

# Cook and Chill: To what extent do US consumers use food thermometers to properly assess the internal cooking temperature of meat and poultry while cooking?

## Conclusion

Strong, consistent evidence shows that the great majority of US consumers do not use food thermometers to properly assess the internal cooking temperature of meat and poultry while cooking.

## Grade: Strong

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades, [click here](#).

## Evidence Summary Overview

A total of eight studies were reviewed regarding the extent to which US consumers follow adequate temperature control during food preparation and storage at home. All of the studies (one systematic review, one laboratory simulation study with a cross-sectional study component and six cross-sectional studies) received Ø quality ratings.

Seven studies (Abbot et al, 2009; Byrd-Bredbenner et al, 2007; Dharod et al, 2004; Dharod et al, 2007a; Kwon et al, 2008; Redmond and Griffith, 2003; Trepka et al, 2007) found that few households reported owning or using a food thermometer to check for the doneness of meats. Dharod et al (2004) found that, among Latino parents, the use of meat thermometers was very rare both before and after exposure to the Fight BAC! Campaign. Redmond and Griffith (2003) found that only 12% to 24% of consumers regularly used meat thermometers. Using a cross-sectional survey, Bergsma et al (2007) found that while thorough heating of chicken was considered very important by the study participants, generally those participants only visibly checked chicken meat for doneness and did not use meat thermometers. In the laboratory simulation component of that study, the authors suggested that cooking chicken for recommended periods of time and visually inspecting it for doneness could result in chicken that may not be sufficiently cooked to reduce levels of harmful bacteria (Bergsma, 2007). It is notable that, although just as important as for meat and poultry, no evidence was identified on consumer use of thermometers for ensuring the adequacy of cooking for seafood.

## Evidence Summary Paragraphs

**Abbot et al, 2009** (neutral quality) In a cross-sectional study, 153 young adults from a university in New Jersey prepared a meal under observation in a controlled laboratory setting, permitted researchers to observe their home kitchen and completed an online survey assessing their food safety knowledge, behavior and psychosocial measures. Mean best practices scale scores were poor, with subjects reporting they engage in less than half of the recommended safe food-handling practices evaluated. Food preparation observation mean scores were suboptimal, with highest mean compliance score for the “separate” scale (67%) and lowest for the Cook scale (29%), such that two-thirds of subjects kept raw animal protein separated from ready-to-eat food; whereas 97% did not use a thermometer to determine that that protein was cooked to safe temperature. The temperatures mean scale score was especially low (e.g., mean refrigerator temperature was higher than 40°F and few had a food thermometer). Few significant differences in mean scores for best practices, risky food consumption, beliefs, self-efficacy, knowledge or observations were noted among demographic groups. Authors conclude that while consumers may possess some food safety knowledge, this does not necessarily translate into safe food handling practices.

**Bergsma NJ et al, 2007** (neutral quality), a cross-sectional study, was conducted in the Netherlands to assess the predominant method of cooking chicken meat, and laboratory inactivation experiments were conducted to assess bacterial levels in chicken meat after utilizing the most common cooking methods. A survey was conducted on self-reported behavior among 284 Dutch citizens (mean age 48 yearSD±14 years, 74% female) asking about chicken breast fillet preparation, psychological constructs and demographic characteristics. Whole chicken fillets were inoculated with *C. jejuni* strains in a five-strain cocktail; diced fillets were inoculated with 1ml strain cocktail and stored overnight in refrigeration and then cooked at minimal gas flow for total cooking times, including searing, between two and 15 minutes. After frying, chicken meat was immediately sampled for enumeration of surviving *C. jejuni* cells. The number of surviving *C. jejuni* cells recovered from fried chicken meat declined with increasing frying times and started to drop below detectable levels after nine minutes and three minutes frying to whole chicken breast fillet and dices, respectively. The study survey showed that consumers tend to verify heating adequacy by visual inspection of the inside of the meat. Authors concluded that although microbiological experiments showed that fried chicken breast fillets looked done, not all *C. jejuni* cells may be inactivated.

**Byrd-Bredbenner et al, 2007** (neutral quality) cross-sectional survey, audited the home kitchens of 154 young adults at a northeastern university to identify food safety problems. Home kitchen audits assessed kitchen cleanliness, appliance cleanliness,

cleaning supplies availability, temperatures (thermometer access and refrigerator and freezer temperatures), cold food storage, dry food storage and poisons storage. Participants scored 70% or higher on poisons storage, dry food storage, kitchen cleanliness and cleaning supplies availability, with females scoring higher than males on kitchen cleanliness ( $P=0.0183$ ) and cleaning supplies availability ( $P=0.0305$ ). Participants scored lower than 60% on the appliance cleanliness and cold food storage scales. Performance was lowest on the temperatures scale; only 7% of kitchens had a food thermometer.

**Dharod et al, 2004** (neutral quality) trend study conducted cross-sectional household surveys pre- and post-population exposure to Fight BAC! food safety campaign media and materials to assess food safety knowledge, attitudes and behaviors among 500 Latino respondents (Pre: 92% females, 8% males; Post: 97% females, 3% males) with at least one child 12 years old or under in household in inner city Hartford, Connecticut. After pre-survey, subjects were exposed to Fight BAC! campaign materials tailored to specific Latin communities for six months. The campaign included TV and radio public service announcements (PSAs), Spanish newspaper ads, and other materials distributed throughout the community. Pre- and post-survey comparisons showed improvements in proper handwashing and meat defrosting technique ( $P=0.010$ ), with very low numbers defrosting meat in a refrigerator after campaign (14% post-survey); few reported storing eggs at room temperature (Pre: 1%; Post: 1%,  $P=0.549$ ) and eating pink hamburgers (Pre: 3%; Post: 2%,  $P=0.213$ ); most reported washing the food preparation area with soap or disinfectant (Pre: 93%; Post: 95%,  $P=0.371$ ) and cleaning cutting boards before placing food on them (Pre: 98%; Post: 98%,  $P=0.797$ ); the use of meat thermometers was very rare both before (2%) and after campaign (less than 1%) ( $P=0.411$ ); regarding meat defrosting, 20% answered correctly of those with two or more exposures, 11% of those with one exposure, 6% of the non-exposed ( $P=0.029$ ). No major differences were found in food safety behaviors among the three groups, representing three different degrees of exposure to the campaign.

**Dharod et al, 2007a** (neutral quality) cross-sectional study, assessed the magnitude of differences between self-reported and observed food safety practices among 60 Puerto Rican women recruited in inner city Hartford, Connecticut. Three home visits were conducted over four days: The first (day one) was the delivery of food ingredients for preparation of chicken breast (CB) and salad meal; the second (day three), household observations; and the third (day four) for a closed-end self-report food safety interview survey. Accuracy of self-report was calculated as follows: (Desirable self-reported food safety behaviors confirmed through direct observation) + (undesirable behaviors observed and then acknowledged through self-report) / total sample. The following behaviors were observed: No subjects reported and no one was observed using a meat thermometer; 47% of participants reported being confident of their own method for determining cooking "doneness." Also, 28% of participants mentioned "inability to use it" as a reason for not using a meat thermometer. Investigators conclude that over-reporting errors must be considered when interpreting data derived from self-reported food safety consumer surveys.

**Kwon et al, 2008** (neutral quality) is a cross-sectional study in which 1,598 female participants in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) from 87 WIC agencies in 31 states in US responded to a nationwide survey to assess food safety knowledge and behaviors of WIC Program participants. Knowledge and behavior scores differed significantly among participants of different education levels and racial or ethnic groups ( $P<0.001$ ), with those with some high school or less education having significantly lower knowledge and behavior scores than respondents with high school or beyond high school; white respondents had significantly higher knowledge scores than did Hispanic respondents and black respondents had significantly lower behavior scores than did members of the other three racial or ethnic groups ( $P<0.001$ ). Regarding associations between knowledge and behaviors and demographic characteristics, respondents older than 25 years had higher mean food safety knowledge and behavior scores than for those 18 to 25 years old; Hispanic or black respondents and those who did not graduate from high school were less likely to have used a food thermometer. Only about 30% of respondents had food thermometers in their kitchens, and while 38% stated that they used a food thermometer to check the doneness of a cooked food, only 7.7% reported that they used a thermometer to test doneness of ground beef patties. Results reinforced previous research indicating discrepancies between knowledge and reported food handling behaviors existed in cleaning and sanitizing cutting boards, handling hot food leftovers, using food thermometers and checking doneness of ground beef patties.

**Redmond and Griffith, 2003** (neutral quality) systematic review, reviewed 88 food safety studies regarding consumer food handling in the home, published over a 26-year period. The majority of all the studies conducted (55 studies) were between 1995 and 1999. After 1999, in only two years, an additional 26 studies were completed, reflecting an increasing trend in foodborne illness incidence. Seven of 15 observational studies involved direct observations, out of which three (43%) were carried out in the US. 98% of American consumers reported at least one unsafe practice. In 1999 and 2000, studies reported that 12% to 24% of consumers regularly used meat thermometers. This systematic review revealed that despite the various nationwide food safety campaign attempts, unsafe food handling practices were still frequently in place during the preparation of food in a domestic environment.

**Trepka et al, 2007** (neutral quality) cross-sectional study, assessed baseline food safety practices among 299 clients served by an inner city MiamiWIC program. A 23-item self-administered questionnaire addressed food safety practices related to cleanliness, separation or avoidance of cross-contamination, proper cooking and chilling methods and avoidance of unsafe foods during pregnancy. Only one-fourth of the participants reported using a cooking thermometer "almost always" or "always" for cooking whole chicken or turkeys (23.4%) or other large pieces of meat (22.3%) and only 24.4% reported owning a thermometer.

[View table in new window](#)

Author, Year, Study Design, Class, Rating	Population / Sample Description and Location	Design / Variables	Results / Behavioral Outcomes / Significance	Limitations
<p>Abbot et al, 2009</p> <p>Study Design: Cross-sectional study.</p> <p>Class: D</p> <p>Rating: ●</p>	<p>N=153 young adults (56% female, 67% white, 97% never married, 85% juniors or seniors in college).</p> <p>Mean age: 20.74±1.30 SD; range 18 to 26 years.</p> <p>Location: Rutgers University, New Brunswick, NJ (United States).</p>	<p><b>Design:</b></p> <p>Each subject prepared a meal under observation in a controlled laboratory setting, permitted researchers to observe their home kitchen and completed an online survey assessing their food safety knowledge, behavior and psychosocial measures.</p> <p><b>Dependent variables:</b> Scores of:</p> <p>Five food preparation observation scales (clean, separate, cook, chill, cross-contamination).</p> <p>Seven home kitchen observation scales (kitchen facilities cleanliness; appliance cleanliness; access to cleaning supplies; thermometer access and temperature control, cold food storage practices, dry food storage practices, poisons storage practices).</p> <p><b>Independent variables:</b></p> <p>Best practices scores, risky food consumption score, beliefs scale scores, self-efficacy score, predominant locus of control, stage of change, knowledge scale scores, demographic characteristics (gender, race, age, year in college), whether they had held a job as a food server or preparer and prior food safety instruction (e.g., completed at least one nutrition, food science or microbiology college course vs. those who had not).</p>	<p>Mean best practices scale scores were poor, with subjects reporting they engage in</p> <p>Majority of subjects reported they or a household member had had food poisoning (86%) and with no <math>\Delta</math> in their eating behavior in response to a publicized food poisoning outbreak.</p> <p>Few significant differences in mean scores for best practices, risky food consumption, beliefs, self-efficacy, knowledge or observations noted among demographic groups; knowledge scale of groups at greatest risk of foodborne disease and cross-contamination prevention self-report behavior scale tended to be significant predictors of actual food preparation behaviors.</p> <p>Food preparation observation mean scores were suboptimal, with highest mean compliance score for the "separate" scale (67%) and lowest for the Cook scale (29%), such that two-thirds of subjects kept raw animal protein separated from ready-to-eat food; whereas 97% did not use a thermometer to determine that that protein was cooked to safe temperature.</p> <p>On the positive side, three home kitchen observation mean scale scores (for kitchen facilities cleanliness, dry food storage and poisons storage) exceeded 81% compliance.</p> <p>Subjects had a predominantly internal locus of control for safe food handling (65%) and high levels of food safety self-efficacy, but their observed food handling practices did not indicate that these health-promoting cognitions are translated into actually performing safe food-handling practices.</p>	<p><b>Per authors:</b></p> <p>Low P-values for the significant predictor variables in the regression models present as a limitation of this analysis.</p> <p>Similar evaluations should be done with larger sample sizes that can further define stronger predictor variables and better descriptions of the disconnect between what young adults report knowing about food safety and what they are observed practicing.</p> <p><b>Other possible limitations to the study:</b></p> <p>Did not assess the socioeconomic status of subjects, which could potentially limit the applicability of these findings to other young adults (e.g., working young adults, community college students, etc.).</p> <p>Study had low response rate (of 432 that met the criteria for participation, only 167 (39%) accepted the invitation and only 153 completed the study. Thus, it is unclear if study sample was representative</p>

				sample of the relevant population.
<p>Bergsma NJ, Fischer ARH et al, 2007</p> <p>Study Design: Cross-sectional study and laboratory inactivation experiments.</p> <p>Class: D</p> <p>Rating: </p>	<p>Microbiological component: Determined whether the predominant method of heating poultry meat by Dutch consumers effectively reduced <i>Campylobacter jejuni</i> contamination.</p> <p>Location: Utrecht area, The Netherlands.</p>	<p>For microbiological component:</p> <p><b>Dependent variables:</b></p> <p>Temperature of the surface of the meat and bacterial count in chicken meat.</p> <p><b>Independent variable:</b></p> <p>Cooking times varied from a total of two to fifteen minutes.</p> <p><b>Intervention:</b></p> <p>Whole chicken fillets were inoculated (108 to 109 CFU per fillet) with <i>C. jejuni</i> strains in a five-strain cocktail and stored (overnight, 4°C) and diced fillets were inoculated with 1ml strain cocktail and stored (overnight, 4°C).</p> <p>Fillets were fired according to recipe in cookbook; cooking times at minimal gas flow ranged from zero to 13 minutes, resulting in total cooking times, including searing, between two and 15 minutes;</p> <p>After frying, chicken meat was immediately sampled for enumeration of surviving <i>C. jejuni</i> cells.</p>	<p><b>Microbiological Component:</b></p> <p>The number of surviving <i>C. jejuni</i> cells recovered from fried chicken meat ↓ with ↑ frying times and started to ↓ below detectable levels after nine minutes and three minutes of frying to whole chicken breast fillet and dices, respectively.</p> <p>The meat surface temperatures recorded varied widely between and within experiments.</p> <p>For experiments conducted with whole fillets, mean meat surface temperature per experiment varied between 105° and 167°C, with SD ranging between 3° and 18°C.</p> <p>Pooling all data resulted in an overall mean meat surface temperature of 127°C with SD 18°C.</p> <p>For diced fillets, similar results were obtained (mean overall meat surface temperature 109°C±17°C).</p>	<p><b>Authors noted that these limitations effectively limit the scientific interpretation of their data:</b></p> <p>Use of whole chicken breast fillets (as opposed to homogenous meat samples) purchased on different dates increased variability of the samples.</p> <p>Variability in water content of fillets may have affected the surface temperature of the meat and thus increased variability in bacterial survival.</p> <p><b>Other:</b></p> <p>Not mentioned if investigators conducting the MPN method and agar plating were blinded to frying time of the chicken homogenate.</p> <p>Use of a standard household cooktop in experiment may not be applicable to all populations and a gas cooktop may have different heating properties than an electric cooktop, and thus, cooking times may need to vary.</p>

<p>Byrd-Bredbenner et al, 2007</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p> <p>Rating: </p>	<p>N=154 young adults at a northeastern university.</p> <p>Location: United States.</p>	<p>Home kitchen audits assessed:</p> <ul style="list-style-type: none"> <li>• Kitchen cleanliness</li> <li>• Appliance cleanliness</li> <li>• Cleaning supplies availability</li> <li>• Temperatures (thermometer access and refrigerator and freezer temperatures)</li> <li>• Cold food storage</li> <li>• Dry food storage</li> <li>• Poisons storage.</li> </ul>	<p>Participants scored <math>\geq 70\%</math> on poisons storage, dry food storage, kitchen cleanliness and cleaning supplies availability, with females scoring <math>\uparrow</math> than males on kitchen cleanliness (<math>P=0.0183</math>) and cleaning supplies availability (<math>P=0.0305</math>).</p> <p>Participants scores <math>&lt;60\%</math> on the appliance cleanliness and cold food storage scales.</p> <p>Performance was lowest on the temperatures scale; only 7% of kitchens had a food thermometer.</p>	<p>Temperature measurements not available for all participants due to thermocouple malfunction.</p> <p>Home kitchen audits limited to participants at one university.</p>
<p>Dharod et al, 2004</p> <p>Study Design: Trend study.</p> <p>Class: D</p> <p>Rating: </p>	<p>N=500 Latino parents of children age <math>\leq 12</math> years.</p> <p>Location: Innerscity Hartford, Connecticut (United States).</p>	<p><b>Design:</b></p> <p>Cross-sectional household surveys conducted pre- and post-population exposure to Fight BAC! food safety campaign media and materials, in participant's language of choice by bilingual and bicultural interviewers.</p> <p>The survey lasted 30 to 45 minutes, and after completion, subject received shopping bag with logo and sanitation supplies, a meat thermometer and food safety materials.</p> <p><b>Dependent variables:</b></p> <ul style="list-style-type: none"> <li>• Food safety knowledge level</li> <li>• Food safety attitudes</li> <li>• Food safety behaviors</li> <li>• Consumer satisfaction with campaign</li> <li>• Level of understanding of campaign.</li> </ul> <p><b>Independent variables:</b></p> <p>Level of exposure to Fight BAC! food safety campaign (media and materials).</p> <p><b>Control variables:</b></p> <ul style="list-style-type: none"> <li>• Respondent's age</li> <li>• Education</li> <li>• Car availability</li> <li>• Language spoken at home</li> </ul>	<p><b>Food safety knowledge:</b></p> <p>No between-survey significant differences with terms "cross-contamination" or "bacteria."</p> <p>After adjustment, subjects exposed to campaign 3.5 times were more likely to have "adequate" food safety knowledge scores (score of <math>\geq 2</math>) than unexposed (<math>OR=3.54</math>; 95% CI: 1.74 to 7.18; <math>P&lt;0.001</math>).</p> <p><b>Food Safety Behaviors:</b></p> <p>Pre- and post-survey comparisons showed improvements in proper handwashing and meat defrosting technique (<math>P=0.010</math>), with very <math>\downarrow</math> numbers defrosting meat in a refrigerator after campaign (14% post-survey)</p> <p>Few report storing eggs at room temperature and eating pink hamburgers.</p> <p>Most reported washing food preparation area with soap or disinfectant and cleaning cutting boards before placing food on them.</p> <p>Use of meat thermometers was very rare both before (2%) and after campaign (less than 1%).</p> <p>Regarding meat defrosting, 20% answered correctly of those with two exposures, 11% of those with one exposure, 6% of the non-exposed (<math>P=0.029</math>).</p>	<p>Multiple NS findings.</p> <p>Participant ages not noted, did not report either collecting this variable or using it in multivariate analysis.</p> <p><b>Authors note:</b></p> <p>No control group in pre- or post-design. Thus, we cannot rule out that part of findings could be explained by parallel food safety promotion efforts aimed at our target community.</p> <p>Self-reported behaviors, not observed behaviors. Thus, we cannot rule our social desirability bias.</p>

		• Employment status.		
<p>Dharod JM, Perez-Escamilla R et al, 2007a</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p> <p>Rating: </p>	<p>N=60 Puerto Rican women recruited from inner city Hartford, CN.</p> <p>Mean age: 40 years.</p> <p>60% spoke only Spanish at home.</p> <p>55%</p> <p>85% unemployed.</p> <p>56.7% monthly income of &lt;\$1,000.</p> <p>Location: United States</p>	<p>Microbial testing, household observation and self-report interview survey.</p> <p><b>Dependent variables:</b></p> <p>Thawing method, use and sanitation of cutting boards and knives, hand washing habits, washing of produce, method of checking chicken doneness.</p> <p>Participants were asked to cook the chicken and salad meal using only the ingredients provided.</p> <p>A closed-end questionnaire was developed to measure self-reported behaviors.</p>	<p><b>Observation (% subjects):</b></p> <ul style="list-style-type: none"> <li>• Washed hands with soap/water before meal preparation (25%).</li> <li>• Washed with soap/water after handling CB and before handling produce (25%).</li> <li>• Used cutting board to cut CB (78%).</li> <li>• Used meat thermometer (0%).</li> <li>• Washed lettuce in colander after cutting (62%).</li> </ul> <p>At all stages of preparation, self-reported handwashing with soap and water was greatly over-reported (only 37% accurately reported handwashing practices).</p> <p>Thawing of CB in water was over-reported, thawing on the counter was under-reported (P&lt;0.05) and no subjects used a microwave to defrost, though most participants had one.</p>	<p>Convenient sample used.</p> <p>Observation could influence practice.</p> <p>No description provided for the validation of the interview survey used.</p>
<p>Kwon et al, 2008</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p> <p>Rating: </p>	<p>N=1,598 female participants in the Special Supplemental Nutrition Program for WIC from 87 WIC agencies in 31 states.</p> <p>Age (percent and year range):</p> <ul style="list-style-type: none"> <li>• 18.6%, 18 to 21</li> <li>• 28.8%, 21 to 25</li> <li>• 22.8%, 26 to 30</li> <li>• 15.6%, 31 to 35.</li> </ul> <p>47.9% Non-Hispanic white, 12.1% Non-Hispanic black, 33.2% Hispanic.</p> <p>Education completion: 36.8% high school (HS), 9.5% college degree, 9.1% ≤8th grade.</p> <p>Location: United States.</p>	<p><b>Design:</b></p> <p>A survey was conducted with clients from 87 WIC agencies nationwide to assess food safety knowledge and behaviors of WIC Program participants in the US.</p> <p><b>Dependent variables:</b></p> <p>Food safety knowledge related to cutting board handling, sanitizing, reheating of hot food leftovers and checking doneness of ground beef patties.</p> <p>Food handling behavior related to cutting board handling, thawing, storing and reheating of hot food leftovers, checking doneness of ground beef patties and handling moldy food items.</p>	<p>30% of subjects had food thermometers in their kitchens, and while 38% stated that they used the thermometer to check doneness of cooked food, only 7.7% reported using thermometer to test doneness of ground beef patties.</p> <p>50.4% of respondents agreed that they often or always used a cutting board when preparing foods while 91.5% stated that they always cleaned the cutting board and knife after using it for raw meat, poultry or fish. However, only 76.1% always sanitized the board and knife after preparing those foods.</p> <p>While 60% of subjects reported using the most desirable or an acceptable method of thawing frozen meat, poultry or fish, 21.0% thawed frozen food on the counter or in a sink filled with water (20.6%).</p>	<p>Results based on self-reported data.</p> <p>Summary statistics may not necessarily be valid due to sample sizes used to assess food safety knowledge and behaviors were inconsistent across study questions.</p> <p>In Table 1, the "other" category represented respondents who did not indicate any specific resources, yet a response category of "none" was also included in the table without any explanation as to how these two categories differed.</p> <p>Because</p>

Food safety information sources.

**Independent**

**variables:** Demographic factors included:

- Age (18 to 25 years, >25 years)
- Ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Other)
- Education (some HS or less, HS diploma, beyond HS)

Only 31.5% reported that they cooled quickly, covered and refrigerated hot food leftovers, while 58.1% reported that they reheated those leftovers until steaming hot.

24.4% stated they reheated the food until it was "just warm enough to eat."

77.4% used color of the meat or juice to check the doneness of meat rather than using a food thermometer.

Average food handling behavior score was  $5.92 \pm 1.07$  (max score 8.0), indicating that respondents reported following acceptable food handling procedures for three-fourths of the items.

46.1% of white respondents reported using a food thermometer than did black (36.2%) or Hispanic (25.4%) respondents.

44.8% of white respondents reported thawing meat in the refrigerator than did black (29.3%) and Hispanic (23.4%) respondents.

Those older than 25 years had significantly  $\uparrow$  knowledge scores ( $4.17 \pm 1.07$ ) and behavior scores ( $6.00 \pm 1.07$ ), than did 18- to 25-year-old respondents ( $4.03 \pm 1.05$  and  $5.84 \pm 1.07$ , respectively) ( $P < 0.01$ ).

Knowledge and behavior scores differed significantly among participants of different education levels and racial or ethnic groups ( $P < 0.001$ ) with those with some HS or less education having significantly  $\downarrow$  knowledge and behavior scores, than respondents with high school or beyond high school.

White respondents had significantly  $\uparrow$  knowledge scores than did Hispanic respondents and black respondents had significantly  $\downarrow$  behavior scores, than did members of the other three racial or ethnic groups ( $P < 0.001$ ).

respondents were only females enrolled in WIC and the majority were relatively young, the study may not be generalized to low-income males, older populations and those not eligible for the WIC Program.

Questions related to food safety knowledge and behaviors used did not represent all aspects of recommended consumer food safety content (e.g., FightBAC!).

Although local WIC offices were randomly selected, it does not appear that the actual respondents were randomly selected.

<p>Redmond E and Griffith C, 2003</p> <p>Study Design: Systematic Review</p> <p>Class: M</p> <p>Rating: </p>	<p>N=88 food safety studies published over a 26-year period.</p> <p>Location: Majority of consumer food safety studies in the last decade conducted in the United Kingdom and Northern Ireland (48%) and in the US (42%).</p>	<p><b>Design:</b></p> <p>Food safety findings relating specifically to food preparation in the domestic kitchen.</p> <p>Information was provided regarding similarities and disparities between knowledge, attitudes, intentions, self-reported practices and actual behaviors from studies on domestic food preparation.</p> <p>Studies were evaluated in terms of the research method implemented for data collection, the study size, the country of origin and the year of study completion.</p> <p><b>Dependent variables:</b></p> <p>Food safety findings relating specifically to food preparation in the domestic kitchen.</p> <p><b>Independent variables:</b></p> <p>Social cognitive components (consumers' knowledge, attitudes, intentions), observed hygiene behaviors and self-reported practices.</p>	<p>Although 86% of consumers indicated that they knew that the implementation of adequate handwashing procedures can ↓ risk of food poisoning, only 66% report actually implementing such procedures.</p> <p>In 1999 and 2000, studies reported that 12% to 24% of consumers regularly used meat thermometers.</p> <p>Up to 100% of study participants failed to wash and dry their hands adequately after handling raw chicken and &gt;half of the participants failed to use separate or adequately washed and dried utensils for the preparation of raw meat and poultry and the preparation of ready-to-eat foods.</p> <p>Only one of the studies linked actual pathogenic contamination with observed food-handling behaviors; the results indicated extensive <i>Campylobacter</i> cross-contamination during food preparation sessions.</p>	<p>Search terms and databases not described.</p> <p>Study quality and validity not assessed.</p>
<p>Trepka M, Newman F et al, 2007</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p> <p>Rating: </p>	<p>Initial N=342; final N=299 female WIC clients from inner-city Miami.</p> <p>64% non-Hispanic, non-Haitian black, 27.1% Hispanic.</p> <p>21.5% pregnant.</p> <p>89.4% high school graduates.</p> <p>87.4% response rate.</p> <p>Location: United States.</p>	<p><b>Design:</b></p> <p>23-item self-administered questionnaire; captured five constructs of food safety behavior, with the first four from the Partnership for Food Safety Education's Fight BAC! campaign.</p> <p><b>Dependent variables:</b></p> <p>Clean, separate, cook, chill, avoidance of unsafe foods during pregnancy.</p> <p><b>Dependent variables:</b></p> <p>Four construct scores (clean, separate, cook, chill).</p> <p>Score concerning avoidance</p>	<p>12.6% reported not properly cleaning cutting boards after contact with raw meat.</p> <p>~25% reported using a cooking thermometer "almost always" or "always" for cooking whole chicken or turkeys (23.4%) or other large pieces of meat (22.3%).</p> <p>24.4% reported owning a thermometer.</p> <p>24.7% reported usually eating undercooked eggs.</p> <p>32.2% reported usually leaving food out for &gt;two hours.</p> <p>3% reported refrigerating large amounts of leftovers in shallow</p>	<p>Conclusions based upon self-reported behaviors.</p>

	<p>of unsafe foods during pregnancy.</p> <p>Variables measured using 23-item self-administered survey.</p> <p><b>Independent variables:</b></p> <p>Nine participant characteristics (age, education, race or ethnicity, country of birth, employment status, pregnancy status, number of children, diarrhea among household members in last month).</p> <p>Household member at risk for food-borne illnesses.</p>	<p>amounts of leftovers in shallow containers.</p> <p>10.8% reported leaving formula or bottled breast milk outside the refrigerator for &gt; two hours "most of the time," "almost always," or "always."</p> <p>61.8% reported thawing foods on the countertop or in the sink in standing water</p> <p>51.6% pregnant women reported eating hot dogs or deli meats without first reheating sometimes or more frequently since becoming pregnant.</p> <p>35.5% reported eating soft cheeses and blue-veined cheeses sometimes or more frequently since becoming pregnant.</p>
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### Research Design and Implementation Rating Summary

For a summary of the Research Design and Implementation Rating results, [click here](#).

#### Worksheets

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