSON SB, McLEAN KE, LEE MJ, KOSATSKY T. Analysis of community deaths during the catastrophic 2021 heat dome: Early evidence to inform the public health response during subsequent events in greater Vancouver, Canada. *Environ Epidemiol* 2022, 6:e189

10. MA W, ZENG W, ZHOU M, WANG L, RUTHERFORD S, LIN H ET AL. The short-term effect of heat waves on mortality and its modi-

fiers in China: An analysis from 66 communities. *Environ Int* 2015, 75:103–109

11. CAN G, ŞAHIN Ü, SAYILI U, DUBÉ M, KARA B, ACAR HC ET AL. Excess mortality in Istanbul during extreme heat waves between 2013 and 2017. *Int J Environ Res Public Health* 2019, 16:4348

12. BENMARHNIA T, BAILEY Z, KAISER D, AUGER N, KING N, KAUFMAN JS. A difference-in-differences approach to assess the effect of a heat action plan on heat-related mortality, and differences in effectiveness according to sex, age, and socioeconomic status (Montreal, Quebec). *Environ Health Perspect* 2016, 124:1694–1699

13. DÍAZ J, CARMONA R, MIRÓN IJ, ORTIZ C, LINARES C. Comparison of the effects of extreme temperatures on daily mortality in Madrid (Spain), by age group: The need for a cold wave prevention plan. *Environ Res* 2015, 143:186–191

14. ARSAD FS, HOD R, AHMAD N, BAHAROM M, TANGANG F. The Malay-version knowledge, risk perception, attitude and practice questionnaire on heatwaves: Development and construct validation. *Int J Environ Res Public Health* 2022, 19:2279

15. SAYILI U, SIDDIKOGLU E, PIRDAL BZ, UYGUR A, TOPLU FS, CAN G. The heat wave knowledge, awareness, practice and behavior scale: Scale development, validation and reliability. *PLoS One* 2022, 17:e0279259

16. GALANIS P. Translation and cross-cultural adaptation methodology for questionnaires in languages other than Greek. *Arch Hellen Med* 2019, 36:124–135

17. GALANIS P. Validity and reliability of questionnaires in epidemiological studies. *Arch Hellen Med* 2013, 30:97–110

18. BAUMGARTNER H, HOMBURG C. Applications of structural equation modeling in marketing and consumer research: A review. *Int J Res Mark* 1996, 13:139–161

19. HU LT, BENTLER PM. Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychol Methods* 1998, 3:424–453

20. LI J, XU X, DING G, ZHAO Y, ZHAO R, XUE F ET AL. A cross-sectional study of heat wave-related knowledge, attitude, and practice among the public in the Licheng district of Jinan City, China. *Int J Environ Res Public Health* 2016, 13:648

21. VAN LOENHOUT JAF, VANDERPLANKEN K, KASHIBADZE T, GIUASHVILI N, GAMKRELIDZE A, SIMAN-TOV M ET AL. Heatwave-protective knowledge and behaviour among urban populations: A multi-country study in Tunisia, Georgia and Israel. *BMC Public Health* 2021, 21:834

22. FOUILLET A, REY G, WAGNER V, LAAIDI K, EMPEREUR-BISSONNET P, LE TERTRE A ET AL. Has the impact of heat waves on mortality changed in France since the European heat wave of summer 2003? A study of the 2006 heat wave. *Int J Epidemiol* 2008, 37:309–317

23. KIM M, KIM H, YOU M. The role of public awareness in health-protective behaviours to reduce heat wave risk. *Meteorol Appl* 2014, 21:867–872

24. LEFEVRE CE, BRUINE DE BRUIN W, TAYLOR AL, DESSAI S, KOVATS S, FISCHHOFF B. Heat protection behaviors and positive affect about heat during the 2013 heat wave in the United Kingdom. *Soc Sci Med* 2015, 128:282–289

25. TOLOO G, FITZGERALD G, AITKEN P, VERRALL K, TONG S. Evaluating the effectiveness of heat warning systems: Systematic review of epidemiological evidence. *Int J Public Health* 2013, 58:667–681

26. LENZHOLZER S, CARSJENS GJ, BROWN RD, TAVARES S, VANOS J, KIM Y ET AL. Awareness of urban climate adaptation strategies – an international overview. *Urban Clim* 2020, 34:100705

27. DIFFENBAUGH NS, PAL JS, GIORGI F, GAO X. Heat stress intensification in the Mediterranean climate change hotspot. *Geophys Res Lett* 2007, 34:11706

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