

Measuring Hamburger Cooking and Ordering Behavior

We compared two different measures of consumer cooking and ordering behavior. The first is the proportion of hamburgers cooked to red or pink in the center, based on descriptions of hamburgers recorded in food diaries in the HECD. The second is the proportion of adult respondents to the HPQ who usually cook or order their hamburgers rare, medium-rare, or medium-pink. Because the HPQ was a separate survey module completed by the same households as the HECD, we had the opportunity to compare two different measures from the same households. The comparison provides a test of the validity of the HPQ questions on usual cooking and ordering, which are similar to a question asked in the Food Safety Survey (FSS) conducted by the Food and Drug Administration (FDA) and USDA's Food Safety and Inspection Service (FSIS) in 1988, 1993, and 1998. These measures differ, as we discuss further below.

The 1996 Hamburger and Egg Consumption Diary and Hamburger Preparation Quiz

The Market Research Corporation of America conducted the HECD and HPQ by including supplemental modules in its ongoing Menu Census Survey (MCS) during March 1996 - February 1997. The MCS is a nationally representative mail survey in which respondents complete a 2-week diary of all food consumption for themselves and their families followed by a questionnaire on attitudes related to food purchases. The survey annually covers about 2,000 households selected from a 12,000-household purchase diary survey.

The HECD supplement accompanied the MCS food diary form sent to survey participants. It requested additional information when someone in the family ate a hamburger: where the hamburger was eaten, and, if at home, how it was prepared (freezing, thawing, cooking method) and the appearance of the cooked hamburger in the center (red, pink, light brown, or dark brown). The Menu Census Survey covered 1,833 households during the period that the supplement was added, with a total of about 5,041 individuals. A total of 2,588 individuals recorded eating hamburgers at least once during the 2-week diary period, of which 2,306 (89 percent) provided sufficient demographic information for weighting purposes. A total of 6,454

hamburgers were eaten during the diary period, of which 5,822 (90 percent) could be linked to demographic weights.

The HPQ module supplemented the attitude questionnaire each household received after completing the Menu Census Survey food diary. To identify consumers who usually cook hamburgers lightly cooked or order hamburgers lightly cooked in restaurants, the HPQ asked respondents how they usually cook hamburgers for themselves (rare, medium-rare, etc.). Consumers who usually cook or order hamburgers medium were asked what color indicates a medium hamburger, so that medium-red and medium-pink hamburgers could be included in estimates of risky behavior. The supplement also included questions on how respondents cooked and ordered hamburgers 5 years previously (in 1991), and respondents' attitudes about foodborne illness and the palatability attributes of hamburgers.

In order to ensure equal probability of selecting male and female heads of households, the household adult with the most recent birthday completed the questionnaire. The survey supplement was completed by 1,132 individuals. Response rates to questions used in this study vary as noted in later discussion.

Weights were applied to each observation to match the 1990 Census proportions for categories based on sex, ethnicity, and education. These variables were chosen so that weights would be comparable to the weights used in the 1993 FSS. Weights were derived as the ratio of the Census cell proportion to the HECD/HPQ respondent's cell proportion. Unfortunately, three cells were completely missing in the HECD/HPQ responses: Black males with less than 12 years of education, Black females with less than 12 years of education, and other males with less than 12 years of education. Thus, the sample provides no representation for these groups.

Measuring Hamburger Doneness

To measure hamburger doneness, the HECD used the respondent's description of the color of the patty in the center (red, pink, light brown, and dark brown) and the HPQ used the respondent's judgment of the doneness of the hamburger (rare, medium-rare, medium, etc). These descriptions were based on the advice by FSIS prior to 1997 instructing consumers to cook hamburgers until neither the juices nor the meat showed any red or pink color. In 1997, FSIS began recommending that consumers cook hamburgers to 160 degrees

Fahrenheit (°F) using a thermometer to accurately measure temperature. In 1998, FDA and the Centers for Disease Control and Prevention (CDC) joined in promoting this recommendation (USDA, FSIS, 1998a). FSIS made the change because research at Kansas State University in 1997, confirmed by the Agricultural Research Service in 1998, showed that some meat appeared brown in the center before reaching a safe temperature (160°F), depending on the meat's age and freezing history, as well as what portion of the ground beef package was used to make the patty (Killenger et al, 2000, Berry and Stanfield, 1993). Other meat still appeared pink in the center even at temperatures above 160°F (USDA, FSIS, 1998b). The new thermometer recommendation was designed to prevent consumers from perceiving a brown, but unsafe, hamburger as thoroughly cooked, and to prevent overcooking of pink, but safe, hamburger or wastage of hamburgers discarded because they were pink and perceived to be unsafe.

While the descriptions of hamburger doneness do not correspond exactly to the safety of the hamburger, the descriptions do give an indication of how well consumers were following previous recommendations.

Results

Based on the HECD, 2.7 percent of hamburgers cooked at home and 9.2 percent in restaurants were reported as red or pink in the center (table 2). When an adult respondent from the same household completed the HPQ question on usual hamburger cooking and order-

Table 2—Hamburger color reported for hamburgers recorded in a food diary survey, 1996 (N=5,822 hamburgers)

Color ¹	At home	In restaurants	All locations ²
	Percent		
Red	0.6	0.5	0.4
Pink	2.1	8.7	3.5
Light brown	33.6	20.8	30.3
Dark brown	61.8	69.8	64.2
Other	2.0	0.2	1.6
Total red or pink	2.7	9.2	3.9

1) Mail survey supplement requested description of appearance of hamburger in the center for hamburgers (red, pink, light brown, dark brown, or other) eaten by all members of the household, including children.

2) "All locations" includes hamburgers in fast food establishments, cafeterias, and other locations, including other homes.

Source: 1996 Hamburger and Egg Consumption Diary. Responses weighted by gender, ethnicity, and education of household head.

ing practices, 20 percent said they usually cooked rare, medium-rare, medium-red, or medium-pink (medium with red or pink in the center) at home. Fifteen percent said they usually ordered that way in restaurants (table 3). The results of the HPQ were similar to results of the 1998 FSS, which asked, "How are hamburgers usually served in your home?" Sixteen percent of respondents to that survey said they served hamburgers rare, medium-rare, or medium-pink in their homes (table 4).

We also compared the percent of hamburgers eaten at different levels of doneness in all locations combined. Among all hamburgers reported in the HECD, 3.9 percent were red or pink in the center (table 2). To estimate a comparable percentage for the HPQ, we used data from the 1994-96 CSFII (table 1) on the percentage of hamburgers eaten at home (34 percent), in restaurants (7 percent), in fast food establishments (51 percent), and in other locations (8 percent). If the frequency of hamburger consumption were the same for all consumers, if children ate hamburgers like adults, and if hamburgers in fast food establishments and other locations were cooked to medium or more, then the percent of hamburgers in all locations eaten rare would be 0.34 times the percent who usually cooked rare, plus 0.07 times the percent who usually ordered rare. We similarly estimated the percent of hamburgers in all locations eaten at each level of doneness and combined these to estimate the total percent eaten rare, medium-rare, medium-red or medium-pink. According to this method, the HPQ results suggest about 8 percent of hamburgers were eaten lightly cooked (table 3), much higher than the comparable result from the HECD.

Several factors contribute to the difference between reported usual behavior and reported actual outcome. First, children were included in the HECD but not in the HPQ, which asks about usual behavior of adult respondents. If adults are more likely than children to eat hamburgers red or pink, their responses will be overweighted, contributing to the discrepancy between these measurements.

We examined hamburgers eaten by adults and children separately to test this explanation. Of hamburgers eaten by adults in the HECD, 2.8 percent were red or pink at home, and 8.6 percent were red or pink in restaurants. Of hamburgers eaten by children (less than 18 years old), 2.1 percent were pink or red at home and 11.6 percent were pink or red in restaurants. These differences were statistically significant, but not enough (or in the case of restaurants, even in the right

Table 3—Usual doneness of hamburgers, 1996 (N=822 adult respondents)

Doneness	At home ¹	In restaurant ²	All locations, estimated ³
			Percent
Rare	5.2	2.0	1.9
Medium-rare	5.5	6.2	2.3
Medium, respondent describes medium as red ⁴	0.8	0.7	0.3
Medium, respondent describes medium as pink ⁴	8.5	6.0	3.3
Medium, respondent describes medium as light brown, dark brown, or other	7.2	6.8	Not estimated
Total medium	16.5	13.5	Not estimated
Medium-well	21.2	16.7	Not estimated
Well done	51.6	39.3	Not estimated
Total rare, medium-rare, medium-red, or medium-pink	20.0	14.9	7.8

1) The HPQ mail questionnaire completed by adult respondents asked: When cooking hamburger patties for yourself to eat, how do you cook them (rare, medium-rare, medium, medium-well, well-done)?

2) The questionnaire asked: When ordering hamburgers in a restaurant, how do you order them (same choices)?

3) Estimates for all locations are calculated by using the proportion of hamburgers eaten at home (34 percent) and in restaurants (7 percent), based on the 1994-96 USDA Continuing Survey of Food Intakes by Individuals. Hamburgers eaten in fast food establishments, cafeterias, and other locations are assumed to be cooked to medium, medium-well, or well-done according to local food codes.

4) The questionnaire asked: Which of the following colors do you think best describes the inside of a hamburger patty that is cooked medium (red, pink, light brown, dark brown, other)? The percentages of respondents who usually cook their hamburgers medium-red and medium-pink are estimated as the percent who cooked medium (16.5 percent) multiplied by the percent of medium hamburger cookers who describe a medium hamburger as red (5.1 percent) or pink (51.5 percent). The proportions of respondents who order medium-red and medium-pink hamburgers are estimated as the percent who ordered medium (13.5 percent) times the percent of those ordering medium who describe medium as red (4.9 percent) or pink (44.3 percent).

Source: 1996 Hamburger Preparation Quiz. Responses weighted by gender, ethnicity, and education of household head.

Table 4—Summary of alternative measures of hamburger doneness

Survey	Measure	At home	In restaurants	All locations
				Percent
1998 FDA/FSIS Food Safety Survey (national) N=1,600 adult respondents	Percent of adult respondents who serve hamburgers rare, medium-rare, or medium-pink	17.0	Not asked	Not asked
1996 Hamburger and Egg Consumption Diary (national, includes adults and children) N=5,822 hamburgers	Percent of hamburgers eaten pink or red	2.7	9.2	3.9
1996 Hamburger Preparation Quiz (national, same households as Hamburger and Egg Consumption Diary, includes only adults) N=822 adult respondents	Percent of adult respondents who usually cook or order hamburgers rare, medium-rare, medium-red or medium-pink	20.0	14.9	7.8 ¹
1996-97 FoodNet Population Survey (CA, CT, GA, MN, OR) N=2,016 respondents who had eaten hamburgers in the past 5 days N=2,760 in restaurants	Percent of respondents who ate pink hamburger, out of those who ate hamburgers in past 5 days	15.8	8.3	10.8 ¹
1998-99 FoodNet Population Survey, (CA, CT, GA, MD, MN, NY, OR) N=969 respondents who had eaten hamburgers in past 7 days	Percent of respondents who ate pink hamburger, out of those who ate hamburgers in past 7 days	Not asked	Not asked	11.3

1) Estimated using data from 1994-96 USDA Continuing Survey of Food Intakes by Individuals for the percent of hamburgers eaten at home, in restaurants, and in other locations.

Sources: 1998 FDA/FSIS Food Safety Survey: Fein and Riggins, 1998.

1996 Hamburger and Egg Consumption Diary: ERS estimates.

1996 Hamburger Preparation Quiz: ERS estimates.

1996-7 FoodNet: USDHHS, CDC, 1999.

1998-9 FoodNet: USDHHS, CDC, 1999.

direction) to account for the difference between the results of the HECD and the results of the HPQ. Thus, the fact that the usual behavior question was directed only at adults does not appear to account for the difference in results.

Second, the frequency of hamburger consumption could differ between respondents who preferred rare, medium-rare, or medium-pink hamburgers and those who preferred well-done. This would result in a different proportion of *hamburgers* that are cooked rare, medium-rare, or medium-pink compared with the proportion of *respondents* who said they usually cooked them that way.

In fact, we did find a small difference. Respondents who preferred rare, medium-rare, or medium-pink hamburgers reported they eat them less frequently than those who preferred them more well-done. This may be because those who preferred them less well-done are less likely to eat hamburgers in fast food establishments, where hamburgers are required to be well-done.

To examine the effect of this difference, we estimated the proportion of adult hamburger eaters who ate pink or red hamburgers, as opposed to the percent of hamburgers eaten pink or red, from the HECD. Of respondents who ate hamburgers at home during the 2-week diary period, 2.3 percent ate all of them pink or red. Of those who ate hamburgers in restaurants, 9.3 percent ate all of them pink or red. About 1 percent of hamburger eaters at home ate their hamburgers different ways at different eating occasions and about half of 1 percent of hamburger eaters in restaurants did so.

Finally, underreporting of lightly cooked hamburgers at home may also contribute to the difference between usual and actual behavior. To explore this possibility we compared the FSS, HECD and HPQ results to the FoodNet Population Survey for 1996-97 and 1998-99 by the CDC and FSIS (table 4). The FoodNet survey asked whether respondents ate a hamburger in the past 7 days and whether it was pink. These questions come closer to measuring individual hamburgers than the usual behavior questions of the HPQ and FSS. In 1996-97, the survey asked about hamburgers at home and in restaurants separately. In that survey, 15 percent of respondents who had eaten hamburgers at home had eaten pink hamburgers, and 8.3 percent of

respondents who had eaten hamburgers in restaurants had eaten pink hamburgers. Using data from the 1994-96 CSFII on where hamburgers were consumed, we estimated that about 11 percent of respondents who had eaten hamburgers in either location had eaten pink hamburgers. In 1998, the location of hamburger eating was not specified, and 11.3 percent of FoodNet respondents who had eaten hamburger in the past 7 days had eaten pink hamburger (U.S. Department of Health and Human Services, CDC, 1999).

The 1996-97 FoodNet responses for hamburgers at home and in restaurants are somewhat lower than the HPQ responses, but the combined responses in both years are higher than the combined estimate for the HPQ. The FoodNet estimate is also higher than the proportion of hamburgers described as red or pink in the center (3.9 percent in all locations together) in the HECD.

FoodNet does include children, making it more comparable to the HECD, but FoodNet is not nationally representative since the survey was conducted only in selected States. In 1996-97 the survey was conducted in California, Connecticut, Georgia, Minnesota, and Oregon. In 1998-99 the survey was conducted in those States plus Maryland and New York.

Further, FoodNet did not distinguish between people who ate one hamburger in 7 days and those who ate more. Respondents who ate more than one hamburger during the week could have eaten them more well-done (or less well-done) than respondents who ate hamburgers only once during the week. In that case, the proportion of hamburgers eaten more well-done would be greater (or less) than the proportion of hamburger eaters who ate their hamburgers more well-done.

More research is needed to explain the difference between reports of actual and usual behavior. In any case, if more hamburgers were actually cooked more thoroughly than people reported as their usual behavior, this does not mean that the number of foodborne illness cases is lower than believed. Instead, the discrepancy may imply that the estimated number of foodborne illness cases resulted from a smaller number of unsafely prepared hamburgers than previously believed.