Background Population Exposure Estimates Using *E. coli* O157 Case Interviews

INTRODUCTION/INTENDED USE

The following data comprise exposure frequencies for sporadic culture-confirmed *Escherichia coli* O157 cases that occurred in Minnesota from 2009 through 2015. Cases were interviewed with a detailed questionnaire about exposures that occurred in the 7 days prior to their illness onset (http://mnfoodsafetycoe.umn.edu/wp-content/uploads/2014/02/Salmonella-and-STEC-Interview-Form.pdf).

Epidemiologists can use these frequencies to estimate the background exposure rate in the population for a particular food item or other exposure and then use this estimate in a binomial model comparison which is available in Epi Info 7 under StatCalc or as an excel spreadsheet at (https://public.health.oregon.gov/DiseasesConditions/CommunicableDisease/Outbreaks/Gastroenteritis/Pages/Outbreak-Investigation-Tools.aspx#binomial). This can be useful to quickly evaluate potential hypotheses during the hypothesis generation phase of an investigation prior to conducting a more resource-intensive study method like a case-control study. Cases that were not interviewed, cases who reported international travel within the week prior to illness onset, and outbreak-associated cases, regardless of the transmission route, were not included in these data.

Epidemiologists should carefully consider any potential biases arising from the use of *E. coli* O157 case exposure information to estimate background population exposure rates. Using *E. coli* O157 cases to estimate the background exposure rate in the population will likely introduce bias away from the null hypothesis when evaluating exposures that are risk factors for *E. coli* O157. For example, the percentage of sporadic *E. coli* O157 cases that were exposed to a known *E. coli* O157 risk factor such as ground beef is potentially higher than the true background rate of exposure to ground beef in the population. Epidemiologists should also consider if the food item under evaluation has seasonal consumption patterns, or if consumption of the food varies by gender or age.

The questionnaire administered to *E. coli* O157:H7 cases was modified in 2011. Food exposure questions that were added to the interview questionnaire are indicated by an asterisk (*). Food exposures questions that were removed from the questionnaire in 2011 are indicated by a double asterisk (**).

Another potential source for background exposure data is the FoodNet Population Survey Atlas of Exposures, 2006-2007 (http://www.cdc.gov/foodnet/surveys/FoodNetExposureAtlas0607_508.pdf).

For more specific exposure food frequencies to match the demographics of your current investigation, please contact Joshua.rounds@state.mn.us

DAIRY

Food Item	Denominator	Overall %	Overall % (including maybe)	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter	Pop Survey MN	Pop Survey National
Eggs	774	63%	68%	66%	60%	59%	69%	61%	71%	64%	59%	63%	77%	75%
Shredded cheese	769	51%	58%	52%	50%	53%	54%	25%	56%	51%	51%	36%	N/A	N/A
Processed cheese slices	771	40%	45%	38%	41%	41%	38%	38%	31%	46%	36%	26%	57%	51%
Block cheese	772	21%	25%	22%	21%	21%	21%	24%	26%	19%	21%	31%	62%	61%
String cheese	770	19%	23%	22%	15%	25%	14%	8%	21%	20%	17%	16%	21%	16%
Cheese curds	769	6%	7%	6%	6%	6%	6%	2%	2%	7%	7%	4%	N/A	N/A
Queso fresco or other Mexican style cheese	768	2%	3%	1%	2%	2%	1%	2%	3%	2%	1%	0%	4%	6%
Gourmet cheese (gouda, blue, other cow, goat or sheep cheeses)*	513	7%	9%	7%	6%	3%	10%	9%	7%	4%	12%	0%	N/A‡	N/A‡
Ice cream	773	44%	50%	44%	43%	51%	33%	51%	36%	52%	37%	26%	63%	59%
Frozen dessert treats	769	14%	19%	15%	12%	20%	8%	9%	7%	19%	12%	4%	N/A	NA
Yogurt	772	46%	49%	53%	38%	51%	41%	39%	51%	46%	45%	44%	45%	43%
Milk	781	85%	86%	84%	97%	93%	76%	82%	84%	87%	85%	76%	85%	79%
Unpasteurized milk	809	3%	3%	3%	3%	3%	2%	4%	2%	2%	4%	6%	2%	3%
Milk alternatives (soy, almond, rice milk)*	508	9%	10%	13%	6%	5%	15%	13%	8%	6%	12%	20%	N/A	N/A
Other dairy (cottage cheese, cream cheese, sour cream)*	511	30%	37%	37%	23%	27%	35%	32%	32%	28%	30%	41%	N/A‡	N/A‡
Buttermilk**	186	1%	2%	1%	0%	0%	0%	8%	0%	0%	0%	6%	5%	6%
Sour cream**	175	15%	22%	16%	14%	16%	15%	15%	10%	14%	18%	24%	37%	32%
Cream cheese**	174	9%	16%	13%	5%	9%	9%	0%	0%	10%	2%	20%	25%	25%
Cottage cheese**	180	3%	8%	4%	2%	4%	2%	8%	0%	4%	2%	6%	25%	22%

‡ Please refer to pages 13-15 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. Question asked by population survey may not have been compatible to MN hypothesis generating form or population survey may include additional details.

MEAT / POULTRY / SEAFOOD

Food Item	Denominator	Overall %	Overall % (including maybe)	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter	Pop Survey MN	Pop Survey National
Ground beef	782	68%	71%	64%	72%	71%	66%	60%	64%	70%	65%	72%	52%‡	40%‡
Other beef (steak)	779	35%	38%	28%	36%	30%	34%	37%	29%	35%	32%	19%	50%	46%
Meat from Hunting, private kill, live animal market, butcher shop	789	32%	32%	31%	34%	33%	32%	26%	40%	33%	27%	39%	N/A‡	N/A‡
Chicken (including ground)	769	74%	76%	75%	73%	74%	76%	67%	63%	76%	77%	63%	63%‡	65%‡
Stuffed chicken product	769	2%	3%	1%	3%	2%	2%	0%	0%	1%	3%	4%	N/A	N/A
Turkey (including ground)	774	25%	31%	24%	25%	22%	29%	22%	24%	26%	22%	31%	20%‡	22%‡
Pork (ham, bacon)	774	48%	53%	43%	53%	47%	44%	71%	45%	49%	46%	49%	49%‡	43%‡
Lamb	768	3%	3%	3%	2%	3%	2%	2%	1%	3%	2%	6%	3%	6%
Sausage	773	34%	36%	30%	38%	34%	26%	31%	28%	32%	29%	25%	29%‡	27%‡
Other meat/poultry	765	18%	20%	13%	23%	20%	16%	11%	10%	18%	21%	12%	N/A‡	N/A‡
Fish	771	18%	23%	19%	17%	16%	22%	19%	18%	18%	20%	16%	14%	23%
Shrimp*	511	8%	10%	10%	7%	5%	13%	7%	6%	7%	11%	6%	24%	28%
Other seafood*	508	2%	2%	2%	2%	1%	4%	2%	3%	2%	1%	7%	N/A‡	N/A‡
Shellfish**	187	7%	8%	9%	4%	6%	10%	0%	0%	10%	2%	6%	N/A‡	N/A‡

‡ Please refer to pages 16-19 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. Question asked by population survey may not have been compatible to MN hypothesis generating form or population survey may include additional details.

FROZEN FOODS

Food Item	Denominator	Overall %	Overall % (including maybe)	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter	Pop Survey MN	Pop Survey National
Frozen dinners/entrees*	512	12%	15%	12%	12%	11%	15%	12%	13%	10%	14%	20%	27%	28%
Frozen pizza*	512	34%	45%	32%	36%	38%	35%	12%	33%	35%	35%	31%	41%	25%
Other frozen microwaveable foods*	507	12%	17%	11%	14%	17%	7%	7%	4%	14%	12%	25%	N/A‡	N/A‡

‡ Please refer to page 25 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. Question asked by population survey may not have been compatible to MN hypothesis generating form or population survey may include additional details.

FRUITS

Food Item	Denominator	Overall %	Overall % (including maybe)	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter	Pop Survey MN	Pop Survey National
Oranges	770	19%	22%	22%	16%	21%	16%	20%	24%	18%	17%	26%	49%	45%
Other citrus (grapefruit, lemon, lime, tangerine)	769	10%	12%	11%	8%	8%	10%	17%	18%	7%	7%	29%	N/A‡	N/A‡
Pears	770	12%	15%	13%	11%	15%	8%	14%	14%	10%	14%	10%	21%	20%
Apples	772	52%	56%	51%	54%	59%	46%	39%	43%	47%	61%	66%	65%	62%
Other tree fruit (apricot, plum, nectarine, peach)	769	16%	21%	17%	16%	17%	13%	27%	8%	19%	15%	16%	N/A‡	N/A‡
Strawberries	771	39%	44%	43%	34%	42%	35%	39%	41%	50%	25%	22%	46%	45%
Other berries (blue, black, raspberries)	768	26%	32%	32%	20%	26%	26%	34%	23%	31%	22%	22%	N/A‡	N/A‡
Grapes	767	45%	50%	47%	42%	51%	37%	46%	40%	49%	43%	26%	N/A‡	N/A‡
Bananas	770	57%	60%	57%	58%	61%	50%	71%	68%	53%	60%	56%	76%	70%
Watermelon	771	23%	27%	22%	23%	28%	16%	23%	8%	35%	13%	2%	27%	28%
Cantaloupe	770	16%	20%	17%	14%	15%	15%	27%	13%	19%	14%	8%	32%	32%
Honeydew or other melon*	512	5%	7%	6%	3%	4%	5%	5%	0%	7%	4%	6%	14%	16%
Other fruit (pomegranate, kiwi, mango, pineapple)	765	17%	21%	19%	15%	18%	18%	14%	18%	16%	17%	33%	N/A‡	N/A‡
Unpasteurized apple cider	508	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	4%
Other unpasteurized juice	510	2%	2%	2%	2%	2%	2%	2%	3%	2%	3%	3%	N/A‡	N/A‡
Other juice*	509	48%	52%	47%	49%	55%	41%	33%	46%	50%	48%	36%	N/A‡	N/A‡

‡ Please refer to pages 11-12 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. Question asked by population survey may not have been compatible to MN hypothesis generating form or population survey may include additional details.

VEGETABLES

Food Item	Denominator	Overall %	Overall % (including maybe)	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter	Pop Survey MN	Pop Survey National
Prepackaged salad	770	22%	28%	24%	20%	18%	28%	22%	24%	21%	23%	29%	37%	39%
Iceberg	768	29%	35%	31%	27%	22%	36%	38%	28%	30%	27%	30%	44%	46%
Romaine*	512	21%	28%	25%	18%	14%	28%	39%	18%	20%	25%	23%	39%	47%
Leaf lettuce**	172	12%	17%	11%	12%	12%	12%	8%	0%	9%	11%	40%	N/A‡	N/A‡
Salad greens**	177	5%	9%	7%	3%	2%	9%	8%	0%	5%	6%	7%	N/A‡	N/A‡
Other lettuce/leafy greens (red leaf, radicchio, mesclun, endive)*	512	7%	10%	9%	4%	4%	11%	7%	7%	6%	7%	10%	N/A‡	N/A‡
Spinach	772	12%	16%	13%	10%	8%	16%	13%	13%	9%	13%	23%	20%	24%
Cabbage	771	9%	12%	8%	10%	5%	12%	20%	11%	8%	10%	6%	23%	28%
Tomatoes	771	38%	43%	39%	38%	29%	45%	67%	37%	34%	45%	43%	49%	60%
Cucumbers	768	21%	24%	25%	16%	16%	22%	38%	15%	19%	25%	18%	39%	47%
Peppers (green, yellow, red, jalapeno, serrano)	768	22%	26%	23%	22%	16%	29%	27%	23%	20%	22%	33%	N/A‡	N/A‡
Asparagus	767	6%	8%	5%	6%	3%	8%	11%	14%	4%	6%	6%	18%	21%
Celery	769	15%	20%	18%	12%	10%	18%	33%	25%	13%	14%	15%	43%	42%
Carrots	770	44%	49%	47%	40%	41%	42%	65%	47%	39%	50%	44%	N/A‡	N/A‡
Radishes	767	5%	6%	5%	5%	2%	6%	21%	8%	6%	4%	4%	N/A	N/A
Pea pods/snap peas	767	8%	10%	8%	7%	7%	8%	5%	2%	8%	8%	10%	N/A	N/A
Onions (red, white, yellow)	769	43%	48%	44%	42%	32%	54%	61%	49%	41%	44%	51%	67%	71%
Green onions/scallions	760	5%	9%	6%	5%	3%	6%	15%	4%	6%	4%	8%	23%	30%
Broccoli	770	25%	31%	25%	24%	23%	25%	32%	28%	22%	28%	27%	45%	53%
Cauliflower*	511	11%	14%	12%	10%	8%	13%	21%	13%	8%	15%	3%	25%	23%
Sprouts (alfalfa, bean, radish, clover)*	512	2%	3%	2%	2%	2%	3%	0%	5%	2%	1%	3%	N/A‡	N/A‡
Micro greens*	454	0.4%	0.7%	0.4%	0.5%	1%	0%	0%	0%	0%	1%	0%	N/A	N/A
Cilantro/parsley*	512	9%	11%	10%	8%	10%	10%	0%	7%	9%	8%	23%	N/A‡	N/A‡
Other fresh herbs (basil, thyme, mint, sage)	768	8%	11%	9%	7%	8%	10%	2%	8%	9%	7%	6%	N/A‡	N/A‡
Other vegetables*	507	21%	24%	24%	18%	22%	19%	25%	14%	23%	21%	26%	N/A‡	N/A‡
Egg Plant or Squash**	184	3%	5%	1%	6%	2%	6%	0%	9%	0%	11%	0%	N/A‡	N/A‡
Jicama**	189	0.5%	1%	1%	0%	1%	0%	0%	0%	1%	0%	0%	N/A	N/A

‡ Please refer to pages 7-10 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. Question asked by population survey may not have been compatible to MN hypothesis generating form or population survey may include additional details.

OTHER

Food Item	Denominator	Overall %	Overall % (including maybe)	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter	Pop Survey MN	Pop Survey National
Mushrooms	769	11%	16%	12%	10%	7%	16%	14%	12%	9%	12%	19%	30%	34%
Tofu	767	1%	1%	0.5%	2%	1%	1%	0%	2%	1%	1%	0%	4%	7%
Hummus or tahini	768	5%	6%	5%	5%	3%	8%	2%	7%	4%	5%	8%	N/A	N/A
Nuts (almonds, pecans, walnuts, peanuts, cashews)	769	29%	34%	30%	28%	21%	35%	47%	38%	28%	25%	37%	N/A‡	N/A‡
Sesame seeds*	511	4%	5%	4%	5%	3%	6%	2%	5%	4%	4%	3%	N/A	N/A
Other seeds (flax, sunflower, alfalfa)*	511	10%	14%	9%	12%	9%	12%	16%	7%	11%	10%	19%	N/A‡	N/A‡
Bean-type snacks (soybeans, garbanzo beans, corn nuts, chickpeas, fava beans, wasabi peas)*	511	4%	5%	4%	4%	4%	4%	7%	4%	4%	5%	3%	N/A	N/A
Salsa	769	20%	26%	20%	20%	14%	29%	13%	19%	18%	23%	28%	29%	28%
Avocado*	511	12%	14%	12%	12%	9%	18%	4%	18%	10%	13%	10%	16%	27%
Recently purchased spices (black pepper, white pepper, paprika, oregano, cumin)*	510	18%	20%	18%	17%	16%	18%	27%	32%	21%	8%	16%	N/A	N/A
Spice rubs or blends*	511	10%	13%	10%	10%	11%	8%	5%	14%	11%	6%	9%	N/A	N/A
Peanut butter	771	53%	57%	54%	52%	59%	45%	55%	54%	53%	51%	62%	65%	58%
Chocolate	765	49%	57%	53%	44%	48%	52%	40%	50%	49%	45%	68%	N/A	N/A
Trail mix*	507	8%	9%	9%	7%	7%	12%	2%	11%	9%	5%	9%	N/A	N/A
Chips, crackers, snack foods*	510	75%	78%	71%	81%	84%	68%	63%	68%	81%	72%	72%	N/A‡	N/A‡
Nutritional supplements*	508	31%	31%	35%	25%	24%	35%	51%	31%	27%	34%	38%	N/A	N/A

‡ Please refer to pages 7-10 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. Question asked by population survey may not have been compatible to MN hypothesis generating form or population survey may include additional details.

RESTAURANTS‡

(Note: Cases were not asked specifically about these restaurants by name. Cases were asked if they ate at a restaurant in the 7 days prior to illness onset. If the case reported eating at a restaurant, the case was asked to name the restaurant.)

Restaurant Name	Denominator	Overall %	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter
Applebee's	756	3%	4%	2%	3%	3%	5%	2%	2%	3%	4%
Arby's	756	2%	2%	2%	1%	3%	3%	1%	2%	2%	2%
Burger King	756	6%	4%	9%	7%	5%	6%	8%	7%	5%	2%
Buffalo Wild Wings	756	2%	1%	3%	1%	3%	0%	3%	1%	3%	0%
Chili's	756	1%	1%	0%	1%	1%	0%	0%	1%	1%	0%
Chipotle	756	3%	3%	2%	1%	5%	0%	1%	3%	2%	2%
Culver's	756	3%	2%	3%	3%	3%	0%	1%	3%	3%	2%
Dairy Queen	756	6%	6%	7%	7%	7%	0%	8%	7%	5%	2%
Denny's	756	0.3%	0.3%	0.3%	0%	0.3%	2%	1%	0%	0.4%	0%
Domino's Pizza	756	1%	1%	2%	2%	2%	0%	1%	2%	1%	2%
IHOP	756	0.1%	0%	0.3%	0%	0%	2%	1%	0%	0%	0%
Jimmy John's	756	2%	2%	1%	1%	3%	0%	1%	2%	1%	4%
KFC	756	1%	1%	1%	1%	1%	3%	1%	1%	1%	0%
McDonalds	756	22%	22%	22%	24%	22%	11%	17%	23%	22%	21%
Noodles and Company	756	0.4%	0.5%	0.3%	0.3%	1%	0%	0%	0.3%	1%	0%
Old Country Buffet	756	1%	0.5%	1%	1%	0.3%	2%	1%	1%	1%	0%
Olive Garden	756	1%	1%	0.3%	0.5%	1%	0%	1%	1%	1%	0%
Outback Steakhouse	756	0.4%	1%	0%	0.5%	0.3%	0%	1%	0.3%	0.4%	0%
Papa John's Pizza	756	1%	0.3%	1%	1%	0%	0%	1%	1%	0.4%	0%
Panera	756	1%	1%	1%	1%	2%	0%	1%	1%	2%	0%
Perkins	756	2%	3%	1%	2%	2%	6%	0%	2%	2%	6%
Pizza Hut	756	1%	1%	1%	2%	1%	0%	1%	1%	2%	2%
Popeye's	756	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Subway	756	8%	8%	8%	8%	9%	5%	6%	9%	8%	0%
Taco Bell	756	2%	1%	3%	2%	3%	0%	0%	3%	2%	2%
Taco John's	756	2%	2%	3%	2%	3%	3%	0%	3%	3%	0%
Red Lobster	756	0.3%	0.3%	0.3%	0%	1%	0%	0%	0.3%	0.4%	0%
Wendy's	756	2%	1%	2%	2%	2%	0%	2%	2%	1%	0%

‡ Please refer to page 26 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. The population survey did not include restaurant names but does have data of types of foods consumed at commercial establishments.

OTHER NON-FOOD TRANSMISSION ROUTES‡

Exposure	Denominator	Overall %	Female	Male	Age: <18	Age: 18 – 65	Age: >65	Spring	Summer	Fall	Winter
International Travel	1392	8%	10%	6%	5%	11%	4%	23%	3%	4%	20%
Ill contact before onset	782	16%	18%	14%	19%	14%	4%	20%	16%	13%	19%
Well water*	526	34%	37%	31%	37%	33%	29%	40%	37%	32%	24%
Raw or Untreated water**	191	23%	20%	25%	24%	18%	36%	18%	23%	27%	13%
Other water (such as from a stream while camping)*	514	5%	5%	4%	6%	3%	2%	1%	8%	2%	0%
Recreational water (swim in ocean, lake, river, or pool)	796	24%	23%	25%	36%	13%	9%	9%	40%	9%	9%
Live on Farm*	545	15%	17%	12%	17%	12%	17%	17%	17%	11%	12%
Work on Farm*	543	2%	2%	2%	1%	3%	0%	2%	1%	1%	6%
Visit Farm*	547	14%	16%	12%	18%	12%	6%	22%	17%	8%	9%
Visit petting zoo, educational exhibit, fair or other venue with animals*	542	13%	14%	12%	20%	7%	4%	6%	18%	13%	0%
Cow (present)*	549	19%	20%	17%	25%	13%	8%	18%	24%	13%	12%
Cow (contact)*	549	8%	9%	7%	11%	5%	2%	8%	10%	6%	3%
Goat (present)*	549	8%	9%	7%	10%	7%	2%	1%	12%	8%	0%
Goat (contact)*	548	4%	5%	4%	6%	4%	0%	1%	6%	4%	0%
Sheep (present)*	549	8%	8%	8%	10%	7%	2%	2%	12%	7%	0%
Sheep (contact)*	549	5%	4%	6%	6%	4%	2%	1%	7%	4%	0%
Pig (present)*	549	7%	8%	6%	8%	6%	4%	1%	10%	7%	0%
Pig (contact)*	549	3%	4%	3%	4%	3%	2%	0%	5%	3%	0%
Chicken (present)*	549	8%	10%	5%	10%	6%	2%	6%	11%	5%	0%
Chicken (contact)*	549	3%	3%	2%	4%	0.5%	2%	4%	3%	2%	0%
Turkey (present)*	549	2%	2%	1%	2%	2%	0%	0%	2%	2%	0%
Turkey (contact)*	549	0.2%	0%	0.4%	0.4%	0%	0%	0%	0.4%	0%	0%

‡ Please refer to pages 27-28 of the FoodNet Population Survey Atlas of Exposures, 2006-2007. Question asked by population survey may not have been compatible to MN hypothesis generating form or population survey may include additional details.

* **Question added in 2011 (data only available for 2011-2015)**

** **Question removed in 2011 (data only available for 2009-2010)**

Technical Details

Exposure frequencies were calculated from *E. coli* O157:H7 case interviews from 2009-2015. One thousand eight hundred and thirty-three laboratory confirmed *E. coli* O157:H7 cases were identified during that time period. One hundred and five (7%) cases were excluded because they were not interviewed. Two hundred ninety-nine cases that were determined to be part of a recognized outbreak were excluded. One hundred and nine cases who reported international travel within the week prior to their illness onset were also excluded.

This left one thousand two hundred and eighty-four cases which were included. However, for each specific exposure if the case did not answer the question they were not included in the denominator for that exposure. Additionally, cases who reported "may have eaten" were only included in the column, "Overall % (including maybe)."

The questionnaire administered to *E. coli* O157:H7 cases was modified in 2011. Food exposure questions that were added to the interview questionnaire are indicated by an asterisk (*). Food exposures questions that were removed from the questionnaire in 2011 are indicated by a double asterisk (**).