Food Safety Education For People with Diabetes and Pregnant Women: a Positive Deviance Approach

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ABSTRACT

Few education programs target audiences at high-risk for foodborne illness, especially people with diabetes and pregnant women. The objective of this study is to develop a food safety education program for each using a positive deviance approach. The positive deviance focus group is a novel educational intervention that allows participants to discuss their food handling behaviors and decide to try recommended positive practices modeled by people like themselves. To fit within the educational programs offered by the collaborating institutions, three sessions were given, discussing safe handling topics: 'Cook and Chill,' 'Clean and Separate,' and 'Choose Safe Food.' People with diabetes (32) and pregnant women (29) participated in the study. Focus groups were audiotaped and transcribed. Participants became involved and inspired by vivid discussions and were inspired to change their behaviors to the recommended food handling practices modeled by their peers. Safe food handling practices were reinforced by take-home tasks focused on using refrigerator and cooking thermometers and using separate cutting boards. Participants were unaware of details associated with safe handling recommendations, such as the recommended temperature for cooking specific items or the temperature of the refrigerator. Results of this study indicate that positive deviance discussion module could be a promising alternative to traditional methods of food safety education.

KEYWORDS

Positive deviance; Qualitative; Food safety education; Food handling; High-risk population

INTRODUCTION

Foodborne illness is an important public health issue in the United States. Data collected by the Centers for Disease Control and Prevention's (CDC) reveal a total of 19,056 cases of culture-confirmed bacterial and laboratory-confirmed parasitic infection, 4,200 hospitalizations, and 80 deaths among 48 million residents of 10 states, 15% of the US population (Humes *et al.*, 2011). Some groups are at higher risk for foodborne illness than others. Smith J. L. reported that down-regulation of the cellular immune system induced by hormonal changes during pregnancy increase the risk of pregnant women experiencing foodborne illness (Smith, 1999). Such changes increase the chance of infection from certain foodborne pathogens, like *Listeria monocytogenes*, *Toxoplasma gondii*, *Brucella* species, *Salmonella* species and *Campylobacter jejuni* (Szekeres-Bartho, 1990). Pregnant women are considered 17 times more likely than the healthy general population to contract listeriosis from *L. monocytogenes* (Silver, 1998, Poulsen and Czuprynski, 2013). Certain organisms, including *Listeria monocytogenes*, *Toxoplasma gondii*, *Salmonella typhi* and *Campylobacter jejuni*, can have adverse consequences for the fetus if they cross placenta (Smith, 1999, Lamont *et al.*, 2011, Poulsen and Czuprynski, 2013). While *Escherichia coli* O157:H7 and *Vibrio cholerae* have not been found to cross the placental barrier; they can infect the mother and cause severe consequences for the mother and her fetus (Smith, 1999). Infection can result in miscarriage, stillbirth, premature labor or severe complications for the baby.

Diabetes can also increase the risk of foodborne infection (Shah and Hux, 2003). During a *Salmonella enteritidis* outbreak in which raw eggs were used in a hospital-prepared mayonnaise, patients with diabetes who required insulin or oral hypoglycaemics were at increased risk (Telzak *et al.*, 1991). According to previous research (Calvet and Yoshikawa, 2001) campylobacteriosis is four times more common and salmonellosis three times more common in persons with diabetes than in the general population. Goulet and Marchetti (Goulet and Marchetti, 1996) report that persons with diabetes are 25 times more likely to have

listeriosis. The increased risk of infection with *Salmonella* enteritidis among diabetics is likely due to decreased gastric acid production and decreased bowel motility. The stomach, through the effect of gastric acidity due to hydrochloric acid, functions as a barrier to ingested bacteria (Giannella *et al.*, 1973). At the time of this paper, current literature does not estimate the increased risk of an *E. coli* infection among pregnant women or people with diabetes.

High-risk individuals are generally unaware of their increased vulnerability to foodborne illness. A multi-state survey results showed that less than 20% of the pregnant women have knowledge about *Listeria*, which is a crucial pathogen during pregnancy (Ogunmodede *et al.*, 2005). Other studies report that women are unaware of the danger of eating higher risk foods during pregnancy (Athearn *et al.*, 2004, Cates *et al.*, 2004, Trepka *et al.*, 2006). Furthermore, a qualitative study of health care professionals suggests that women are not being educated about this issue during pregnancy (Morales *et al.*, 2004). Few studies address awareness of the increased risk of foodborne illness among people with diabetes. Educational programs for this condition focus on food choice and seldom or never include a discussion of food safety (Institute, 2011).

This study was aimed to address the gap of high-risk population food safety education, and to evaluate a food safety educational program which uses a positive deviance approach. Positive deviance is based on the observation that in every community there are certain individuals whose uncommon practices enable them to find better solutions to problems than others despite having access to the same resources. This approach has been successfully used to solve problems in the field of nutrition, like childhood malnutrition (Zeitlin *et al.*, 1993) and poor infant health (Guldan *et al.*, 1993). At the time of this writing, positive deviance has not been used in food safety education.

METHODS AND MATERIALS

1. Participants

1.1 People with diabetes

The authors recruited participants from the University of California Davis Health Center Health Management and Education diabetes classes in Sacramento. The study was announced in classes and study flyers and a blank contact information forms were left with participants. The interested parties could contact the author by phone or email. All participants were required to be 18 years old or older, have Type I or II diabetes, act as the primary meal preparer in their family, and cook meals at least three times a week. Classes were scheduled based upon participant's availability. After four months of recruitment (from January 2014 to May 2014), 32 people with diabetes were recruited (30 completed all three sessions and the post-survey). Participants were separated into six groups of four to eight people each.

1.2 Pregnant women

Participants from Sutter Health Davis were recruited from their monthly two to two and half hour 'centering program meeting', and they were grouped by their due date months, for example, the participants, whose due dates were in May, were grouped together. The author announced the study in their centering program meetings, and handed out the consent forms and pre-surveys to those who indicated that they would like to participate in the study. Participants from Women Infants and Children (WIC) were recruited through flyers in the office lobby. Inclusion criteria stated that participants must prepare meals at least three times per week, and act as the primary meal preparer in the family. Discussions with participants from Sutter Health Davis took place in a conference room in the Sutter Health Davis hospital, and with participants from WIC took place in a conference room in UC Davis Food Science department. Participants were advised that they could discontinue participating in the study at any time. In return for participation, participants were given a \$30 gift card. The study was approved through the Institutional Review Board, University of California, Davis.

2. Procedure

At the first meeting all participants completed a survey, which measured their safe food handling knowledge, and perceived risk of contracting foodborne illness. The pre-survey included four self-efficacy questions that were adapted from previous work (Byrd-Bredbenner *et al.*, 2007); two self-risk assessment questions developed by the authors; and eleven food safety knowledge questions that were adapted from an educational program delivered in California (Blackburn *et al.*, 2014). At the conclusion of the food safety intervention, participants completed a post-survey which consisted of three program evaluation questions and the same self-risk assessment and food safety knowledge questions in the pre-survey.

To fit within the education programs cooperated by the medical institutions, three PD group sessions were led by the authors. Due to the nature of the programs for the two audiences, each PD session with the diabetes group lasted one and one-half hours; while the pregnant women sessions were one hour. Topics for each session were 'Cook and Chill', 'Clean and Separate' and 'Choose Safe Food'. Topics were selected based on the educational programs offered by the Partnership for Food Safety (www.fightbac.org). Previous research (Anderson *et al.*, 2011, Kosa *et al.*, 2015, Nesbitt *et al.*, 2014) also showed that consumers especially need information around those topics. In each session the author provided an introduction, answered questions and conducted a structured discussion using a written guide (**Error! Reference source not found.**) based on the Positive Deviance approach (Zeitlin *et al.*, 1993). Participants were invited to discuss their food handling practices related to the topic. If a respondent was practicing the recommended behavior, the group would analyze the strategy leading to this behavior. The discussion would then lead to a consensus that others would try the behavior before the next session. Finally the entire group was assigned a take home task that reinforced the concepts discussed. A co-moderator took notes and operated the tape recorder. After the first session, the participants were provided a cooking thermometer (model IRT220, Component Design Northwest, Inc., Portland, OR), a refrigerator thermometer (model FG80, Component

Design Northwest, Inc., Portland, OR), and a take-home task sheet (see **Error! Reference source not found.**). After the second session, the participants were provided three cutting mats (Greenbrier International, Inc., Chesapeake, VA), and a take-home task sheet (see **Error! Reference source not found.**). After the third session, post-survey data was collected. A follow-up telephone interview took place two to three weeks after the third session. Employing a casual chatty manner, the author asked

What did you think about the program?

Do you do anything differently now after completing the program?

Audio recording with notes were taken during the session by an assistant. All sessions were audio-taped, transcribed verbatim, reviewed for accuracy, and entered into and analyzed using XSight (version 2.0.75.0 SP2, QSR International, Cambridge, MA), a qualitative data management software program. All procedures were pilot tested with a group of 6 participants prior to finalizing the questions and recruiting the study population. The University of California, Davis's Institutional Review Board approved this study.

RESULTS

1. Demographic

Participants consisted of thirty people with diabetes, with 57% females. See Table 1. The majority, 60%, was above 60 years old. Most participants identified as of Caucasian decent (73%), 13% as Hispanic, 10% identified as Asian descent, and 3% identified with African-American decent. For the pregnant women group (n=29), 55% were in age group 20-29, and 45% were between 30 and 39. Most of the participants identified as of Caucasian decent (69%), followed by 28% Hispanics,

2. Session I: 'Chill' and 'Cook'

The focus of the first session was temperature control. Participants were invited to discuss the issues related to 'chill', including 'thawing food', 'storage of leftovers', 'storage of groceries' and 'keeping refrigerator at recommended temperature'. In response to the probe, 'What are some

165 of the things you do to keep the temperature of the refrigerator cool enough,' some participants
166 responded that they used a thermometer, and others stated that they would like to try this
167 practice.

168 The participants also discussed the issues related to 'cook'. 'How do you tell when your food is
169 done?' was asked, and at least one participant in every group mentioned that they used a
170 cooking thermometer. The author then led the discussion to focus on the merits or
171 disadvantages of using a thermometer. Following this, the author led the participants toward a
172 consensus to practice using a cooking thermometer.

173 At the conclusion of the session, each participant was given a refrigerator and cooking
174 thermometer. They were asked to complete two "homework" assignments: record the
175 temperature in at least three places in their refrigerator and record the final temperature of at
176 least two items they either cooked or, if leftovers, warmed up. These take-home tasks were
177 selected to reinforce the concepts discussed and provide an opportunity for participants to
178 practice the recommended behaviors.

179 **2.1 Comments related to chilling food**

180 **2.1.1 Refrigerator Temperature**

181 Most participants did not know their refrigerator temperature. Some participants had
182 refrigerators with a built-in thermometer, however, this thermometer only measures one area of
183 the refrigerator. That the temperature on the built-in thermometer was not accurate for every
184 part of the refrigerator, was a surprise for many participants. Participants noticed that different
185 parts of the refrigerator had different temperatures, and usually the closer to the freezer or the
186 main cooling fan, the colder the area. The shelf in the refrigerator door was the warmest area of
187 the refrigerator.

188 *My fridge tells me but I don't trust it. I bought one to tell me. And especially the door, I*
189 *want to make sure my milk is safe because I leave it on the door. (Pregnant women)*

190 *Our fridge has numbers 1-9, I just make sure foods in front are not frozen. (Diabetics)*

191 Some participants organized their refrigerators by temperature, not according to the
192 recommendation to store raw meat below cooked ready-to-eat food.

193 *I put leftover on the bottom shelf, because that is the coldest. (Diabetics)*

194 *I was surprised because I keep my eggs by the freezer sides and I moved it to the other*
195 *side because it started looking weird and it was even colder. (Pregnant women)*

196 **2.1.2 Thawing Food**

197 When asked how they thaw meat, most participants knew the recommendation to thaw meat in
198 the refrigerator. During the discussion about strategies to comply with this practice, many
199 participants mentioned they would follow ‘alternative’ methods if they needed the meat sooner.
200 However those ‘alternative’ methods were usually not recommended, like putting the item in
201 sink, on the counter, or in the sun. After the discussion, all participants said they would try to
202 thaw meat in the refrigerator.

203 **2.1.3 Take-home task**

204 The first take-home task was to measure the temperature of different spots of their home
205 refrigerators using a refrigerator thermometer. Before completing this task, only one out of thirty-
206 four pregnant women had a separate refrigerator thermometer at home, and about one third had
207 a built-in thermometer in their refrigerator. Only three of participants recalled the temperature of
208 their refrigerator. Among diabetic participants, 20% had a built-in thermometer in their
209 refrigerator. Over half were not sure of the recommended refrigerator temperature.

210 Twenty-five out of thirty participants in the diabetics group and twenty out of twenty nine
211 pregnant women turned in their take-home task report sheets of refrigerator temperatures, and
212 the participants who did not turn in the report sheets claimed that they also completed the take
213 home tasks. One third of participants from the diabetics group and over 40% from pregnant
214 women group reported refrigerator top-shelf temperatures higher than 40°F (**Error! Reference**

215 **source not found.**). All participants reported the temperature at the refrigerator door was the
216 highest.

217 **2.2 Comments related to cooking food**

218 Most of the participants were confident as to their cooking skills. When asked how they knew
219 when the poultry or burgers was cooked, they all agreed that 'white' or 'no pink' was the
220 indicator for chicken parts, and some used 'color' and some used 'touching, feel' for burger. The
221 only time most of them mentioned using thermometer was cooking whole poultry. Some
222 participants did not have thermometers, and they used a 'pop-up timer' which came with the
223 turkey package. They did not know what temperature the 'pop-up timer' was set to.

224 *When my family makes whole turkey, I eat the dark meat. We strictly tell by color not by*
225 *temperature. (Diabetes)*

226 *I usually go with look and color. Only time we use a thermometer is for roast turkey.*
227 *(Pregnant woman)*

228 **2.2.1 Using a cooking thermometer**

229 The participants asked many questions about using a thermometer, which reflected some of the
230 reasons why they did not use the thermometers frequently. First, they did not know the
231 recommended temperature for different cooking items;

232 *What is the temperature for chicken? Is that 180°F or 185°F? (Pregnant women)*

233 *Should I cook my leftovers to the same temperature (165°F)? (Diabetes)*

234 Secondly, they did not know how to use the thermometer, when cooking small or thin pieces;

235 *It's so small that you just poke through the whole thing. (Diabetes)*

236 Thirdly, they never learned the thermometer should be calibrated or how to calibrate it. Since an
237 inaccurate thermometer could result in overcooked or undercooked food items the thermometer
238 was viewed as less reliable than appearance and texture;

239 *I could not get it over 140°F, and it was the most dried out disgusting ever. (Pregnant*
240 *women)*

241 Many of the participants did not know why it is important to cook the food to certain temperature.

242 Some mentioned that they just followed the recipe or the cooking show.

243 *Why not the same temperature for everything? It would be much easier for us to*
244 *remember. (Pregnant women)*

245 *I've listened to a lot of cooking show and they say salmon is really good when its*
246 *medium rare. (Diabetes)*

247 *Some participants said they trust the meat quality, so it would not be necessary to cook it to that*
248 *high temperature:*

249 *I use tri-tip to make burgers. You can eat it raw, and it's okay, but if you buy cheap*
250 *quality burger at the market then it's not safe. (Diabetes)*

251 After the take-home task (using cooking thermometer), all participants reported that they used
252 the thermometer, and they agreed that it was not as difficult as they expected. Some said they
253 would use a thermometer more often in the future, however some still struggled with using the
254 thermometer.

255 *I could not get the temperature up to the recommended temperatures for a microwave*
256 *meal. (Pregnant women)*

257 but most participants enjoyed the experience:

258 *I cooked my chicken to 166°F. It was not dry and I liked it. (Diabetes)*

259 **2.2.2 Handling leftovers**

260 Participants agreed that leftovers could be a potential food safety hazard if they were not
261 handled properly. Some participants even refused to eat leftovers because they did not know
262 what they should do to keep them safe. When asked how to reheat leftovers, many participants
263 didn't know the recommended end point temperature for leftovers. Most used a microwave to
264 reheat the items until steamy, and only used the oven for baked food like pizza.

2.2.3 Take-home task

The first take-home task also included measuring the temperature of home cooked items using a cooking thermometer. Among pregnant women 60% had cooking thermometer at home, and most only used the thermometer when cooking whole poultry. Half of the persons with diabetes had a cooking thermometer at home, and all only used it when cooking whole poultry. Participants were asked to record the end point temperature of three items. About 80% of the cooked items from the diabetics participants, and two third of the cooking items from the pregnant women were at or above the recommended temperature. The items not reaching the recommended temperature, were either because the participants did not remember the recommended temperature or because of misuse of the thermometer. Four participants in the diabetics group and two in the pregnant women group reported their thermometer could not reach the recommended higher temperature, even though they kept cooking the food items.

3. Session II: 'Clean' and 'Separate'

During the second session, participants were led to discuss issues related to 'clean' and 'separate', including 'washing hands', 'washing fruit and vegetable', 'avoiding washing poultry under running water' and avoiding 'cross-contamination'. In response to the probe, 'What are some of the things you do to avoid cross contamination?' some participants responded using separate cutting boards and cleaning kitchen items that were highly likely to contribute to get cross contamination. Others indicated that they would like to try to practice these behaviors. After the session, each participant was given two cutting boards and asked to use a separate cutting board for items to be eating raw, such as fruit or greens, and items to be cooked, like raw meat, poultry, or fish. They were also asked to record how frequently they cleaned specific kitchen items: sink, counter, utensils, cutting boards.

3.1 Comments about 'Clean'

'Clean' was a more familiar topic for all participants. They immediately linked 'clean' to hand washing and produce washing.

291 **3.1.1 Washing hands**

292 Almost all participants knew they should use soap and water to wash hands, and they
293 responded with various versions for duration of washing:

294 *I use the hottest water I can, and use soap, and I sing happy birthday. (Pregnant*
295 *woman)*

296 However, when asked how long they actually washed their hands in daily life, the washing
297 duration was much shorter:

298 *A lot of people know 20s but they don't do it. I am one of them. (Diabetes)*

299 *I usually don't pay attention until the soap is off my hand and that's it. (Pregnant woman)*

300 Some participants just did not believe their hands were 'that dirty'.

301 *If I am at home all the time, do I still need to wash my hands that often? (Diabetes)*

302 **3.1.2 Washing fruit and vegetable**

303 Most participants reported that they washed their vegetables before eating. One participant said
304 she had never washed an apple before. She thought everything she bought from the
305 supermarket was free of germs. Many participants did not wash fruit that needed to be peeled,
306 like oranges, watermelon, and pineapple. After the explanation that cutting through a fruit would
307 transfer germs from the outside to the inside, participants were much more comfortable with
308 complying with the recommendation to wash all fruit.

309 *I also need to wash the apple, even if I will not eat the peel? (Pregnant women)*

310 Some participants mentioned folk remedies of 'killing bacteria' which have not been validated by
311 scientific documentation, such as using a little vinegar or salt in the wash water.

312 *If strawberries, I also put vinegar in the water and soak them for 5-10 minutes. (Pregnant*
313 *women)*

314 *What if you do a vinegar wash like my mother-in-law to keep it fresh longer? (Diabetics)*

315 When asked whether they wash the 'pre-washed' salad leaves, almost half of the participants
316 did not wash these products. Many who still wash them indicated that they did not trust the
317 manufactories or merchants to wash adequately.

318 **3.1.3 Take-home task**

319 The second take-home task for this session was to record the frequency of kitchen items
320 cleaning. Twenty-three out of thirty participants in the diabetics group and nineteen out of twenty
321 nine participants in the pregnant women group turned in their take-home task report sheets
322 recording usage of multiple cutting boards and frequency of cleaning home kitchen items.
323 Participants who did not turn in the report sheets claimed that they also completed the take
324 home tasks.

325 The frequency of cleaning activities in a week among both people with diabetes and pregnant
326 women is presented in Figure 1. Participants cleaned their utensils and cutting boards much
327 more frequently than their sinks and countertops. Before this take-home task, some participants
328 seldom cleaned their sink. Participants commented that understanding the 'cross-contamination'
329 concept, caused them to pay more attention to cleaning other items in their kitchen such as the
330 countertop and sink.

331 **3.2 Comments about 'Separate'**

332 Cross contamination was introduced into the focus groups as part of the discussion around
333 'Separate'. This was the first time most participants had heard about this concept. However,
334 after introducing this word, it was frequently used by participants in later discussions.

335 **3.2.1 Cleaning in the home kitchen (avoiding cross-contamination)**

336 Participants agreed that using a dishwasher was a good way to sanitize the utensils and cutting
337 board in the home kitchen because of the high heat used by the washer. However, half of the
338 participants did not have a dishwasher at home. Many participants used sponges or wash
339 clothes to wash utensils and other cooking ware, but two focus groups suggested using a

microwave to sanitize the sponge and using a washing machine to sanitize a wash cloth. Most participants did not consider a sponge or wash cloth as a medium of cross contamination. After the take-home task to record cleaning items in their kitchen, all participants agreed that they should clean their countertop and sink more often. Participants mentioned many other kitchen tools that were not listed on the take-home task, which suggests that the take-home task raised their food safety alertness.

3.2.2 Separating cutting board (avoiding cross-contamination)

Most participants agreed that using a separate cutting board for raw meat and fruit and vegetable was an appropriate safe food handling practice. It was common to have more than one cutting board at home.

I bought a glass cutting boards that goes in the dishwasher. I have been using those especially for meat so I wouldn't use the same one for raw meat. I believe they should sterilize well in the dishwasher. (Diabetes)

When asked how they used their cutting boards, many the participants responded they used a different board for meat and produce. Some participants, more people with diabetes than pregnant women, used only one cutting board for everything. They did this out of convenience and believed that 'rinsing between usages' (without soap) was sufficient.

My boyfriend will cut everything on the same board but I tell him to rinse with soap and water in between, at least with water for veggies. (Pregnant women)

I was cutting the same thing on the same cutting board and I would wash the cutting board and put the vegetables on top. (Diabetes)

3.2.3 Take-home task

After completing the second take-home task which specified using separate cutting boards, all participants reported they separated the cutting boards for raw meat and fruit. One of the participants who was a vegetarian used a separate board for fruit and vegetables.

365 **4.Session III: 'Choose'**

366 During the third session, the participants discussed issues related to 'choose safe food',
367 including 'choosing pasteurized juice/milk/soft cheese', 'sell-by and use-by date', and 'food
368 irradiation'. When participants were asked, 'Do you check if the juice and milk you buy is
369 pasteurized', some participants responded positive on both, and the others also agreed this
370 was a practice that was feasible in their daily life. Since this was the last session, no take
371 home tasks were assigned.

372 **4.1 Comments about choose safe food**

373 Diabetics participants were more engaged in this topics than pregnant women. Some even took
374 notes with them about the food items that were safe or less safe to eat. Not eating runny yolk
375 egg and cookie dough were the two practices most difficult for participants to adopt.

376 *Over easy eggs? I always eat my eggs over easy. (Diabetes)*

377 *I have thought about it (cookie dough) with the raw eggs. I do think about it briefly but it*

378 *doesn't stop me from licking off my fingers or something. (Pregnant women)*

379 Many pregnant participants were surprised that deli meat may contain *Listeria*. Some of them
380 said, 'if it is not safe, then I will not eat it for the rest of my pregnancy.'

381 **4.2 Comments about food irradiation**

382 When told that irradiation would make food safer by destroying harmful bacteria, persons with
383 diabetes were much more open to the idea of irradiated food compared to the pregnant women.
384 Around two thirds of the diabetic participants responded that they would like to 'try' irradiated
385 food, if it is safer to eat. In contrast, only one third of the participants in the pregnant women
386 group said they would like to try irradiated food. Those who were hesitant to try said they had
387 not seen evidence that irradiated foods are safe.

388 *I won't eat it. It is just too new to me. (Pregnant woman)*

389 *I would rather not eat meat than eat irradiated (meat). (Pregnant woman)*

Although not part of the topics covered, pregnant women also raised many questions about controversy topics, like genetically modified food. Most of them were negative about what they perceived as “unnatural concepts” in food.

5. Comments about this program

The program was well received by the participants in both the diabetes and the pregnant women groups. Many described the facts delivered in the program as ‘surprising’ and ‘memorable’. All participants agreed the information in the program was helpful to them and would recommend the program to other people with the same condition, diabetes and pregnancy.

The info about the luncheon meat is surprising. These are eye openers. (Diabetes)

However, there were also complaints about this program, mainly from pregnant women, some felt stressed with all the new information they had received.

Now, I feel I am a bit paranoid with the food I eat. (Pregnant woman)

6. Follow-up evaluation

Twenty-seven of thirty participants with diabetes and fourteen out of twenty nine pregnant women participated in the follow-up interview. The low rate of pregnant women group participation was mainly because the pregnant women had not previously received a phone call from the author, while participants in diabetics group received the author’s phone call many times for scheduling and reminding of the sessions. Additionally when the follow up call was scheduled, it was difficult for the new moms to find time in their schedule to talk.

When asked ‘what do you think about the program’, participants with diabetes were still very excited about the information they had received. Most pregnant women said it was helpful, and some said they would still prefer more information on childbirth, which was their primary focus.

When asked ‘do you do anything differently after the program?’ many participants in both groups mentioned using refrigerator and cooking thermometers. Some also reported that they were more careful about hand washing and home kitchen cleaning.

DISCUSSION

Many people with diabetes and pregnant women did not know they were at increased risk of foodborne illness. This is consistent with previous studies (Athearn *et al.*, 2004, Cates *et al.*, 2004, Trepka *et al.*, 2006, Ogunmodede *et al.*, 2005). Even if participants were aware that people could become ill from food handling mistakes, and they knew what was recommended, like washing hands for 20s, they still would not do it every time. Consumers tended to associate foodborne illness with food handling violations at restaurants instead of home cooking. Others have also reported that consumers perceive home produced food as lower risk, and food prepared by others as higher risk (Frewer *et al.*, 1994, Bruhn, 2014).

The above phenomena may be due to 'Optimism Bias,' in which people perceive their own risk of getting foodborne illness or handling food unsafely is lower than that of others. 'Optimism Bias' can reduce the consumer's health-protective behaviors and their precautions regarding personal risks (da Cunha *et al.*, 2014). Optimistic bias is not unique to consumers in their home. A recent study in Brazil (da Cunha *et al.*, 2014) found that food handlers perceived themselves as less likely than their peers to transmit a foodborne disease to consumer and their friends.

Differences in session involvement were found between pregnant women and people with diabetes. Pregnant women tended to have a lower turn-in rate of take-home task response and were less involved in the focus group discussions. This difference could be related to medical condition length (pregnant women facing short-term condition vs. people with diabetes facing long-term condition), recruitment (pregnant women from university community vs people with diabetes from metropolitan area), age-group (pregnant women in 20-39 age group vs. people with diabetes in 40-79 age group), and motivation (pregnant women focused childbirth vs people with diabetes focused on improving diet and health). People with diabetes were older, and were more comfortable accepting recommendations from health authorities. Those with

441 diabetes were from metropolitan area, and were less skeptical about information from a
442 university source. Additionally, those with diabetes were motivated to improve their health.

443 Also, when talking about food irradiation, pregnant women were less open to this process than
444 people with diabetes. Participants also wondered if irradiation affects tastes nutrition, and
445 safety. Since irradiated food is not widely available in the marketplace, few had a chance to
446 personally verify the sensory qualities of irradiated items. Previous research found that
447 insufficient information about the risks, benefits and safety concerns are major factors driving
448 consumers reluctance of buying irradiated food (Fox *et al.*, 2001, Fox *et al.*, 2002, Boland and
449 Fox, 2012).

450 To reach the target audiences, food safety educators must gain the support of health educators
451 currently offering pregnancy or nutrition management programs. To recruit a larger audience,
452 food safety educators should consider adding food safety education to existing programs
453 compared to offering food safety education alone. Mentioning surprising food safety information
454 during recruitment motivates the audience to attend. Props can help dramatize facts on bacteria
455 multiplication or cross contamination. Take-home tasks enable the participant to practice
456 recommended behavior often with surprising results which can motive further compliance to
457 recommendations. The video about chicken washing allowed participants to visualize cross
458 contamination making the concept much more easily understood.

459 Participants frequently asked why a specific action should be taken. Many times, they were
460 surprised by the reason behind a specific recommendation. For example, they wanted to know
461 why the cooking end point temperature for poultry was higher than that for ground beef. When
462 they heard that *Salmonella* requires a higher killing temperature than *E. coli*. they understood
463 the rational for the difference and were also reminded that these healthy foods could contain
464 pathogens that required control. While brief and succinct recommendations are more easily

465 communicated, this research suggests that a short explanation may assist consumers in
466 remembering and following the guidelines.

467 A discrepancy in poultry recommended end-point cooking temperature led to consumer
468 confusion. The author found that there were recipes in cook books, web sources, and blogs that
469 still recommended 185°F as the end point temperature. Further, some cooking thermometers
470 currently for sale in the supermarket listed on the dial 185°F as the recommended temperature
471 for poultry. It is necessary for book and blog publishers and thermometer manufacturers to
472 update their products' temperature recommendation to 165°F.

473 The results from this study indicate that a positive deviance discussion module could be a
474 promising alternative to traditional methods of food safety education. Although traditional food
475 safety reading materials can increase food safety knowledge, consumers could be more
476 involved and inspired by vivid discussions. Participants indicated that they changed their
477 behavior to the recommended handling practice, by following their peers' positive deviance.
478 Further, the discussion format provides insight into the current knowledge of participants and
479 the living condition challenges they face. This can guide educators in shaping and delivering a
480 more effective food safety program. For example, that women pregnant with their first child were
481 seeking information and those who had previously delivered believed they were well informed
482 suggests that first time moms should be a higher priority in program delivery.

483 A curriculum for health professionals to deliver to high-risk populations is being developed
484 based upon this work. Increased emphasis on food safety education by hospital associated
485 health professionals will help protect people at increased risk of foodborne illness from
486 infections and resulting complications such as miscarriages, reactive arthritis and Guillain Barre'
487 syndrome. Future positive deviance food safety projects should include additional high-risk
488 population groups, like people with compromised immune systems.

One of the limitations of this study was that the results were based on self-report data. Consumers were overly optimistic about their food handling practices, and over report their compliance with safe handling recommendations, compared to actual observed practices (Bruhn, 2014, Phang and Bruhn, 2011). Future research should expand the evaluation of educational interventions to include observational research.

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584

1 Table 1 Demographic information of study participants

	Diabetics n=30 %(n)	Pregnancy n=29 %(n)
Gender		
Male	43(13)	0
Female	57(17)	100(29)
Age group		
20-29	0	55(16)
30-39	0	45(13)
40-49	13(4)	0
50-59	27(8)	0
60-69	47(14)	0
70-79	13(4)	0
Ethnicity		
Caucasian	73(22)	69(20)
Hispanic	13(4)	28(8)
Asian	10(3)	3(1)
African-American	3(1)	0

2

3

Session 1

Background

What is foodborne illness?
Who do you think are high-risk to foodborne illness?
How much risk do you think you are after you have diabetes (or you are pregnant), compared with general population?
What foods do you think are commonly associated with foodborne illness?
Have you heard of safety issues relate to food? If so, what have you heard of?

Chill

How long should left-overs be at room temperature before going to refrigerator?
How far are you from your grocery or favorite to-go restaurant?
When do you put leftovers in the refrigerator? What kind of container do you use to put them in the refrigerator?
Do you feel comfortable in your own home that foods are kept cold enough?
 If yes, tell us what you do
 If no, what exactly are your concerns?
Do you know how cold your refrigerator is? Do you know how cold it should be?
What are some of the things you do to make sure the refrigerator to stay cold? (PD)

Cook

How do you tell when your food is done?
Have you ever thought food was done, and then you cut into it, the food was only lukewarm? If this has never happened to you, what is your secret? (PD)
Do you ever use a food thermometer? Why or Why not?

Session 2

Checking Take-home task I

How did you managed the cooking and chilling projects? Did everything go well? Let's talk about the results.

Clean

When and how to wash hands
How often do you think you actually wash your hands?
Are you concerned about the safety of the produce that you purchase? Why or why not?
Do you wash poultry under running water?
Do you think everyone does a good job in cleaning?
What are some of the things you do to be sure the food and the kitchen are clean? (PD)

Separate

Do you remember seeing these 'cross-contamination' mistakes?
What are some of the things you do to avoid cross contamination?(PD)

Session 3

Checking Take-home task II

What did you do and how did it work for you?

Choose

Are you concerned about the safety of the produce that you purchase? Why or why not?

Have you heard of any problems associated with drinking raw milk or un-pasteurized juice? If yes, what have you heard?

Do you buy raw milk, juice or soft un-ripened cheese with raw milk? Why or why not? (PD)

Have you heard people getting ill from soft un-ripened cheese, like Brie or soft Mexican cheese (Queso Fresco).

Do you know any strategy to make these foods safe? (PD)

Have you heard of any meat recalls or people becoming ill from eating burgers? If yes, what have you heard?

Do you check dates on the perishable foods you purchase from the market?

Do you know the difference between 'best-use-by-date' and 'use-by-date'?

What are some of the things you can do to reduce your risk?

Have heard of irradiation? Have you tried irradiated meat? Would you like to?

5 PD identifies questions that brought out positive deviance behaviors

6

7

8 Table 3 Take-home task response sheet – Task I

Name:_____	
Refrigerator Thermometer	Door_____
	Top shelf_____
	Bottom shelf_____
	Other_____
Food thermometer	
Item	Temperature

9

10

Name:_____

How do you use those two cutting boards? (separate or mixed)

Cleaning checkbox

Item	How many times you cleaned in this week	How you cleaned (paper towel or cloth)
Utensils		
Countertop		
Sink		
Cutting boards		

14 Table 5 Refrigerator temperature locations that were higher than 40°F

	People with diabetes	Pregnant women
	N=25	N=20
	%(n)	%(n)
Door	39(10)	45(9)
Top-shelf	29(7)	41(8)
Bottom-shelf	32(8)	35(7)

15

16 Table 6 Most common volunteered behavior that changed after completing the program

Item	Total Sample N=41 %(n)
Use a cooking thermometer	40(16)
Use a refrigerator temperature	33(14)
Wash hands (according to recommendation)	18(7)
Wash or clean home kitchen more frequently	15(6)

17

18

Figure 1 Frequency of cleaning activities in a week for both people with diabetes and pregnant women groups (N=#)