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The U.S. Government's Global Hunger & Food Security Initiative

EatSafe: Evidence and Action Towards Safe, Nutritious Food

Consumer-Facing Interventions to Improve Food Safety Perceptions and Practices in Low- and Middle-Income Countries: A Review

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This EatSafe report presents evidence that will help engage and empower consumers and market actors to better obtain safe nutritious food. It will be used to design and test consumer-centered food safety interventions in informal markets through the EatSafe program.

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ACRONYMS

Below is a list of all acronyms and abbreviations used in the report.

DALYs	Disability Adjusted Life Year
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IEC	Information Education Communication
LMIC	Low- and Middle-Income Countries
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analysis
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behavior
WHO	World Health Organization

EXECUTIVE SUMMARY

Foodborne illnesses are a global public health issue. Responsibility to prevent foodborne disease is shared by many actors along the food supply chain, including consumers. However, there are many factors that affect consumer food risk perception and many strategies to motivate and drive food choices on food safety (or risk). EatSafe conducted a scoping review to assess consumer-facing food safety interventions carried out globally over the past 20 years, and categorized and analyzed them by type of theory, intervention strategy, evaluation design, and outcomes to understand which perception and practice interventions might be effective in changing consumer behavior, knowledge, attitudes, beliefs and perceptions on food safety. Ninety-two interventions were reviewed, the majority of which were published in the last 10 years in North America. Most targeted adults and 25% were directed at women and mothers. Health or risk communication interventions were the most common strategy to reach a wide-range of audience types in community or market settings and move beyond just skill-based education at the individual-level. This scoping review offers recommendations on how to communicate with consumers to modify their risk perceptions and potentially change food purchasing behaviors, which is relevant to develop programmatic models for consumer-driven or demand-driven approach to food safety in low-and-middle income countries. The most relevant recommendations are:

- Emotions are powerful motivators and should be used to deliver risk information. The emotions that appear to hold most promise for communicating about food safety are: 1) trust (feeling of safety/positive feeling), 2: fear (or fear of loss or heightened risk), 3) disgust, and 4) nurturance. Future *studies should seek to understand how these motivators are expressed in each EatSafe country and their importance for different consumer audiences (men vs. mothers vs. children).*
- Consumer motivation will set the foundation for desirability. Consumer desire and purchasing behavior are strong market signals. EatSafe should *test various strategies to address motivation and purchasing in-markets before scaling up programmatic activitie*s.
- Consumers' overt demands and *collective expression for safe food may require different strategies than the ones used for motivation and purchases at the individual-level.* Some of the studies reviewed here addressed elements of consumer advocacy and citizen participation, such as governance (e.g., community management councils) and accountability ('community score cards').
- The community remains an important place for intervention implementation, either via community events, marketplaces, or community members or influencers. *Interventions that rely on social signals (norms, cues, peer-to-peer modeling) and trust will likely have a significant community component.*
- Since most perception and practice interventions rely on communication approaches or tactics, selecting several theories will help in organizing and designing the content/information, delivery channels, intervention exposure/dose. EatSafe should

design interventions using tactics and delivery channels that cut across disciplines such as social and behavior change communication, information, education, communication, social marketing.

EatSafe will consider these findings and their application in the context of informal markets, where the audience for food safety communication are adults and communication between the vendors and consumers is direct.

1. INTRODUCTION

Food safety generally refers to the control of adverse human health effects from consuming foods containing hazards, such as pathogens in the food supply, [3] harmful chemical compounds (e.g. pesticides), extraneous objects that can cause injuries (e.g. plastics or glass pieces) or radioactive elements that have the potential to cause acute or long-term adverse health outcomes. The World Health Organization (WHO) estimates that globally, every year, almost one in every 10 people will fall ill due to a foodborne illness.[1]

Worldwide, unsafe food causes 600 million cases of foodborne related illness and 420,000 deaths a year, one third of which occur among children under the age of 5.[1] Unsafe food containing pathogens or chemical hazards can cause more than 200 different diseases. 92% of illness and 55% of deaths are attributed to diarrheal diseases, most often caused by food contaminated with pathogens such as norovirus, pathogenic *E. coli*, and *Salmonella*.[2] An estimated 33 million years of healthy life (DALYs - Disability Adjusted Life Year) are lost every year due to foodborne disease, much of which affects low and middle income countries (LMICs) – defined by the World Bank as a Gross National Income per capita of $1,025 or less for low income and between $1,026 to $12,375 for middle income[4]. Those living in poverty also bear the burden of having a reduced ability to cope with foodborne illnesses due to presence of other diseases, lack of adequate health care, and generally lower health status.[6] These illnesses compound issues of under-nutrition and nutrient deficiencies, as well as the impact of parasitic infections, especially in women and children.[7]

In addition to the global public health burden, the socio-economic burden caused by these diseases is also significant, especially in LMICs. The World Bank estimates that these countries lose approximately $110 billion US dollars in productivity and medical expenses each year.[5] This translates to reduced productivity and inability to care for self and family, which can perpetuate cycles of poverty in individuals and families. Broader societal effects also include impacts on national economies, trade, tourism, and sustainable development.[5]

Food quality and safety are universal consumer concerns. Most consumers have some knowledge of the quality (e.g., freshness, taste) and safety (e.g., do not eat rotten food; cooking food to kill bacteria) of the foods they eat.[8] However, safety knowledge varies within and outside the household and willingness to consume risky foods also differs.

Consumers may obtain safety and quality information from a range of sources. While many food hazards are non-perceptible, consumers still use sensory cues to assess quality and freshness. [9] Some consumers are even willing to pay more for products they perceive as safe.[10] Yet many food handlers both in retail and home settings report they have poor understanding of how to properly prepare and cook foods, including proper handwashing, reducing cross-contamination, and cooking and storing foods at the correct temperature.[11-12] In addition, consumers can choose where to shop, but may be limited in the choice of food sources, and hence the degree of safety these sources can provide. In LMICs, for instance, people buy food from both traditional and informal markets. [3,5] While food in these markets is not by default less safe than what can be obtained in more formal retail establishments, informal markets lack public health oversight and often fail to comply with food quality and safety assurance standards .[13]

Consumers can directly impact food safety in two main domains: the home environment and places where individuals shop for or acquire food and where they interact with other food system actors. Indirectly however, the market pull they may generate for safety across the supply chain remains untested.

A recent scoping review of food safety education interventions aimed at consumers have mostly focused on changing attitudes and behavior related to food safety at home.[14] While consumer food handling can directly impact food safety, positively or negatively, other actors in the food chain also have responsibility in ensuring safe food.[15] While research has mostly focused on either consumers or other food handler in the supply chain, many of the food safety practices are of similar nature (e.g., hand washing, adequate temperature storage, etc.) and can be used as interventions on at multiple stages along the "farm-to-form" supply chain. In other words, knowledge, attitudes, and practices cut across the food supply chain continuum.[16]

According to some behavior models there are three domains to individual behavior that can apply to both consumers and food handlers: individual factors (e.g. motivation, attitudes, perceptions), social and cultural factors (e.g. income/social class, ethnicity, religious beliefs), and external stimuli factors (e.g. communication through mass media or other channels, regulations, legislation).[17] All three domains can be leveraged in food safety interventions, and have been applied in interventions in home food environments. More recent attempts at changing risk perception have elucidated new avenues for changing individual behavior and attitudes, as well as the sociocultural and external stimuli factors to create a food safety culture, driven by consumer demands.[18] Thus, it is increasingly recognized that consumers can be potential "agents of change" by fostering a positive "food safety culture" and influence other actors in the supply chain. However, evidence is lacking on whether consumer-facing or consumer-driven interventions can effectively and sustainably lead to improved food safety in food environments outside of the home or in the wider supply chain, for instance in "wet" markets or street vending environments.

The purpose of this scoping review is to characterize and examine the intervention literature in the past 20 years aimed at changing consumer perceptions, attitudes, and behaviors on food safety. Our analysis includes a categorization by geography, intervention type (channels, modalities), theory, method, and key outcomes during this period. Our discussion focuses on the novel intervention approaches and food safety actions that have the potential for improving consumer demand for safe foods. Our discussion also highlights knowledge and research gaps as well as insights informing intervention design in the context of the EatSafe Program.

2. METHODS

Scoping reviews are a way to synthesize research evidence that maps an existing literature by documenting the volume, nature and characteristics of the primary research that has been done in a field of interest.[19,20] This is especially valuable if the topic has not been extensively reviewed or includes multiple viewpoints that can be summarized, as well as identify research gaps or needs for future study.[21] Scoping reviews share some of the same processes as systematic reviews, including a rigorous and transparent search method, but the purpose of a scoping review is to provide a wider lens for analysis of the literature, such as identifying themes and knowledge gaps, rather than presenting empirical evidence of a smaller number of studies.[22] Overall, scoping reviews aim to provide a descriptive overview of the existing body of knowledge, without critically appraising or synthesizing evidence from individual studies.[23]

The methodology for this review was conducted in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines[24] and we then applied the scoping review framework outlined by Arksey and O'Malley.[20] This framework outlines five key phases for a scoping review: identifying the research questions, identifying relevant studies, selecting studies for review, charting the data, and collating, summarizing and reporting the results.

2.1 Research Questions

The review of food safety studies was guided by the following questions:

1. What types of food safety studies have been conducted globally, to change consumer attitudes, beliefs, perceptions, and behaviors about food safety over the last 20 years?
    a. Which population(s) have these interventions targeted (e.g., mothers/women, schoolchildren; in low- or high-income countries)?
    b. What are the key characteristics of these studies (e.g., intervention design and evaluation design)?

2. What outcome have been used to assess intervention success in these studies?

3. Which perception and practice interventions have shown statistically significant outcomes, and what approaches, contexts, or factors have been associated with these outcomes?

2.2 Data Sources and Search Strategy

With the assistance of a medical librarian, detailed search strategies for each database were developed. The search queries were tailored to the specific requirements of each database. The initial search was done June 16, 2020 in seven electronic databases: PubMed (National Library of Medicine), Embase (Elsevier), Web of Science (Clarivate Analytics), Cochrane Central (Wiley), CINAHL (EbscoHost), Green File (EbscoHost) and Clinicaltrials.gov using a combination of keywords and subject headings where appropriate. These databases were selected to cover a broad range of disciplines, understanding that food safety is a topic in both empirical and social sciences. Handsearching was also performed by other members of the review team by examining review articles, looking at references used in articles as a way of spot-checking for consistency, and reviewing findings from the grey literature. The search was limited to the English language and to publications since 2000. The full search details are provided in APPENDIX I.

EatSafe's *Publicly available food safety information: Grey Literature resources for consumers and practitioners, with a focus on Nigeria* looked at 36 organizational or governmental websites, was also conducted to identify any other potential studies to include in the scoping review. Research articles deemed to be peer reviewed were pulled and became a hand sorted reference.

2.3 Citation management

All citations were first uploaded to Endnote X.7 and duplicates removed. Remaining citations were then imported into the web-based systematic review software DistillerSR (Evidence Partners Incorporated, Ottawa, ON) for subsequent title and abstract review.

2.4 Eligibility Criteria

Studies were eligible for inclusion in the scoping review if they had a consumer focus (vs. only food handlers such as workers or vendors), had a food safety focus (vs. interventions to treat or target food borne diseases directly, such as vaccinations, drugs, or other therapies or studies or clinical studies of disease pathogens), and were an intervention attempting to change knowledge, attitudes, beliefs or behaviors/practices related to food safety. Although we did not limit eligibility by geographical focus, the search was limited to English-only publications. We also abstracted cross-sectional studies, which are presented separately in a review of cross-sectional literature. Papers that described the development of an intervention, developed and psychometrically tested a measurement tool, or were reviews articles were not included as they did not have outcomes related to answering the research questions. However, references in these studies were checked to identify additional studies

that may not have been captured in our search. Any relevant study found via this 'snowballing' search had to also comply with the search (published since 2000 and available in English) and eligibility criteria (i.e., intervention study with a consumer- and food-safety focus, etc.).

2.5 Title and Abstract Relevance Screening – Levels 1 and 2

For the level-one screening, citations were screened by title and abstract by two independent reviewers for the first 1500 entries. They were not masked by author or journal name. Titles for which an abstract or author was not available were included for subsequent review. If a tiebreaker was needed, a third reviewer was called in to decide. Once a Kappa of at least .80 was found between two reviewers,[25] signaling agreement in screening among reviewers, we went to a "one reviewer to include, 2 reviewers to exclude" review. As recommended by Levac et al.,[21] reviewers met regularly to resolve conflicts and discuss the selection process. This process was repeated for full text article screening and article selection.

For level-two screening, included citations were carefully reviewed for applicability, eligibility criteria (e.g. consumer food safety focus), and duplicates. Citations that did not provide an abstract or author were also looked at in detail to see if they met inclusion and eligibility criteria. A review of journals was also done to ensure that no citation was from a predatory journal or publisher by checking against the List of Predatory Journals[26] and assessing whether the journal is a member of the Committee on Publication Ethics (COPE)[27] or the Open Access Scholarly Publishers Association.[28]

2.6 Data Characterization and Synthesis

Once a final list of citations was created, all full text articles were retrieved. If a full text was not available through institutional holdings or through inter-library loans, attempts were made to reach out to authors or the journal for assistance. A data extraction form was then used to categorize each study by the following information: author/title/journal/year of publication, intervention description, theory(ies) used, summary of study, outcomes, location, and sample description (APPENDIX II). This form was reviewed by the research team and slight modifications were made after the first 10 studies were reviewed. Any study found to not fit eligibility criteria at this level was flagged and the study team reviewed for inclusion. Excluded studies were either added to the exclusion number or moved to another review examining cross-sectional and qualitative research evidence (i.e. was a cross-sectional study and did not test an intervention or was a description of "pre implementation" and there were no study outcomes).

A summary table was completed to extract relevant information such as type of intervention (e.g. school based, community based, mass media), theory used, geography, target group, outcomes, and findings with statistical significance (for full summary table, see APPENDIX II).

Once the analysis to characterize the studies was completed, we reviewed the studies to answer the research questions. Descriptive statistics were calculated to summarize the data, including frequencies and percentages to depict nominal data and then analyzed by outcomes to characterize which types of interventions showed statistically significant results.

3. RESULTS

The initial search resulted in 21,397 studies (149 from grey literature sources); 3,221 duplicate studies were found and omitted, leaving 18,176 references eligible to screen. After relevance screening, 322 met the eligibility criteria based on title and abstract. Level 2 review eliminated 149 based on duplicates not identified previously, not peer-reviewed, or out of date range, leaving 173 citations. An additional 50 were hand-added from reference and grey literature searches with a final sample of 223 citations. This included 92 interventions, 85 cross-sectional surveys, 21 qualitative studies, and 25 mixed-methods studies. The flow of articles is presented in the PRISMA diagram in Figure 1.

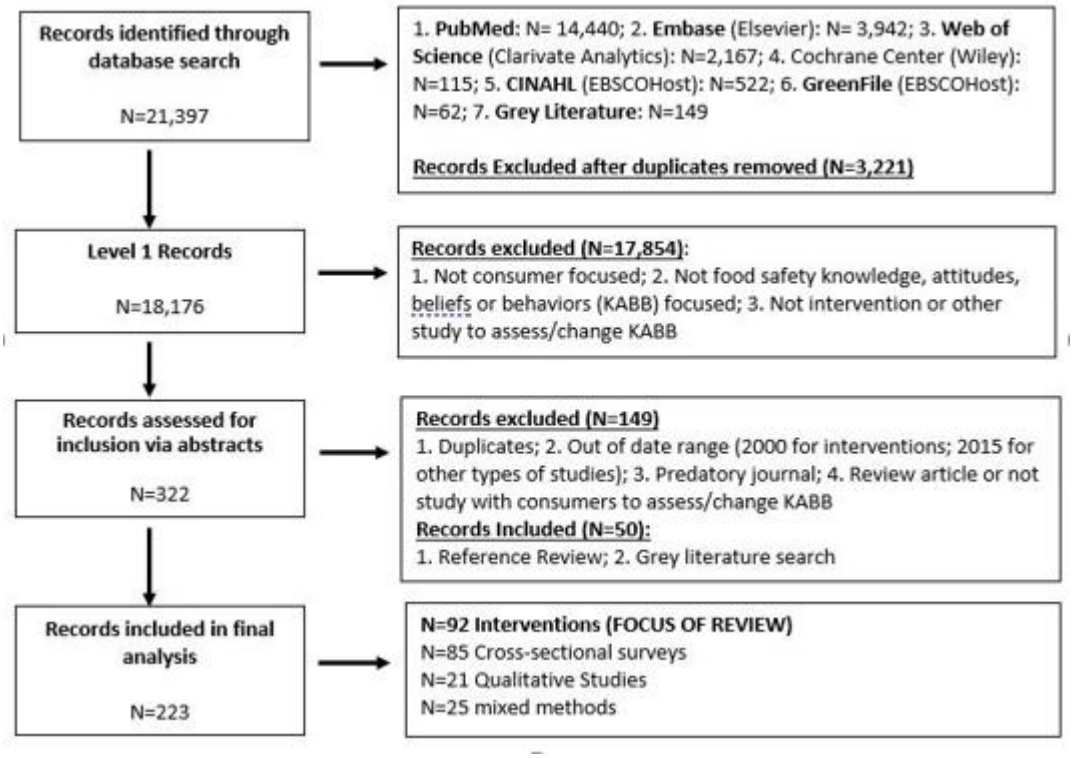

Figure 1. Inclusion Flow Chart

3.1 General Characteristics of Intervention Studies

Of the 92 food safety perception and practice intervention studies included in the review[29-120], two thirds were published since 2010. Over 40% have occurred in North America (United States and Canada), 23.9% in Asia, 15.2% in Europe, 15.2% in Africa, and 2.2% in Australia (Table 1). One study was multi-continent (South America, Africa, and Asia). Only two interventions were conducted in South America, representing two countries, Guatemala, and

El Salvador. In Asia, a total of 22 interventions have been conducted: 5 in India, 3 in South Korea, and 4 in China. Other countries include Lebanon, Iran, Thailand, Myanmar, Bangladesh, Vietnam, and Turkey. Fourteen studies have been conducted in Africa, including four in Malawi, three in Kenya, and two in Ethiopia. Other African countries where consumer food safety studies were conducted include Zambia, Ghana, Togo, Benin, Egypt, Mali and Nigeria. In Europe, 14 studies have been conducted, half of which occurred in Italy. Other countries include Switzerland, the United Kingdom, the Netherlands, Sweden, France, and Belgium.

Using the World Bank characterization of Gross National Income per capita to categorize countries by income, 57.6% of the studies have been conducted in high-income countries, in North America, Europe and Australia. Only 8% have occurred in low-income countries, where the public may be more exposed to and at risk of food-borne illnesses. A total of 34.4% have occurred in middle-income countries, with 12.2% in upper-middle-income countries and 22.2% in lower-middle-income countries (Table 1).

Table 1. General Characteristics of Consumer Food Safety Interventions

Characteristic	Number and Percentage
Publication Year (N=92)	
2000-2005	6 (6.5%)
2006-2010	23 (25.0%)
2011-2015	31 (33.7%)
2016-2020	32 (34.8%)
Continent (N=92)	
Africa	14 (15.2%)
Asia	22 (23.9%)
Australia	2 (2.2%)
Europe	14 (15.2%)
North America	37 (40.2%)
South America	2 (2.2%)
Multi Continent	1 (1.1%)
Type of Country by Income (N=99)*	
High Income	57 (57.6%)
Middle Income	
Upper Middle	12 (12.2%)
Lower Middle	22 (22.2%)
Low Income	8 (8.0%)

*Total is higher than 92 intervention studies because some studies had multiple country sites, intervention theories, or target groups, which were tallied separately.

3.2 Evaluation Study Design, Theory, and Target Groups

About 40% of studies used a one group, pre/post-test evaluation study design with no control group and 23.9% were quasi-experimental studies (Table 2). Quasi-experimental studies do not include randomization in the design; instead, the intervention and comparison (or

control) interventions are assigned by the research team. Many of the quasi-experimental studies in this review consisted of pre/post-test design, with the control group selected from a similar community. Only 20.7% were randomized controlled trials (RCTs) which provide the best evidence of intervention efficacy.[121] These RCTs were carried out in all regions of the world, but proportionately more in Australia (where both studies were RCTs) and Europe, where over a third of the considered interventions were either randomized experiments testing risk messages or RCTs testing interventions. North America (NA) has the fewest RCTs or randomized experiments (8/37; 22%). The majority of studies in NA are instead one group, pre-post or post-test only (21/37; 56.8%). The remaining 22% are quasi-experimental (8/37). Asia is similar to North America in that 22.7% (5/22) of its studies have been RCTs or randomized experiments. Here, most studies are either quasi-experimental (8/22, 36%), using geographic location as controls, or one group pre/post or post-test only designs (9/22, 40.9%). In Africa, six of the 14 were one group, pre/post or post-test only (42.9%), five were RCTs or randomized experiments (35.7%), and three were quasi-experimental (21.4%).

One-third of the studies were theory-based interventions, and most of these were cognitive-based theories, which give primacy to rational, deliberative judgement as antecedents for behavior change. The most commonly used theory was the Theory of Planned Behavior/Theory of Reasoned Action (TPB/TRA) (8.5%).[122] In these studies, the constructs of perceived behavioral control, behavioral intention and subjective norms were used to develop interventions that would increase perceived risk in the target audience.[29,34,56,59,72,79,82] Applying the TPB/TRA resulted in an array of intervention designs. The most common were communication interventions that use media, videos or fact sheets.[29,34,82] Other types of intervention designs were “discussion maps” and cooking classes to learn about food safety,[59] community-based education interventions conducted by female community health volunteers,[56] computer-based curriculum interventions,[79] and food safety messaging at point of purchase.[72] The ‘other’ category included theories or models that were used only in one study.

There were three theories worth mentioning because these are drawn from the field of communication and decision making rather than health, including the Theory of Cognitive Biases[123] and the anchoring effect,[95] Prospect theory,[114,124] and Mediatization Theory.[119,125] These theories were applied to interventions or experiments that tested different message strategies, such as the concept of gain or loss framing, or different message (media) channels for food safety messages. Applying a theory, however, did not mean that the interventions were effective.

The “general public” category (adult population, teachers, parents, and adults over the age of 65, and women) was a main focus of consumer food safety studies (64/98, 65.3%). Six studies targeted vulnerable adult groups, including those with low income or low literacy, minority groups (e.g. Latinos), or refugees/recent immigrants.[30,46,57,59,81,86] Many food safety interventions specifically target women (21/98, 22%), and there was a strong focus on

motherhood, but not on pregnancy. The preference for mothers (15/21, 71%) may be due to their control over their children's food choices or their responsibility for food preparation and cooking.

Another target audience for food safety interventions were students, from primary school through university (34.6% of the considered studies). Most of the studies that targeted younger students used in-school curriculum to implement food safety education or training. Among college students, the type of interventions were health communication interventions, such as experimental test of various risk communication messaging or social marketing interventions on campuses to increase food safety knowledge and change behaviors.

Table 2. Characterizing Consumer Food Safety Perception and Practice: Interventions by study design, theory and target

Evaluation Study Design (N=92)	
Randomized Control Trial	19 (20.7%)
Randomized Experiment	7 (7.6%)
Quasi-Experimental, with control	22 (23.9%)
One group, Pre/Post: No Control	36 (39.1%)
One group, Post Only: No Control	8 (8.7%)
Theory (N=94)*	
No theory identified	65 (69.1%)
Theory of Planned Behavior/Theory of Reasoned Action	8 (8.5%)
Health Belief Model	4 (4.3%)
Transtheoretical Model	2 (2.1%)
Social Cognitive Theory	2 (2.1%)
Adult Learning Theory	2 (2.1%)
Other theories	11 (11.7%)
Target Group (N=98)*	
School-going groups	34 (34.6%)
Children – Primary School (elementary/middle school)	17 (17.3%)
Low Income Youth	2 (2.0%)
Children – Secondary School (high school)	2 (2.0%)
Young Adults – College	13 (13.3%)
General Public -	64 (65.3%)
Adults	22 (22.4%)
Limited Resource Adults (income, literacy, refugees etc.)	6 (6.1%)
Teachers	4 (4.1%)
Parents	1 (1.0%)
Latin ethnicity Adults	1 (1.0%)
Elderly Adults	3 (3.2%)
Adult patients with Health issues (e.g. HIV, Cancer)	2 (2.0%)
Women	21 (21%)
Non-mothers, non-pregnant women	5 (5.1%)
Mothers	14 (14.4%)
Pregnant women	1 (1.0%)
American women of Latin ethnicity (US)	1 (1.0%)

Whole Household	4 (4.1%)

*Total accounts for studies with multiple country sites, intervention theories, or target groups

Across geographies there was a preference for target audiences. In North America students (43.2%, 16/37) and adults (40.5%, 15/37) were most frequently targeted. In contrast, among interventions conducted in Asia and Africa, the most frequent target audience was women and specifically mothers (36.4%, 8/22 in Asia; 57.1%, 8/14 in Africa), which may reflect the roles of women in food handling and childcare. Europe, on the other hand, had no interventions aimed at women and most targeted either students (42.9%, 6/14) or non-female adults (50%, 7/14).

3.3 Characterizing Intervention Strategy: Channels and Intervention Modalities

Our results also revealed a wide range of delivery channels and intervention modalities used in studies. We identified seven different types of delivery channels (or intervention contexts): schools (kindergarten through secondary schools and post-secondary university campuses), communities, clinics, homes, 'population-based', and mixed (Figure 2). The interventions modalities used in the delivery of the intervention are in Table 3. For a table outlining channel, modality and references, see APPENDIX III.

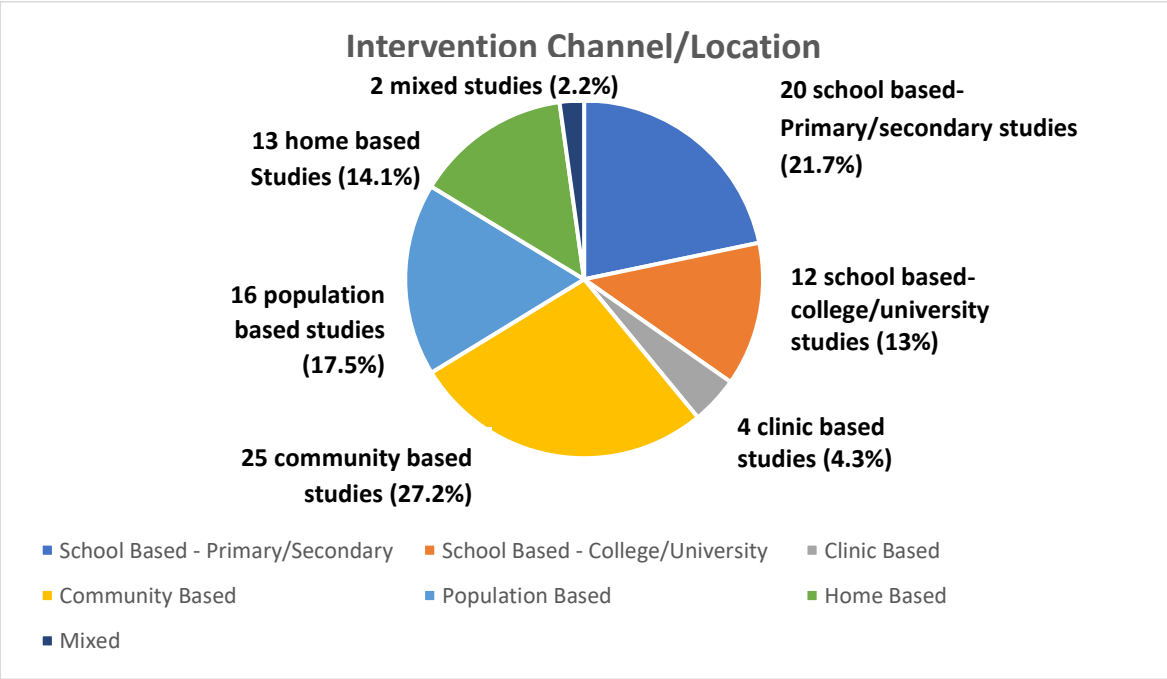

Figure 2. Intervention Channels/Delivery Location

Table 3. Intervention Modalities by Channel Types

CHANNEL	MODALITY
SCHOOL – Primary/Secondary	• Teacher online modules • Curriculum for students in the classroom • Self-paced online app • Educational video or computer-based games • Teacher curriculum for high school • Teacher curriculum for middle school • Food safety workshops in primary school • Curriculum with lab experiments • Lessons using “mind maps” • Health campaign to reach kids in class, parents and teachers with posters, lessons, events, skits
SCHOOL – College/University	• On-campus media campaign using campus media or social media • In-class curriculum • Web-based food science tutorial for students • Health communication using postcards, brochures, safe foods preparation information • Risk communication messages provided in experiments – messages, flyers • Food safety education through email and handouts for employees
CLINIC	• Comic book for HIV/AIDS patient • Group education – people with diabetes and pregnant women • One on one education with caregivers of children with cancer
COMMUNITY	• Education curriculum provided in groups of adults • Education curriculum for kids in after-school program or community centers • Community campaign videos shown in groups of adults and kids • Cooking classes for youth and adults in community settings • Brochures given to fishermen • Food safety “maps” and cooking classes for immigrants and refugees • Multimedia food safety program on kiosks for WIC mothers • Public seminars on food safety for adults • Computer education program • Social Marketing campaigns in specific community: leaflets, posters, fridge magnets, TV documentary, news articles • Brochures provided to parents of elementary school students • Community health worker education sessions with women • Community education using role play, skits, demonstration, group discussions etc.
POPULATION	• Mass media campaigns (TV, radio, billboards etc.) • Communication experiments or education using online panels – Videos, message phrasing, web-based education tool

	• Social marketing campaigns for large populations campaign pamphlets, posters, banners distributed by health care volunteers, retail markets, media, etc. • Mailed intervention materials – fact sheets, sliding inserts, flyers etc. Communication experiments testing message effectiveness or education materials using in-person cross sectional surveys
HOME	• Self-guided education tool for the home kitchen • One on one counseling on food safety with families – street food • One on one counseling with mothers on food and cooking safety using education materials, kitchen hardware
MIXED	• Child-to-parent education strategy in home and in community groups • In-house and community demonstrations on food safety

In our sample, community-based interventions and population-based interventions were the most common delivery channels (41/92, 44%). Community-based studies (27.2%) are those studies that deploy activities within community settings (e.g., local meeting spaces) or by community-level actors (e.g., community health volunteers). Population based studies (17.5%) are those studies that intervene in the wider external environment, via mass media channels or mass mailings. Among school-based delivery channels, 21.7% were either primary/secondary school interventions with a focus on students, teachers, or staff, and 13% were in colleges/universities. The remaining delivery channels that were used infrequently were home-based studies, defined as those activities deployed in an individual's home (14.1%; 13 studies), clinic-based studies implemented at a healthcare location (4.3%; 4 studies), or "mixed" studies where activities were deployed in at least two delivery channels noted above (i.e. home and community; 2 studies, 2.2%). A wide variety of intervention modalities were represented in the reviewed studies. Many were specific to the channel delivery (i.e. in-class curriculums most often occur in school settings), but some modalities can be seen across channels. For example, health communication interventions—which include a wide range of communication tactics, from the use of mass media (television, radio) or social media (Facebook), often bundled into a campaign—were found in both community-based and population-based interventions. The use of print materials, e.g., flyers, fact sheets, posters, or banners, have also been used across most of the delivery channels. A number of the interventions used unique modalities to reach their audience segment with more culturally or age appropriate content, such as interactive multimedia at kiosks,[108] comic books,[48] low literacy booklets,[80] and mailed flyers with sliding inserts so that bilingual children can teach their newly immigrant parents,[86] to home-based package of videos or posters delivered by mail.[102,104]

3.3.1 Social marketing.

Social marketing campaigns was a strategy used in food safety interventions. Social marketing is an approach that adapts commercial marketing techniques used to sell products to change social behaviors.[127] In the case of public health, social marketing interventions are founded

on the exchange principle, where the costs and benefits of behavior change are clearly and repeatedly communicated to the target audience. Social marketing interventions may also use theory and are often deployed as campaigns. Consumer exposure to the campaign is usually achieved by using various delivery channels and communication tactics to persuade or influence the target audience. Biran et al.,[38] for example, deployed a social marketing campaign, SuperAmma (means SuperMom) in rural villages in India. In that study, the authors used "emotional drivers", rather than cognitive theories, to increase hand washing behaviors. They posited that focusing on "disgust", or the desire to avoid and remove contamination, rather than focusing on health-related messaging, along with the maternal emotional driver for "nurturing", would influence behaviors. They conducted school and community events, as well as household visits. They used various tactics, such as flipcharts, posters, and even a campaign truck. This campaign was shown to significantly affect hand washing behavior in the intervention villages.

3.3.2. Mass Media.

Mass media was another food safety intervention strategy, both in North America and Africa. Wogu et al.[117] used mass media in Nigeria to increase awareness and personal hygiene behaviors through social media, radio, and television. It was not found to change behaviors or increase awareness of Lassa fever and its transmission, but the intervention did increase understanding of hygiene behaviors directly related to food safety. In the United States, Dharod et al.[47] created a food safety media campaign using materials from the Fight Bac! Campaign from the US Department of Agriculture,[127] and disseminated it through several channels (radio, television, newspapers) aimed specifically to reach Latino populations in Connecticut and southwest Massachusetts. Campaign materials focused on four central messages – clean, separate, chill, and cook. This intervention showed that a third or more of respondents remembered seeing campaign ads and those that had were significantly more likely to have adequate food safety knowledge on a pre/post-test assessment.

3.3.3. Risk messaging.

A portion of the studies we reviewed were aimed at changing consumer perceptions by manipulating the messaging strategy. Many of these interventions were designed as brief experiments in laboratory settings, where consumers were randomly exposed to different message strategies and then were asked to disclose their perceived risk for foodborne illness or self-efficacy in being able to act on food-safety directives. For example, Nauta et al.[83] tested web-based messages that embedded cues to improve food safety. One group received basic information, a second with same messages but with "aggressive" language, colors and images that evoked an emotional response, and a third group, which used disgust along with risk information and was embedded with a behavioral cue to perform self-protective food related behaviors. Finally, a fourth group was given control information on nutrition. In this study, risk information increased food safety behavior intention, and behavior and emotional reactions like "disgust" were associated with intended and actual food safety behavior.

These experimental studies suggest how one might communicate risk to motivate consumers. This is especially relevant given that many normative agencies (i.e., World Health Organization) use risk communication, which is the dissemination of risk information and mitigation strategies from experts to the general public to enable informed decision-making.[128] Often this type of strategy is used in an emergency, such as a foodborne illness outbreak, but it can also be used to more generally communicate food safety risk, such as poor hygiene at food or improper holding temperature for food at food retail locations.

We also found risk communication strategies tested in market settings[42,72,105]. Chalak et al.,[42] for example, choice experiment tested messages based on quantitative risk reduction attributes of purchasing street food (specifically "shawarma") with families in Lebanon. They found that disclosing food safety attributes and food safety certification were two independent factors that affected consumer preferences and willingness to pay for shawarma that was assessed to be safer. Another study by Lagerkvist et al.[72] was a field experiment that provided shoppers with information about actions that a vendor had taken to minimize food safety risks from kale (washing, gloves, proper storage, etc.). The experiment showed that compared to customers who were not exposed to information on safety enhancing attributes at point of sale (control group), customers who were exposed reported less perceived risk and higher volitional control, which led them to choosing vendors who had taken measures. They also were willing to pay more for kale that was handled safely than customers in the control group. These two studies underscore how perceived risk and information disclosure might be useful for supporting purchase decisions in market.

3.3.4. Consumer education.

Another common strategy, especially in LMICs, was education. Takeuchi et al.[103] worked with community health volunteers to implement an information, education, communication (IEC) strategy in communities in Vietnam, providing group education sessions, public display banners, pamphlets, and posters. This strategy showed significant knowledge gains and behavioral change in the target communities. One study in Thailand[105] also used an IEC, using banners, leaflets, and posters, implemented by a network of public health practitioners in health and market settings (wet/dry markets, retail shops). This was one of the few studies that tracked bacteriological outcomes and found that while the 2-year campaign was implemented there was a lower annual case incidence which increased after the campaign ended, indicating that public health campaigns require sustained efforts.

Within an education strategy, one-on-one counseling was a common modality used to increase skills, especially of mothers, in preparing food for and feeding infants. Skills include how to wash hands properly, how to store and prepare food, how to feed an infant to avoid cross-contamination, and other behaviors. Some of these studies included the use of "promotors" or other types of community health volunteers.[43,89,] Chidziwisano et al.[43] relied on local residents in the Chikwawa District in Malawi and trained them on complementary food hygiene behaviors, such as handwashing with soap, washing kitchen tools, and reheating

food. This study showed that a psychosocial approach was effective with significant improvements in hand washing and proper cleaning and storage of kitchen utensils. The community-based volunteers' modality to provide education has been implemented as one-on-one instruction or through group meetings via community channels and schools.[31,49,58,78,98-100]

In a multi-national study by Edward et al.(49) for example, communities in four countries (Cambodia, Guatemala, Kenya, Zambia) were provided a package of interventions and implementation instructions they could choose to implement, including household level training by community health workers, "social accountability" mechanisms using scorecards to enhance community knowledge about resources, and community management councils that provided targeted counseling about hand washing and infant feeding. This study found that handwashing behavior in intervention sites in Cambodia, Guatemala and Kenya were significantly improved and this was directly correlated with lower incidence of diarrhea in children.

3.3.5. Children and Youth Education.

Finally, many interventions have targeted school-aged children and young adults, from primary school through college. These have mainly consisted of curriculum or courses that are embedded in the school day and have used general food safety information to increase awareness and knowledge of food safety concepts. Many use multi-media strategies that employ more than one medium of communication, such as videos, videogames, or other "entertainment education" strategies to provide information that engages children and young adults. For example, Quick et al.[85] developed and tested a videogame called "Ninja Kitchen" to enhance food safety information, and Hobbs et al.[61] tested a computer-based education program called "The Vicious Worm" to educate students about a zoonotic parasite and its association with food hygiene. The Ninja Kitchen videogame used games, a "fun" spokes-character who modeled safe food handling behaviors, and 15 levels of gaming that had "hazards" that players had to navigate (i.e. leaving food out or cross-contamination). Evaluation indicated that students who used the game were more likely to believe themselves to be at risk for foodborne illness, had stronger attitudes about the importance of food safety, and had greater intention to practice proper handwashing behaviors. Similarly, the "Vicious Worm" is a computer based program for students in Zambia that is set in a sub-Saharan African context and allows for tailoring the educational content to suit the needs of the audience (e.g. farmers, consumers, school-aged children). This study with children showed significant increases in knowledge of hygiene and cooking safely remained well understood one year after implementation.

At the college level, social media campaigns for students have been a strategy to increase safe food handling knowledge and behaviors,[76,101] very "hands on" case studies that allow for outbreak "investigations"[96] or use of computer based programs about food safety.[79] For

example, Mayer et al.[76] initiated the "Safe Eats" social media campaign for a college campus, using Facebook and traditional lectures on food safety to enhance student engagement in material**.** Results indicated that the combination of the social media posts and the traditional lectures showed the highest increases in food safety attitudes, practices, and knowledge.

3.4 Characterizing Evaluation Design: Outcomes, Study Designs, and Study Effectiveness

Most outcomes involve measuring knowledge, self-reported behavior, or intentions. Some, however, incorporate direct observations of behavior or biomedical testing to assess intervention effectiveness, increasing the rigor of the evaluation. By far the most common outcome is knowledge of food safety (52/88, 59.1%). Some examples of variables used are proper meat temperature, hygiene (e.g. handwashing), or specific knowledge of a disease caused by improper food handling. Similarly, 35 studies (39.8%) asked participants to self-report their behavior, usually from a pre- to post-test to assess potential change. Only 14 (15.9%) conducted actual observations of behavior. Risk perception, defined as the subjective judgement a person makes about how risky something is to them (i.e. chance of getting a foodborne illness) and an important construct in food safety and food safety behavior, was assessed in only 10 of the studies (11.4%). Table 4 outlines the major outcome noted in the interventions. We excluded four studies that assessed process outcomes only. For all studies and their outcomes, see APPENDIX IV.

Table 4. Outcome categories used to evaluate Consumer Food Safety Interventions

Outcome	Number of Studies (%)1 N=88 2
Food safety, hygiene, or disease specific knowledge	52 (59.1%)
Self-report behavior	35 (39.8%)
Food safety beliefs/attitudes	18 (20.5%)
Observed behavior (handwashing, food prep etc.)	14 (15.9%)
Perceived Risk (of foodborne diseases)	10 (11.4%)
Environmental health variables (assess to water, sanitation, fecal contamination etc.)	6 (6.8%)
Intention of behavior	5 (5.7%)
Recognition of communication campaign messages	5 (5.7%)
Health outcomes (i.e. diarrheal disease)	5 (5.7%)
Self-efficacy (confidence in being able to perform behavior)	4 (4.5%)
Theory of Planned Behavior Constructs (Perceived behavioral control, volitional control, anticipated regret[3])	4 (4.5%)
Preference for business certification in food safety	1 (1.1%)
Self-reported exclusive/predominate breastfeeding[4]	2 (2.2%)

1 Most studies had more than one outcome variable so percentages will not add up to 100%

2 Four studies only assessed process related outcomes and are not included in the total number

3 Theory of Planned Behavior construct definitions: Perceived behavioral control: a person's perception of the ease or difficulty of performing the behavior of interest; Volitional Control: cognitive process when person commits to particular choice; Anticipated Regret: regret a person may feel in the future after a decision is made.

4 Breastfeeding was chosen over feeding weaning food to the infant, to protect them from foodborne hazards.

Table 5 describes the outcome by study design. Thirty percent of the studies we reviewed used randomized evaluation design, either as RCT or randomized experiments. In contrast, 70% of the studies were non-experimental evaluation designs. In randomized controlled trials, self-reported behavior is the most common type of outcome measured. In contrast, change in knowledge of food safety is the most common outcome assessed in non-experimental studies. Randomized experiments, most often testing different types of messages on food safety, predominately are assessing perceived risk of foodborne illness.

Table 5. Evaluation Design and Proportion of Outcomes Assessed 1

Outcome assessed	RCT (n=19)	Randomized Experiment (n=7)	Quasi Experimental (n=22)	One Group, Pre/Post (n=34)	One Group, Post only (n=6)
Knowledge	47.4% (9/19)	14.3% (1/7)	59.1% (14/22)	70.6% (26/34)	50% (2/6)
Beliefs/Attitudes	0	14.3% (1/7)	36.4% (8/22)	20.6% (8/34)	0
Behavior Intention	0	28.6% (2/7)	4.5% (1/22)	0	33.3% (2/6)
Self-efficacy	0	14.3% (1/7)	4.5% (1/22)	5.9% (2/34)	0
Self-reported Behavior	57.9% (10/19)	0	45.5% (10/22)	44.1% (14/34)	16.7% (1/6)
Perceived Risk	0	71.4% (5/7)	9.1% (2/22)	5.9% (3/34)	0
TPB Constructs	5.3% (1/19)	14.3% (1/7)	4.5% (1/22)	2.9% (1/34)	0
Observed Behavior	15.8% (3/19)	14.3% (1/7)	13.6% (3/22)	17.6% (6/34)	16.7% (1/6)
Business Certification Preference	5.3% (1/19)	0	0	0	0
Recognition of Media Campaign	0	0	4.5% (1/22)	5.9% (2/34)	33.3% (2/6)
Environmental Health Outcomes	21.1% (4/19)	0	4.5% (1/22)	2.9% (1/34)	0
Breastfeeding	5.3% (1/19)	0	0	2.9% (1/34)	0
Health Outcomes	10.5% (2/19)	0	4.5% (1/22)	5.9% (2/34)	0

[1] Percentages are based on experimental design category (column). In each column, percentages add to more than 100% as some studies assessed more than on outcome variable category. TBP = Theory of Planned Behavior

Finally, effectiveness of studies was assessed by examining whether statistically significant findings were achieved in the main study outcomes. In studies with multiple outcomes, effectiveness was assessed on whether the majority of those outcomes had reached statistically significant results. If a study was effective on a minority of outcomes, it was rated as "marginally" effective. Of studies reviewed here mostly all can be classified as effective (74/88, 87.1%) or marginally effective (9/88, 10.2%), except five studies (5.6%) that showed null results for all outcomes (Reference available upon request). The studies with stronger evaluation designs showed more effectiveness in their outcomes: for quasi-experimental studies 19 of 22 studies (86.4%) showed statistically significant results; randomized controlled trials 16 of 19 (84.2%) demonstrated statistically significant results. All seven (100%) of the randomized experiments reported statistically significant results.

The studies with less rigorous evaluation designs were also found to be effective. One group pre/post designs reported intervention effectiveness for 27 of the 34 studies (79.4%). While only 2 of 6 studies (33.3%) of one group post-test only design showed statistically significant results. In studies with less rigorous evaluation designs, statistically significant results were found in outcomes related to knowledge and attitudes about food safety.

4. DISCUSSION

This review of 88 intervention studies related to consumer food safety showed that the majority were conducted in the last 10 years in North America and used a non-experimental before/after study design. Most studies used communication strategies or tactics, deployed in wide arrange of designs and using various target groups. Most studies have assessed knowledge, attitudes, or self-reported behavior, with a preference for non-experimental designs. In population studies, evaluation designs tend to favor one group, pre/post-test due to the inability to 'control' the delivery of the intervention via mass communication tactics, for example. Similarly, to Sivaramalingam et al.[14] we found that most studies, regardless of evaluation designs tended to rely on self-reported behaviors. These outcomes are at risk of bias due to the Hawthorne effect (overestimation of effects because participants are being observed)[129] or social desirability bias (participants answer as socially expected) or bias related to gender roles.[130] About thirty percent of the studies were randomized interventions, conducted as randomized controlled trials in community, clinic, or school settings, or as randomized experiments by presenting different types of risk information to understand what messages were most effective.

Most of the studies we reviewed reported statistically significant results, so there is a likelihood of positive publication bias, which favors publication of studies with positive results than those with null results,[131,132] and studies with positive results are more likely to be accepted by high-ranking journals.[133,134] This can overestimate the effect that consumer-facing food safety interventions will achieve positive outcomes, so it can be difficult to make inferences about what does and does not work. However, our findings on theory, evaluation

design and outcomes may provide insight as to the type of strategies that merit consideration for designing consumer food safety interventions.

Risk perception is an important component of changing consumer food safety behavior across a number of the interventions, such as experiments[114,115], in-market experiments at points of sale[72], or consumer education [105,118]. These studies examined the concept of risk perception as an important antecedent to purchasing food or food safety behavior. Risk perception research has shown that consumers or "lay people" perceive hazards and risk differently than experts,[136] based on overall knowledge and how they prioritize risk in their everyday lives. Risk perception might be heightened if the person feels they do not have control or if they do not trust those providing the risk information.[137] Often risk is conceptualized at an emotional level (affect)[138] and decisions are made using heuristics or short cuts that are influenced by psychological or cultural factors.[139,140] Risk evaluations may then not be based on real risk or quantifiable estimates, but on how individuals perceive that risk and whether it has been deemed to be important.

In the high income countries, where there is generally a high level of perceived trust in food system and where people are generally positive about their food supply, communicating about the risks associated with consumption of unsafe food have not been shown to be important factors in consumer food decision making.[140,141] But little is known about how risk perceptions may differ in middle- or low-income countries or when there is far less trust or understanding of the food chain and how it is regulated. There are few national level surveys in these countries, but smaller studies have indicated that there is significant concern over food safety.[13,143] Thus, risk perception could be a powerful way of framing various communication messages.

Another modality found also to be effective in the reviewed interventions is the use of community health workers. Ten studies[31,49,53,55,56,78,80,90,99,105] used this approach as a way to specifically target households, women, or mothers. This strategy occurred most often in LMICs and all showed significant or marginally significant results on outcomes, including changing food safety knowledge and attitudes, self-reported and observed behaviors, and changes to the home environment. Consumer trust influences how consumer receive and respond to information, including risk information[5], and community health workers or volunteers often engender trust in their communities. A recent systematic review on the use of community health workers in maternal and child health outcomes showed that they were particularly effective in promoting exclusive breastfeeding[143]. Thus, using trusted community members to disseminating food safety risk information may be an effective influencing strategy.

Many of the studies targeted children, either in school, after school, or through community-based events. Eleven studies[32,50,65,69,71,73,89,97,98,109,120] reported on in-school curriculums and another four used computer-based modules or video games[45,61,75,85] as a way to teach food safety principles to primary or secondary school students. While most of these studies were

not randomized controlled trials, most showed effectiveness in increasing knowledge and behaviors. Children are powerful motivators of parental behavior, modelers of new behaviors, and a conduit of new 'wordily' information to families. Kang et al.[67] showed that you could combine community health volunteers with community-based education for adults and children through the use of role plays, demonstrations, group discussions, and events as a way to focus on whole communities for changing food safety culture. This is a strategy that seems to have great promise in helping communities understand the role all members have in food safety.

Consumer demand initiative for food safety is an approach to creating the right market incentives, which rely on market presenting the right signals and consumers responding to those signals. [13] Two experiments, one conducted in market in Kenya[72] the other as laboratory choice experiment among Lebanese consumers[42], are noteworthy in their attempts to assess in-market incentives. In Kenya, the study improved in-market conditions for selling vegetables and explained to consumers the market changes and their benefits (via leaflet); whereas in the Lebanon choice experiment, the study disclosed information about a food's safety attributes and a vendor's certification. In both studies, consumer risk perception was an antecedent to behavior, while in the Lebanon study, consumer trust in the certification was also an important factor. In both studies, the market signals were information disclosure, either by telling the consumer how their vegetables had been grown, transported, and handled or in ready-to-eat vending context by disclosing the food attributes and the existence of a certification scheme.

Overall, the high number of studies that use educational modalities and report knowledge outcomes indicate an overall preference to address consumer awareness of food safety practices. This is not to imply that knowledge is not needed, but that knowing what or how to do something, is not sufficient for behavior change. Recent advances in social psychology show that decisions are mostly sub-conscious or automatic in response to social and environmental cues[144]. A formative research study in Vietnam[145] that has examined social and environmental cues using the MINDSPACE Framework[146] (Messenger, Incentives, Norms, Defaults, Salience, Priming, Affect, Commitment, Ego) to understand what type of cues may drive consumer and vendor behavior change in the pork value chain.

It should be noted that while feeding the family has traditionally been seen as the responsibility of the woman,[147] the gendered division of food-care has declined over the past two decades,[148] especially in high income countries like the United States. An analysis of the US National Health and Nutrition Examination Survey noted that a majority of men and women reported sharing the meal planning/preparing and food shopping.[149,150] In many middle- and- low- income countries, more specialized gender roles may exist. In our review, women were the main targets of food safety interventions in Asia and Africa but not Europe. In some Asian and African countries, women might buy and prepare foods, and are responsible for cleanup as well as for childcare while in other countries men are responsible

for buying food. Many food safety interventions are designed assuming that food handling at purchase, preparation, cooking, and cleaning up are the primary entry points for foodborne illness. Individual-level behaviors, such as washing hands before eating, or after using the toilet, are also critical practices for preventing foodborne illnesses and cut across all members of a household. Future research will need to be mindful of the gender roles and to extend food safety responsibility to children and other adult members of a household, especially men.

4.1 Limitations

This scoping review has some limitations. First, only articles available in English were included, so interventions published in other languages may have enriched the review. We also excluded predatory publishers, which may have eliminated articles, perhaps of lower quality studies, in our review. Additionally, due to key word variability in peer review publishing, some potentially relevant articles may have been missed by our search; although we attempted to mitigated this limitation by a comprehensive key words search, by working with a medical librarian, and by searching seven database and the grey literature. We also spot-check results by completing a hand citation search on a few articles. In addition, as the review focused on food safety, it did not include other fields that could be relevant to designing consumer-facing food safety interventions, such as water quality or other aspects of public health. Finally, the review only encompasses interventions over the past 20 years. This could limit the results, although we found that the majority of the interventions in the past two decades had occurred in the past 10 years.

5. CONCLUSIONS

We used a structed scoping review methodology to identify consumer-facing food safety interventions over the last 20 years. We found that most interventions showed positive results, despite a wide range of intervention designs, target audiences, and evaluation approaches. Most of the studies did not use a theory to design the intervention and yet most aimed to address knowledge, attitudes, beliefs as antecedents to behavior. When theories were used, they were health-behavior theories, with a strong cognitive (e.g., idea-focused) orientation, as opposed to social (e.g., role modelling, social norms) or environmental (e.g., external environmental design or physical cues) orientation.

In intervention design, there was a clear preference for interventions that relied on communication modalities, from using only mass media to more comprehensive social marketing campaigns, but most lacked communication theories and message framing strategies (gain vs. losses; risk vs. benefits). Education was another common modality, from curriculum-based interventions in school settings to information, education, and communication interventions in the community, and yet adult education theory only appeared twice in these studies.

This review also provided insights on how to present content to consumers. Consumers were most responsive to risk perception, either by explicitly stating the risks or losses or in using an emotional framing, such as disgust, and those strategies seemed to work most effectively for sharing food safety information. This is especially relevant to the goal of creating demand since what we desire is expressed by our choices/purchases. It seems trust is a key factor that further drives consumer food safety perceptions and preferences. Trust appeared to be achieved by using community-based staff or through certification mechanisms or information disclosure.

In conclusion, in designing successful interventions to influence consumer behaviors (choices) EatSafe should consider a theory-based approach, frame messages to enhance emotion and consumer's risk perceptions, and to design interventions with social and environmental elements to influence (consciously and subconsciously) consumer choices towards better food safety practices. EatSafe will consider these findings and their application in the context of informal markets, where the audience for food safety communication are adults and communication between the vendors and consumers is direct. The community remains an important place for intervention implementation, either via community events, marketplaces, or community members or influencers. EatSafe should test various intervention strategies to address motivation and purchasing in-markets before scaling up programmatic activities. Consumers' overt demands and collective expression for safe food may require different strategies than the ones used for motivation and purchases.

Recommendations for Intervention Design and Future Studies under EatSafe

EatSafe aims to generate the evidence and knowledge on leveraging the potential for increased consumer demand for safe food to substantially improve the safety of nutritious foods in informal market settings in Nigeria and future EatSafe countries. Central to EatSafe's work is to design consumer-facing interventions.

Consumer demand consists of two components. The first is the motivational aspect, often captured as desirability, and the second is the choice (behavior). Thus, interventions that focus only on motivation will not be enough, nor will interventions that narrowly focus on choice because the 'desire' component is missing. The review of consumer-facing interventions on food safety provides key take-aways for considering motivation and choice in designing our interventions:

- Emotions are powerful motivators. The emotions that appear to hold most promise for communicating food safety are trust (feeling of safety/positive), fear (or fear of loss or heightened risk), disgust, and nurturance. Future studies should seek to understand how these concepts are expressed, and their importance for different consumer audiences (men vs. mothers vs. children).
- Consumer information should aim to motivate the consumer and influence choice, not just to improve consumer knowledge. Content that focuses on the former and not the latter will be more emotive, persuasive, and will be delivered precisely when the consumer needs to make a decision.
- Consumer motivation will set the foundation for desirability (see next point). Consumer desire and purchasing behavior are strong market signals. EatSafe should test various intervention strategies to address motivation and purchasing in-markets before scaling up programmatic activities.
- Consumers' overt demands and collective expression for safe food may require different strategies than the ones used for motivation and purchases. Some of the studies reviewed here addressed elements of consumer advocacy and citizen participation, such as governance (e.g., community management councils) and accountability ('community score cards'). There are other strategies, not reviewed here, such as food safety monitoring (citizen monitoring and outbreak reporting strategies) that are relevant and should also be tested separately from strategies that aim to improve consumer purchase decisions.
- The community remains an important place for intervention implementation, either via community events, marketplaces, or community members or influencers. Interventions that rely on social signals (norms, cues, peer-to-peer modeling) and trust will usually have a significant community component.
- Since most interventions rely on communication approaches or tactics, selecting several theories will help in organizing and designing the content/information, delivery channels, intervention exposure/dose. EatSafe should avoid designing based on 'labels', such as *social and behavior change communication*, *information, education, communication*, *social marketing* since many of the tactics and delivery channels are used across all of these labels.

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APPENDIX I – Full Search Strategy with Search Terms by Database

PubMed (NLM)

Consumer*[tiab] AND ((behavior*[tiab] OR behaviour*[tiab] OR intervention*[tiab] OR "Health Literacy"[Mesh] OR “health literac*”[tiab] OR educat*[tiab] OR attitud*[tiab] OR "Perception"[Mesh] OR "Attitude"[Mesh] OR "Attitude to Health"[Mesh] OR "Behavior"[Mesh] OR "Behavior and Behavior Mechanisms"[Mesh] OR "Risk Reduction Behavior"[Mesh] OR choice*[tiab] OR select*[tiab] OR decision*[tiab] OR factor*[tiab] OR judgement*[tiab] OR “decision mak*”[tiab] OR preferenc*[tiab] OR belief*[tiab] OR practic*[tiab] OR guidanc*[tiab] OR guideline*[tiab] OR perception*[tiab] OR awareness*[tiab] OR knowledg*[tiab] OR teach*[tiab] OR "Teaching"[Mesh] OR campaign*[tiab] OR media*[tiab] OR program*[tiab] OR radio*[tiab] OR TV[tiab] OR "Television"[Mesh] OR "Mass Media"[Mesh] OR televis*[tiab] OR "mass media*"[tiab] OR instruct*[tiab] OR celebrit*[tiab] OR ad[tiab] OR “targeting messag*”[tiab] OR “target messag*”[tiab] OR advertis*[tiab] OR video*[tiab] OR billboard*[tiab] OR “Motivation”[MeSH] OR motivation*[tiab] OR information*[tiab] OR inform*[tiab] OR prevent*[tiab] OR "Primary Prevention"[Mesh] OR “Health Behavior”[MeSH] OR “Choice Behavior”[MeSH] OR risk factor*[tiab] OR “Risk Factors”[MeSH] OR risk*[tiab] OR “risk perception*”[tiab] OR “cognitive bias*”[tiab] OR bias*[tiab] OR “Bias”[MeSH]) OR (“Consumer Behavior”[MeSH] OR “Consumer product safety”[MeSH] OR “Health knowledge, Attitudes, Practice”[MeSH] OR “consumer food safet*”[tiab]))) AND ((Food*[tiab] OR nutritio*[tiab] OR diet*[tiab] OR meal*[tiab] OR fruit*[tiab] OR vegetabl*[tiab] OR meat*[tiab] OR "Seafood"[Mesh] OR "Red Meat"[Mesh] OR "Meat"[Mesh] OR “red meat*”[tiab] OR cook*[tiab] OR “Cooking”[MeSH] OR poultr*[tiab] OR "Poultry"[Mesh] OR "Poultry Diseases"[Mesh] OR seafood*[tiab] OR fish*[tiab] OR "Raw Foods"[Mesh] OR “raw food*”[tiab] OR “raw meat*”[tiab] OR uncook*[tiab] OR “under cook*”[tiab]) AND ((safe*[tiab] OR hygien*[tiab] OR "Hand Hygiene"[Mesh] OR “hand hygien*”[tiab] OR clean*[tiab] OR hand wash*[tiab] OR mask*[tiab] OR glov*[tiab] OR wash*[tiab] OR “Hygiene”[MeSH] OR control*[tiab] OR qualit*[tiab] OR safety precaution*[tiab] OR safety procedur*[tiab] preperat*[tiab] OR manag*[tiab] OR disinfect*[tiab] OR sanitiz*[tiab] OR sanitis*[tiab] OR handl*[tiab] OR choice*[tiab] OR decision*[tiab] OR purchas*[tiab] OR consum*[tiab] OR eat[tiab] OR eating[tiab] OR eats[tiab] OR digest*[tiab] OR diseas*[tiab] OR “Decision Making”[MeSH] OR thermometer*[tiab] OR temperatur*[tiab] OR contamin*[tiab] OR cross contaminat*[tiab] OR spoil*[tiab] OR handl*[tiab])) OR (((food borne*[tiab] OR foodborne*[tiab] OR “Foodborne Diseases”[MeSH] OR “Food Contamination”[MeSH] OR “Food Handling”[MeSH] OR “Food safety”[MeSH] OR foodbook*[tiab] OR “food borne illness*”[tiab] OR “foodborne diseas*”[tiab] OR “foodborne illness*”[tiab] OR “food borne diseas*”[tiab] OR virus*[tiab] OR bacteria*[tiab] OR “Food Microbiology”[MeSH] OR food microbiolog*[tiab] OR cross contaminat*[tiab] OR FBD[tiab])))) AND (wet market*[tiab] OR street vendor*[tiab] OR restaurant*[tiab] OR “Restaurants”[MeSH] OR market*[tiab] OR home*[tiab] OR canteen*[tiab] OR school*[tiab] OR residenc*[tiab] OR hall*[tiab] OR bar*[tiab] OR kitchen*[tiab] OR food truck*[tiab] OR food cart*[tiab] OR commerc*[tiab] OR “Commerce”[MeSH] OR “Food Chain”[MeSH] OR food chain*[tiab] OR fast food*[tiab] OR consumer*[tiab]) AND ((((“semi structur*”[tiab] OR semistructur*[tiab] OR unstructur*[tiab] OR informal*[tiab] OR “in depth*”[tiab] OR indepth*[tiab] OR “face to face*”[tiab] OR structure*[tiab] OR guide*[tiab] OR guide*[tiab]) AND (interview*[tiab] OR discussion*[tiab] OR questionnaire*[tiab])) OR (“focus group*”[tiab] OR qualitative*[tiab] OR ethnograph*[tiab] OR fieldwork*[tiab] OR “field work*”[tiab] OR “key informant*”[tiab])) OR (((“interviews as topic”[Mesh] OR “focus groups”[Mesh] OR “narration”[Mesh] OR “qualitative research”[Mesh] OR "personal narratives as topic"[Mesh] OR “Cross-Sectional Studies”[Mesh] OR “cross sectional*”[tiab] OR “Prevalence”[mesh] OR prevalenc*[tiab] OR “transversal stud*”[tiab]))))) OR ((((((food*[tw] OR "Food"[Mesh] OR pork*[tw] OR "Pork Meat"[Mesh] OR "swine"[mesh] OR poultr*[tw] OR "Poultry Diseases"[Mesh]

OR "Poultry"[Mesh] OR "Poultry Products"[Mesh] OR seafood*[tw] OR "Seafood"[Mesh] OR meat*[tw] OR "meat"[mesh] OR "Meat Products"[Mesh] OR "Meat-Packing Industry"[Mesh] OR "red meat*"[tw] OR "Red Meat"[Mesh])))) AND (((nutritio*[tiab] OR diet*[tiab] OR food*[tiab] OR cook*[tiab] OR "cooking"[mesh] OR prepar*[tiab] OR consum*[tiab] OR "consumer behavior"[mesh]) AND (safe*[tiab] OR "Safety"[Mesh] OR hygien*[tiab] OR "Hygiene"[Mesh] OR consumer*[tiab])) AND (“Foodborne Diseases”[MeSH] OR “Food Contamination”[MeSH] OR “Food Handling”[MeSH] OR “Food safety”[MeSH] OR "hand wash*"[tiab] OR soap*[tiab] OR thermometer*[tiab] OR foodbook*[tiab] OR “food borne illness*”[tiab] OR “foodborne diseas*”[tiab] OR “foodborne illness*”[tiab] OR “food borne diseas*”[tiab] OR virus*[tiab] OR bacteria*[tiab] OR "cross contaminat*"[tiab] OR FBD[tiab] OR "hand disinfection"[mesh] OR "hand disinfect*"[tiab] OR "hygiene"[mesh] OR "hand hygiene"[mesh] OR "hand hygien*"[tiab])))) AND ((((health*[tw] OR communit*[tiab] OR school*[tiab] OR market*[tiab] OR "wet market*"[tiab] OR informat*[tiab] OR vendor*[tiab] OR street*[tiab] OR cart*[tiab] OR truck*[tiab] OR campus*[tiab] OR colleg*[tiab] OR universit*[tiab] OR rural*[tiab])))) AND ((safety* AND method*)) OR educat*[tiab] OR /education OR "health education"[mesh] OR "Health Promotion"[Mesh] OR learn*[tiab] OR teach*[tiab] OR campaign*[tiab] OR "mass media*"[tiab] OR media*[tiab] OR intervent*[tiab] OR inform*[tiab] OR "Consumer Health Information"[Mesh] OR "health behavior"[mesh] OR "health behavior*"[tiab] OR intention*[tiab] OR "intention"[mesh] OR "decision making"[mesh] OR decision*[tiab] OR behav*[tiab] OR communicat*[tiab] OR "risk reduction behavior"[mesh] OR "Risk benefit communicat*"[tiab] OR risk*[tiab] OR "risk factors"[mesh] OR bias*[tiab] OR "bias"[mesh] OR access*[tiab] OR aware*[tiab]) AND (english[Filter]))))))
Year 2000 date limit

Embase (Elsevier)

((consumer*:ti,ab OR 'consumer'/exp) AND (behavior*:ti,ab OR behaviour*:ti,ab OR intervention*:ti,ab OR 'health literacy'/exp OR 'health literacy' OR 'health literac*':ti,ab OR educat*:ti,ab OR attitud*:ti,ab OR 'perception'/exp OR 'perception' OR 'attitude'/exp OR 'attitude' OR 'attitude to health' OR 'behavior'/exp OR 'behavior' OR 'behavior mechanisms'/exp OR 'behavior mechanisms' OR 'risk reduction'/exp OR 'risk reduction' OR 'risk reduction behavior women'/exp OR 'risk reduction behavior women' OR 'risk reduction behavior men'/exp OR 'risk reduction behavior men' OR choice*:ti,ab OR select*:ti,ab OR decision*:ti,ab OR factor*:ti,ab OR judgement*:ti,ab OR 'decision making'/exp OR 'decision making' OR 'decision mak*':ti,ab OR preferenc*:ti,ab OR belief*:ti,ab OR practic*:ti,ab OR guidanc*:ti,ab OR guideline*:ti,ab OR perception*:ti,ab OR awareness*:ti,ab OR 'awareness'/exp OR 'awareness' OR 'knowledge'/exp OR 'knowledge' OR 'advocacy group'/exp OR 'advocacy group' OR 'advocacy group*':ti,ab OR knowledg*:ti,ab OR campaign*:ti,ab OR media*:ti,ab OR program*:ti,ab OR radio*:ti,ab OR tv:ti,ab OR 'television'/exp OR 'television' OR teach*:ti,ab OR instruct*:ti,ab OR celebrit*:ti,ab OR ad:ti,ab OR 'advertising'/exp OR 'advertising' OR 'targeting messag*':ti,ab OR 'target messag*':ti,ab OR advertis*:ti,ab OR video*:ti,ab OR billboard*:ti,ab OR 'motivation'/exp OR 'motivation' OR motivation*:ti,ab OR information*:ti,ab OR 'information'/exp OR 'information' OR inform*:ti,ab OR prevent*:ti,ab OR 'prevention'/exp OR 'prevention' OR 'health behavior'/exp OR 'health behavior' OR 'risk factor*':ti,ab OR 'risk factor'/exp OR 'risk factor' OR risk*:ti,ab OR 'risk perception*':ti,ab OR 'risk perception'/exp OR 'risk perception' OR 'cognitive bias*':ti,ab OR 'cognitive bias'/exp OR 'cognitive bias' OR bias*:ti,ab) OR 'consumer attitude'/exp OR 'product safety'/exp OR 'attitude to health'/exp OR 'consumer food safet*':ti,ab OR 'food safety'/exp OR ((consumer* NEAR/3 behav*):ti,ab)) AND (((food*:ti,ab OR 'food'/exp OR nutritio*:ti,ab OR 'nutrition'/exp OR diet*:ti,ab OR 'diet'/exp OR 'meal'/exp OR meal*:ti,ab OR 'fruit'/exp OR 'vegetable'/exp OR fruit*:ti,ab OR vegetabl*:ti,ab OR meat*:ti,ab OR 'meat'/exp OR 'sea food'/exp OR 'red meat'/exp OR 'red meat*' OR cook*:ti,ab OR 'cooking'/exp

OR poultr*:ti,ab OR 'poultry'/exp OR 'poultry product*':ti,ab OR 'poultry diseases'/exp OR 'bird disease'/exp OR 'bird diseas*':ti,ab OR seafood*:ti,ab OR 'sea food':ti,ab OR fish*:ti,ab OR 'fish'/exp OR 'raw food'/exp OR 'raw food*':ti,ab OR 'raw meat*':ti,ab OR 'raw meat'/exp OR uncook*:ti,ab OR 'under cook*':ti,ab) AND ((((safe*:ti,ab OR 'safety'/exp OR hygien*:ti,ab OR 'hygiene'/exp OR 'hand washing'/exp OR 'hand hygien*':ti,ab OR 'hand wash*':ti,ab OR clean*:ti,ab OR 'cleaning'/exp OR hand) AND wash*:ti,ab OR mask*:ti,ab OR 'mask'/exp OR glov*:ti,ab OR 'glove'/exp OR wash*:ti,ab OR control*:ti,ab OR qualit*:ti,ab OR 'quality control'/exp OR safety) AND precaution*:ti,ab OR safety) AND procedur*:ti,ab OR eat*:ti,ab OR 'eating'/exp OR digest*:ti,ab OR diseas*:ti,ab OR thermometer*:ti,ab OR temperatur*:ti,ab OR 'diseases'/exp OR contamin*:ti,ab OR preperat*:ti,ab OR manag*:ti,ab OR disinfect*:ti,ab OR 'disinfectant agent'/exp OR 'disinfection'/exp OR sanitiz*:ti,ab OR sanitis*:ti,ab OR 'hand saniti*':ti,ab OR choice*:ti,ab OR decision*:ti,ab OR 'hand sanitizer'/exp OR purchas*:ti,ab OR 'purchasing'/exp OR consum*:ti,ab) OR food) AND borne*:ti,ab OR foodborne*:ti,ab OR 'food poisoning'/exp OR 'food contamination'/exp OR 'cross contamination'/exp OR 'food handling'/exp OR 'food handler'/exp OR 'food handl*':ti,ab OR 'food safety'/exp OR 'food spoil*':ti,ab OR foodbook*:ti,ab OR 'food borne illness*':ti,ab OR 'foodborne diseas*':ti,ab OR 'foodborne illness*':ti,ab OR 'food borne diseas*':ti,ab OR virus*:ti,ab OR bacteria*:ti,ab OR 'virus'/exp OR 'bacterium'/exp OR 'virus infection'/exp OR 'food control'/exp OR 'food microbiolog*':ti,ab OR fbd:ti,ab OR ((food* NEAR/3 safet*):ti,ab)) AND ('wet market*':ti,ab OR 'street vendor*':ti,ab OR 'vendors'/exp OR restaurant*:ti,ab OR 'restaurant'/exp OR market*:ti,ab OR home*:ti,ab OR canteen*:ti,ab OR 'canteen'/exp OR 'residence'/exp OR school*:ti,ab OR residenc*:ti,ab OR hall*:ti,ab OR bar:ti,ab OR bars*:ti,ab OR kitchen*:ti,ab OR 'kitchen'/exp OR ((food* NEAR/3 truck*):ti,ab) OR ((food* NEAR/3 cart*):ti,ab) OR commerc*:ti,ab OR 'commercial phenomena'/exp OR 'food chain'/exp OR ((food* NEAR/3 chain*):ti,ab) OR ((fast* NEAR/3 chain*):ti,ab) OR 'fast food'/exp OR 'consumer'/exp OR consumer*:ti,ab OR ((wet* NEAR/3 market*):ti,ab) OR ((wet* NEAR/3 vendor*):ti,ab)) AND (('semi structur*':ti,ab OR semistructur*:ti,ab OR 'unstructured interview'/exp OR 'semi structured interview'/exp OR unstructur*:ti,ab OR informal*:ti,ab OR 'in depth*':ti,ab OR indepth*:ti,ab OR 'in depth interview'/exp OR 'face to face*':ti,ab OR 'face to face interview'/exp OR structure*:ti,ab OR guide*:ti,ab) AND (interview*:ti,ab OR discussion*:ti,ab OR 'interview'/exp OR 'discussion group'/exp OR questionnaire*:ti,ab OR 'questionnaire'/exp) OR 'focus group*':ti,ab OR qualitative*:ti,ab OR ethnograph*:ti,ab OR fieldwork*:ti,ab OR 'field work*':ti,ab OR 'key informant*':ti,ab OR 'focus group'/exp OR 'qualitative research'/exp OR 'ethnographic research'/exp OR 'ethnography'/exp OR 'field work'/exp OR 'verbal communication'/exp OR 'literature'/exp OR 'cross-sectional study'/exp OR 'prevalence'/exp OR 'cross sectional*':ti,ab OR prevalenc*:ti,ab OR 'transversal stud*':ti,ab OR ((structur* NEAR/3 interview*):ti,ab)) AND [english]/lim AND [2000-2020]/py

Cochrane Central (Wiley)

#1	consumer:ti,ab,kw AND (behavior*:ti,ab,kw OR behaviour*:ti,ab,kw OR intervention*:ti,ab,kw OR "health literac*":ti,ab,kw OR educat*:ti,ab,kw OR attitud*:ti,ab,kw OR choice*:ti,ab,kw OR select*:ti,ab,kw OR decision*:ti,ab,kw OR factor*:ti,ab,kw OR judgement*:ti,ab,kw OR "decision mak*":ti,ab,kw OR preferenc*:ti,ab,kw OR belief*:ti,ab,kw OR practic*:ti,ab,kw OR guidanc*:ti,ab,kw OR guideline*:ti,ab,kw OR perception*:ti,ab,kw OR awareness*,ti,ab,kw OR knowledg*:ti,ab,kw OR campaign*:ti,ab,kw OR media*:ti,ab,kw OR program*:ti,ab,kw OR radio*:ti,ab,kw OR TV:ti,ab,kw OR televis*:ti,ab,kw OR “mass media*”:ti,ab,kw OR instruction*:ti,ab,kw OR celebrit*:ti,ab,kw OR ad:ti,ab,kw OR "targeting messag*":ti,ab,kw OR "target messag*":ti,ab,kw OR advertis*:ti,ab,kw OR video*:ti,ab,kw OR billboard*:ti,ab,kw OR motivation*:ti,ab,kw OR information*:ti,ab,kw OR inform*:ti,ab,kw OR prevent*:ti,ab,kw OR "risk factor*":ti,ab,kw OR risk*:ti,ab,kw OR "risk perception*":ti,ab,kw OR "cognitive bias*":ti,ab,kw

	OR bias*:ti,ab,kw) OR "consumer food safet*":ti,ab,kw
#2	food*:ti,ab,kw OR nutritio*:ti,ab,kw OR diet*:ti,ab,kw OR meal*:ti,ab,kw OR fruit*:ti,ab,kw OR vegetabl*:ti,ab,kw OR meat*:ti,ab,kw OR "red meat*":ti,ab,kw OR cook*:ti,ab,kw OR poultr*:ti,ab,kw OR seafood*:ti,ab,kw OR fish*:ti,ab,kw OR "raw food*":ti,ab,kw OR "raw meat*":ti,ab,kw OR uncook*:ti,ab,kw OR "under cook*":ti,ab,kw
#3	safe*:ti,ab,kw OR hygien*:ti,ab,kw OR "hand hygien*":ti,ab,kw OR clean*:ti,ab,kw OR "hand wash*":ti,ab,kw OR mask*:ti,ab,kw OR glov*:ti,ab,kw OR wash*:ti,ab,kw OR control*:ti,ab,kw OR qualit*:ti,ab,kw OR "safety precaution*":ti,ab,kw OR "safety procedur*":ti,ab,kw OR eats:ti,ab,kw OR digest*:ti,ab,kw OR diseas*:ti,ab,kw OR thermometer*:ti,ab,kw OR temperatur*:ti,ab,kw OR contamin*:ti,ab,kw OR "cross contaminat*":ti,ab,kw OR spoil*:ti,ab,kw OR handl*:ti,ab,kw OR preperat*:ti,ab,kw OR manag*:ti,ab,kw OR disinfect*:ti,ab,kw OR santiz*:ti,ab,kw OR sanitis*:ti,ab,kw OR choice*:ti,ab,kw OR decision*:ti,ab,kw OR purchas*:ti,ab,kw OR consum*:ti,ab,kw OR eat:ti,ab,kw OR eating:ti,ab,kw
#4	“food borne*”:ti,ab,kw OR foodborne*:ti,ab,kw OR foodbook*:ti,ab,kw OR "food borne illness*":ti,ab,kw OR "foodborne diseas*":ti,ab,kw OR virus*:ti,ab,kw OR bacteria*:ti,ab,kw OR "food microbiolog*":ti,ab,kw OR "cross contaminat*":ti,ab,kw OR FBD:ti,ab,kw
#5	#2 AND #3
#6	#4 OR #5
#7	#1 AND #6
#8	"wet market*":ti,ab,kw OR "street vendor*":ti,ab,kw OR restaurant*:ti,ab,kw OR market*:ti,ab,kw OR home*:ti,ab,kw OR canteen*:ti,ab,kw OR school*:ti,ab,kw OR residenc*:ti,ab,kw OR hall*:ti,ab,kw OR bar*:ti,ab,kw OR kitchen*:ti,ab,kw OR "food truck*":ti,ab,kw OR "food cart*":ti,ab,kw OR commerc*:ti,ab,kw OR "food chain*":ti,ab,kw OR "fast food*":ti,ab,kw OR consumer*:ti,ab,kw
#9	"semi structur*":ti,ab,kw OR semistructur*:ti,ab,kw OR unstructur*:ti,ab,kw OR informal*:ti,ab,kw OR "in depth*":ti,ab,kw OR indepth*:ti,ab,kw OR "face to face*":ti,ab,kw OR structure*:ti,ab,kw OR guide*:ti,ab,kw OR guide*:ti,ab,kw
#10	#7 AND #8 AND #9
	with Publication Year from 2000 to 2020, in Trials

CINAHL (EBSCOHost)

S1	TI ((Consumer* AND (behavior* OR behaviour* OR intervention* OR "health literac*" OR educat* OR attitud* OR choice* OR select* OR decision* OR factor* OR judgement* OR "decision mak*" OR preferenc* OR belief* OR practic* OR guidanc* OR guideline* OR perception* OR "awareness* OR knowledg*" OR campaign* OR media* OR program* OR radio* OR TV OR instruction* OR celebrit* OR "targeting messag*" OR "target messag*" OR advertis* OR video* OR billboard* OR motivation* OR information* OR inform* OR prevent* OR risk factor* OR risk* OR "risk perception*" OR "cognitive bias*" OR bias*))) OR AB ((Consumer* AND (behavior* OR behaviour* OR intervention* OR "health literac*" OR educat* OR attitud* OR choice* OR select* OR decision* OR factor* OR judgement* OR "decision mak*" OR preferenc* OR belief* OR practic* OR guidanc* OR guideline* OR

	perception* OR "awareness* OR knowledg*" OR campaign* OR media* OR program* OR radio* OR TV OR instruction* OR celebrit* OR "targeting messag*" OR "target messag*" OR advertis* OR video* OR billboard* OR motivation* OR information* OR inform* OR prevent* OR risk factor* OR risk* OR "risk perception*" OR "cognitive bias*" OR bias*)))
S2	TI (("consumer food safet*" AND (food* OR nutritio* OR diet* OR meal* OR fruit* OR vegetabl* OR meat* OR "red meat*" OR cook* OR poultr* OR seafood* OR fish* OR "raw food*" OR "raw meat*" OR uncook* OR "under cook*"))) OR AB (("consumer food safet*" AND (food* OR nutritio* OR diet* OR meal* OR fruit* OR vegetabl* OR meat* OR "red meat*" OR cook* OR poultr* OR seafood* OR fish* OR "raw food*" OR "raw meat*" OR uncook* OR "under cook*" OR (MH "Consumer Attitudes") OR (MH "Attitude+") OR (MH "Behavior+") OR (MH "Perception+") OR (MH "Motivation+") OR (MH "Risk Factors+") OR (MH "Consumer product safety+") OR (MH "Health knowledge"))))
S3	S1 OR S2
S4	TI (((((safe* OR hygien* OR "hand hygien*" OR clean* OR hand wash*) AND (mask* OR glov* OR wash* OR (MH "Handwashing") OR (MH "Hygiene") OR control* OR qualit* OR thermometer* OR temperatur* OR contamin* OR spoil* OR handl* OR preperat* OR manag* OR disinfect* OR sanit* OR eat*) OR ("food borne*" OR foodborne* OR foodbook* OR "food borne illness"* OR "foodborne diseas*" OR virus* OR bacteria* OR "food microbiolog*" OR "cross contaminat*" OR FBD))))) OR AB (((((safe* OR hygien* OR "hand hygien*" OR clean* OR hand wash*) AND (mask* OR glov* OR wash* OR control* OR qualit* OR thermometer* OR temperatur* OR contamin* OR spoil* OR handl* OR preperat* OR manag* OR disinfect* OR sanit* OR eat*) OR ("food borne*" OR foodborne* OR foodbook* OR "food borne illness"* OR "foodborne diseas*" OR virus* OR bacteria* OR "food microbiolog*" OR "cross contaminat*" OR (MH "Food Contamination+") OR (MH "Food Handling+") OR (MH "Food safety+") OR FBD)))))
S5	TI (((“wet market*” OR “street vendor*” OR restaurant* OR market* OR home* OR canteen* OR school* OR residenc* OR hall* OR bars* OR kitchen* OR “food truck*” OR “food cart*” OR commerc* OR Commerce OR food chain* OR fast food* OR consumer*))) OR AB (((“wet market*” OR “street vendor*” OR restaurant* OR market* OR home* OR canteen* OR school* OR residenc* OR hall* OR bars* OR kitchen* OR “food truck*” OR “food cart*” OR commerc* OR Commerce OR food chain* OR fast food* OR consumer* OR (DE "CONVENIENCE foods") OR (DE "FAST food restaurants"))))
S6	TI ((("semi structur*" OR semistructur* OR unstructur* OR informal* OR "in depth*" OR indepth* OR "face to face*" OR structure* OR guide*) AND (interview* OR discussion* OR questionnaire*)) OR (("focus group*" OR qualitative* OR ethnograph* OR fieldwork* OR "field work*" OR "key informant*" OR "cross sectional*" OR prevalenc* OR "transversal stud*")))) OR AB (((("semi structur*" OR semistructur* OR unstructur* OR informal* OR "in depth*" OR indepth* OR "face to face*" OR structure* OR guide*) AND (interview* OR discussion* OR questionnaire*)) OR (("focus group*" OR qualitative* OR ethnograph* OR fieldwork* OR "field work*" OR "key informant*" OR "cross sectional*" OR prevalenc* OR "transversal stud*"))))
S7	S3 AND S4 AND S5 AND S6
	Year 2000, English Language limit

GreenFile (EBSCOHost)

S1	TI ((Consumer* AND (behavior* OR behaviour* OR intervention* OR "health literac*" OR educat* OR attitud* OR choice* OR select* OR decision* OR factor* OR judgement* OR "decision mak*" OR preferenc* OR belief* OR practic* OR guidanc* OR guideline* OR perception* OR "awareness* OR knowledg*" OR campaign* OR media* OR program* OR radio* OR TV OR instruction* OR celebrit* OR "targeting messag*" OR "target messag*" OR advertis* OR video* OR billboard* OR motivation* OR information* OR inform* OR prevent* OR risk factor* OR risk* OR "risk perception*" OR "cognitive bias*" OR bias*))) OR AB ((Consumer* AND (behavior* OR behaviour* OR intervention* OR "health literac*" OR educat* OR attitud* OR choice* OR select* OR decision* OR factor* OR judgement* OR "decision mak*" OR preferenc* OR belief* OR practic* OR guidanc* OR guideline* OR perception* OR "awareness* OR knowledg*" OR campaign* OR media* OR program* OR radio* OR TV OR instruction* OR celebrit* OR "targeting messag*" OR "target messag*" OR advertis* OR video* OR billboard* OR motivation* OR information* OR inform* OR prevent* OR risk factor* OR risk* OR "risk perception*" OR "cognitive bias*" OR bias*)))
S2	TI (("consumer food safet*" AND (food* OR nutritio* OR diet* OR meal* OR fruit* OR vegetabl* OR meat* OR "red meat*" OR cook* OR poultr* OR seafood* OR fish* OR "raw food*" OR "raw meat*" OR uncook* OR "under cook*"))) OR AB (("consumer food safet*" AND (food* OR nutritio* OR diet* OR meal* OR fruit* OR vegetabl* OR meat* OR "red meat*" OR cook* OR poultr* OR seafood* OR fish* OR "raw food*" OR "raw meat*" OR uncook* OR "under cook*")) OR (DE "FOOD storage" OR DE "FOOD supply"))))
S3	S1 OR S2
S4	TI (((((safe* OR hygien* OR "hand hygien*" OR clean* OR hand wash*) AND (mask* OR glov* OR wash* OR DE "PUBLIC health" OR DE "BIOSURVEILLANCE" OR DE "DISEASE eradication" OR DE "ENVIRONMENTAL health" OR DE "EPIDEMIOLOGY" OR DE "FOOD inspection" OR DE "HEALTH risk assessment" OR DE "HOUSING & health" OR DE "RURAL health" OR DE "SANITARY districts" OR DE "SANITARY engineering" OR DE "URBAN health" OR DE "WORLD health" OR control* OR qualit* OR thermometer* OR temperatur* OR contamin* OR spoil* OR handl* OR preperat* OR manag* OR disinfect* OR sanit* OR eat* OR DE "FOOD consumption") OR ("food borne*" OR foodborne* OR foodbook* OR "food borne illness"* OR "foodborne diseas*" OR virus* OR bacteria* OR "food microbiolog*" OR "cross contaminat*" OR FBD))))) OR AB (((((safe* OR hygien* OR "hand hygien*" OR clean* OR hand wash*) AND (mask* OR glov* OR wash* OR control* OR qualit* OR thermometer* OR temperatur* OR contamin* OR spoil* OR handl* OR preperat* OR manag* OR disinfect* OR sanit* OR eat*) OR ("food borne*" OR foodborne* OR foodbook* OR "food borne illness"* OR "foodborne diseas*" OR virus* OR bacteria* OR "food microbiolog*" OR "cross contaminat*" OR DE "FOOD contamination" OR DE "CONTAMINATION of edible fish" OR DE "CONTAMINATION of potatoes" OR DE "DAIRY product contamination" OR DE "FEED additive residues" OR DE "FOOD of animal origin -- Contamination" OR DE "FRUIT contamination" OR DE "FUNGICIDE residues in food" OR DE "MEAT contamination" OR DE "OYSTER contamination" OR DE "PESTICIDE residues in food" OR DE "RADIOACTIVE contamination of food" OR DE "SEAFOOD contamination" OR DE "SHELLFISH contamination" OR DE "VEGETABLE contamination" OR (DE "FOOD handling") OR (DE "FOOD safety") OR FBD)))))

S5	TI (((“wet market*” OR “street vendor*” OR restaurant* OR market* OR home* OR canteen* OR school* OR residenc* OR hall* OR bars* OR kitchen* OR “food truck*” OR “food cart*” OR commerc* OR Commerce OR food chain* OR fast food* OR consumer*))) OR AB (((“wet market*” OR “street vendor*” OR restaurant* OR market* OR home* OR canteen* OR school* OR residenc* OR hall* OR bars* OR kitchen* OR “food truck*” OR “food cart*” OR commerc* OR Commerce OR food chain* OR fast food* OR consumer* OR (MH "Restaurants") OR (MH “Fast Foods”))))
S6	TI ((((“semi structur*" OR semistructur* OR unstructur* OR informal* OR "in depth*" OR indepth* OR "face to face*" OR structure* OR guide*) AND (interview* OR discussion* OR questionnaire*)) OR (("focus group*" OR qualitative* OR ethnograph* OR fieldwork* OR "field work*" OR "key informant*" OR "cross sectional*" OR prevalenc* OR "transversal stud*")))) OR AB (((("semi structur*" OR semistructur* OR unstructur* OR informal* OR "in depth*" OR indepth* OR "face to face*" OR structure* OR guide*) AND (interview* OR discussion* OR questionnaire*)) OR (("focus group*" OR qualitative* OR ethnograph* OR fieldwork* OR "field work*" OR "key informant*" OR "cross sectional*" OR prevalenc* OR "transversal stud*" OR (MH "Interview Guides+") OR (MH "Questionnaires+") OR (MH “Surveys+”) OR (MH "focus groups") OR (MH "Narratives+") OR (MH "Qualitative Studies+") OR (MH "Cross Sectional Studies") OR (MH "Prevalence")))))
S7	S3 AND S4 AND S5 AND S6
	Year 2000, English Language limit

Web of Science (Clarivate Analytics)

#1	TS=(Consumer* AND (behavior* OR behaviour* OR intervention* OR "health literac*" OR educat* OR attitud* OR choice* OR select* OR decision* OR factor* OR judgement* OR "decision mak*" OR preferenc* OR belief* OR practic* OR guidanc* OR guideline* OR perception* OR "awareness* OR knowledg*" OR campaign* OR media* OR program* OR radio* OR TV OR instruction* OR celebrit* OR "targeting messag*" OR "target messag*" OR advertis* OR video* OR billboard* OR motivation* OR information* OR inform* OR prevent* OR risk factor* OR risk* OR "risk perception*" OR "cognitive bias*" OR bias*))
#2	TS=("consumer food safet*" AND (food* OR nutritio* OR diet* OR meal* OR fruit* OR vegetabl* OR meat* OR "red meat*" OR cook* OR poultr* OR seafood* OR fish* OR "raw food*" OR "raw meat*" OR uncook* OR "under cook*"))
#3	#2 OR #1
#4	TS=((((safe* OR hygien* OR "hand hygien*" OR clean* OR hand wash*) AND (mask* OR glov* OR wash* OR control* OR qualit* OR thermometer* OR temperatur* OR contamin* OR spoil* OR handl* OR preperat* OR manag* OR disinfect* OR sanit* OR eat*) OR ("food borne*" OR foodborne* OR foodbook* OR "food borne illness"* OR "foodborne diseas*" OR virus* OR bacteria* OR "food microbiolog*" OR "cross contaminat*" OR FBD))))
#5	TS=((“wet market*” OR “street vendor*” OR restaurant* OR market* OR home* OR canteen* OR school* OR residenc* OR hall* OR bars* OR kitchen* OR “food truck*” OR “food cart*” OR commerc* OR Commerce OR food chain* OR fast food* OR consumer*))
#6	TS=(((“semi structur*" OR semistructur* OR unstructur* OR informal* OR "in depth*" OR indepth* OR "face to face*" OR structure* OR guide*) AND (interview* OR discussion* OR questionnaire*)) OR (("focus group*" OR qualitative* OR ethnograph*

	OR fieldwork* OR "field work*" OR "key informant*" OR "cross sectional*" OR prevalenc* OR "transversal stud*")))
#7	(#6 AND #5 AND #4 AND #3) AND LANGUAGE: (English)
	Year 2000, English Language limit

Clinicaltrials.gov

food OR meat OR seafood OR poultry) AND (market OR home OR restaurant OR vendor) AND (handling OR washing OR sanitize OR "hand washing" OR safety) | Completed Studies

APPENDIX II - Reviewed Interventions - Food Safety in Consumers

Author(s), Title, Journal, Year	Intervention	Theory	Summary	Outcomes	Location	Sample
Abbot JM, et al. Development and evaluation of a university campus-based food safety media campaign for young adults. *J Food Protection,* 2012.	Food safety media campaign targeting college students on 8 campuses.	Theory of reasoned action/Theory of Planned Behavior	Focus groups with university students and interviews with food safety experts helped to inform the creation of a university campus-based food safety media campaign. Surveys were conducted before and after the campaign to assess its efficacy. Posttest self-ratings of food safety knowledge and skills were significantly higher than at pretest. All were aware of the campaign and 90% recalled seeing or hearing campaign specific materials or messages.	Pre/Post test on food safety knowledge, stage of change for safe food handling, self-efficacy, self-reported behavior; awareness of campaign.	USA	N=53 University Students (focus groups) N=7 food safety experts (interviews) N=1,159 pre-test surveys (607 pre/post)
Adedokun OA, et al. Healthy Choices for Every Body Adult Curriculum Improves Participants' Food Resource Management Skills and Food Safety Practices. *J Nutr Educ Behav*, 2018.	Educational curriculum for limited -resource adults about nutritious meal planning, safe-food handling practices, and appropriate	Adult Learning Theory	Quasi-Experimental study with 8 intervention counties and 8 comparison counties. “Healthy Choices for Everybody” curriculum in quasi-experimental study (9 intervention counties; 8 comparison counties in Kentucky). Ten units provided by para-professionals in group/community	Pre/post test surveys: food resource management skills, food safety practices, frequency of handwashing.	Kentucky; USA	N=526 limited-resource adults

Adedokun OA, et al. Healthy Choices for Every Body Adult Curriculum Improves Participants' Food Resource Management Skills and Food Safety Practices. *J Nutr Educ Behav*, 2018. (Cont'd)	food preparation skills.		settings. The intervention group had statistically significant higher improvements in food resource management skills, food safety practices, and frequency of handwashing compared with the comparison group.			
Andrade EL, et al. Evaluating the effectiveness of a community-based hygiene promotion program in a rural Salvadoran setting. *Glob Health Promot*, 2019.	Hygiene promotion intervention in a rural Salvadoran community, delivered to community members through health promotors in the household, school, and community levels, to increase hygienic skills and decrease diarrheal disease.	None	Quasi experimental design with some communities receiving intervention. The intervention group had higher disease transmission knowledge, water handling adherence, latrine cleaning practices, personal hygiene soap use, and food preparation practice scores post-intervention than the control group. Cleaning methods adherence was higher in the control group post-intervention, but not statistically significant.	Pre/post/follow up surveys assessing hygiene knowledge, water hygiene practice, sanitation practice, domestic hygiene practice, personal hygiene practice, and food hygiene practice.	El Salvador	N=751 individuals in rural El Salvador
Antony D, et al. Effectiveness of a Structured Teaching Programme on Knowledge Regarding Food and Water Borne Diseases among	Structured teaching program on food and water borne diseases and prevention conducted among upper primary school children.	None	Quasi experimental design with convenience sample of students. Pre and post tests were conducted with an experimental and a control group to assess knowledge of food and water safety before and after a one-hour educational workshop vs. no educational	Pre/Post: Food safety knowledge.	Kochi, Keralla India	N=100 primary school students

School Children. Indian *J Public Health Res Dev,* 2018.			workshop. The post-test knowledge score was significantly higher in the experimental group compared to the control group.			
Baker AD, Gilley J, James J, Kimani M. "High Five to Healthy Living": A health intervention program for youth at an inner-city community center. *J Comm Health*, 2011.	"High Five to Healthy Living": A health intervention program for youth at an inner-city community center. *J Comm Health.* 2011.	None	One group, pre/post study design: The intervention included a number of modules, each focused on a specific health related topic and included pre/post tests before and after the lessons. Modules included: oral health and hygiene, hand washing, physical health, body hygiene and care, and healthy eating habits. Positive change was observed among participants based upon their pre/post tests. Recommendations for more assessments and focus groups to be conducted among community members in order to understand the needs of the community that should be addressed within a health intervention program.	Pre/Post: Self-reported behavior changes in regard to: oral health and hygiene, hand washing, physical health, body hygiene and care, and healthy eating habits, assessed through qualitative questionnaire.	Atlanta, Georgia; USA	N=73 11-14 year old students in an afterschool program.
Barrett T, et al. Evaluation of the Fight BAC! The Story of Your Dinner Campaign Video: A Multistate Study. *J Food Prot*, 2020.	Holiday food safety campaign video "The Story of Your Dinner", watched before and after pre/post survey, offering education in food safety knowledge, risk	Theory of Planned Behavior	Two and half minute animated video. Participants were recruited by 15 registered "Bac! Fighters", volunteer food safety volunteers in 13 states and were incentivized by number of completed pre/post tests. The video was available on the study website or could be watched in community settings.	Pre/post tests assessing knowledge, risk perception and perceived behavioral control; repeated over three years.	USA	N=930 adults and adolescents

Barrett T, et al. Evaluation of the Fight BAC! The Story of Your Dinner Campaign Video: A Multistate Study. *J Food Prot*, 2020. (Cont'd)	perception, and perceived behavioral control.		No significant correlation between knowledge and perceived behavioral control was found. Knowledge and risk perception changed significantly. Respondents reported increased confidence in their ability to use a cooking thermometer.			
Bearth A, Cousin M, Siegrist M. Uninvited guests at the table – A consumer intervention for safe poultry preparation. *J Food Safety*, 2013.	Food safety intervention included an informational brochure and one of two cues: either an informational postcard, or two cutting boards to use to encourage safe poultry handling habits.	None	Randomized control trial with three groups. The intervention targeted first year college students for an intervention about safe poultry preparation. Pre/post tests were given among three groups, one control and two experimental groups, one of which received a postcard with poultry preparation information and the other received two colored cutting boards to use during food preparation. Overall, the brochure was more successful in increasing awareness of food safety. The "cues" (postcard and cutting boards) played a minor role in changing participants' behaviors, though participants rated the postcards as significantly less helpful and attractive than the cutting boards.	Pre/Post: Objective and perceived knowledge of hygienic cooking and safe preparation, behavior, awareness of food safety, perceptions of the intervention.	Zurich, Switzerland	N=11 interviews with food safety experts N=13 interviews with consumers N=289 (out of 323) surveys: first year college students
Beffa-Negrini PA, et al. Development and evaluation of an online,	Interdisciplinary team of faculty and staff developed	Social Cognitive Theory	Food Safety FIRST was designed to provide science teachers with online professional development	Rate of completion of the educational modules, feedback	USA	N=221 science teachers

inquiry-based food safety education program for secondary teachers and their students. *Food Sci Ed,* 2007.	online modules for an Internet-based training program entitled Food Safety FIRST (Food Scient, Inquiry, Resources, Science Education Standards, Teaching Critical Thinking).		on the topic of food safety so they could feel comfortable and confident to integrate food safety education into their science curriculum. The Food Safety FIRST training was found to be a valuable professional development experience. Teachers enjoyed the online content and felt more confident teaching food safety after completing the training. Some completed pre/post tests before and after completing the training.	about the time taken to complete, behavioral improvement in food safety practices, confidence in teaching materials, satisfaction of the program.		developed needs assessment N=46 (71 total) teachers completed one or more module of the Food Safety FIRST program. N=38 teachers completed pre/post tests.
Bertrand J, Crerar A, Randall Simpson JA. Canadian University "Understanding Foods" Course Improves Confidence in Food Skills and Food Safety Knowledge. *Can J Diet Pract Res*, 2018.	The intervention in this study is the "Understanding Foods" course taught in university.	None	Course focused on the scientific principles of food, providing theory and as well as hands-on practices of food safety and preparation. One group, pre/post design. Food skills, confidence, and food safety improved significantly after the course. Quality of participants' eating habits decreased from pre to post test.	Pre/post surveys assessing food skills, confidence, food safety, and shopping.	Canada	N=47 undergraduate students in "Understanding Foods" course (87% female)
Biran A, et al. Effect of a behavior-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomised trial. *Lancet Glob Health*, 2014.	Educational intervention about hand washing included community and school-based events incorporating	Evo-Eco Model	Quasi-experimental design. Social marketing campaign was used to influence hand washing behavior using emotional drivers. Seven villages did not receive the intervention and seven did. Villages with the intervention saw and increase in hand washing	Pre/Post: Behavioral observations in handwashing made before and after intervention.	Andhra Pradesh, India	14 villages randomly assigned: N=348 households randomly chosen for evaluation

Biran A, et al. Effect of a behavior-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomised trial. *Lancet Glob Health*, 2014. (Cont'd)	animated film, skits, and public pledging ceremonies.		behavior while the villages without it saw no change. When the intervention was implemented in those control villages later into the study, their hand washing behavior increased and matched the intervention group's behavioral change.			
Brown BJ, Hermann JR. Cooking classes increase fruit and vegetable intake and food safety behaviors in youth and adults. *J Nutr Educ Behav*, 2005.	Program using produce cooking classes for youth and adults to provide education on basic fruit and vegetable preparation skills, food safety practices, and nutrition related to produce.	None	In an effort to increase fruit and vegetable intake, cooking classes were conducted for both youth and adults at county extension offices. Classes included safe food handling, in order to prevent disease and dispel the idea that fruits and vegetables are dangerous. Pre/post tests were conducted. Individuals who took part in the intervention reported eating more fruits and vegetables afterward, as well as improving safe food handling practices.	Pre/Post: Self-reported behavior changes in safe food handling practices.	Okla-homa; USA	N=602 youth and adults.
Burger, J, et al. Fish consumption: efficacy among fishermen of a brochure developed for pregnant women. *J Risk Res*, 2008.	Intervention included an informational brochure containing fish safety information.	None	Fishermen/women were given an informational brochure about fish consumption safety for pregnant women to read for 10-15 minutes in their preferred language (English or Spanish) and were administered a survey. Most (94%) stated that the brochure was easy to understand and a majority (62-75%) correctly	Post-test only: Knowledge of fish safety was assessed as well as intention to alter behavior in regard to cooking or consumption behavior.	Newark Bay Complex, USA	N=151 adults

Burger, J, et al. Fish consumption: efficacy among fishermen of a brochure developed for pregnant women. *J Risk Res*, 2008. (Cont'd)			answered questions about fish consumption safety. Relatively small percentage of subjects were persuaded to change their cooking or consumption behavior.			
Byrd-Bredbenner C, Schaffner DW, Abbot JM. How food safe is your home kitchen? A self-directed home kitchen audit. *J Nutri Educ Behav*, 2010.	The Home Kitchen Check-Up educational tool was adapted from an instrument used by researchers to evaluate home kitchens, for laymen to use to assess the safety of their kitchen.	None	Adult participants used the tool and evaluated it based on their experience. Participants found the tool to be readable, understandable, and personally relevant and useful. The tool improved their food safety knowledge and the likelihood that they would improve their behavior.	Post test only: participants rated their knowledge, intention to improve behavior, impact of the intervention as well as satisfaction of the intervention.	New Jersey; USA	N=42 undergraduates pilot-tested the intervention. N=275 adults field tested.
Chalak A, et al. Qualitative and quantitative cues in consumers' valuation of food safety: Evidence from Lebanon. *J Food Safety,* 2019.	Intervention included risk reduction information materials given to experimental group about street food "shawarma".	None	Randomized trial in which households were surveyed about the purchase of Middle Eastern traditional street food "shawarma". Pre/Post surveys were given to experimental group which was given education material, and control group which was given none. Consumers have high preference for and willing to pay more for food from businesses with safety certifications. After quantitative information about risk reduction was communicated, consumers'	Preference among consumers for businesses with safety certification and behavioral intent were assessed before and after intervention.	Beirut, Lebanon	N=700 households

			preferences toward certification issuers increased.			
Chidziwisano K, et al. Improving Complementary Food Hygiene Behaviors Using the Risk, Attitude, Norms, Ability, and Self-Regulation Approach in Rural Malawi. *Am J Trop Med Hyg*, 2020.	"Hygienic Family" intervention for villagers which involved door-to-door household visits by volunteers aimed to promote the performance of the targeted behaviors (handwashing and food hygiene) by all family members.	RANAS Model of Behavior Change - Risk, attitude, norms, ability, and self-regulation	Quasi experimental with villages randomly assigned to intervention and control groups. Intervention was delivered over 9 months through group meetings using demonstrations, games, rewards, and songs to address food hygiene behaviors in all family members. Follow up visits to each household were then conducted by female community volunteers to reinforce group communication. Control group received no intervention. Results showed intervention had significant effect on the three targeted behaviors.	Pre/Post and follow-up: Face to face structured surveys; 2 at baseline and follow up assessing hand washing, washing kitchen utensils, utensil storage.	Chikwawa District, Malawi	320 caregivers of children
Cho TJ, et al. Development of an effective tool for risk communication about food safety issues after the Fukushima nuclear accident: What should be considered? *Food Control*, 2017.	Pilot educational book related to food safety was administered to focus groups and assessed for usability as well as knowledge change based on intervention. Pilot intervention with no control group.	None	Qualitative focus groups were conducted which helped to inform development of a pilot educational booklet about food safety related to radioactivity and radiation. Survey participants read the materials and then answered questions about it. Most respondents (81%) said the tool was easy or very easy to fully understand. Over 80% of respondents answered knowledge-based questions correctly. 90% of respondents thought that the pilot education	Pre/Post: Change in knowledge of food safety and satisfaction of the food safety tool were assessed.	South Korea	N=116 consumers (16 in focus groups, 100 in pilot test)

			book helped to relieve their anxiety about the health risk associated with radioactive contamination in foods.			
Crovato S, et al. Food safety and young consumers: Testing a serious game as a risk communication tool. *Food Control*, 2016.	A videogame was used as an educational tool among secondary school students to education young people about milk safety.	None	Pre/Post test were administered and the video game was found to have changed players' perception of risk exposure and increased their knowledge about the risks associated with raw milk consumption.	Pre/Post: Perception of risk and knowledge were assessed after the intervention.	Italy	N=359 upper secondary school students
Dharod JM, et al. Influence of the Fight BAC! Food safety campaign on an urban Latino population in Connecticut. *J Nutr Educ Behav*, 2004.	Food safety media campaign was disseminated through a number of channels (radio, television, newspapers, etc.) that reach Latino populations.	Theory of Diffusion of Innovation	Pre/post surveys were conducted among participants before and after the campaign. Individuals exposed to the campaign showed improvement in food safety knowledge. A dose-response relationship was observed in regard to recognition of the Fight BAC! logo but no other major differences were found among exposure groups.	Food safety knowledge was assessed as well as recognition of the Fight Bac! logo.	Connec-ticut & South-west Massa-chusetts; USA	N=500 Latino consumers
Duong M, et al. An observational study of thermometer use by consumers when preparing ground turkey patties. *J Food Prot*, 2020	Intervention included experimental group watching a Department of Agriculture food safety video about cooking to a safe internal temperature.	None	Randomized experimental design with intervention receiving a 3-minute United States Department of Agriculture food safety video and the control group did not. Both groups were then observed cooking a meal and answered questions afterwards. Individuals who participated in watching the video were more	Direct observation of participants' cooking to evaluate thermometer use, patty flipping, endpoint temperature. Interviews conducted with those in the experimental group.	North Carolina; USA	N=383 Individuals

	Direct observation of meal preparation was undertaken.		likely to utilize safe food handling practices and the majority stated that the video informed their safe handling practices.			
Dworkin MS, et al. Efficacy of a food safety comic book on knowledge and self-reported behavior for persons living with AIDS. *PLOSOne,* 2013	Food safety educational comic book targeting knowledge gaps related to food safety among individuals living with AIDS.	None	Patients living with AIDS were recruited from four healthcare facilities, read a comic book and were given pre/post surveys. A significant increase in food safety knowledge, beliefs, and self-reported behavior was seen after	Food safety knowledge, beliefs and self-reported behavior improved as assessed by two-week follow up.	Chicago, New Orleans, Puerto Rico; USA	N=150 individuals living with AIDS
Edward A, et al. Association of mother's handwashing practices and pediatric diarrhea: evidence from a multi-country study on community-oriented interventions. *J Prev Med Hyg*, 2019.	Health promotion interventions on diarrhea in children under five years included household level health promotion by community health workers and institution support.	None	Quasi-experimental design using matched areas. Intervention used community health workers doing targeted counseling about hand washing and social accountability mechanisms in communities. Results showed access to safe drinking water was higher for communities in Guatemala and Zambia. Higher levels of access to safe drinking water was found in intervention sites for Guatemala and Kenya. Handwashing behaviors improved significantly in intervention sites in Cambodia, Guatemala and Kenya. Women who were married, had higher educational status, had female children and were wealthier participated in more handwashing practices and had were less likely	Pre/post household surveys assessing access to safe drinking water, sanitation, hand washing behavior.	Guate-mala, Zambia, Kenya, Cambodia	Mother/child pairs: 2995 in Cambodia, 1992 in Guatemala, 2581 in Kenya, 1057 in Zambia

			to report diarrhea in their children.			
Faccio E, et al. Drawing instead of answering to evaluate the effectiveness of food safety programmes in primary school. *Health Educ J*, 2017	Health promotional program "Mission to the Invisible World", taught by food safety experts, sought to improve food handling and personal hygiene.	None	Quasi experimental design with 6 schools getting a theoretical and 6 schools getting practical teaching approach, randomly assigned. Children ages 9-11 were given two 2-hour long lessons on health promotion and were evaluated before and after using both a pre/post questionnaire, as well as pre/post drawings of, bacteria, for example. Some drawing features correlated with and predicted high scores in the questionnaire on knowledge of microorganisms.	Food safety knowledge and behaviors, comparison between children's food safety scores on questionnaires and based upon their drawings.	Northern Italy	N=184 primary school students
Fajardo-Lira C, Heiss C. Comparing the effectiveness of a supplemental computer-based food safety tutorial to traditional education in an introductory food science course. *J Food Sci Edu*, 2006.	Web-based food science tutorial set up so that students could navigate through the site in a linear or nonlinear fashion.	None	Students were randomly assigned to attend either an in-person lecture or have access to a web-based computer tutorial about food safety to ascertain the efficacy of the web-based tool. Only those who utilized the web-based program significantly improved their food safety knowledge scores.	Pre/Post and compared: Knowledge, acceptability of intervention.	California; USA	N=31 Food science and nutrition college students
Feng YH, Bruhn C, Marx D. Evaluation of different food safety education interventions. *Brit Food J*, 2016.	Three approaches to food safety education were utilized: "positive deviance" focus groups, personal story reading, and	None	Quasi-experimental design with patients assigned to one of three conditions (not randomly). Compared to those who read educational information, participants in a PD Intervention had higher knowledge scores and	Pre/Post: Knowledge, safe handling behavior change.	Sacra-mento, California; USA	N=182 (89 pregnant women, 93 people with diabetes)

Feng YH, Bruhn C, Marx D. Evaluation of different food safety education interventions. *Brit Food J*, 2016.(Cont'd)	standard reading material among individuals with diabetes and pregnant women.		adopted more safe handling recommendations.			
Forster-Cox SC, et al. The environmental health/home safety education project: A successful and practical US-Mexico border initiative. *Health Promot Pract*, 2010.	The Environmental Health/Home Safety Education Project included visitation to people's homes by promatoras, to help to engage in home safety recommendations and evaluations.	Health Belief Model	The Environmental Health/Home Safety Education Project was implemented by Promatoras, who are well-trained community members. They visited homes and assessed for potential environmental hazards. Data analyzed from project years 2002-2005 show a significant increase in knowledge levels and initial behavior change among participants in regard to food safety issues.	Pre/Post: Knowledge, food safety and food safety behavior change.	New Mexico; USA	N=380 Hispanic/Latinx women
Frisby BN, Veil SR, Sellnow TL. Instructional messages during health-related crises: Essential content for self-protection. *Health Commun*, 2014.	Media campaign to warn consumers of egg contamination and recall using two separate types of messaging.	Protection Motivation Theory	Individuals were randomly assigned to receive high instructional messages related to egg contamination or a standard media message about the egg recall. Those who was the high instructional messages increased in knowledge and self-efficacy and those who viewed the standard media message demonstrated a significant decrease in self-efficacy, decreasing their confidence to protect themselves from foodborne illness.	Pre/Post: Perceived risk knowledge, foodborne illness efficacy.	Kentucky, USA	N=651 college students

Geresomo NC, et al. Targeting caregivers with context specific behavior change training increased uptake of recommended hygiene practices during food preparation and complementary feeding in Dedza district of Central Malawi. *Ecol Food Nutr*, 2018.	Context specific behavior change training, informed by gaps identified from in-depth interviews and observations, on uptake of recommended hygiene practices during food preparation and complementary feeding by caregivers.	None	Trainings for caregivers by community health workers in villages. There were highly significant differences in hygiene practices before and after training. Improvements were seen in washing of clean cooking utensils before cooking, getting rid of refuse and animal wastes around homesteads to keep the surroundings clean, and clearing dust and sprinkling water to prevent dust from contaminating food. The majority of caregivers washed hands with soap before the intervention.	Pre/post test: observations made of cleaning utensils, food preparation, hand washing, personal hygiene, food storage and covering in the home after the intervention.	Malawi	N=40 caregivers
Ghaffari M, et al. Effectiveness of a health intervention based on WHO food safety manual in Iran. *BMC Public Health*, 2020.	Month long food safety educational course, based upon World Health Organization guidelines, held inside each health center	Theory of Planned Behavior	Quasi experimental research design with female community health volunteers from five health centers assigned to two groups. Intervention received food safety manual and instruction; the control received nothing. The intervention was shown to significantly improved the results of knowledge, attitude and behavior scores.	Pre/post surveys with control and intervention group on food safety knowledge, attitude and behavior.	Iran	N=125 female community health volunteers
Ghebrehewet S, Stevenson L. Effectiveness of home-based food storage training: a community development	Community-based home hygiene training initiative with visitation from facilitators to the	None	Community-based facilitators made home visits to engage low-income people in home-based hygiene training. Following the home-based hygiene training,	Pre/Post: Food safety knowledge and behaviors.	Liverpool; UK	N=904 low income households

approach. *Int J Environ Health Res*, 2003.	homes of participants.		food safety knowledge and behaviors improved significantly.			
Gizaw Z, Addisu A. Evidence of Households' Water, Sanitation, and Hygiene (WASH) Performance Improvement Following a WASH Education Program in Rural Dembiya, Northwest Ethiopia. *Environ Health Insights*, 2020.	An educational intervention to improve household hygiene and sanitation practices delivered to households in Dembiya, northwest Ethiopia.	None	WASH education program provided to school children and rural communities, including role-play, demonstration, group discussion, song, games etc. Access to sanitation was improved significantly following intervention (43.1% at bls, 50.7% post-intervention). Access to protected water sources increased from 73.8% to 81.1%. Safe food handling practices also improved from 52.4% of households to 69.5%.	Drinking water safety, Sanitation; observed personal hygiene, Food safety (not preparing food while having diarrhea/vomiting or other disease, having clean utensils, usage of shelves for food and utensil storage, absence of rodents or other vectors in storage areas,	Dembiya, northwest Ethiopia	N=225 mothers/caregivers and N=302 children 6-59 months
Gold A, et al. Discussion map and cooking classes: Testing the effectiveness of teaching food safety to immigrants and refugees. J Nutr Edu Behav, 2014.	Educational tools to improve food safety among English language learners. Food safety discussion map to engage learners in dialogue and game.	Theory of Planned Behavior	Refugee and immigrant participants recruited through community, randomly assigned to one of three groups: Discussion map, cooking class; control. The cooking class and the map class were both significantly more effective in increasing food safety knowledge than for those in the control group.	Pre/post knowledge; 2 week post Food safety habits	USA	N=73 English language learners
Hashmi A., et al. The Healthy Baby Flipbook: piloting home-based counseling for refugee mothers to improve infant	A home-based, one-on-one counseling intervention to improve infant	None	Study to pilot educational materials including a “flip book” with refugee mothers. In-home visits with counseling and information for six months. The	Pre/Post: Proportion of infants (<6mo) who were exclusively, predominantly, and	Thailand-Myanmar	N=20 refugee mothers

feeding and water, sanitation, and hygiene (WASH) practices. *Glob Health Action*, 2019.	feeding and water, sanitation and hygiene practices was implemented.		number of infants who were exclusively breast fed increased from 42% to 65%. Handwashing prior to meal preparation increased from 94% to 100%. Adequate dietary diversity increased from 10% to 90%; appropriate meal amount increased from 10% to 100%.	partially breast fed. Proportion of infants with minimum dietary diversity (≥4 food groups), Meal frequency, handwashing, safe stool disposal, safe water.		
Hobbs EC, et al. Effects of 'the vicious worm' educational tool on taenia solium knowledge retention in Zambian primary school students after one year. *Plos Neglect Trop D*, 2019.	Computer-based education program 'The Vicious Worm' to educate students about Taenia solium, a zoonotic parasite.	None	Pre/post questionnaires were administered to primary school students before and one year after an educational workshop was given on Taenia solium (parasite). Knowledge of T. solium at follow-up was significantly higher than when the initial questionnaire was administered.	Knowledge of T. solium assessed pre/one year post educational workshop.	Eastern Zambia	N=86 primary school students
Islam MS, et al. Hygiene intervention reduces contamination of weaning food in Bangladesh. *Trop Med Intl Health*, 2013.	Female field workers provided training to mothers about how to avoid contamination of weaning food during storage and feeding of the child.	None	Sixty households were randomly selected: 30 intervention, 30 control and then randomized to control and intervention. Intervention received visits from female field workers and helped women with food prep. Samples of weaning food were collected and found to be heavily contaminated with fecal coliforms and fecal streptococci. The intervention group were then trained for four weeks in attaining the control point conditions and food samples were taken again.	Pre/Post: Measurement of level of contamination taken of weaning food before and after the intervention.	Bangla-desh	N=60 households

Islam MS, et al. Hygiene intervention reduces contamination of weaning food in Bangladesh. *Trop Med Intl Health*, 2013. (Cont'd)			The intervention group showed a significant reduction in contamination and maintained food hygiene three months after the study.			
James, B, et al. Public information campaign on aflatoxin contamination of maize grains in market stores in Benin, Ghana and Togo. *Food Addit Contam*, 2007.	Information campaign to raise public awareness of aflatoxin in Benin, Ghana, and Togo.	None	The information campaign related to aflatoxin awareness within Ghana, Togo, and Benin among maize farmers, maize traders, and consumers helped to increase awareness about the toxin. A strength of the program was that community members helped to create it and that it was disseminated among many different avenues (radio, tv, family members, etc.) Awareness, beliefs and behavior change related to decreasing the risk of aflatoxin increased among farmers, traders, and consumers after the intervention.	Pre/post assessment of awareness, beliefs and behavior changes related to aflatoxin risk.	Ghana, Togo, Benin	N=2416 adults
James KJ, et al. A summative evaluation of a food safety social marketing campaign "4-Day Throw-Away" using traditional and social media. *J Food Sci Edu*, 2013.	"4-Day Throw-Away" social marketing campaign aimed to educate the public about proper storage time of leftover food.	Health Belief Model	A mass media campaign was implemented and then measured among community members to assess exposure to the campaign. Twenty-four percent of individuals in the pilot-test communities provided unprompted or prompted awareness of the 4 Day Throw Away campaign whereas 1% of control group participants	Post test only: Awareness of the campaign, self-reported behavior change related to leftover foods.	Nebraska, Iowa; USA	N=600 Adults

James KJ, et al. A summative evaluation of a food safety social marketing campaign "4-Day Throw-Away" using traditional and social media. *J Food Sci Edu*, 2013. (Cont'd)			had heard of the campaign. Individuals in the pilot-test communities were significantly more likely to throw leftovers away in the recommended timeframe.			
Johnson, S, Stephens, CA, Kleihauer S. The effectiveness of a dynamic interdisciplinary food safety curriculum targeted on middle school students in Tennessee. *NACTA J*, 2009.	Interdisciplinary curriculum focused on food safety among seventh graders.	None	An interdisciplinary curriculum, designed to teach food handling skills and behavior knowledge, while using the content to also teach science, language arts, math, and social studies. This was compared to a control group. Pre and post tests, and a follow-up test covered all 6 topics. Mean scores in the school and food handling topics only had a small increase compared to the control group.	Pre/post tests In science, language arts, math and social studies to assess knowledge.	Tenne-ssee; USA	N=239 middle school students
Kang, HJ, et al. Development of Safe Food Handling Guidelines for Korean Consumers. *J Food Protect,* 2015.	Leaflet on safe food handling was created and pilot application was done to assess its efficacy.	None	A survey related to food safety was completed by 417 parents. The results informed the creation of safe food handling guidelines which was disseminated to 50 parents of elementary school children and was evaluated. Guidelines were evaluated based upon satisfaction of the consumer: Most respondents were satisfied with the ease of understanding (94%), usefulness (94%),	Post only: Consumer's evaluation of the safe food handling guidelines.	Seoul, South Korea	417 parents with elementary school children for survey; 50 consumers for pilot test

			knowledge (94%), attitude (98%), and practices (92%) answering "positive" or "very positive".			
Kang Y, Kyoung Suh Y, Debele L, Juon H, Christian P. Effects of a community-based nutrition promotion programme on child feeding and hygiene practices among caregivers in rural Eastern Ethiopia. *Pub Health Nutri*, 2017; 20(8):1461-1472.	A cluster randomized trial to evaluate the effectiveness of a community-based participatory nutrition program involving 2 week group sessions for mothers with children aged 6-12 months.	None	12 geographical clusters – 6 intervention and 5 control randomly assigned to condition. Women in the intervention were involved in daily group sessions for a two week period which promoted optimal feeding and food hygiene but also included mothers by cooking together and participating in songs and other activities, as well as washed their and their infant's hands and feet. Up to two follow up visits in the participants' homes were also completed. Results showed that intervention mothers had better meal frequency and composite feeding scores, but no differences in hand washing with the controls.	Pre/Post: self-reported meal frequency, breastfeeding; observed hand washing.	Habro and Melka Bello Districts, Ethiopia	N=1199 mother/child pairs (629 in control; 570 in intervention)
Kendall P, et al. Food safety instruction improves knowledge and behavior risk and protection factors for foodborne illnesses in pregnant populations. *Matern Child Health J*, 2017	A comparison of pathogen-specific vs. generic food safety instruction in improving knowledge and behavior in Spanish- and English-speaking pregnant women.	Health belief model, Social cognitive learning theory, Adult learning theory	Women were randomly assigned to pathogen-specific vs. basic food safety instruction. Knowledge and awareness of pathogens of high-risk concern for pregnant women improved for both groups, though significantly more in the pathogen-specific instruction group. Those in the pathogen-specific instruction condition also self-reported significantly	Pre/Post: Food safety knowledge, food safety behavior specifically related to pathogens of high-risk concern to pregnant women	Colorado, Ohio; USA	N= 550 low-income pregnant women

Kendall P, et al. Food safety instruction improves knowledge and behavior risk and protection factors for foodborne illnesses in pregnant populations. *Matern Child Health J*, 2017 (Cont'd)			improved food handling behaviors: checking meat safety with meat thermometer and checking for proper refrigeration temperature. Spanish-speaking women in the pathogen-specific training condition also reported less consumption of high-risk foods: eggs with runny yolks, cold hot dogs, soft cheeses, homemade Mexican soft cheeses, cold deli meats, and raw unpasteurized milk.			
Kim EJ, et al. The effects of food safety education on adolescents' hand hygiene behavior: An analysis of stages of change. *Nutr Res Pract*, 2012	Educational intervention was conducted to increase student's food safety behavior.	Trans-theoretical Model	Three 30-minute lessons and one lab experiment on hand hygiene, food poisoning, and general food safety were given by High school mentors. Pre and post-tests were used. Students in the pre-contemplation and contemplation stages moved significantly towards the action stage, and hand washing and food safety knowledge also increased.	Self-reported hand washing behavior, self-efficacy, positive and negative beliefs about hand washing, food safety knowledge.	Seoul & Gyeonggi-do, South Korea	N=400 middle school students
Kosa KM, et al. Effectiveness of educational interventions to improve food safety practices among older adults. *J Nutr Gerontol Geriatr*, 2011	Web-based and print materials used for improving food safety practices to reduce the risk of foodborne illness among older adults.	None	A randomized control trial was done to evaluate the effectiveness of an online food safety curriculum compared to a print material booklet with the same content, and a control group. Pre and post survey questionnaires were used to evaluate intervention effectiveness. Both	Pre/post self-reported food safety behaviors.	USA; National web-enabled panel	N=300 adults between 70 and 75 years old

			the online and print material interventions did not have a significant effect on improving participant's food safety practices.			
Lacroix, BJ, Lee, MB. Lessons learned from developing a food safety education kit for students in grades 7 to 9. *Can Home Econ J*, 2002	Food safety education kit for students, including activities and an educator's guide.	None	A food safety education kit was sent to teachers of family studies/home economics classes. It included an episode about food safety, an educator's guide, and 10 activities. A questionnaire was used afterwards to evaluate teacher's and student's reception of the kit, and it's perceived effectiveness. 48% of teachers felt confident that their students could discern when food was unsafe after using the kit, 40% were unsure, and 12% were not confident.	Post test only: Perception of usefulness by teachers, perceived effectiveness among teachers and students.	Canada	N=320 students in grades 7-9
Lagerkvist CJ, Okello J, Karanja N. Consumers' evaluation of volition, control, anticipated regret, and perceived food health risk. Evidence from a field experiment in a traditional vegetable market in Kenya. *Food Control,* 2015	Treatment group participants were given information about the actions that were taken to minimize risks from kale sold from intervention sales stands.	Theory of Planned Behavior	The treatment group received information about the actions taken through the intervention to minimize risks and participants used their own money to bid to upgrade from kale sold from non-intervention sales stands based on information about food safety. Participants in control group were observed after buying kale from non-intervention sales points within the same market.	Item scores for perceived risks and anticipated regret were consistently lower and scores for volition and control were higher in the treatment group. Among treatment group, significant negative correlations were found between risk perception and volition as well as	Nairobi, Kenya	N=252 consumers

Lagerkvist CJ, Okello J, Karanja N. Consumers' evaluation of volition, control, anticipated regret, and perceived food health risk. Evidence from a field experiment in a traditional vegetable market in Kenya. *Food Control,* 2015 (Cont'd)				between risk perception and control. Among control group non-significant negative relationships were observed. Volition and control were strongly correlated in both groups.		
Losasso C, et al. Food safety and hygiene lessons in the primary school: Implications for risk-reduction behaviors. *Foodborne Pathog Dis*, 2014	Health campaign to improve children's knowledge about characteristics of microorganisms and food contamination, as well as personal hygiene.	None	Quasi-experimental design with classes randomly assigned. The intervention was split into two groups, practical teaching and theoretical teaching styles, but both were given the same food safety materials. Pre and post-test questionnaires were given to both children and parents around knowledge and behaviors. An overall improvement in knowledge and behavior occurred in both classes.	Pre/post knowledge and self-reported behavior changes related to food safety.	Padua, Italy	N=249 5th grade students (ages 9-11)
Losasso C, et al. Food safety and nutrition: Improving consumer behavior. *Food Control*, 2012.	Health campaign "Alimentinsalute" was implemented at a public University weekly program attended by older adults.	Habit theory	Lessons aimed to improved food safety knowledge and behaviors. Pre/post tests were conducted though the majority of individuals only completed the pre-test. Food safety knowledge and behaviors and nutritional safety knowledge improved significantly after implementation of the intervention, particularly in regard	Pre/post: Food safety knowledge, and self-reported behaviors.	Italy	N=450 older adults completed pre-test

			to food label reading, safe usage of kitchen utensils to avoid cross-contamination, correct usage of food packaging materials to improve food conservation.			
Lynch R, et al. Delivering food safety education to middle school students using a web-based, interactive, multimedia computer program. *J Food Sci Educ*, 2008	A multi-media, self-paced online resource, including animations, activities, quizzes and games.	None	Pre and post tests were given as a learning achievement and recorded. Overall, there were statistically modest gains in knowledge, with lower improvement in 6th graders compared to 7th and 8th graders. Students indicated enjoying the program overall, and the program was effective in addressing varying student learning styles.	Pre/post tests in knowledge and enjoyment of the program.	Michigan, New York, Rhode Island, Tenne-ssee, Vermont; USA	N=217 middle school students
Mayer, AB, Harrison, JA. Safe Eats: An evaluation of the use of social media for food safety education. *J Food Protect*, 2012	Social-media intervention about food safety.	None	A quasi-experimental design used a social-media intervention through Facebook and compared it both to the control of a traditional lecture, and the social-media intervention combined with the traditional lecture. Pre and post-tests were used to evaluate intervention effectiveness. The social-media intervention improved food safety attitudes, practices, and knowledge. Students reported learning more in the intervention than a lecture, but those who did both had the highest score results.	Pre/post survey on food safety attitudes, practices, and knowledge.	Georgia, USA	N=710 undergraduate college students

Meivi Sesaneivira AD, Mulyono S, Sukihananto. Improving food safety behavior through mind map methods in school-age children. *Compr Child Adolesc Nurs*, 2019.	A quasi-experimental study of the effect of a mind map intervention to improve food safety behavior in school-aged children.	None	Quasi experimental design with one school as intervention and one school as control. Intervention received food safety education using a "mind map" method. Compared to controls, knowledge, attitudes and skills all improved significantly in the mind map intervention group.	Pre/post on knowledge, attitudes and skills	Karwang regency, Indonesia	N=88 school-aged children (44/44, intervention/control)
Metwally AM, et al. Improving the roles of rural women in health and environmental issues. *Int J Environ Health Res*, 2006.	Environmental health education course for women in rural villages of Egypt to improve knowledge and change behaviors within the villages.	None	Community health volunteers were trained to provide hygiene messages to their communities after participating in an environmental health education training course. Results of the course showed knowledge related to sanitation and hygiene improved significantly. There were some challenges related to changing behaviors and beliefs that were deeply entrenched in their culture such as opposition to washing hands after defecation, so further training is warranted.	Pre and post tests on knowledge and behavior; observational checklists of water and sanitation facilities and personal hygiene.	Egypt	N=375 women
Milton, AC, Mullan, BA. An application of the Theory of Planned Behavior – A randomized controlled food safety pilot intervention for young adults. *Health Psych*, 2012	Computer-based program aimed to improve food safety behavior of college students.	Theory of Planned Behavior	The intervention consisted of a computer program about food safety. Pre and post tests were used for food safety observations and Theory of Planned Behavior measures. The intervention was compared to a general control group, and a mere measurement control group. The intervention	Observed food safety behavior and perceived behavioral control.	Australia	N=45 college students

			significantly improved perceived behavioral control and food safety behavior compared to both control groups.			
Morse T, et al. Health outcomes of an integrated behaviour-centered water, sanitation, hygiene and food safety intervention- A randomized before and after trial. *Int J Environ Res Public Health*, 2020.	A multi-arm, randomized control trial to assess the efficacy of a behavior centered water, sanitation, and hygiene (WASH) intervention was conducted.	None	Two treatment arms were compared in addition to a non-intervention control. The two arms consisted of (1) a food hygiene only intervention and (2) an integrated WASH intervention. Reduction in diarrheal disease and respiratory infection was observed in both treatment groups relative to controls. Across all proxy measures, there was a significant increase comparing both treatment groups to controls.	Two health outcomes were assessed: Diarrheal disease and acute respiratory infections; and proxy measures including presence of soap in household, presence of handwashing facilities and presence of dish rack	District of Chik-wawa, Malawi	N=1000 household (400/400/200, T1/T2/CTRL)
Mosby TT, et al. Testing efficacy of teaching food safety and identifying variables that affect learning in a low-literacy population. *J Cancer Educ*, 2015.	An educational nutritional intervention using a low-literacy booklet targeting low-literacy caregivers of children with cancer was assessed.	None	Caregivers of children recently diagnosed with leukemia were invited to participate. Nurses provided one-on-one education. Baseline knowledge was associated with literacy. Knowledge significantly increased from pretest to post test.	Food safety knowledge assessed pre/post intervention.	Guat-emala and El Salvador	N=162 caregivers
Mullan B, Wong CL. Using the Theory of Planned Behaviour to design a food hygiene intervention. *Food Control*, 2010	Food hygiene intervention based on the Theory of planned behavior.	Theory of Planned Behavior	Randomized trial with three groups. Group 1 had a fact sheet and implementation planning guide. Group 2 had the fact sheet, implementation planning guide, and information about perceived	Pre/post food hygiene knowledge and behaviors, perceived behavioral control.	Australia	N=148 college students

Mullan B, Wong CL. Using the Theory of Planned Behaviour to design a food hygiene intervention. *Food Control*, 2010 (Cont'd)			behavioral control and how to improve self-efficacy. Group 3 was a control group. Pre and post-tests were used to measure food hygiene knowledge and behaviors. Neither intervention improved food hygiene behaviors, but knowledge and perceived behavioral control improved in Group 2, which included content about perceived behavioral control.			
Nauta M, et al. Food safety in the domestic environment: The effect of consumer risk information on human disease risks. *Risk Analysis,* 2008	Web-based interventions aimed using risk messages and embedded cues to improve food safety were compared.	None	Randomized experiment with three groups. The first used basic information about food safety and domestic hygiene. The second had the same information, but more "aggressive" language, colors, and images. The third also had the same information, but used images, language and colors to incite "disgust" and embedded it with a behavioral clue to perform self-protective behaviors. The control group was given information about general nutrition. Pre and post-tests were used to measure observed food-preparation behavior and intended behavior. Risk information alone did increase motivation to cook more safely,	Pre/post observed food safety behavior, motivation for self-protection regarding food safety behaviors, intention to cook more safely.	Nether-lands	N=240 adults

			but there was slight improvement when combined with "disgust".			
Nydahl M, et al. A simplified health information model increased the level of knowledge regarding "five a day" and food safety in a city district. *Brit Food J*, 2012	Educational computer programs highlighting the "five a day" concept and food hygiene along with a group discussion.	None	Focused on fruit & vegetable consumption, and food safety. Used two informational meetings with computer programs and discussions. Pre and post test and a follow-up questionnaire were used. There was a significant increase in knowledge for both topics, but there was no increase in behaviors around either topic.	Pre/post knowledge and self-reported behavior.	Uppsala, Sweden	N=92 adults
Quick V, et al. Ninja Kitchen to the rescue: Evaluation of a food safety education game for middle school youth. *Brit Food J*, 2013	Food safety educational video game "Ninja Kitchen" targeting middle school students.	None	Quasi experimental design where classes were randomly assigned to two groups. An intervention group was given a food safety educational videogame for classrooms and was compared to a control group. Pre and post-test, and a follow-up test were used to measure food safety knowledge, intended behaviors, and beliefs. The intervention improved knowledge, susceptibility perceptions, attitudes, and self-efficacy	Pre/post measures of food safety knowledge, intended behaviors, perceptions, attitudes, and self-efficacy.	USA	N=1,268 middle school students
Ratnapradipa D, et al. Child-to-parent instruction in an immigrant population. *J Environ Health*, 2011.	Quasi Experimental study using educational material focused on Eastern European refugees who were seeking	None	Participants were nonrandomly assigned to a study (n = 15) or control group (n = 17). 90-minute education with activity on washing hands. Materials were in English, but those in the child-education group provided instruction in	Pre/post test and follow-up: assessing food handling knowledge: personal hygiene and hand washing, cooking and temperature/time.	Salt Lake City, Utah USA	N=32 adults (Eastern European refugees)

Ratnapradipa D, et al. Child-to-parent instruction in an immigrant population. *J Environ Health*, 2011.(Cont'd)	a food handler permit and taught by either their middle school aged child in their native tongue or the health department.		native language. This study demonstrated that child-parent instruction in the parent's native language was more efficacious than traditional methods of instruction regarding foodborne disease and food handling practices, but study was non-random and there were baseline differences between groups.			
Redmond EC and Griffith CJ. A pilot study to evaluate the effectiveness of a social marketing-based consumer food safety initiative using observation. *Brit Food J*, 2006.	Behavioral observations made before and after social marketing informational campaign implemented utilizing leaflets, posters, magnets, videos, and newspapers.	None	Randomized control trial with two groups were observed preparing meals in order to assess food safety behaviors. The intervention group received food safety information less than 3 weeks after the first meal preparation in the form of leaflets, posters, magnets, videos and newspapers. Both intervention and control group were observed two more times to observe if any changes took place in food safety behaviors. The intervention group showed improvement in food safety 2-4 weeks after receiving food safety information when preparing the second meal. At the third meal, the intervention group showed improvements from the first meal but decreased in safety practices compared with the second meal preparation. No	Behavior observations during food preparation.	South Wales, UK	N=38 adult consumers

			changes were seen among the control group.			
Rheinberger CM, Hammitt JK. Dinner with Bayes: On the revision of risk beliefs. *J Risk Uncertain,* 2018	Experiment to investigate risk perception attributed to food illness, and food illness specifically from fish consumption	Bayesian learning hypothesis	Online sample of French adults was asked their perceived likelihood of succumbing to food illness before and after learning of actual population risks and eating habits (specifically fish) of the average population after provided risk communication messaging. Roughly a fourth of participants did not change their perceptions, or perception changes were inconsistent with Bayesian learning hypothesis.	Pre/Post: Perceived health risk beliefs	France	N= 987 French consumers between the ages of 18-80
Richards J, et al. Validation of an interdisciplinary food safety curriculum targeted at middle school students and correlated to state educational standards. *J Food Sci Edu Res*, 2008	Food safety curriculum was created with the help of food safety and microbiology experts and was implemented in five middle schools.	None	Pre/post/six week follow up tests were conducted among students. The curriculum included two-day training for teachers prior to implementation and 6-8 day curriculum for students. Knowledge means increased among all schools from pre to post tests and decreased slightly from post test scores at six week follow up. There was a significant increase in attitudes and behaviors between pre and post tests but no significant change from post to follow up.	Pre/post knowledge, attitudes, and self-reported behavior.	Tenne-sseee, North Carolina; USA	N=233 middle school students
Safari Y, et al. The role of educational intervention in changing knowledge	Educational intervention aimed to improve	None	Education provide by community health workers, Pre and post tests were conducted before and after	Pre/post survey of knowledge.	Bisotun, Iran	N=100 rural homemakers

and attitudes of rural homemakers in relation to food safety and hygiene: A case study: Iran. *Ann Trop Med Public Health*, 2017.	knowledge of food hygiene among rural homemakers.		an educational training program with single and married rural women to assess their knowledge of food hygiene. Prior to the educational program, single women's knowledge was significantly greater than married women's knowledge but there were no significant differences in knowledge after the educational program.			
Schlegelmilch MP, et al. Evaluation of water sanitation and hygiene program outcomes shows knowledge-behavior gaps in Coast Province, Kenya. *Pan Afr Med J,* 2016.	Sombeza Water and Sanitation Improvement Program (SWASIP)	None	Cluster randomized study evaluated the intervention, which constructed water and sanitation infrastructure and delivered health and hygiene promotion education to communities. Time needed to access water decreased from baseline. Number of latrines per home increased from baseline. While hand hygiene after defecation improved from baseline, hand hygiene before food prepping, feeding kids, eating, and cleaning up after a child who has defecated all decreased from baseline levels. Results demonstrate persistent knowledge behavior gap despite SWASIP.	Pre/post and follow-up: Latrine coverage, distance to water source, Self-reported hygiene behaviors.	Coast Province, Kenya	N= 250 households (10 randomly selected household from 25 villages). 1 person per household interviewed.
Scott AR, Pope PE, Thompson BM. Consumer's fresh produce	Educational program for consumers on	None	Participants were "captive audiences" at county extension units. 1 hour education and	Pre/post on knowledge, Attitudes; Follow-up	USA	N=2,651 Adult Consumers

food safety practices: Outcomes of a fresh produce safety education program. *J Food Sci Educ*, 2008.	foodborne disease associated with beef, poultry, and seafood was developed and evaluated.		provided by county extension agents. Knowledge gains were noted comparing baseline to immediate post knowledge scores with proportion of participants answering all knowledge items correctly. Attitudes significantly improved from baseline to immediate post, however the gains assessed at 3mo follow-up were modest. Behavior significantly improved from baseline to follow-up.	post on Behaviors regarding preparation, and storage of fresh produce to reduce risk of food borne disease		
Seetha A, Tsusaka TW, Munthali TW, et al. How immediate and significant is the outcome of training on diversified diets, hygiene and food safety? An effort to mitigate child undernutrition in rural Malawi. Public Health Nutr. 2018	Educational program for mothers of small children (<2) to aid in the adoption of better hygiene and nutrition for themselves and their children.	Positive Deviance/Hearth model	Education included nutrition sessions, small group meetings with other mothers and volunteers, complementary porridge, and hands on cooking experience and training. Volunteer mothers were trained to assist and monitor mothers for good hygiene and feeding practices. Results showed that diarrhea decreased significantly after the first week only within the intervention group, indicating that the hygiene practices were effective.	Pre/Post: health and weight of babies.	Malawi	N=179 mothers and their children under 2 years old
Sellers T, et al. Home food safety program for the Georgia Older Americans Act nutrition program. *J Nut Elderly*, 2006.	Educational intervention aimed to improve home food safety	Health Belief Model	Participants recruited from senior centers. Three lessons were provided at the senior centers in groups. Of the 16 practices assessed, two increased	Pre/Post: Self-reported home and food safety practices, physical performance, food	Georgia, USA	N=136 Older adults

Sellers T, et al. Home food safety program for the Georgia Older Americans Act nutrition program. *J Nut Elderly*, 2006. (Cont'd)	practices in older adults.		significantly post intervention: washing hands with soap/water for 20sec before eating, and before preparing food. Post intervention, a significant increase in the proportion of participants who answered "yes" to items regarding practices that they, food preparers, and everyone can do was observed.	thermometer ownership		
Shan L, et al. Cognitive biases of consumers' risk perception of foodborne diseases in China: Examining anchoring effect. *Int J Environ Res Public Health*, 2019	Educational intervention (pts read information about food borne diseases [FBDs])	Anchoring Effect Theory of Cognitive Biases	Stratified random sample survey with risk messaging embedded as "anchors". Sample randomized to three conditions: control, high anchor, and low anchor. An anchoring effect was demonstrated for the risk perception of FBDs. The experimenter-provided information regarding FBDs, a history of FBD, and familiarity with FBD all significantly influenced this effect.	Difference in risk perception of FBDs compared pre/post intervention and by high/low anchor index (AI)	Wuxi, China	N=400 adult consumers
Shearer AEH, Snider OS, Kniel KE. Development, dissemination and preimplementation evaluation of food safety educational materials for secondary education. *J Food Sci Edu*, 2012	Food safety educational materials focusing on secondary school science teachers and college students.	None	Food safety educational materials were disseminated to secondary school science teachers and were evaluated for the quality of the curriculum. Teachers were also given pre/post knowledge tests. All activities were rated as good or better by participants. Participants improved knowledge of food safety after the workshop.	Pre/post knowledge tests, assessment of the intervention.	Delaware, USA	N=27 Secondary Science Teachers

Shearer AEH, Snider OS, Kniel KE. Implementation and assessment of food safety educational materials for secondary and postsecondary education. *J Food Sci Edu*, 2014	Classroom-based educational materials "Foodborne Illness Outbreak Investigations for Food Safety Education" for high school and college students	None	Curriculum provided by high school and community college instructors to students. Educational materials on food safety were rated favorably by teachers. Among students, increase in correct responses were noted following intervention; however this varied significantly based on subject matter.	Pre/Post: Number of correct responses on a range on items assessing knowledge of safe handling and storage, types of food borne pathogens, and knowledge of regulatory and oversight activities related to food.	Delaware, New Jersey and Pennsyl-vania; USA	N=6 Educators and N=270 high school students
Shen M, Hu M, Sun Z. Assessment of school-based quasi-experimental nutrition and food safety health education for primary school students in two poverty-stricken counties of West China. *PLoS One,* 2015.	Intervention arm received targeted nutrition and food safety lectures ½ per week for 2 semesters.	None	Quasi-experimental design. Biology teachers in primary schools delivered intervention about nutrition and food safety. The intervention specifically emphasized: 1) food diversity, 2) water consumption, 3) breakfast, 4) food poisoning from wild foods, 5) food safety and snacks. The questionnaire was psychometrically sound. Knowledge increased and behaviors improved post intervention. However, attitudes did not.	Pre/Post: Knowledge, attitudes, and behaviors about nutrition and food safety.	Zhen'an of Shaanxi Province and Huize of Yunnan Province.	Primary school students (grade 4-6) in poor Chinese counties. 12 schools were selected with 6 from Zhen'an, Shaanxi Province and 6 from Huize, Yunnan province. Within each province, 3 schools were intervention,3 were control sites. Baseline n= 378 (intervention n=184, control n=194)

						End point n=478 (intervention n=236, control n=242
Sheth M, Obrah M. Diarrhea prevention through food safety education. *Indian J Peds*, 2004	Food safety educational intervention provided by Anganwadi (community childcare centers in rural India) workers to decrease incidence of diarrheal disease in children	None	Anganwadi workers from the community provided messages and used lectures, slogans, posters, charts, flash cards, role-play and other methods to educate low-income mothers on hygiene, sanitation, and food safety practices. Following the interventions 52% decrease in incidence of diarrhea. Mother's knowledge and practices concerning hygiene and sanitation also improved.	Pre/Post: Diarrhea incidence in children, KAP of hygiene, sanitation, feeding, and detection of enterococci in hand rinse samples.	Baroda, India	N=200 households with children 6-24 mons; under 8
Sheth M, et al. Food safety education as an effective strategy to reduce diarrhoeal morbidities in children less than two years of age. *Indian J Nutr Diet*, 2006.	Food safety educational intervention targeting mothers of children to reduce incidence of diarrhea.	None	Quasi experimental design where food safety education was given to one group of mothers following a hygiene assessment by researchers while the control group was given no education. The children of mothers who received the food safety education saw a significant reduction of diarrhea and showed significant improvements in food safety knowledge.	Pre/post survey food safety knowledge, reported incidence of diarrhea.	India	N=65 mothers
Simiyu S, et al. Designing a food hygiene intervention in low-income, peri-urban	Hardware and messaging intervention to	Behavior-Centered Design	Quasi experimental study with 30 caregivers provided with hardware (household items)	Intervention feedback centered on usability of the	Obunga (peri-urban	N=40 Caregivers of children 6-9 months.

context of Kisumu, Kenya: Application of the trials of improved practices methodology. *Am J Trop Med Hyg,* 2020.	address handwashing with soap, hygienic feeding, reheating, and hygienic storage of infant food.	Theory of Behavior Change Interventions	including safe storage and feeding devices and a soap dish for infant feeding and messages on how food hygiene leads to happy & healthy babies makes for successful children over six visits. A second group of 10 women were only visited twice and received the intervention after iterative adaptation. Hardware was accepted and food storage and handwashing practices improved. Messaging reportedly motivated participants. Results informed subsequent intervention design and implementation.	hardware and acceptability of messaging; self-reported use of equipment; observation of environmental changes with provided equipment	settlement) in Kisumu City, Kenya	
Stein SE, Dirks BP, Quinlan JJ. Assessing and addressing safe food handling knowledge, attitudes, and behaviors of college undergraduates. *J Food Sci Edu*, 2010	A social marketing campaign designed to increase safe food handling knowledge and practices among college students	None	Knowledge, attitudes and behavior were compared pre/post campaign. Comparing pre/post, more students reported washing hands and checking refrigeration temp. following the campaign; also demonstrated a significant increase in number of correct responses on a number of items assessing safe food handling and prep knowledge.	Self-ported behavior and attitudes, and knowledge of safe food handling practices measured pre/post campaign.	Philadel-phia, PA; USA	N=1,122 college students
Takanashi K, et al. Long-term impact of community-based information education and communication activities on food hygiene	Information, education and communication (IEC) intervention targeted to caregivers	None	Community interventions including workshops, newsletters, loudspeaker announcements, and flip chart communication in targeted areas. Childhood diarrhea incidence reduced from	Pre/Post: Sefl-reported 17 food hygiene and food safety (FHFS) behaviors, as well as caregiver-reported	Hanoi, Vietnam	N ranged from 298-356 child-caregiver pairs for all three time points (baseline, post1 and post2)

and food safety behaviors in Vietnam: A longitudinal study. *PLOSOne*, 2013			21.6% at baseline to 7.6% at the 1st post-intervention evaluation and 5.9% at the 2nd evaluation. 11 out of 17 food hygiene and food safety behaviors were improved or maintained by the 2nd evaluation. Flip chart communication administered by community groups was identified to be the most effective IEC channel for effecting behavior change.	incidence of childhood diarrhea		
Takeuchi MT, et al. Educational intervention enhances consumers' readiness to adopt food thermometer use when cooking small cuts of meat: An application of the Transtheoretical Model. *J Food Protect,* 2005	An educational intervention to promote use of food thermometers when cooking small cuts of meat	Trans-theoretical Model	Pre questionnaire and cover letter sent to 2500 randomly chosen residents in Washington and Idaho. Respondents were then sent education materials about food thermometer use, including a 15 minute video, five illustrated recipe cards, and a refrigerator magnet. Post intervention, thermometer use when cooking small cuts of meat increased significantly. Ownership of thermometers also significantly increased. The three constructs related to the Transtheoretical Model that were used in the study (decisional balance, self-efficacy, and processes of change) were very useful for examining differences among people at different stages of change.	Pre/Post: Stage of Change (SOC) classification, self-efficacy, and self-reported thermometer use and ownership	USA; Washington and Idaho	N=793 sent materials; 295 completed evaluation; adult consumers

Takeuchi D, et al. Impact of a food safety campaign on streptococcus suis infection in humans in Thailand. *Am J Trop Med Hyg.* 2017.	Food safety campaign delivered by healthcare volunteers to villages consisting of educational lectures.	None	The intervention included information on transmission routes, symptoms of the disease, and prophylactic methods. Public display banners, pamphlets, and posters were distributed by community health volunteers. Cases of *S. suis* decreased after the intervention. Incidence proportion of cases also decreased. One year follow up showed an increase in cases, which was attributed to cultural practices and underscoring the need for sustained intervention.	Pre and Post campaign survey of knowledge about *Streptococcus suis* and behavioral change related to bacterial transmission	Phayao Province, Thailand	Local residents within the nine districts in Phayao Province.
Tiozzo B, et al. Development and evaluation of a risk-communication campaign on salmonellosis. *Food Control*, 2011	A risk communication campaign on salmonellosis targeted to Italian households.	None	Information materials (flyer and sliding insert) were mailed to all households in the campaign area. The communication materials reached 20.7% (212 out of 1026 households). 89.3% of the persons who reported that they had received the material remembered the topic of the campaign. On a set of ten questions on food practices and behaviors, the percentages of correct answers was higher for the persons who had read the material than for those who had not received it	Post test: After intervention telephone survey with persons responsible for preparing meals in the household. Message penetration, level of interest generated in the households, and effectiveness of the campaign in raising awareness of salmonellosis and the means of preventing it.	Italy	Target of campaign: 54,291 households Evaluation – 1,026 randomly selected households

Toure O, et al. Piloting an intervention to improve microbiological food safety in peri-urban Mali. *Int J Hyg Environ Health*, 2013	Information and training in the prevention of food contamination intervention targeted to mothers.	None	Randomized trial with mothers assigned to home-based intervention providing in-person training on how to prepare two cultural dishes and the control with no education. Thermotolerant coliform (TTC) were detected in 55% of food samples prior to intervention, and 17% after intervention in the intervention. A further reduction in contamination was noted at 3-mo f/u with 0% to 17% of food samples failing to meet a standard of <10 TTC/g.	Pre/post and follow-up: Thermotolerant coliform (TTC)/ gram in food samples both before and after cooling, reheating and prior to child service.	Bamako, Mali	N=60 mothers (30/30, intervention/control)
Townsend MS, et al. Evaluation of a USDA nutrition education program for low-income youth. *J Nut Educ Behav*, 2006	USFA Nutrition education intervention for low-income youth	None	EFNEP programs randomized to treatment and control. In treatment, program leaders held 90 minute workshops. General knowledge prior to intervention was high (59% correct responses), scores did improve significantly across three out of four impact indicators: Nutrition knowledge; Food selection; Food preparation skills and safety practices (Eat a variety of foods did not change significantly)	Pre/Post: Four USDA impact indicators: Eat a variety of foods; Nutrition knowledge; Food selection; Food preparation skills and safety practices	California; USA	N=5,111 7-14 y/os
Traversa A, et al. Food safety and sustainable nutrition workshops: Educational experiences	Ninety-minute educational workshops delivered by a tutor	None	Five education workshops for students in summer school with 35 participants. Components included: an “allergen hunt”(about	Post: Three observers followed participants and collected data to assess knowledge	Turin, Italy	1708, 6-11 year old children.

for primary school children in Turin, Italy. *Ital J Food Saf,* 2017.	and 3 observers. Children participated in interactive activities to learn about nutrition and food safety.		food allergies), "the good and the ugly: meet the bacteria in food" (good and bad bacteria in food), "I love breakfast" (the importance of breakfast), "Batterikit: walking in the footsteps of the mysterious bacteria" (identifying source of food-borne outbreaks), "stay health with fruits and veggies" (nutritional promotion). Many participants knew of food allergens already and many knew the precautions to take regarding allergens to food. Few knew about microorganisms and their relation to food illness. Children focused on good hygiene to inactivate bad bacteria.	through percent correct answers based on show of hands, written or oral answers, and correct observed behaviors during activities.		
Trepka MJ, et al. Randomized controlled trial to determine the effectiveness of an interactive multimedia food safety education program for clients of the special supplemental nutrition program for women, infants and children. *J American Diet Assoc*, 2008	Interactive multimedia food safety education program for WIC supplement recipients	None	WIC participants randomized to receive pamphlet or interactive multimedia food safety education on a computer kiosk. There was a statistically significant improvement in food handling practices for all participants, but not by group assignment. Controlling for age, a significant improvement was noted for those in the interactive multimedia vs. pamphlet group.	Change in pre- to post-intervention food safety scores	Miami-Dade County, FL; USA	N= 255 mothers enrolled in WIC
Trifiletti E, et al. Evaluating the effects of a	A risk communication	None	Randomized experiment to receive risk messages or control.	Pre/Post: Positive/negative	Italy	N=45 university students

message on attitude and intention to eat raw meat: Salmonellosis prevention. *J Food Protect*, 2012	intervention to alter attitudes and intentions around raw meat consumption targeted to university students.		Relative to controls, those who received messages about salmonellosis risk considered raw or rare meat a greater source of contamination. Intention to eat well-done meat did not differ across conditions, however intention to eat raw or rare meat was lower in the experimental condition. In GNAT analysis, those in the experimental group associated themselves more with well-done meat than raw or rare.	evaluations and attitudes, intentions, and go/no-go association task (GNAT) scores.		
Unusan N. E-mail delivery of hygiene education to university personnel. *Nuti Food Sci*, 2007	A food safety course adapted for delivery through email and handout.	None	Quasi experimental design with one group provide food safety course materials through email and another group receiving printed handouts. The email group indicated higher satisfaction with the course overall compared to those who received a handout. In terms of items to assess practices to improve food safety, email respondents indicated improvement on 11 of 25 practices, while handout respondents only improved on 1.	Post Test only: Satisfaction with delivery method and change in number of correct responses to items addressing food safety concerns.	Turkey	N=68 university administrative personnel
Veena K. School-based health education intervention for prevention of Taeniasis and Neurocysticercosis: A	Awareness raising campaign about the prevention of taeniasis and neurocysticercosis among teachers,	None	Awareness campaign including mass media, skits, slideshows, and posters. Pre/post tests were conducted though comparisons were not available in the article. The program was rated positively	Pre/Post: Program rated by physicians and teachers.	Delhi, India	N=5,976 (200 teachers, 4786 primary school students, 846 parents,

pilot study. *J Commun Dis*, 2012.	students, and physicians.		by school teachers and physicians. Slideshows and skits were rated by physicians as being the most effective method used during the program.			79 sanitation workers, 65 public health nurses, 23 physicians)
Verbeke W, et al. Communicating risks and benefits from fish consumption: Impact on Belgian consumers' perceptions and intention to eat fish. *Risk Analysis,* 2008.	Dissemination of different types of messaging about the risks and benefits of fish consumption and assessment of their influence.	Prospect Theory (endow-ment effect)	Women were randomized to four different message conditions about the risks and benefits of fish consumption (benefit-only; risk-only; benefit-risk; risk-benefit) combined with three information sources (fish and food industry; consumer organization; government). Exposure to benefit-only message results in an increase in intended fish consumption frequency while fish attribute perceptions only marginally improved. The risk-only message resulted in a strong negative perceptual change and a decrease of behavioral intention to eat fish. Balanced messages referring to both risks and benefits yielded no significant change in behavioral intention but did show a significant worsening of fish attribute perception. In balanced messaging, first messages were more influential.	Pre/post survey about perception of and intent to consume fish.	Belgium	N=381 women
Verbeke W, Liu R. The impacts of information about the risks and	Dissemination of different types of messaging about	None	Individuals were surveyed before and after being exposed to either positive, negative or neutral	Pre/post surveys about perception of the healthiness and	Beijing Baoding City, China	N=909 consumers

benefits of pork consumption on Chinese consumers' perceptions towards, and intention to eat, pork. *Meat Sci* 2014.	the risks and benefits of pork consumption and assessment of their influence.		messages about pork. Negative messages resulted in a significant negative change in consumer's perception of pork safety. Balanced information resulted in a negative change in the perceived nutritional value of pork. Exposure to positive messages caused a positive change in consumers' perception about pork's healthiness and safety. Participants intended frequency of pork consumption decreased after exposure to information regardless of the type.	safety of pork consumption.		
Winter CK, et al. Food safety education using music parodies. *J Food Sci Edu*, 2009;	Evaluating music parodies for food safety education	None	Food service managers and supervisors, and culinary arts teachers and students were provided the music parodies in a variety of settings (i.e. summer curriculum meetings etc.). All demonstrated recall of the main topics of each parody song, though students had the lowest rates of recall overall. Students also indicated less preference over all for parody songs though they did show more preference for animated videos by comparison.	Post test only: Qualitative and quantitative evaluation on acceptability and recall of the topic of the parody and preference for individual songs/animated videos.	USA	N=105 foodservice managers N=25 culinary arts teacher N=17 Family and Consumer Science N=1,125 youth attending a summer program
Wogu JO. Mass media awareness of campaign and the prevention of the spread of Lassa	Mass media awareness campaign on the prevention of the	Media-tisation Theory	Questionnaires were conducted in six rural villages to assess the impact of mass media awareness campaign on the prevention of the	Post test only: Survey of knowledge of Lassa Fever and	Nigeria	N=354 adults

fever in the rural communities of Ebonyi State, Nigeria: Impact evaluation. *J Public Health Afr*, 2018.	spread of Lassa Fever.		spread of Laser Fever. Knowledge was assessed as well as exposure to the mass media campaign. There is a high-level awareness of Lassa fever disease but only 31.2% learned about it from television or radio. The majority lack appropriate knowledge of the symptoms of the disease and the personal hygiene behaviors required to prevent it.	exposure to the mass media campaign.		
Yarrow L, Remig V, Higgins MM. Food safety education intervention positively influences college students food safety attitudes, beliefs, knowledge and self-reported practices. *J Envi Hlth*, 2009	Educational food safety intervention targeted to college students	Theory of Planned Behavior	Students in health and non-health majors were compared across time-points prior and following education intervention. Across all time points, health majors scored significantly higher than non-health majors on knowledge, attitudes, beliefs and self-reported practices. Attitudes, beliefs and knowledge also increased significantly for all students from pre-to immediate post-intervention.	Pre/Post: Knowledge, attitudes, beliefs, self-reported practice and self-reported intake of high-risk food.	USA	N=59 college students
Yeasmin L, et al. Targeted interventions of ultra-poor women in rural Rangpur, Bangladesh: Do they make a difference to appropriate cooking practices, food habits and sanitation? *J Biosoc Sci*, 2014	Intervention to improve cooking practices, food habits and sanitation targeted to ultra-poor women in Rangpur, Bangladesh	None	Randomized trial with villages allotted to intervention and control. Intervention group had monthly health forums three times a week. Households in the intervention group noted significantly more use of soap for daily washing, as well as greater instances of handwashing before	Pre/Post: Nutritional knowledge and sanitary behavior including: reuse of cooking oil, use of soap for hand washing, and washing rice before cooking	Rangpur, Bangla-desh	N=200 women in households (100/100, intervention/control)

			and following a number of activities as appropriate such as: before preparing food, before eating, and before washing or peeling vegetables.			
Zhou WJ, et al. Effectiveness of a school-based nutrition and food safety education program among primary and junior high school students in Chongqing, China. *Glob Health Promot.* 2016.	School based nutrition and food safety education program consisting of lectures about nutrition, good personal eating habits, prevention of nutrient deficiency diseases, and food safety issues. There were also quiz games incentivized with prizes.	None	Cluster randomized study with classes randomly assigned to school-based nutrition and food safety program. After participating, general nutrition information and prevention of nutrition related disease knowledge improved. Gains decreased at 9 months post-intervention but remained elevated above baseline levels. Greatest improvement was with the student's understanding of the Chinese food pyramid. Food safety knowledge scores also improved in the intervention group. There were no significant changes in the control group.	Pre/Post: Nutrition and food safety knowledge-behavior-change in attitude	Chongqing, China	N=1058 students from grades 5-8 across 12 classes. Intervention n=501 (256 boys, 245 girls) Control n=522 (261 boys, 261 girls) Intervention follow up n=472 (235 boys, 237 girls)

APPENDIX III – Summary of Channel, Modality and Citations

CHANNEL	MODALITY	REFERENCE
SCHOOL – Primary/Secondary **21.7%**	1. Teacher online modules 2. Curriculum 3. Curriculum 4. Self-paced online app 5. Educational video game 6. Curriculum 7. Teacher curriculum for high school 8. Curriculum 9. Teacher curriculum for middle school 10. Video game 11. curriculum 12. curriculum middle school 13. Food safety workshops in primary school 14. Curriculum 15. Curriculum with lab experiments 16. Lesson using "mind map" 17. Curriculum 18. Comm - Health campaign within primary schools to reach kids in class, parents and teachers with posters and other activities like skits. 19. Curriculum 20. computer education game	1. Beffa-Negrina 2007 2. Johnson 2009 3. Lacroix 2002 4. Lynch 2008 5. Quick 2013 6. Richards 2008 7. Shearer 2012 8. Shearer 2014 9. Winter 2009 10. Crovato 2016 11. Faccio 2017 12. Losasso 2014 13. Traversa 2017 14. Antony 2018 15. Kim 2012 16. Meivi Sesaneivira 2019 17. Shen 2015 18. Veena 2012 19. Zhou 2016 20. Hobbs 2019
SCHOOL – College/University **12.0%**	1. comm - on-campus media campaign 2. In-class curriculum 3. Web-based food science tutorial for student 4. comm - on-campus media campaign 5. on-campus social media intervention and in-class lectures 6. comm - on-campus social media campaign 7. Curriculum on food safety 8. Comm (postcards, brochure, poultry prep info) 9. Comm - Risk comm messages provided in experiment. 10. Comm – edu through email and handouts for employees 11. Compute based education program 12. Fact sheets for students with TPB constructs experiment	1. Abbott 2012 2. Bertrand 2018 3. Fajardo-Lira 2006 4. Frisby 2014 5. Mayer 2012 6. Stein -2010 7. Yarrow 2009 8. Bearth 2013 9. Trifiletti 2012 10. Unusan 2007 11. Milton 2012 12. Mullan 2010
CLINIC BASED **4.3%**	1. Comic book for HIV/AIDS patient 2. Group education – people with diabetes and pregnant women 3. Group education – pregnant women 4. one on one education with caregivers of children with cancer	1. Dworkin 2013 2. Feng 2016 3. Kendall 2017 4. Mosby 2015
COMMUNITY BASED 25%	1. education curriculum in groups of adults	1. Adedokun 2018

COMMUNITY BASED 25% (Cont'd)	2. health promoter education in home, school and community 3. Education curriculum for kids in after-school program 4. Community campaign videos shown in groups of adults and kids 5. Mass media and in community events 6. Cooking classes youth and adults in community settings 7. Brochures given to fishermen 8. Food safety "map" and cooking classes for Immigrants and refugees 9. group education of refugees 10. Group education adults 11. In-group education, senior centers 12. Education curriculum for kids in community centers 13. Multimedia food safety program mothers in WIC on kiosks at WIC centers 14. Education in public seminars for adults 15. Computer education program provide in community settings 16. Comm – social marketing campaign in geographic area including leaflets, posters, fridge magnets, TV documentary, news articles 17. community health volunteers education health centers for women 18. Comm - brochures provided to parents of elementary school 19. Community health workers education sessions with women 20. community health workers group education with mothers. 21. Comm education (role play, demonstration, group discussion etc.) for adults and children 22. Community education group sessions for mothers 23. women health volunteers group health ed course for women 24. community education to communities and schools 25. community education in groups of mothers	2. Andrade 2019 3. Baker 2011 4. Barrett 2020 5. Biran 2014 5. Brown 2005 6. Burger 2008 7. Gold 2014 8. Ratnapradipa 2011 9. Scott 2008 10. Sellers 2006 11. Townsend 12. Trepka 2008 13. Losasso 2012 14. Nydahl 2012 15. Redmond 2006 16. Ghaffari 2020 17. Kang 2015 18. Safari 2017 19. Geresomo 2018 20. Gizaw 2020 21. Kang 2017 22. Metwally 2006 23. Schlegelmilch 2016 24. Seetha 2018
Population Based 17.4%	1. Comm -Mass media campaign aimed at Latinos 2. Comm - Videos in online experiment 3. Comm - Social marketing campaign 4. Comm - Web-based education tool online panel of elderly adults 5. Comm - Mailed intervention materials to random addresses 6. Comm - Sample messages in online experiment 7. Comm – online panel messaging experiment	1. Dharod 2004 2. Duong 2020 3. James 2013 4. Kosa 2011 5. Takeuchi 2005 6. Nuata 2008 7. Rheinberger 2018 8. Tiozzo 2011 9. Verbeke 2008

Population Based **17.4%** (Cont'd)	8. Comm – social marketing campaign with flyers and sliding inserts sent in the mail 9. Comm - Cross sectional surveys with women provided four different risk comm messages 10. Comm – education booklet cross sectional survey 11. Online survey using risk comm messages experiment on anchoring effect 12. Social media campaign pamphlets, posters, banners distributed by health care volunteers, retail markets, media etc 13. Comm - Online survey with different risk comm messages about pork – experiment 14. Comm – mass media campaign 15. Comm – risk comm messages provided through field experiment with point of sale purchase 16. Comm – mass media campaign	10. Cho 2017 11. Shan 2019 12. Takeuchi 2017 13. Verbeke 2014 14. James 2007 15. Lagerkvist 2015 16. Wogu 2018
HOME BASED 14.1%	1. Education tool for the home kitchen 2. Promotoras visit homes and do education with Latinas 3. Community facilitators education in home 4. education with families on street food 5. One on one counseling with mothers 6. One on one counseling with mothers 7. one one one with mothers using education and comm materials. 8. one on one with mothers education 9. one on one with mothers to improve cooking safety 10. in house intervention with mothers with infants 11. one on one with mothers on cooking and providing kitchen hardware 12. one on one with mothers education 13. one on one with mothers with community health workers	1. Byrd-Bredbenner 2010 2. Forster-Cox 2010 3. Ghebrehewet 2003 4. Chalak 2019 5. Hashmi 2019 6. Islam 2013 7. Seth 2004 8. Sheth 2006 9. Yeasmin 2014 10. Morse 2020 11. Simiyu 2020 12. Toure 2013 13. Edward 2019
MIXED 5.4%	1. education for child/parent pairs with individuals and groups. 2. Community and household level education with in house demonstrations.	1. Takanashi 2013 2. Chidziwisano 2020

APPENDIX IV: Study Type, References and Effectiveness

Study Type	Refs	Effectiveness
One group, Post only Effective: 2/6= 33.3%	1. Burger et al. 2008 2. Byrd-Bredbenner et al. 2010 3. Kang et al. 2015 4. Tiozzo et al. 2011 5. Traversa et al. 2017 6. Wogu 2018	1. Marginal (but no baseline) 2. Marginal (but no baseline) 3. Marginal (but no baseline) 4. Yes (but no baseline) 5. No 6. Yes (but no baseline)
One group, Pre/Post Effective: 27/34 = 79.4%	1. Abbot et al. 2012 2. Baker et al. 2011 3. Barrett et al. 2020 4. Bertrand et al. 2018 5. Brown and Hermann 2005 6. Cho et al. 2017 7. Crovato et al. 2016 8. Dharod et al. 2004 9. Dworkin et al. 2013 10. Forster-Cox et al. 2010 11. Geresomo et al. 2018 12. Ghebrehewet et al. 2003 13. Gizaw and Addisu 2020 14. Hashmi et al. 2019 15. Hobbs et al. 2019 16. James et al. 2007 17. Kim et al. 2012 18. Losasso et al. 2014 19. Lynch et al. 2008 20. Metwally et al. 2006 21. Mosby et al. 2015 22. Nydahl et al. 2012 23. Rheinberger et al. 2018 24. Richards et al. 2008 25. Safari et al. 2017 26. Scott et al. 2008 27. Sellers et al. 2006 28. Shearer et al. 2012 29. Shearer et al. 2014 30. Sheth and Obrah 2004 31. Stein et al. 2010 32. Takanashi et al. 2013 33. Takeuchi et al. 2005 34. Takeuchi et al. 2017	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes 7. Yes 8. No 9. Yes 10. Yes 11. Yes 12. Yes 13. Yes 14. Yes 15. Yes 16. Yes 17. Yes 18. Yes 19. Yes 20. Yes 21. Yes 22. Marginal 23. No 24. Marginal 25. Marginal 26. Yes 27. Yes 28. Yes 29. Marginal 30. Yes 31. Yes 32. Yes 33. Yes 34. Marginal
Quasi experimental Effective 19/22= 86.4%	1. Adedokun et al. 2018 2. Andrade et al. 2019 3. Antony et al. 2018 4. Biran et al. 2014 5. Chidziwisano et al. 2020 6. Edward et al. 2019	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes (3 out of 4 countries)

Quasi experimental Effective 19/22= 86.4% (Cont'd)	7. Faccio et al. 2017 8. Feng et al. 2016 9. Ghaffari et al. 2020 10. James et al. 2013 11 Johnson et al. 2009 12. Losasso et al. 2012 13. Mayer et al. 2012 14. Meivi Sesanelvira et al. 2019 15. Milton et al. 2012 16. Quick et al. 2013 17. Ratnapradipa et al. 2011 18. Shen et al. 2015 19. Sheth et al. 2006 20. Simiyu et al. 2020 21. Unusan 2007 22. Yarrow et al. 2009	7. Yes 8. Yes 9. Yes 10. Yes 11. Marginal 12. No 13. Yes 14. Yes 15. Yes 16. Yes 17. Marginal 18. Yes 19. Yes 20. Yes 21. Yes 22. Yes
Randomized Experiment Effective 7/7=100%	1. Frisby et al. 2014 2. Lagerkvist et al. 2015 3. Nuata et al. 2008 4. Shan et al. 2019 5. Trifiletti et al. 2012 6. Verbeke et al. 2008 7. Verbeke et al. 2014	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes 7. Yes
RCT Effective 16/19 =84.2%	1. Bearth et al. 2013 2. Chalak et al. 2019 3. Duong et al. 2020 4. Fajardo-Lira et al. 2006 5. Gold et al. 2014 6. Islam et al. 2013 7. Kang et al. 2017 8. Kendall et al. 2017 9. Kosa et al. 2011 10. Morse et al. 2020 11. Mullan et al. 2010 12. Redmond et al. 2006 13. Schlegelmilch et al. 2016 14. Seetha et al. 2018 15. Toure et al. 2013 16. Townsend et al. 2006 17. Trepka et al. 2008 18. Yeasmin et al. 2014 19. Zhou et al. 2016	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes 7. Yes 8. Yes 9. No 10. Yes 11. Marginal 12. Yes 13. Marginal 14. Yes 15. Yes 16. Yes 17. Yes 18. Yes 19. Yes

Studies without outcome data – only Process

1. Beffa-Negrinni 2007
2. Lacroix and Lee 2002
3. Veena et al. 2012
4. Winter et al. 2009