

# A meta-analysis of social factors predicting household-level heat-related illness in Phoenix, Arizona

Mary K. Wright, David M. Hondula, and Kelli L. Larson

## Introduction

The social and environmental characteristics that make residents more vulnerable to heat-related mortality and morbidity have been the subject of extensive study, particularly in the hot, desert city of Phoenix, Arizona. As part of this effort, numerous social surveys have been conducted in the Phoenix area over the past decade (including the Phoenix Area Social Survey (PASS)). Social surveys are highly valuable to the heat vulnerability research community because they are time and resource-intensive to collect yet are the only way to obtain information related to households' adaptive capacity to heat and experiences with heat that do not necessarily result in formal medical care or mortality. Unfortunately, the findings from these surveys are often not published and the administration of the surveys in Phoenix has been fairly disparate.

Thus, to synthesize the valuable knowledge contained in these surveys, we conducted a meta-analysis of the various risk factors predicting heat-related illness using eight heat-oriented social surveys conducted in Phoenix over the past decade to address how survey measures of heat vulnerability are related to incidence of heat-related illness.

## Methods

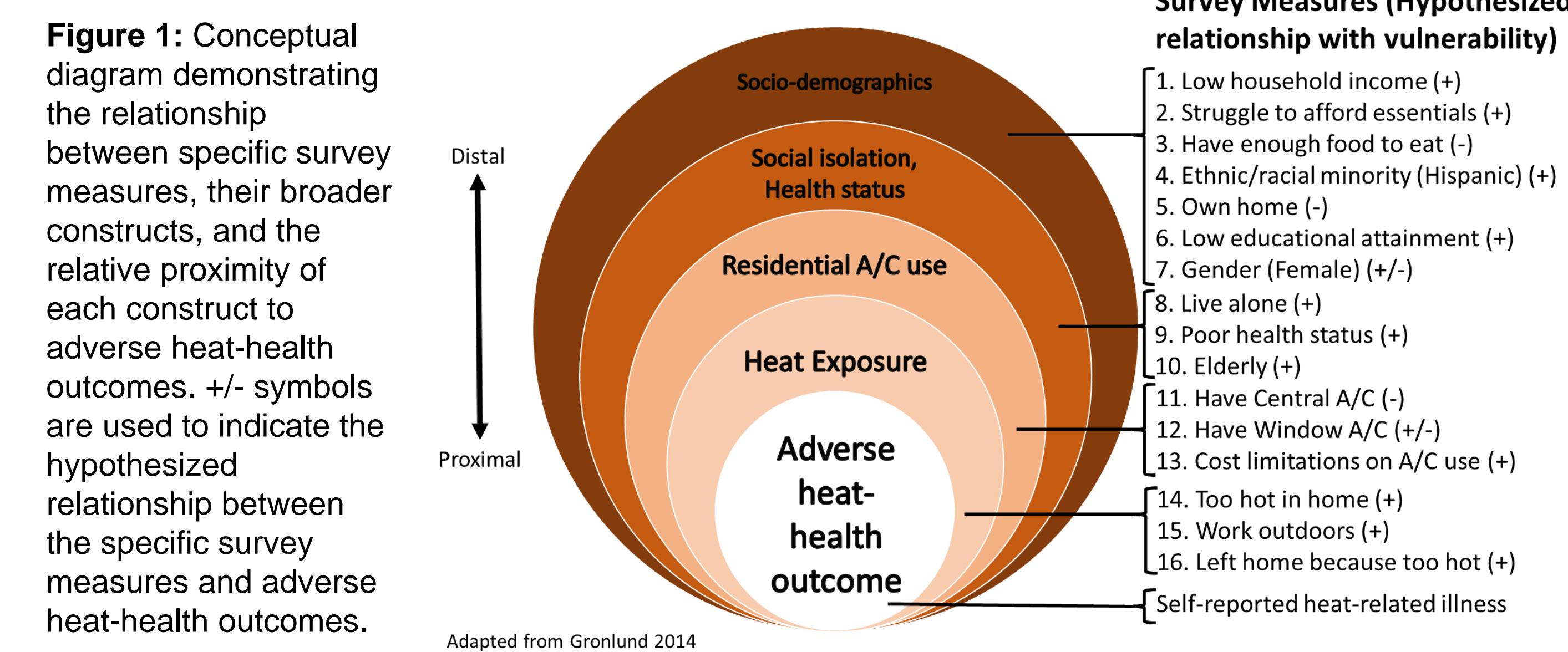
### Heat surveys in the Greater Phoenix Area (2010-2020)

Seven surveys (right) were included in the meta-analysis. Each survey asked about residents' experience with heat-related illness.

Survey	Administered by	N	year
PASS 2011	Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER)	744	2011
CASPER	Maricopa County Department of Public Health	328	2015
3HEAT	ASU, Georgia Tech, and University of Michigan researchers	163	2016
PASS 2017	Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER)	487	2017
HOME-Air	ASU Urban Climate Research Center	303	2017
Schmidt Futures	ASU Knowledge Exchange for Resilience via Schmidt Futures project	45	2019
Tempe	City of Tempe	193	2020

### Selection of survey measures

Sixteen survey measures (Figure 1) related to heat vulnerability occurred in at least three of the surveys, and so were included in the meta-analysis.



### Using meta-analysis to synthesize survey responses in relation to heat-related illness (HRI)

Calculate effect sizes as odds ratios, controlled for household size where appropriate

Synthesize effect sizes → "summary effect"

In a random-effects model, individual studies are weighted to minimize both **within study variance** and **between study variance**

Can quantify heterogeneity of effect sizes between studies:

$T^2$  – estimated between studies variance

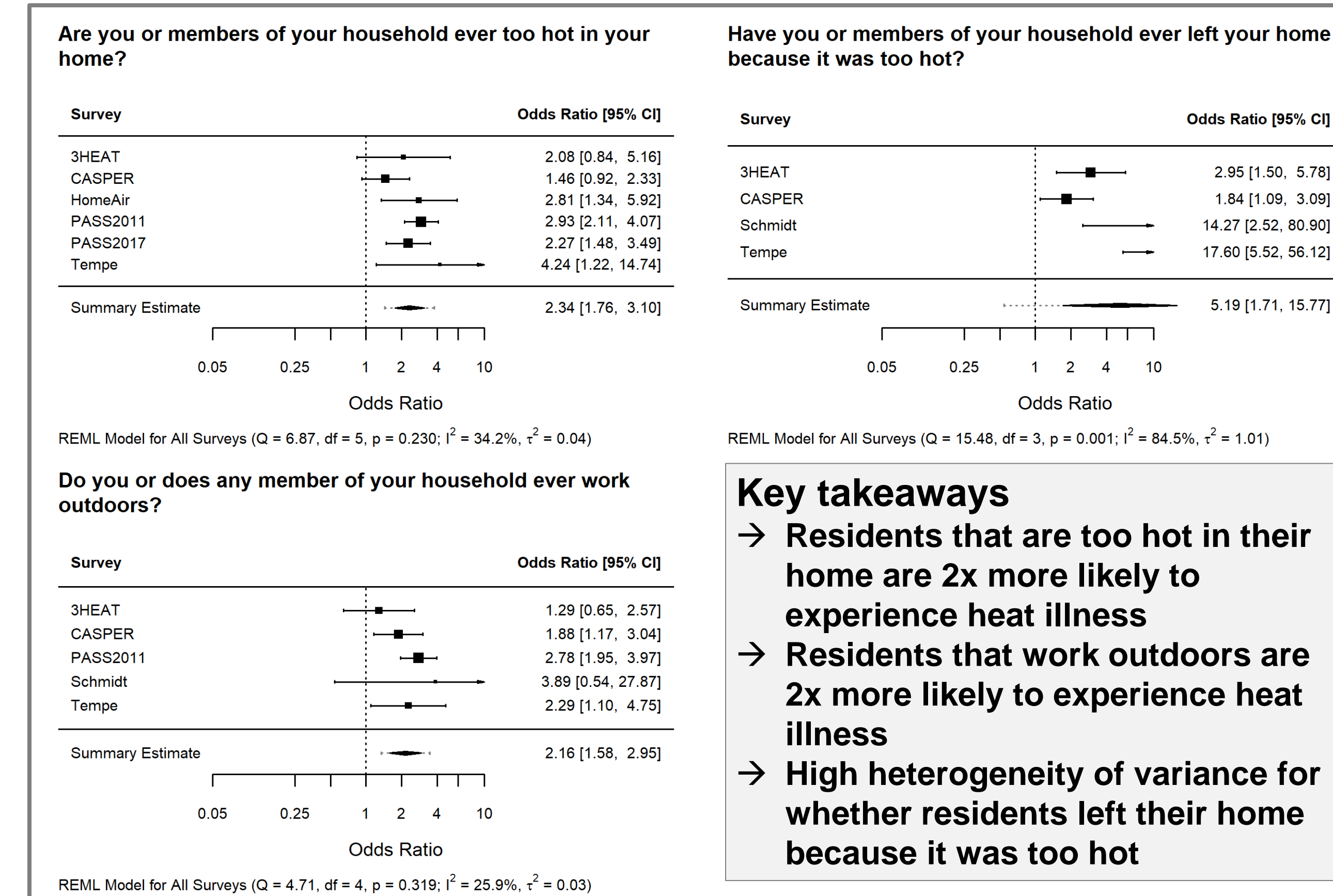
$I^2$  – proportion of observed variance that reflects real differences in effect size

$Q$  – test statistic to assess certainty of apparent heterogeneity

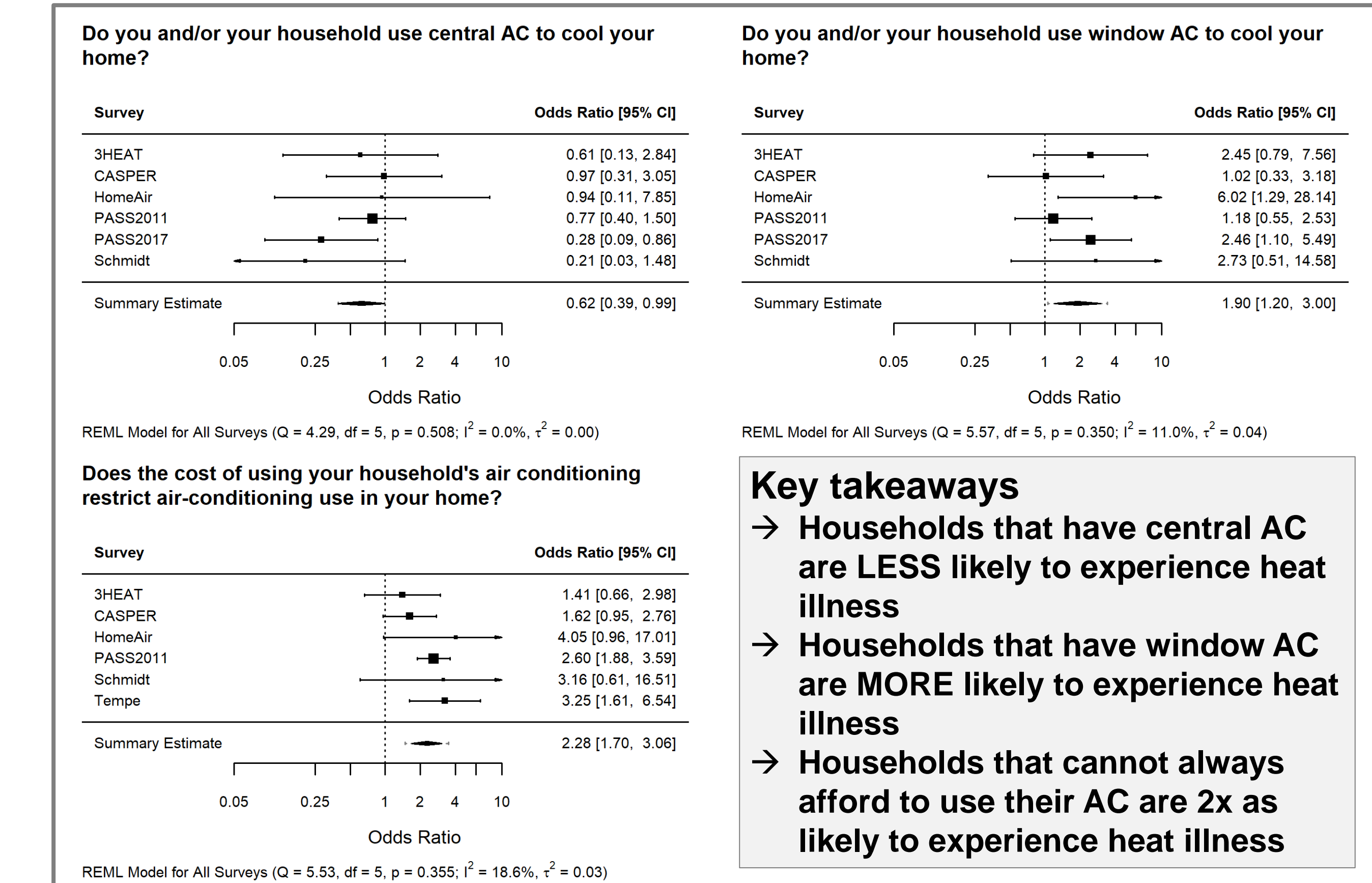
Used a random-effects meta-analysis model with restricted maximum-likelihood (REML) to estimate  $T^2$

## Results

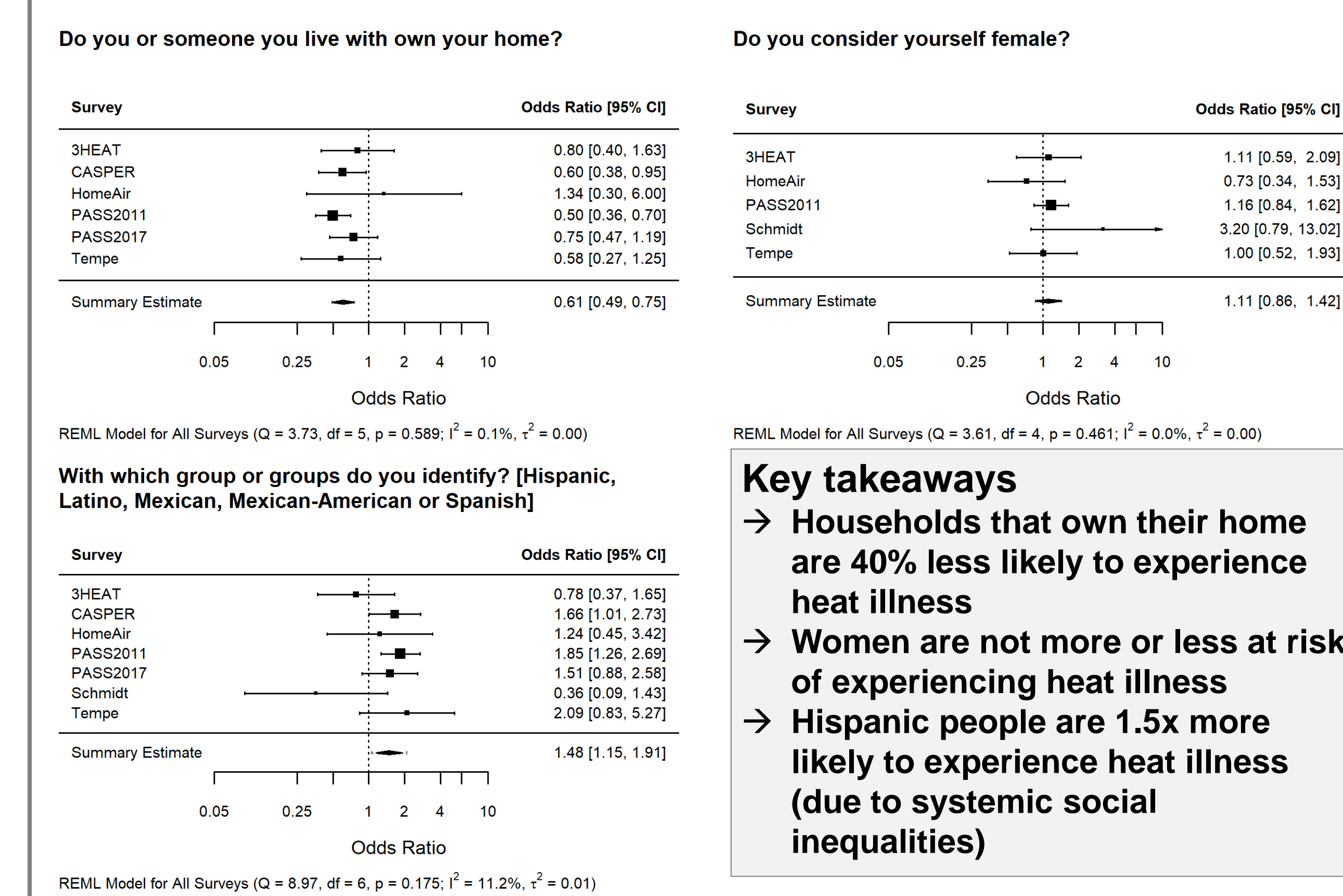
### Heat Exposure



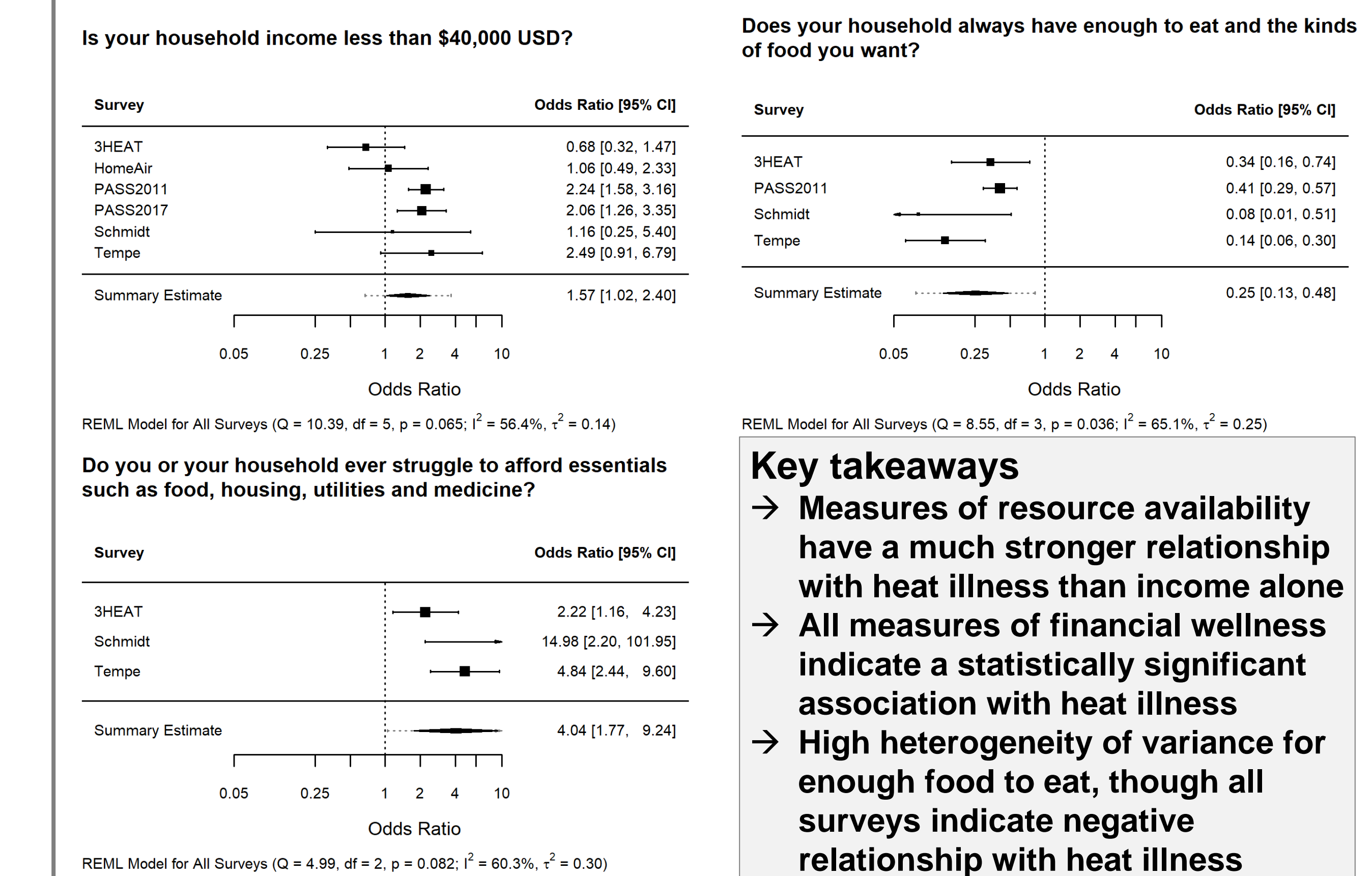
### Residential A/C use



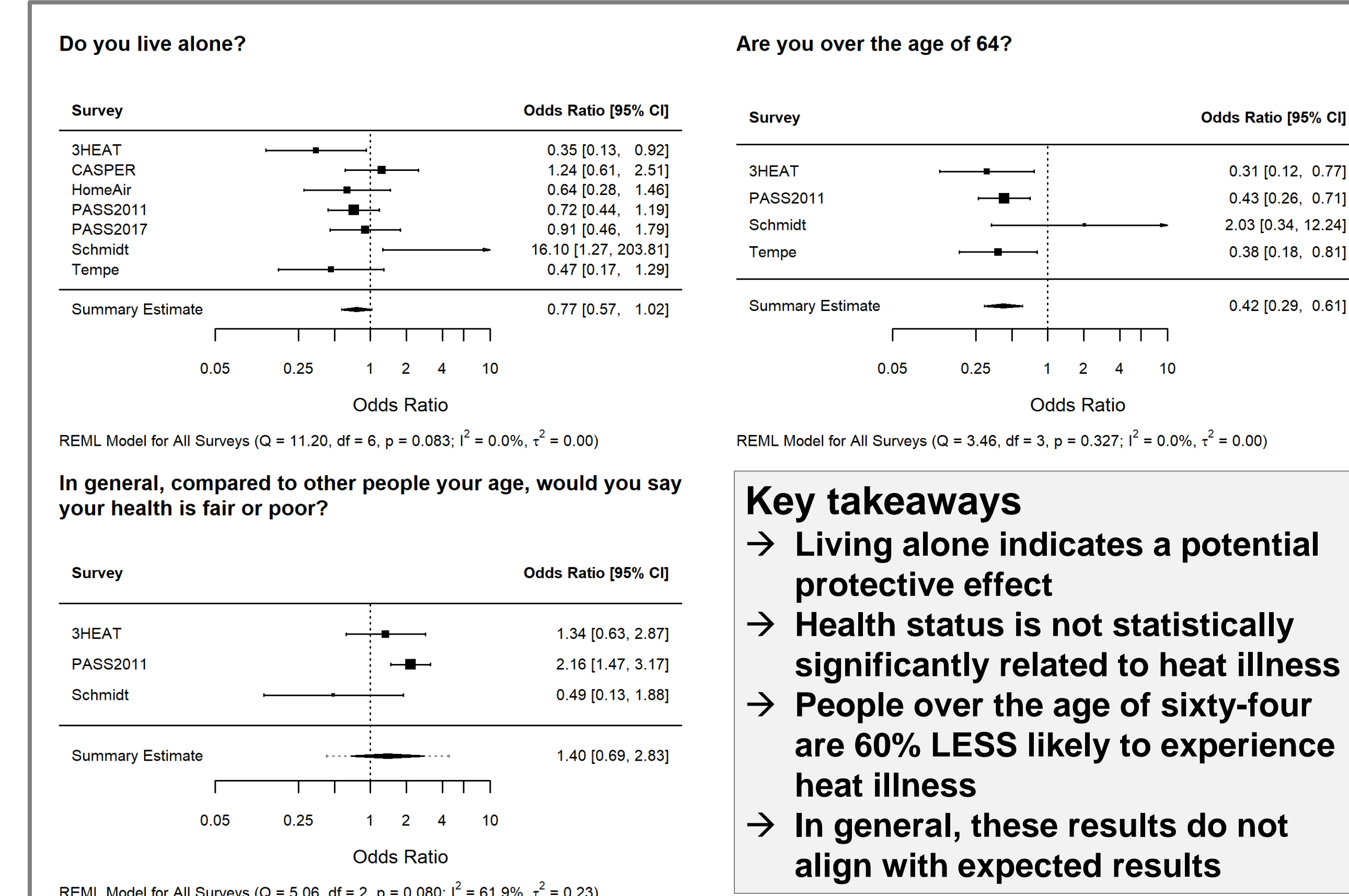
### Socio-demographics



### Socio-demographics (financial measures)



### Social isolation and health status



## Discussion

- Measures of financial wellness other than income may be better indicators of heat vulnerability. Cost restrictions on AC use, not being able to afford essentials, and not having enough food to eat all have a larger effect size on heat illness than household income.
- The ability to modify the indoor thermal environment without restriction protects residents from heat illness; having a central AC unit, being able to use AC without restriction, and home ownership (potentially indicates ability to modify home weatherization) all have a protective effect.
- Living alone, elderly, and health status did not align with the general expectations of heat vulnerability and will require further investigation.

## Acknowledgements

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