Prevalence of risk and protective factors associated with heat-related outcomes in Southern Quebec: A secondary analysis of the NuAge study

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ABSTRACT

OBJECTIVES: Heat vulnerability is increasing owing to climate change, aging and urbanization. This vulnerability may vary geographically. Our study examined the prevalence and distribution of risk and protective factors of heat-related outcomes among older adults across three health regions of Southern Quebec (Canada).

METHOD: This secondary cross-sectional study used data from the 1st follow-up of the NuAge longitudinal study, a cohort of community-dwelling older adults, aged 68–82 years at baseline, of three health regions: Eastern Townships, Montreal and Laval. Prevalence of factors, identified in Health Canada guidelines, was measured. An Older Adult Heat Vulnerability Index (OAHVI) simultaneously considering medical, social and environmental factors was constructed. The distribution of each factor and OAHVI was examined across the three regions. Results were weighted for age, sex (overall and region-specific analyses) and region (overall analyses).

RESULTS: Ninety percent of participants had ≥ 1 risk factor, the most prevalent being: cardiovascular medication (50.8%), hypertension (46.7%), living alone (39.2%), cardiovascular disease (36.9%), living in an urban heat island (34.7%) and needing help in activities of daily living (26.5%). Two thirds of participants had ≥ 1 protective factor, the most prevalent being talking on the phone daily (70.9%). Heat vulnerability varied greatly by region and this variation was mainly attributable to social and environmental rather than medical factors. According to the OAHVI, 87.2% of participants cumulated ≥ 2 factors (median = 3.0 factors/participant).

CONCLUSION: Our results support the need for small-scale assessment of heat vulnerability. This study could help stakeholders tackle heat-related illness and develop regionally tailored prevention programs.

KEY WORDS: Extreme heat; risk factors; protective factors; aged

La traduction du résumé se trouve à la fin de l'article.

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Extreme heat can cause a range of heat-related illnesses and exacerbate certain pre-existing chronic conditions.¹ In Quebec, extreme heat is defined as a temperature $\geq 30^{\circ}\text{C}$ and a humidex value $\geq 40^2$ and heat wave definitions vary according to region (maximal and minimal temperature thresholds are $\geq 31^{\circ}\text{C}$ and $\geq 18^{\circ}\text{C}$; $\geq 33^{\circ}\text{C}$ and $\geq 20^{\circ}\text{C}$ for at least 3 days for Eastern Townships and Montreal/Laval respectively).³ During an intense and long heat wave that occurred from July 6 to 11, 2010, 106 deaths probably or possibly attributable to heat were observed in the city of Montreal.⁴ During the same week, 30.1% excess deaths were observed, mainly among older adults (≥ 75 years of age), in the province of Quebec as compared with 2008 and 2009.⁵

Older adults are particularly at risk of heat-related outcomes¹ owing to multimorbidity, polypharmacy, loss of autonomy, social isolation, and altered physiological response to extreme thermal conditions.⁶

Quebec's population heat vulnerability is expected to increase due to predictable climate change. It has been estimated that the expected mean annual numbers of hot temperature days (maximal temperature $\geq 30^{\circ}\text{C}$) by 2039–2063 will be double those

from 1975–1999, and the extent of geographical areas at risk will increase dramatically over the coming decades, particularly in urbanized areas of Southern Quebec.⁷ Heat vulnerability will also

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increase given demographic changes. In Quebec, 11.7% of the population was aged 65 years and over in 2011, a proportion projected to reach almost a third of the population by 2056.⁸ In 2011, 78% and 85% of older adults aged 65-74 years and 75 years and over respectively lived in urban areas.⁹ Urban areas tend to have fewer green spaces and more impervious cover, which contribute to the urban heat island (UHI) effect.¹⁰ Urbanization thus increases the probability of being exposed to higher temperatures.¹

Because adverse heat-related health outcomes is a growing public health problem, it is essential to identify and support people deemed most at risk based on factors that positively or negatively influence their heat vulnerability. These factors mainly include medical (e.g., cardiovascular disease, diuretic use), social (e.g., living alone, low income) and environmental (e.g., high land surface temperature) predictors.

Few Heat Vulnerability Indexes (HVI), summarizing social and environmental predictors of heat vulnerability¹⁰⁻¹² and, more rarely, medical risk factors¹⁰ and protective factors,^{10,11} have been created. In Quebec, a social vulnerability index to high temperature events was developed using advanced age, low income, social isolation and low education.⁷ Only one study, conducted in Ontario, targeted older adults, a highly vulnerable subgroup of the population, and includes in its senior vulnerability index, factors specific to this population, namely very old age (75 years and over), frailty, disability, $\geq 30\%$ of family income on housing, and emergency visits.¹³ Major risk factors, such as pre-existing health conditions, medication use and the degree of social connections among individuals within a community, were not included due to insufficient data availability.^{7,10-13} Inclusion of major protective factors was also limited by data availability. For example, air conditioning (AC), a highly protective factor, was included in some HVI^{10,11} but not in others.^{7,12,13}

The HVI can be mapped to the study area. Using this method, a substantial geographic variation across census tracts or census block groups has been observed in heat vulnerability in some states in the United States¹⁰⁻¹² and in the city of Toronto (Ontario, Canada).¹³

Development of previous HVI usually followed procedures outlined by Reid et al. (2009).¹⁰ Briefly, a principal components analysis is applied and, for each factor retained, a range of possible values (where higher ones denote higher vulnerability) is assigned and the sum constitutes the HVI. However, this analysis can be quite complex. There is a need for simple and easily computed HVI, encompassing all relevant dimensions (i.e., medical, social and environmental) of heat vulnerability, which could be useful for 1) public health practitioners to locate vulnerable populations and 2) health and social care professionals to identify and protect their most vulnerable clients. Although some of these HVI have been linked with heat-related health outcomes, mainly mortality, they do not appear to be well-validated tools.

The aim of this study was to assess, at small scale, a wide range of risk and protective factors of heat-related outcomes that could occur simultaneously among older adults living in Southern Quebec. Our objectives were to 1) estimate the global frequency

of risk and protective factors associated with heat-related health outcomes, 2) examine geographic variation across health regions of these factors and 3) construct a simple Older Adult Heat Vulnerability Index (OAHVI) simultaneously taking into account these factors.

METHODS

Setting

This study was conducted in 3 of the 18 Quebec health regions located in Southern Quebec: Eastern Townships (mix of urban, semi-urban, and rural areas), Montreal (metropolitan area) and Laval (urban area). In 2013, the population and population density (inhabitants/km²) of these regions were: 318,350 and 31.2 for Eastern Townships, 1,959,987 and 3,935.7 for Montreal, and 417,314 and 1,696.4 for Laval. In 2013, older adults (65 years and over) represented 18.7%, 15.7% and 15.9% of the population in Eastern Townships, Montreal and Laval respectively.¹⁴

Participants and study design

The Quebec longitudinal study of nutrition as a determinant of successful aging (The NuAge study) is a five-year longitudinal study of generally healthy community-dwelling older adults (853 men and 940 women born between 1921 and 1935) living in Eastern Townships, Montreal and Laval health regions. A random sampling from the Régie de l'assurance maladie du Québec medico-administrative database was used to identify potential participants and a sample stratified for age (68-72, 73-77, 78-82 years), sex and region was set up. Approximately equal proportions of participants were recruited at the two participating research centres: the Geriatric University Institute of Montreal (GUIM) covering the Montreal and Laval health regions, and the Geriatric University Institute of Sherbrooke (GUIS) covering the Eastern Townships health region. The participation rate was 58.6%. Characteristics of the cohort were described previously.¹⁵

This secondary cross-sectional study includes all community-dwelling participants still in the cohort at the 1st follow-up (2005-2006) residing in Eastern Townships ($n = 901$), Montreal ($n = 471$) and Laval ($n = 307$) health regions; no participants were excluded. At that time, only 6% of participants were lost to follow-up.

Variables

Health Canada Extreme Heat Events Guidelines (2011) provide an up-to-date overview of the national and international literature regarding health impacts of extreme heat. A systematic approach was used to identify factors associated with heat-related morbidity and mortality.¹ All factors examined in the current study were selected from these guidelines and are presented in Figure 1. Explaining the mechanisms linking these factors to heat-related disorders is beyond the scope of this study. All data, except those relating to material deprivation, living in a UHI or in a coolness island (which were obtained from the Institut national de santé publique du Québec (INSPQ)), were self-reported during in-person interviews with trained nurses or dietitians using validated questionnaires.¹⁵

Figure 1. Older adult's heat vulnerability model, adapted from Health Canada guidelines (2011)

Health Conditions

Self-reported physical health disorder variables were obtained via the Older Americans' Resources and Services (OARS) Multidimensional Functional Assessment Questionnaire¹⁶ and classified according to the International Classification of Diseases, ninth revision, except for obesity, defined as a body mass index ≥ 30 kg/m².¹⁷ The 30-item Geriatric Depression Scale (GDS),¹⁸ the Modified Mini-Mental State examination (3MS)¹⁹ and the Functional Autonomy Measurement System (SMAF)²⁰ have been used to assess the presence of depressive symptoms (GDS ≥ 11), cognitive impairment (3MS < 80) and disability in activities of daily living (needing help in ≥ 1 activity) respectively. Staying in bed for health reasons was measured during the 6-month follow-up phone calls.

Medication Use

Central nervous system and cardiovascular medication use were classified according to the American hospital formulary system.

Social Factors

Material deprivation was calculated at the dissemination area level (assigned based on the postal code of participant's residence) using the Pampalon deprivation index.²¹ Participants in the fifth quintile (Q5) were considered to be living in materially deprived neighbourhoods.

Environmental Factor

Using participants' personal address transformed into unique latitude and longitude, a geomatic specialist of the INSPQ determined whether this localization was in a UHI, a coolness

island or neither according to analysis of thermal information from Landsat satellite images.

Protective Factors

Social participation was measured using a 10-item questionnaire scored on a 5-point scale ranging from 1—almost every day to 5—never. Final scores ranged from 10 to 50; a score ≤ 30 reflected several activities at least once a week to almost daily, indicating high social participation. Visiting places with AC was defined as visiting at least one air-conditioned place almost every day.

Older Adults Heat Vulnerability Index (OAHVI)

The OAHVI was developed to assess the cumulative risk of heat-related health outcomes. A score ranging from 0 to 9 was calculated from the sum of factors (0 or 1 point/category): physical health disorders, mental health and cognitive disorders, loss of autonomy factor, central nervous system medication use, cardiovascular medication use, social isolation factor, low socio-economic status (SES) factor, environmental risk factor, and absence of highly protective/protective factor. Higher values reflect elevated heat vulnerability.

Data analysis

As the NuAge sample was stratified for age, sex and region, overall and health region-specific analyses were weighted for age and sex, and weights for regions were also applied for overall analyses. The prevalence of each factor was calculated in the total sample and within each region and corresponds to the valid percentage (no replacement of missing data). Partial non-response rates were computed separately for each risk and protective factor (i.e., dividing the number of participants with

missing data by 1,679 participants for each factor examined) and ranged from 0 to 14%. Pearson's chi-squared (χ^2) test was used to compare the prevalence of factors between regions. Some *p*-values were not reported when the χ^2 test could not be performed where basic assumptions were not met. Because of stratification of the sample, Fisher's exact test could not be performed. For the OAHVI, the Kruskal-Wallis test was carried out. Analyses were performed with SPSS 18 and SAS 9.2 statistical software and level of statistical significance was set at 0.05.

Ethics

The NuAge study has been approved by the ethics committees of the GUIM and GUIs. All participants signed the consent form, including authorization for their data and biological samples to be included in the NuAge Database and Biobank for investigative work by NuAge investigators and their collaborators. The current study has been approved by the ethics committee of the GUIs.

RESULTS

Table 1 shows global and health region-specific prevalence of risk and protective factors associated with heat-related outcomes in Southern Quebec. Health conditions and medication use were frequent in our sample (78.3% and 53.6% respectively). Overall, frequency of physical health disorders was higher than that of mental health and cognitive disorders or loss of autonomy, and was more elevated in the Eastern Townships relative to the other regions under study. About 10% of participants had depressive symptoms or took antidepressants, with the highest prevalence observed in Montreal ($p = 0.02$). More than half of the sample had social risk factors, with major differences between regions. Social isolation was more frequent among Montreal participants, whereas low SES was twice as frequent in the Eastern Townships as in Montreal or Laval. More than a third of participants lived in a UHI in the Eastern Townships and Montreal, compared to only 18.3% in Laval. Having at least one protective factor was frequent overall (69.4%) and significant differences were observed between regions ($p < 0.0001$). While participants living in Montreal were more likely to report high social participation, visiting places with AC, and talking on the phone daily, a higher proportion of Eastern Townships participants lived in a cooling island. Globally, a median of 3.0 factors per participant was computed, increasing their heat vulnerability, yet significant disparities were observed between regions ($p < 0.0001$).

Figure 2 shows global and regional distributions of the OAHVI score. Having more than one factor increasing heat vulnerability was very common (92.9% Eastern Townships, 87.1% Montreal, 82.7% Laval).

DISCUSSION

Montreal/Laval and Eastern Townships residents were bothered by more than several hot temperature days (i.e., 45 and 34 days respectively) during the 2006-2010 summer seasons. Describing the prevalence of potential factors contributing the most to heat vulnerability is essential in order to inform public health authorities.

Overall, this study showed that heat vulnerability was very common among older adults in Southern Quebec, as the simultaneous presence of several factors increasing vulnerability was observed in most participants.

The most prevalent risk factors were cardiovascular conditions, with approximately 60% of older adults having cardiovascular disease or hypertension and half of them reporting cardiovascular medication use. These prevalences are similar to previous observations in Montreal.²² Our results show that physical health disorders are five times more prevalent than mental health and cognitive disorders. However, these results might reflect the general good health and autonomy of NuAge participants at baseline. Nevertheless, depressive symptoms were present in 12% of participants, which is similar to previous observations made for the province of Quebec.²³ Clinicians should consider cardiovascular diseases and depression when assessing patients' vulnerability to heat, given that they are frequent, relatively easy to detect, and have been identified as major underlying causes of heat-related mortality in Quebec⁴ and elsewhere.

Needing help in activities of daily living (ADL) was prevalent (26.5%) and much higher than proportions reported in surveys for the province of Quebec among individuals aged 65 years and older (range 2.2%–6.29%).²⁴ However, ADL disabilities were self-reported in these surveys while the SMAF is based on a clinical evaluation of functional autonomy, including disabilities and handicaps. Knowing that older adults tend to overestimate their level of functioning,²⁵ clinical assessment, rather than self-reported information, is needed to adequately assess this risk factor. Presence of disability in self-care could translate to difficulties in taking appropriate actions to prevent heat-related health issues, such as voluntary hydration or effective cooling.¹ Living alone was highly prevalent (39.2%) in this study sample and, as previously reported, prevalence varies greatly according to regions,²⁶ with the highest proportion in Montreal,²² highlighting the need for region-tailored prevention strategies.

About a third (34.7%) of our participants were living in a UHI. In 2011, 18.7% of the adult population, including older adults, were living in a UHI in Sherbrooke (main city in Eastern Townships).²⁷ Thus, the likelihood of living in a UHI may vary greatly according to place of residence and possibly by age. Our study also suggests that this factor is not solely related to the level of urbanization, since our results show similar proportions of participants living in a UHI in the Eastern Townships and Montreal, despite important differences in residential density between these areas. UHIs more frequently occur in large cities; however, they can form over any built-up area,¹ depending on climatic, energetic, geographic, morphologic, politic and structural factors.²⁸

This study showed that heat vulnerability varied by health region and was mainly due to social and environmental factors rather than medical conditions. To our knowledge, this is the first study examining variation of a wide range of risk and protective factors at a small scale. The important and numerous disparities observed between regions in several potential predictors of heat-related outcomes support the need for small-scale assessment of heat vulnerability among older adults.

Table 1. Prevalence of risk and protective factors associated with heat-related outcomes in a community-dwelling cohort of older adults

	Total sample (n = 1679)	Eastern Townships (n = 901)	Montreal (n = 471)	Laval (n = 307)	χ^2 test p-value
Risk factors (%)					
Health conditions					
Physical health disorders					
Cardiovascular disease	36.9	43.5	35.9	36.4	0.10
Pulmonary disease	4.7	5.0	4.7	4.1	0.89
Neurological disease	0.8	1.7	0.5	1.7	0.12
Renal disease	3.2	5.1	2.3	6.9	0.002
Hypertension	46.7	58.0	44.9	46.3	0.002
Diabetes	11.4	11.2	11.5	11.3	0.99
Obesity	25.2	27.4	25.4	22.1	0.46
≥1 physical health disorder	72.1	81.0	70.5	72.9	0.006
Mental health and cognitive disorders					
Depressive symptoms	12.0	9.1	13.2	7.8	0.02
Cognitive impairment	1.9	3.9	1.6	1.5	0.09
Bipolar disorders	0.3	0	0.4	0	—
≥1 mental health or cognitive disorder	13.7	12.3	14.7	9.1	0.06
Loss of autonomy					
Needing help in activities of daily living	26.5	23.0	28.9	15.6	<0.0001
Obligation to stay in bed	7.5	11.8	7.1	5.4	0.03
≥1 factor related to loss of autonomy	30.3	29.4	32.5	18.2	<0.0001
≥1 health condition (physical or mental health and cognitive disorders, or loss of autonomy)	78.3	83.3	78.1	74.4	0.07
Medication use					
Cardiovascular medication use					
Diuretics	20.7	19.7	21.2	18.7	0.64
Antiarrhythmics and cardiotonics	36.2	40.5	35.7	35.2	0.37
Nitrate vasodilators	4.6	7.7	4.2	4.0	0.07
Angiotensin-converting enzyme inhibitors	16.8	22.4	15.4	19.7	0.02
Calcium channel blockers	17.9	23.8	17.0	17.2	0.05
≥1 cardiovascular medication use	50.8	55.9	49.8	51.9	0.24
Central nervous system medication (CNS) use					
Antipsychotics/neuroleptics	1.1	0.1	1.3	0.6	0.16
Antidepressants	7.3	6.4	8.1	3.5	0.02
Lithium	0.1	0.1	0	0.6	—
Antiepileptics	1.9	2.0	1.9	2.1	0.98
Anti-Alzheimer's agents	0.1	0.3	0	0.3	—
Anti-Parkinson's agents	0.8	1.5	0.5	2.2	0.05
≥1 CNS medication use	9.2	9.6	9.2	8.4	0.91
≥1 CNS or cardiovascular medication use	53.6	59.6	52.1	57.2	0.07
Social factors					
Social isolation					
Living alone	39.2	32.1	42.9	24.1	<0.0001
Knowing nobody enough to visit them	1.3	1.2	1.5	0.2	0.10
Not leaving home	6.7	4.1	6.7	9.0	0.12
≥1 factor related to social isolation	44.3	36.4	47.6	32.5	<0.0001
Low SES					
Family household income <\$20,000	14.9	21.4	14.2	12.8	0.03
Primary school level or less	10.2	30.0	6.5	13.7	<0.0001
Material deprivation	8.9	10.8	9.2	5.4	0.08
≥1 factor related to lower SES	25.7	46.5	23.0	22.4	<0.0001
≥1 social factor	53.2	61.7	53.9	42.0	<0.0001
Environmental factor					
Living in an urban heat island	34.7	39.6	36.8	18.3	<0.0001
Protective factors (%)					
Highly protective factors (%)					
High social participation	13.6	10.2	15.1	7.7	0.002
Visiting places with AC	10.6	7.3	12.0	5.4	0.0009
Living in a coolness island	1.2	5.4	0.5	1.4	<0.0001
Protective factor					
Talking on the phone daily	70.9	54.9	74.6	64.4	<0.0001
≥1 highly protective or protective factor	69.4	59.8	72.8	58.2	<0.0001
OAHVI score (0–9) (median)	3.0	4.0	3.0	3.0	<0.0001*

* Kruskal-Wallis test for independent samples.

Examination of the OAHVI developed for this study showed that simultaneous presence of risk factors (or absence of protective factors) was the norm among study participants. A median of 3.0 factors per participant was observed, suggesting heat vulnerability; however, this varied significantly across the three regions investigated. Using mainly social and environmental predictors, spatial clustering of heat vulnerability has been observed in the US^{10–12} and Canada.¹³ The predictive validity of the OAHVI should be examined in further studies in

relation to heat morbidity or mortality. Once validated, this index would be useful in clinical settings to identify heat-vulnerable older adults and implement intensive interventions among these high-risk individuals.

Strengths

Based on a large representative sample of older adults living in Southern Quebec, with a very low rate of loss to follow-up (6%), our findings contribute to current knowledge on global and

Figure 2. Distribution of the OAHVI score in a community-dwelling cohort of older adults

health region-specific frequency of risk and protective factors associated with heat-related health outcomes. All factors examined were previously identified in the 2011 Health Canada guidelines. Moreover, our study went further than published literature by examining the distribution of these factors at a smaller scale and by providing information on a wider range of factors, including health conditions and medication use. Finally, our study proposed a new HVI, targeting older adults (OAHVI), which could be an important predictor of individuals' global risk of heat-related outcomes.

Limitations

Our study presents limitations. First, all factors were measured in 2005 or 2006 and not necessarily during hot temperature days. This could lead to an over- or underestimation of social factors, such as being homebound vs. high social participation or visiting locations with AC, that may vary over time.

Global participation rate was 58.6%. Non-responders were more likely to be older and living in a metropolitan area. This might have led to underestimation of the prevalence rates of risk and protective factors globally (e.g., medical factors which may be more frequent with advanced age) and among the Montreal/Laval subsample.

Furthermore, no data were available on AC at home (highly protective factor in Health Canada guidelines). However, this protective factor was indirectly considered through the inclusion of the low family household income variable. Indeed, Quebecers with a lower household income (<\$20,000) are 1.3 to 2.8 times less likely to have AC at home compared to their more affluent counterparts (household income ≥\$80,000).^{27,29} AC utilization might be less frequent among low SES persons due to purchase and operation costs.¹² Other heat-related factors were not available in the NuAge database, such as living on the top floor of a building, history of heat stroke/illness and lack of or improper acclimatization.¹ Finally, as our sample is composed of generally healthy community-dwelling older adults residing in private households in the Eastern Townships, Montreal and Laval, generalizability of our results to other contexts might be limited.

CONCLUSION

Risk and protective factors associated with heat-related health outcomes were prevalent among older adults in Southern Quebec, and the vast majority of respondents presented multiple factors. Heat vulnerability also varied according to health regions. Our proposed OAHVI should be tested further by linking it to heat-related morbidity or mortality data in order to evaluate its predictive validity.

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RÉSUMÉ

OBJECTIFS : La vulnérabilité à la chaleur est en augmentation en raison des changements climatiques, du vieillissement de la population et de l'urbanisation. Cette vulnérabilité peut varier géographiquement. Notre étude examine la prévalence globale et la distribution des facteurs de risque et de protection des problèmes de santé liés à la chaleur chez les personnes âgées dans trois régions sociosanitaires du sud du Québec (Canada).

MÉTHODES : Il s'agit d'une étude transversale des données du 1^{er} suivi de l'étude longitudinale NuAge, une cohorte de personnes âgées de 68–82 ans à l'inclusion et vivant dans la communauté, dans trois régions sociosanitaires: Estrie, Montréal et Laval. La prévalence des facteurs, identifiés dans les lignes directrices de Santé Canada, a été mesurée. Un indice de vulnérabilité à la chaleur des aînés (IVCA) considérant simultanément plusieurs facteurs médicaux, sociaux et environnementaux a été construit. La distribution de chaque facteur et de l'IVCA a été examinée dans chacune des trois régions. Les résultats ont été pondérés selon l'âge, le sexe (analyses globales et régionales) et les régions (analyses globales).

RÉSULTATS : Quatre-vingt-dix pour cent des participants présentaient ≥1 facteur de risque, les plus fréquents étant la médication cardiovasculaire (50,8%), l'hypertension (46,7 %), vivre seul (39,2 %), les maladies cardiovasculaires (36,9 %), vivre dans un îlot de chaleur urbain (34,7 %) et le besoin d'aide dans les activités de la vie quotidienne (26,5 %). Les deux tiers des participants présentaient ≥1 facteur de protection, le plus fréquent étant de parler au téléphone tous les jours (70,9 %). La vulnérabilité à la chaleur variait grandement selon la région et cette variation était principalement attribuable à des facteurs sociaux et environnementaux plutôt qu'à des facteurs médicaux. Selon l'IVCA, 87,2 % des participants cumulaient ≥2 facteurs (médiane = 3,0 facteurs/participant).

CONCLUSION : Nos résultats appuient la nécessité d'évaluer la vulnérabilité à la chaleur à une échelle régionale. Cette étude pourrait aider les parties prenantes à lutter contre les maladies liées à la chaleur et à développer des programmes de prévention adaptés aux différentes régions.

MOTS CLÉS : chaleur extrême; facteurs de risque; facteurs de protection; vieillissement