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

EatSafe: Evidence and Action Towards Safe, Nutritious Food

Global Review of Consumer and Vendor Perspectives on Food Safety

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USAID FROM THE AMERICAN PEOPLE

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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.

Codex	Codex Alimentarius
FAO	Food and Agriculture Organization
FGD	Focus Group Discussions
GAIN	Global Alliance for Improved Nutrition
GPS	Global positioning system
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
KAP	Knowledge, Attitude and Practice
KABB	Knowledge, Attitudes, Beliefs, Behaviors
LMICs	Low- and Middle-Income Countries
PPE	Personal protective equipment
SPS	Sanitary and Phytosanitary measures
WHO	World Health Organization
WTO	World Trade Organization
WB	World Bank

OVERVIEW

Unsafe food causes 600 million cases of foodborne related illness and 420,000 deaths a year worldwide, one third of which are among children under the age of 5.(1) The World Health Organization (WHO) estimates that every year, one in every 10 people will fall ill due to foodborne illness.(1) Unsafe food containing pathogens, chemical hazards (e.g., pesticides, radiological residue), or physical agents such as plastics can cause more than 200 different diseases.(2) Foodborne disease can include both acute and long-term effects. Foodborne disease is also has closely linked with nutrition, as many of the most nutritious foods such as vegetables and meat can be highly susceptible to contamination.

Worldwide, 92% of foodborne illnesses and 55% of deaths are due to diarrheal diseases, most often caused by food contaminated with norovirus, pathogenic *E. coli*, and *Salmonella*.(3) An estimated 33 million years of healthy life (DALYs - Disability Adjusted Life Years) are lost every year due to foodborne disease, mostly occurring in low- and middle-income countries, where regulation of food production processes and food handling are less restrictive and consumers and food handlers have less access to water and adequate food storage.(3) The economic consequences of foodborne disease for these countries are also significant. The World Bank estimates approximately $110 billion US dollars are lost in productivity and medical expenses each year (4), At the individual level, this translates to an inability to care for oneself and one's family, perpetuating cycles of poverty. It also impacts the greater society, including national economies, trade, tourism, and sustainable development.

Prevention of foodborne illness is a shared responsibility across the food chain, including both consumers and food vendors. At the local level in lower-income countries, food safety practices of local stakeholders (such as farmers, vendors, and consumers) may have a large impact on reducing the burden of foodborne disease. This is particularly true in settings where regulations may not be enforced due to lack of knowledge or government resource constraints. Central to the approach of EatSafe is that the interaction between consumers and vendors offers a leverage point for significantly improving food safety in informal markets in lower-income countries by empowering consumers to demand safe food, and vendors to deliver it. This makes it essential to understand how both food vendors and consumers conceptualize food safety, their attitudes and beliefs about the risk of foodborne illness and how to prevent it, and how this knowledge and these beliefs are reflected in their practices. It is also essential to better understand how consumers and food vendors interact in order to develop effective, targeted interventions to improve food safety.

To meet these goals, EatSafe commissioned two scoping reviews, one on consumer perceptions of food safety (Part 1) and one on vendor perceptions of food safety (Part 2). We present them here as two separate sections within this document, though some differences in scope and methods are unique to each.

- The consumer review identified a total of 131 studies: 84 cross-sectional surveys, 22 qualitative, and 25 mixed-methods studies. The majority of studies assessed consumer food safety knowledge, attitudes, beliefs, behaviors, and/or risk perceptions, used general adult audiences, and occurred in Asia. Several research methodologies were found to have been used, including respondent and investigator driven surveys, in-depth individual interviews, focus groups, and direct observation. Most did not have a specific commodity focus. The consumer review covered a shorter time period than the vendor review (5 years vs. 20 years).

- The vendor review identified 84 relevant studies, most of them conducted in or after 2015 and concentrated in urban and peri-urban Africa (especially East Africa), followed by South-East Asia. Most studies used a cross-sectional design with mixed methods, with a typical sample size of less than 50 individuals. The majority of the food vendors studied were women and were either illiterate or had attended/completed primary education. Common food value chains studied were dairy, meat (including bushmeat), and fruits and vegetables. Very few studies examined more than one type of commodity or value chain. While the vendor review focused only on low- and middle-income countries, the consumer review did not use this restriction.

- Importantly, 15 of the 131 studies uncovered in the consumer review, and about 20 of the 84 studies uncovered in the vendor review, included both consumers and vendors or other food chain actors in the study population. Such studies tend to focus on examining consumer trust in food purchased from vendors, consumers' perceptions of vendors' food safety practices, and/or comparing consumers' and vendors' views on food safety.

Several gaps to address in future research emerged from each review. These included a need for evidence from a greater range of geographies (notably, South Asia and Latin/South America), more integrated work examining both vendors and consumers, and more work examining gender and social dynamics as related to food safety. There is also a need for more research examining the meaning of "food safety" as a concept or value among vendors and consumers, and for studies that increase our understanding of the relative importance of food safety concerns (among other criteria and concerns driving food choices) for both consumers and vendors. The consumer review also highlighted a need for more theory-based examinations of individual and social behavior, while the vendor review noted a gap in understanding vendors' sources of information on food safety (and their trust therein).

This Global Review contains Part 1 on the Consumer and Part 2 on the Vendor. Each part has its own Table of Contents, References and Appendices.

EatSafe - Evidence and Action Towards Safe, Nutritious Food

PART 1: The Consumer

SUMMARY

Prevention of foodborne illness is a shared responsibility across the food chain, including both consumers and food vendors. This review covers how consumers conceptualize food safety and food safety behavior, their beliefs about their risk of foodborne illness, and how they interact with and perceive food vendors, all of which are key to developing effective and targeted interventions that will improve food safety behavior as well as expand access to safe food in informal markets.

This section of the global review presents a rigorous scoping review of consumers perceptions related to food safety. It synthesizes evidence from cross-sectional studies (qualitative, mixed-methods, and survey studies) carried out globally over the past 5 years. The studies are categorized and analyzed by geography, target group, study objective and focus to understand how consumers conceive of food safety, how it might differ by group or region and how these perceptions are connected to their behavior and perception of risk.

A total of 131 studies was reviewed - 84 cross-sectional surveys, 22 qualitative, and 25 mixed-methods. The majority of studies focus on general adult audiences, and most studies were carried out in Asia. Several research methods have been used, including respondent and investigator driven surveys, in-depth individual interviews, focus groups, and direct observation. We found 22 studies on consumers and vendors interactions and perceptions of food safety, including consumer experiences and trust in the food purchased from street vendors or markets. Some of these studies sought to characterize the extent to which food safety was a relevant decision criterion. In general, however, most of the studies examined food handling and hygiene behaviors with a focus on the practice of food safety (i.e., 'what is food safety') rather than how consumer perceive the consequences of unsafe food.

In the last five years, this review shows that the research has primarily conceptualized food safety practices, with less research on the gains or losses that consumer experience because of safe or unsafe foods, respectively. The emotions or emotional experiences related to unsafe food were explored only in a few of these cross-sectional studies. There is some evidence to suggest that consumers are making trade-offs between food safety criteria, price, and convenience.

1. BACKGROUND

Food quality and safety are universal consumer concerns and consumer knowledge, attitudes, and behaviors impact food safety throughout the food system. (12) Food safety is impacted by the places where consumers buy and prepare foods. A large portion of consumers in low- and middle-income countries primarily purchase food in informal outdoor "wet" markets, and from street vendors, where food is generally not subject to oversight and food is not inspected to meet quality and safety standards.(11) While food from such markets does not necessarily pose a higher risk than food from 'formal' supermarkets, there is room for significant food safety improvements in informal markets

Most consumers have knowledge of the quality and safety of the foods they eat (6) and studies indicate that consumers use sensory cues to assess quality and freshness when buying foods (7) and will chose products they perceive as safe even if they cost more.(8) Once purchased consumers need an understanding of food safety practices to properly prepare and cook foods, including proper handwashing, preparing food to reduce cross-contamination, and cooking and storing foods at the correct temperature.(9, 10)

Consumers can influence other actors in the food chain who are responsible for ensuring food safety at the stage of the supply chain they control or influence. Consumers can be "agents of change" by elevating their demands for food safety, including through their interactions with food handlers and food suppliers. Consumers and food vendors may work together or build upon each other's efforts, to foster a culture of food safety. In this context, understanding how food safety is perceived and valued across the food supply chain, in particular how attitudes, beliefs, and information motivate the behaviors and choices of consumers and food vendors is key to develop effective food safety interventions both inside and outside the home.

The purpose of this scoping review is to examine cross-sectional studies – quantitative surveys, qualitative studies, and mixed-method studies – that have occurred in the past 5 years (2015-2020) to understand the current knowledge, attitudes, beliefs, and perceptions of food safety among consumers to inform future EatSafe interventions at informal markets where many vulnerable consumers buy their food.

Our analysis includes a categorization by study, theoretical underpinning, method, and geography to elucidate potential differences. We discuss how these findings might be used to identify research gaps, advance the conceptualization of food safety, and create a food safety culture where consumers are able to demand that other food chain actors deliver safe foods.

EatSafe will examine the important role consumers play in identifying safety issues and demanding improved safety in markets and vending stalls. But many countries may not have regulatory standards or the ability to ensure food safety at informal markets, including through certification and food safety training to individual vendors. While the trend to certify specific products as being hazard-free (169) may play a role in consumer choice, some studies noted that having certification of products may lead to higher prices,(170, 146) negating the perceived benefit to consumers.

2. METHODOLOGY

Scoping reviews are a way to synthesize research evidence by documenting the volume, nature and characteristics of the primary research that has been done in a field of interest.(13, 14) 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.(15)

The methodology for this consumer part of the review was conducted in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (16) and we then applied the framework outlined by Arksey and O'Malley.(14) 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 cross-sectional studies was guided by the following questions:

1. What do current cross-sectional and descriptive studies indicate are consumer knowledge, attitudes, beliefs, and behaviors (KABB) of food safety and how can findings inform interventions that address food safety for both consumers and food vendors?

2. What studies have included both consumers and street or food market vendors to better describe how food safety is conceptualized among these actors?

3. What theories have been used to describe consumer attitudes, beliefs, and perceptions of food safety?

2.2 Data Sources and Search Strategy

To identify relevant studies, the review team worked with a medical librarian to develop detailed search strategies for each database. 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), GreenFile (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 studied in the empirical and the 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 2015. This was to ensure research was relevant to the present understanding of the current research trends in consumer food safety. The full search details are provided in Appendix I.

An EatSafe review, *Publicly available food safety information: Grey Literature resources for consumers and practitioners, with a focus on Nigeria,* looked at 36 organizational or governmental websites. It was conducted to identify any other potential studies to include in the scoping review. Cross-sectional and descriptive 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 were 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. studies asking consumers about their knowledge of nutrition), and were a cross-sectional survey, qualitative study (using interviews, focus groups or observation), or mixed-method study (i.e. using both quantitative and qualitative methods) with the aim of understanding consumer food safety knowledge, attitudes, and perceptions, as well as consumer or vendor behavior. We included studies on other food chain actors (e.g. vendors) if consumers were included as a target audience. We also reviewed

the abstracts of intervention studies, but these are not reviewed here: they were instead reviewed separately[1].

Only studies that included primary empirical data were included. Papers that described the development of a survey measurement, 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 used 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 criteria (published since 2015 and available in English) and eligibility criteria (e.g., a cross-sectional study with a consumer and food safety focus).

2.5 Title and Abstract Relevance Screening – Levels 1 and 2

For the Level 1 screening, citations were screened by title and abstract by two independent reviewers for the first 1,500 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 make a determination. To determine inter-rater reliability (a statistical measurement of agreement between two or more coders), a Kappa statistic was run. Once a Kappa of at least 0.80 was found between two reviewers,(17) we went to a "one reviewer to include, two reviewers to exclude" review (i.e., both reviewers had to agree to exclude a study, but only one was needed to decide to include a study). As recommended by Levac et al., (18) 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, year of publication), and duplicates. Citations that did not provide an abstract or author were looked at in detail to see if they met 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 (19) and assessing whether the journal is a member of the Committee on Publication Ethics (COPE) (20) or the Open Access Scholarly Publishers Association.(21)

[1]Global Alliance for Improved Nutrition. 2020. Consumer-facing interventions to improve food safety perceptions and practices in low- and middle-income countries: a review. A USAID EatSafe Project Report.

2.6 Data Characterization and Synthesis

Once a final list of citations was created, all full text articles were pulled. 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, theory(ies) used, summary of study, study design, results, location, and sample description for cross-sectional surveys (Appendix II), for qualitative studies (Appendix III), and one for mixed-methods studies (Appendix IV). These forms were reviewed by the research team, and slight modifications were made after the first ten studies were reviewed and summarized. 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 the companion review examining interventions (i.e., if the study was not cross-sectional study but instead tested an intervention meant to change knowledge, attitudes or behaviors).

Once these summary tables were complete, analysis to characterize the studies and answer the research questions was completed. This included looking at each study by region where it occurred, target group, theoretical underpinning, study objective, and focus. Descriptive statistics were calculated to summarize the data, including frequencies and percentages to depict nominal data; these statistics were then analyzed by outcome to characterize the overall findings.

2.7 Limitations

This scoping review has some limitations. First, only articles available in English were included. Some interventions published in other languages may have enriched the review (particularly those in Spanish, in the case of Latin/South America). Additionally, some potentially relevant articles may have been missed by the search; this was mitigated as much as possible by a comprehensive search strategy, working with a medical librarian, and a search that encompassed seven databases, a grey literature search, and a hand citation search to spot-check results.

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 hygiene, water and sanitation, or other aspects of public health as well as broader food features relevant to consumer preferences. Finally, the review only encompasses studies published within the past five years, to capture new trends in food safety research. This also limits the results, although other scoping reviews of earlier studies have been conducted and report on those findings. (172)

Most of the studies were atheoretical and simply cataloged knowledge and behaviors of the populations under study. The few studies that did use theory to drive understanding of food

safety KABB may provide a better context to understand how and why risk perception occurs. The Freivogel and Visschers study,(47) for example, used the theory to model intention to perform safe food handling behaviors by assessing risk perception of getting foodborne illness, positive outcome expectancy (that performing the behavior would prevent that illness), and self-efficacy in being about to perform the behavior. Ruby et al. (87) showed that in Malaysia, subjective norms (in this case the familial expectation of safety) and perceived behavioral control were significant predictors of intention of food safety behavior in the home. Theory-based studies can better explain the context in which KABB exists and the connections among knowledge, attitudes, beliefs, behaviors. EatSafe surveys and research on interventions should seek not only to describe food safety perceptions or practices, but also examine the linkages among knowledge, beliefs (including social norms), attitudes, emotions, gains/losses, and intention.

3. STUDY CHARACTERISTICS

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 studies met the eligibility criteria based on title and abstract. Level-two review eliminated 149 studies based on duplicates not identified previously, not being peer-reviewed, or being out of date range, leaving 173 citations. An additional 50 were hand-added from reference and grey literature searches, for a final sample of 223 citations. This included 84 cross-sectional surveys, 22 qualitative studies, 25 mixed-methods studies, and 92 interventions; in this paper the interventions are excluded, so the analysis focuses on 131 cross-sectional studies. The flow of articles is presented in the PRISMA diagram in Figure 1.

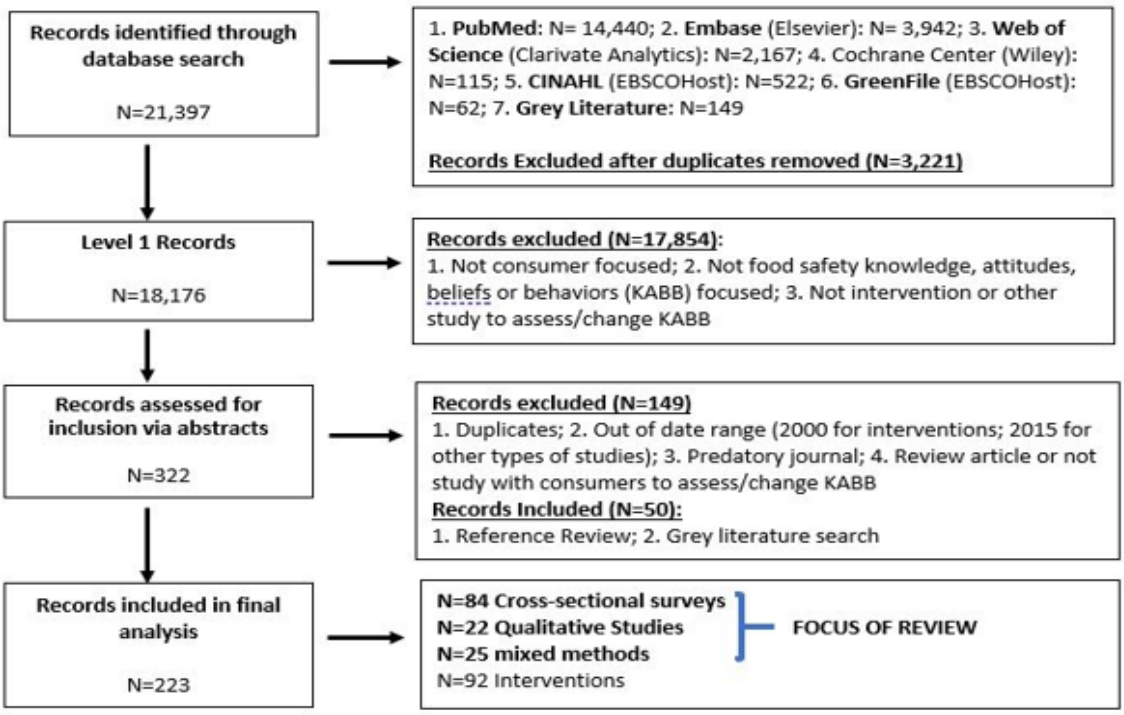

Figure 1. Inclusion Flow Chart

3.1 General Characteristics of Cross-sectional Studies

Of the 131 cross sectional studies (84 surveys (22-105), 22 qualitative (106-127), 25 mixed methods (128-152)), 58% have been published in the past three years (Appendix II-IV). For all types of studies, they have been more likely to occur in Asia, with a total of 54 studies. This represents 41.2% of all studies (45.2% of survey studies, 36.4% of qualitative studies, and 32% of mixed methods studies); for comparison, approximately 60% of the global population lives in Asia. Africa, Europe, and North America jointly represent another 46.5% of the total (n=61). Three studies (2.3% of total) have covered more than one continent. Overall, 49 different countries are represented in these studies, 20 of which are in Asia. Countries with the most studies include the United States (11), China (10), South Africa (8), and Vietnam (7) (Appendix V).

Using the World Bank characterization of Gross National Income per capita to categorize countries by income (5) 38.2% of the studies have been conducted in High Income countries, in North America, Europe, and Australia. Only 3.8% have occurred in Low-Income countries, where the public may be more exposed to and at risk of foodborne illnesses. A total of 56.5% have

occurred in Middle Income countries, with 37.4% in Upper Middle-Income countries and 19.1% in Lower Middle-Income countries (See Table 1).

Table 1. General Characteristics of Consumer Food Safety Perspectives

Characteristic	Surveys (n=84)	Qualitative (n=22)	Mixed-Methods (n=25)	Total (n=131)
Publication year				
2015	14 (16.7%)	4 (18.2%)	4 (16.0%)	22 (16.8%)
2016	7 (8.3%)	6 (27.3%)	7 (28.0%)	20 (15.3%)
2017	8 (9.5%)	5 (22.7%)	3 (12.0%)	16 (12.2%)
2018	22 (26.2%)	1 (4.5%)	3 (12.0%)	26 (19.8%)
2019	24 (28.6%)	5 (22.7%)	6 (24.0%)	35 (26.7%)
2020	9 (10.7%)	1 (4.5%)	2 (8.0%)	12 (9.2%)
Continent	**(n=84)**	**(n=22)**	**(n=25)**	**(n=131)**
Africa	11 (13.1%)	2 (9.1%)	8 (32.0%)	21 (16.0%)
Asia	38 (45.2%)	8 (36.4%)	8 (32.0%)	54 (41.2%)
Australia	3 (3.6%)	2 (9.1%)	-	5 (3.8%)
Europe	14 (16.7%)	5 (22.7%)	2 (8.0%)	21 (16.0%)
North America	12 (14.3%)	2 (9.1%)	5 (20.0%)	19(14.5%)
South America	4 (4.8%)	3 (13.6%)	1 (4.0%)	8 (6.2%)
Multi Continent	2 (2.4%)	-	1 (4.0%)	3 (2.3%)
Income	**(n=84)**	**(n=22)**	**(n=25)**	**(n=131)**
High	32 (38.1%)	9 (40.9%)	9 (36.0%)	50 (38.2%)
Middle				
Upper Middle	38 (45.2%)	7 (31.8%)	4 (16.0%)	49 (37.4%)
Lower Middle	11 (13.1%)	5 (22.8%)	9 (36.0%)	25 (19.1%)
Low	2 (2.4%)	-	3 (12.0%)	5 (3.8%)
Multi-income	1 (1.2%)	1 (4.5%)	-	2 (1.5%)
Data Collection Methods*	**(n=85)**	**(n=28)**	**(n=62)**	**(n=174)**
Self-Administered Survey	47 (55.3%)	-	18 (29.0%)	65 (37.4%)
Interviewer Admin. Survey/Inventory	24 (28.2%)	-	8 (12.9%)	32 (18.4%)
Online Survey	14 (16.5%)	-	-	14 (8.0%)
Structured/semi-structured/in-depth interview	-	13 (46.4%)	14 (22.6%)	27 (15.5%)
Structured/Semi-structured focus group	-	11 (39.3%)	13 (21.0%)	23 (13.2%)
Observational	-	4 (14.3%)	9 (14.5%)	13 (7.5%)

Study Population*	**(n=95)**	**(n=27)**	**(n=34)**	**(n=156)**
General adult consumers	47 (49.5%)	16 (59.3%)	16 (47.1%)	79 (50.6%)
Older Adults	3 (3.2%)	-	1 (2.9%)	4 (2.6%)
Parents/Heads of household	4 (4.2%)	3 (11.1%)	1 (2.9%)	8 (5.1%)
Primary/Secondary School aged Children/Adolescents	8 (8.4%)	-	2 (5.9%)	10 (6.4%)
College/University and Professional Students	12 (12.6%)	-	1 (2.9%)	13 (8.3%)
Food producers/ Preparers/Handlers[1]	7 (7.4%)	3 (11.1%)	5 (14.7%)	15 (9.6%)
Experts/Academics/Officials	1 (1.1%)	2 (7.4%)	1 (2.9%)	4 (2.6%)
Mothers/Female heads of household	6 (6.3%)	1 (3.7%)	3 (8.8%)	10 (6.5%)
Women (general, excluding mothers/heads of household)	3 (3.2%)	2 (7.4%)	1 (2.9%)	6 (3.8%)
Adult patients with health issues (e.g., HIV, Cancer, Salmonella infection)	3 (3.2%)	-	1 (2.9%)	4 (2.6%)
Other populations[2]	1 (1.1%)	-	2 (5.9%)	3 (1.9%)
Theory*	**(n=86)**	**(n=23)**	**(n=25)**	**(n=134)**
None noted	77 (89.5%)	18 (78.3%)	20 (80.0%)	115 (85.8%)
Theory of Planned Behavior/Theory of Reasoned Action	6 (7.0%)	1 (4.3%)	1 (4.0%)	8 (6.0%)
Health Belief Model	-	-	1 (4.0%)	1 (.8%)
Grounded Theory	-	2 (8.7%)	-	2 (1.4%)
Other Theory[3]	3 (3.5%)	2 (8.7%)	3 (12.0%)	8 (6.0%)

* Categories are not mutually exclusive so total numbers are larger than number of studies

1. Studies including food producers, preparers, and handlers were only included if they also had consumers as a target group.

2. Other populations include: Caregivers of cancer patients, Native Americans

3. Other theories include: Health Action Process Approach (HAPA), Information Integration Theory, Protection Motivation Theory, Social Practice Theory, Ecological Systems Theory, Precede-Proceed model, Theory of Social Representation

3.2 Data Collection Methods, Target Populations, and Theory

Data collection methods varied by study type. Cross-sectional survey studies used three modes: 1. self-administered surveys, where the respondent was given a survey and they completed it; 2. interviewer-administered surveys, where the researcher read the survey to the respondent and marked their answers either on paper or on a computer or hand-held device (either in person or over the phone); and, 3. online surveys, where the respondent completed the survey online. Over half (55.3%) of the 84 survey studies used self-administered survey collection methods, while 28.2% were interviewer-administered and 16.5% were done online.

Qualitative studies also used three data methods: in-depth interviews; focus groups, in which a group of people come together and are guided in a discussion about the topic; and observation of purchasing or food preparation behavior. In-depth interviews were the most used method, representing 46.4% of the total, followed by focus groups with 39.3% of the total. Observation was used in 14.3% of the studies. Finally, mixed-methods studies used a variety of methods, usually pairing surveys (41.9% of mixed-methods studies) with either interviews (22.6%) or focus groups (21%). Some mixed-method studies used observation (14.5%) of either individual behavior at home or street vendor behavior along with surveys of consumers.

The cross-sectional studies reviewed present data from a variety of populations, although general adult consumers (79 studies, 50.6% of total) were the most represented group in each study category. This represents 47 survey studies, 16 qualitative studies and 16 mixed-methods studies. Other populations include mothers/female heads of households or parents/heads of households (18 studies; 11.6% of total), food preparers or handlers (15 studies; 9.6% of total. These studies were only included if they also included consumers in their target group), college/university students (13 studies; 8.3% of total), and primary/secondary school children (10 studies; 6.4% of total). The rest all represent less than 5% of the total. Women are specifically targeted in an additional six studies (3.8%), outside of their role as mothers or heads of household (See Table 1).

Across geographies, there is a preference for certain audiences. In Africa, target audiences include general adults (4 survey studies, 2 qualitative studies, 4 mixed methods studies) and mothers or female heads of households (6 survey studies, 2 mixed-methods studies). Asia has more studies with general adults (23 surveys, 5 qualitative studies, 5 mixed-methods) and students, either primary/secondary school or university (11 surveys, 1 mixed-methods). Studies done in Asia are also most likely to include food producers/preparers/handlers along with consumers (3 surveys, 2 qualitative, 2 mixed methods). Europe, North America and South American studies focus mainly on general adults **(Appendix V).**

Of relevance to EatSafe, reviewers found 22 studies that specifically connect consumers to vendors or other food chain actors by exploring food safety within the context of street foods or foods purchased in open or wet markets. These studies highlight a range of issues from food retailing locations (supermarket or wet market), who is selling the food (and their knowledge or practices) and whether they are 'trusted' sellers, to the role of media and information that creates misinformation among consumers and vendors alike.

Only 14.2% of the studies indicated a theoretical underpinning for the research. Cross-sectional survey studies were least likely to be theory based (only 10.5%), compared to 21.7% of qualitative studies and 20% of mixed-methods studies. Of those that did note a theory base, the most

common theory used was the Theory of Planned Behavior/Theory of Reasoned Action (8.5%).(153) In these studies, the constructs of perceived behavioral control, behavioral intention and subjective norms were used to guide survey or interview/focus group questions. These studies include understanding psychosocial determinants of safe food handling,(47, 73, 87) the ways people feel about street food and its effect on behavioral intentions,(50) beliefs about specific food products,(122, 139) and intentions to store food properly.(98) Other theories represented included the use of Grounded Theory (a systematic methodology to construct theory through qualitative research) (154) in two qualitative studies,(110,126) and, in one mixed-methods study, the Health Belief Model,(151) which assesses the perceived severity and susceptibility of health threats to understand behavioral intention.(155) Two theories used in mixed-methods studies, Social Practice Theory (156) and Social-Ecological Systems Theory,(157) are aimed at understanding behavior in the context of societal or social settings and included observational components.(138, 152)

3.3 Study Objectives and Focus

Reviewers identified five general categories of study **objectives** (See Figures 2-4 and Appendix V).

Studies investigating general risk perceptions associated with food safety, often related to specific types of foods, such as milk or seafood, or perceived risk of getting a foodborne illness. Risk perception or perception of food safety is assessed in 16 survey studies (19%), 11 qualitative studies (50%), and two mixed-methods studies (8.3%).

Studies of general food safety knowledge/attitudes/beliefs/behaviors (KABB). KABB studies assess actual levels of knowledge, types of attitudes, or behavior in a population. General food safety KABB in adult consumers include 20 surveys (23.8%), two qualitative studies (9.1%), and one mixed-methods study (4%). Other KABB studies have focused on sub-populations of consumers, including students (both primary/secondary and university students), older adults, and special populations (See Figure 2-4). Another important objective as part of our gender analysis was to assess KABB in mothers or caretakers of children and households, which was studied in eight survey studies (9.4%), two qualitative studies (9.1%), and six mixed-methods studies (25%) **(See Figure 2-4).**

Studies that assess food safety information sources (i.e. how people use labels or use of/recall of food safety information). Information sources as they relate to food safety and trust of food sources are the objective for seven survey studies (8.2%), three qualitative studies (13.6%), and

two mixed-methods studies (8.3%). These studies asses use of food labels, influence of written or Internet-based information, or media campaign information recall. (See Figures 2-4).

Studies that primarily assess consumer KABB as it relates to street vendors, markets or restaurants. These studies are differentiated from the risk perception and KABB categories by their focus specifically on vending or purchasing of food or street food. There are 10 survey studies (11.8%), 2 qualitative studies (9.1%), and 10 mixed methods studies (41.7%) with this focus (See Figure 2-4).

Studies that include expert opinions on food safety for consumers. There are 2 qualitative studies (9.1%) with this focus (See Figure 3).

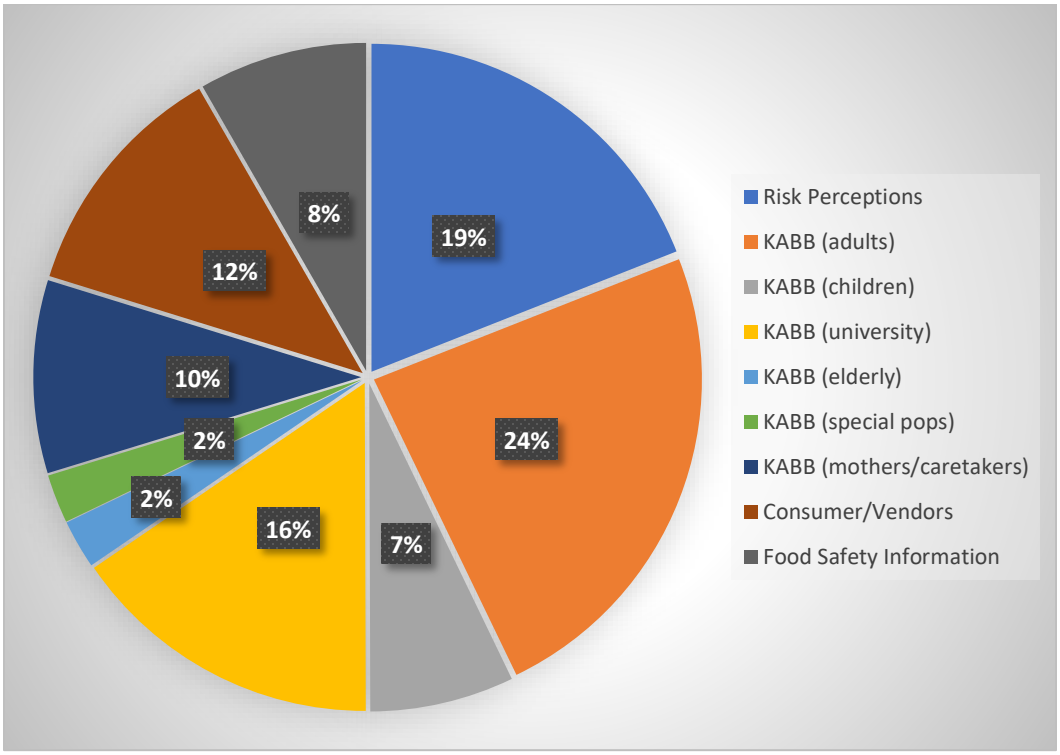

Figure 2. Study Objectives for Survey Studies

KABB: knowledge, attitudes, beliefs, behaviors. Legend matches the pie chart if pie chart is read clockwise beginning at 12 o'clock. 'Special pops' is short form of special populations. Numbers in figures are rounded to the nearest integer.

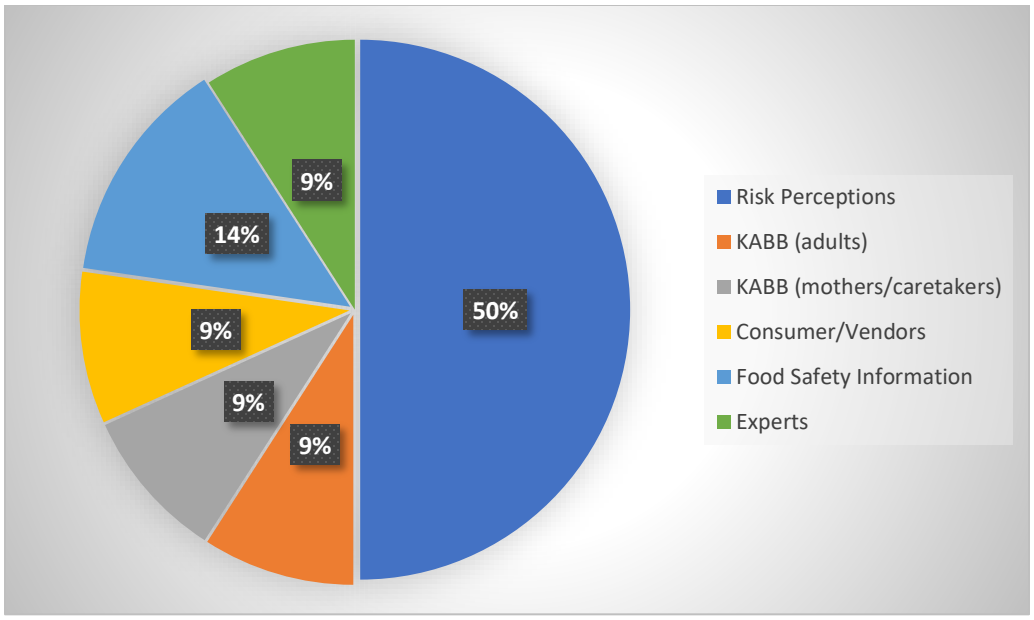

Figure 3. Study Objectives for Qualitative Studies

KABB: knowledge, attitudes, beliefs, behaviors. Legend matches the pie chart if pie chart is read clockwise beginning at 12 o'clock. Numbers in figures are rounded to the nearest integer.

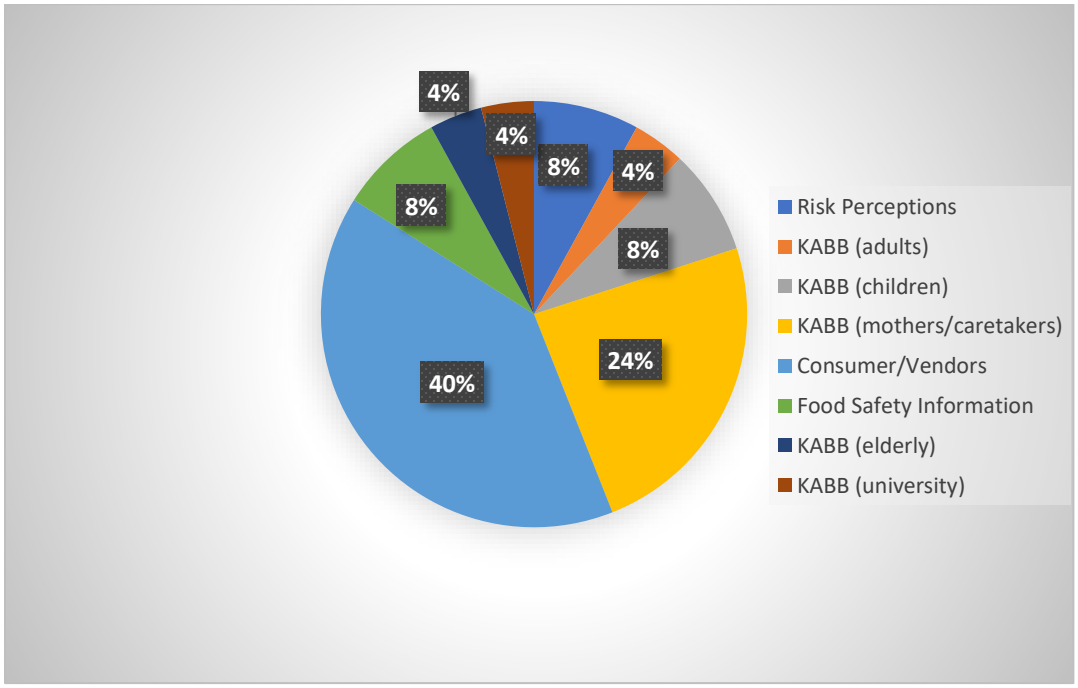

Figure 4. Study for Mixed-Methods Studies

KABB: knowledge, attitudes, beliefs, behaviors. Legend matches the pie chart if pie chart is read clockwise beginning at 12 o'clock. Numbers in figures are rounded to the nearest integer.

Though reviewers identified five general categories of study objectives, the **focus** of the identified studies examined were much more varied (See Table 2).

Table 2. Study Objective and Focus by Category

SURVEYS (n=84)	
Study Objective	**Study Focus**
Risk perceptions or perceptions of food safety (16 studies, 19.0%)	• Perceptions of Fura and nunu food products in Nigeria • Perceptions of the safety of seafood consumption • Food safety cues used when purchasing food • Perceptions of safety of online food products • Perceived risk and control of food safety • Perceptions of the safety of milk • Perceptions of safety of food additives and contaminants • Perceptions of risk of getting Campylobacter, Salmonella, Toxoplasmosis • Perceived qualities important to assess food quality and safety • Perceptions of safety of food additives and contaminants and traits of food safety • Perceived safety of rice and vegetables • Perceived safety of fresh fruits and vegetables • Perceptions of food quality and relationship to safety • Perceived safety of slaughtering and handling of goats • Risk perception and risk avoidance of foodborne disease • Risk perception of foodborne disease
General Food Safety KABB – General Adults (20 studies; 23.8%)	• Chicken prep and raw chicken labels • Shopping and storage behavior and knowledge • Awareness of food safety and factors deemed important • Factors related to food handling behaviors • Food safety KABB and self-perception of salmonella exposure • Poultry handling, purchasing of minorities • Purchasing behavior related to food safety • Personal hygiene in refugee camp • Raw chicken handling and knowledge • Raw chicken handling and knowledge • General food safety KABB • Food safety behaviors • General food safety KABB • General food safety KABB • General food safety KABB at home • General food safety KABB at home

	• Food safety KABB around poultry purchasing, transport • General food safety knowledge and behavior • Food poisoning knowledge and food preparation • Knowledge of foodborne risks during pregnancy
General Food Safety KABB - Children/Adolescents/Teens (6 studies; 7.1%)	• Knowledge and food hygiene practice, secondary schools • General food safety KABB • General food safety KABB • General food safety KABB in high school students • General food safety KABB in males • General food safety KABB
General Food Safety KABB - University Students or Young Adults (13 studies; 15.5%)	• General knowledge of foodborne illness and transmission; behavior • Eating behavior, food safety knowledge, behavior • General food safety KABB • Handwashing frequency • General food safety KABB • Knowledge of food safety • General food safety KABB • Food safety knowledge in nutrition majors • Food storage knowledge • General food safety KABB in young women • General food safety KABB in young consumers • General food safety KABB in vet students • General food safety KABB
General Food Safety KABB - Older Adults (2 studies; 2.4%)	• Food safety KABB with ready to eat food products • Food safety intentions and beliefs about food storage
General Food Safety KABB - Special Populations (2 studies; 2.4%	• Food safety KABB Cancer patients on chemo • Food safety risk perception, attitudes, behaviors in cancer patients
General Food Safety KABB - Mothers/Caregivers (8 studies; 9.5%)	• Knowledge of food storage and handling; personal hygiene and food poisoning risks • Food safety knowledge and attitudes • Food safety practices at home • Food handling practices in parents • Hand washing practices • Hand washing practices • Knowledge and practices related to disease and cooking • General food safety KABB
Influence of Food Safety Information Sources (7 studies; 8.3%)	• Perceptions of food labels and packing; relationship to beliefs about food safety • Perceived food safety and customer loyalty • Relationship between sources of information on food safety perceptions • Sources of information and food safety handling at tailgates

	• Information sources on food safety and relationship to demographics • KABB related to influence of media campaign • Food safety evaluation and association with Internet use
Consumer Food Safety KABB in Connection to Street Vendors/Markets/Restaurants (10 studies; 11.9%)	• Food safety knowledge, microbial hazard awareness related to using vendors • Food safety perceptions and preferences of street food • Risk perception and knowledge food handlers and consumers in restaurants • Perceptions of street food safety • Tourist perceptions of food safety in ports • Food safety KABB in consumers, street vendors • Perceptions of informal food markets and factors that influence purchasing and food safety • Customer KABB about food facilities • Customer and vendor food safety KABB • Chicken customer, farmer and vendor knowledge about avian flu virus and food safety
QUALITATIVE STUDIES (n=22)	
Study Objective	**Study Focus**
Risk perceptions or perceptions of food safety (11 studies; 50%)	• Definitions of food safety and perceptions of mold/fungus infestations • Consumer perceptions of risk of purchasing and consuming bivalve meat • Perceptions of meat safety • Perceptions of trust in food sources • Perceptions of health risks related to kitchens • Perceptions of mistrust in food and strategies used to identify and cope • KABB of consumers on what “healthy eating” means • Perceptions of safety of local beef • Food risk perceptions in food purchasers • Food incident scenarios and consumer opinion on risk and response • Perceptions of grain safety
General Food Safety KABB – General Adults (2 studies; 9.1%)	• Understanding of food borne diseases and self-involvement in food chain • Domestic kitchen interpretation through diaries to assess food safety KABB
General Food Safety KABB - Mothers/Caregivers (2 studies; 9.1%)	• Behaviors and knowledge of prevention of cross contamination in home kitchens • Caregiver hygiene practices
Influence of Food Safety Information Sources (3 studies; 13.6%)	• Perceptions of trust for food safety and purchasing decisions in women; influence of certification and food labels

	• Perceptions of good food governance and trust of food safety information from government • Use of information sources to make purchasing decisions about food safety and trust of the food system
Consumer Food Safety KABB in Connection to Street Vendors/Markets/Restaurants (2 studies; 9.1%)	• Barriers to health literacy and knowledge in customers and street vendors • Feelings related to presence of flies in fish market in consumers and traders
Expert Opinion on Food Safety for Consumers (2 studies; 9.1%)	• Develop food safety hygiene checklist with consumer input • Areas of food safety education important to learn in school
MIXED-METHODS (n=25)	
Study Objective	**Study Focus**
Risk perceptions or perceptions of food safety (2 studies; 8.0%)	• Perceptions of safety of mangoes • Perceptions of European products and food safety/food fraud
General Food Safety KABB – General Adults (1 study; 4%)	• Knowledge of risk of using personal electronic devices in kitchen and behavior
General Food Safety KABB - Children/Adolescents/Teens (2 studies; 8.0%)	• General food safety KABB among male school students • Hand washing in students and observation of available facilities in schools
General Food Safety KABB - University Students or Young Adults (1 study; 4.0%)	• Food safety knowledge, eating habits and beliefs about microbiological risk in vet, ag and university students
General Food Safety KABB - Older Adults (1 study; 4.0%)	• Home kitchen safety and KABB in home-bound adults
General Food Safety KABB - Mothers/Caregivers (6 studies; 24%)	• Behaviors in home related to food safety • Behaviors of female caregivers in home related to food safety • Caregiver input on a food safety questionnaire to assess home behavior • Household hygiene and food safety • Food safety preparation and child feeding practices • Food safety KABB of food preparer in Native American families
Influence of Food Safety Information Sources (2 studies; 8.0%)	• Food related information sources in people on chemotherapy • Eye tracking of attention and impressions from website use on milk safety
Consumer Food Safety KABB in Connection to Street Vendors/Markets/Restaurants (10 studies; 40.0%)	• Safety perceptions and practices in pork food chain actors, including consumers • Perceptions of food quality and safety of food in markets – consumers and market vendors

	• KABB of food safety of street food in those attending Carnival and vendors • Consumer food safety and nutrition knowledge; government officials and food vendors perceptions of certification • Perceptions of food safety of vegetable in traditional markets • Perceptions of safe food handling practices in grocery stores • Perceptions to assess consumer trust of vegetables and stakeholder assessment of food chain production • Consumer perceptions of safety of "fast food" in Ghana • Food safety perceptions of consumer and street food vendors; observation of vendors • Food retailing and association with food safety, food choice and behavior

The **risk perception studies** assessed a wide range of perceptions on different food safety practices (111) and food categories, such as fruits and vegetables (74, 77, 129) and meat or seafood. (31, 85, 110, 111, 122)

General food safety KABB studies examined consumers' formal knowledge and general food safety behaviors. This was the case for adults, as well as the sub-populations (i.e. mothers/caretakers, children etc.). Several studies look at KABB related to food safety for specific food items, for example purchasing, handling, and cooking poultry (23, 55, 61, 62, 93).

Information sources studies look at specific sources of information accessed by the study population (i.e. the Internet) and the relationship that information has to food safety KABB, risk perception or purchasing behavior.(51, 52, 75, 103, 124, 150). Information sources studies have also examined labeling and food packaging and its associations with consumer beliefs (32) or purchasing decisions. (109)

Reviewers included in the information source category two studies on governance of the food chain and its influence on consumer perceptions about food safety or the integrity of the food supply chain. (112,125)

Consumers and vendors KABB studies.

Reviewers identified 22 studies that investigate consumer and vendor or other food chain actor KABB related to food safety (**Appendix VII**). Of these, five studies include consumers only and focus on their perceptions of street food or market vendors, and 15 studies include both consumers and vendors as the study population. Of the 22 studies, five have occurred in Vietnam, (76, 88, 133, 146, 152) three in South Africa,(28, 67, 138) two in Brazil,(29, 39) and two in China.(65, 104). There were three studies in Asia (India, Bangladesh, Myanmar),(50, 116, 134) three in Africa (Zambia, Nairobi, Ghana),(121, 140, 147) three in North American (United States) and three in the Caribbean (Haiti, Barbados,),(56, 137, 142, 149). These studies either survey consumers about their experiences and trust of food purchased from street vendors or markets,(28, 29, 50, 56, 67) or survey both consumers and vendors about food safety.(39, 65, 76, 88, 104)

Consumers Views on Government Certification

Three studies specifically looked at governmental certification or trust and the relationship to beliefs about food safety.(138, 146, 152) For example, Wertheim-Heck et al. (152) looked at food retailing and its association with perceived food safety, food choice and behavior in Vietnam. They found that there were more informal "wet" markets than supermarkets and while the variety of fresh fruits and vegetables was similar, wet markets lacked visual food safety claims and certificates. Despite this, consumers still preferred to shop at informal markets.

Qualitative and mixed-methods studies add personal experiences by looking at barriers to health information and knowledge of food safety among both customers and vendors (116, 121), or combine surveys with in-depth interviews or observations to understand the relationship between consumer trust and food safety knowledge, with vendor or food chain actors' behavior (133, 134, 137, 140, 147, 149). Gaps in knowledge were found not only among consumers but also among vendors. For example, Haque et al.'s (116) qualitative study linking food safety knowledge to social determinants (such as societal mores, laws, skills) found that there were significant gaps in food safety knowledge and behavior that could be related to health literacy skills, despite the presence of a vendor training program in Bangladesh.

4. SYNTHESIS OF EVIDENCE

This review of 131 cross-sectional survey, qualitative, and mixed-methods studies related to consumer food safety showed that the majority assess consumer KABB and risk perceptions about food safety through the study of adult audiences. Research methodologies included surveys, in-depth interviews, focus groups, and direct observation.

It should be noted that in most of the studies, food safety as a concept is assumed, meaning that studies are assessing concrete knowledge about food safety, safe food storage, personal hygiene

behaviors, and foodborne illness. Survey studies either use validated surveys or have developed their own scales to measure self-reported knowledge or compliance with food safety behaviors (e.g., questions about the specific temperature to safely store food or the correct way to wash hands). Qualitative and mixed methods studies were similar in this respect, often using qualitative interviews or focus groups to understand how people think about concrete behaviors such as handwashing or food storage. This is seen in studies across the globe, suggesting that researchers assume that consumers conceive food safety as a salient construct, not as a dimension of food "healthiness."

The reviewers identify three areas of relevant findings to help characterize the type of consumer-driven interventions that may be better suited for informal markets. These include:

- **Food safety concerns and attitudes**
- **Risk perception**
- **Consumer behavior (purchasing)**

4.1 Food safety concerns and attitudes

Public Health Concerns. Seven common public health concerns, with the majority occurring in LMICs, were identified in a systematic review of 81 studies on public health risks related to food safety issues in food markets. (159) These seven concerns included:

- Microbial contamination
- Chemical contamination
- Food adulteration
- Misuse of food additives
- Mislabeling
- Genetically modified foods
- Outdated foods

Addressing such concerns can be challenging in LMICs where regulatory oversight may be weaker (11) and food sellers tend to be informal players, (160) making compliance with food hygiene and safety regulations weaker. (161)

Socio-demographic differences. Though the majority of the studies reviewed showed that the consumer populations studied have knowledge about food safety, it seems to be associated to a number of socio-demographic characteristics including education level, age and gender, with women consistently showing higher knowledge then men. A study by Odeyemi et al. (79) done in seven LMICs showed that those in Asia and the upper middle income category (Iran, Jordan, Malaysia, Pakistan) had better food safety knowledge than those in Africa and the low middle income category (Ghana, Cameroon, Nigeria). However, interventions that simply attempt to increase knowledge may not increase preventive behavior. A survey study by Sanlier and Baser

(89) with women in Turkey found that positive attitudes about food safety was an important mediator between food safety knowledge and actual behavior. Attitudes, which are evaluative dispositions of objects or events, are important constructs that include thoughts (what we know and believe), emotions, and behavioral intentions. (153, 171) Attitude strength is associated with topical relevancy (often called 'top of mind') and the considerations consumers give to food safety as a decision-criterion (171).

Knowledge of consumers vs. vendors. Many of the studies that assessed both consumers' and vendors' food safety KABB showed that consumers had more knowledge than vendors (see Samapundo et al. (88)). Various studies noted that consumer use visual clues, such as appearance of a food stall, presence of flies, smell, and vendor hygiene, to decide where to buy food.(34, 65, 68,77) That food vendors do not exceed consumers in their knowledge of food safety may be a function of its place in the economic hierarchy. Often, food vending, especially mobile or street vending, is a subsistence business,(168) and those operating those businesses often lack training in food safety.(169) Regulation of street vending is an important mechanism to increase food safety practices of vendors.(138) Only two studies,(137, 152) however, assessed the presence of a training certificate or a symbol of regulatory compliance as a factor in consumers food decisions.

4.2 Risk perception

Risk threshold is personal and knowledge as an influencer varies. Risk perception research has shown that consumers perceive hazards and risk based not only on overall knowledge but on how they prioritize that risk in their everyday lives. That perception might be heightened if the person feels they do not have control or if they do not trust those providing the information(162), as illustrated in studies by Chiu and Yu (109), Devany et al. (112) and Tonkin et al. (124). Often risk is conceptualized at an emotional level (163) and decisions are made using heuristics or short cuts that are influenced by psychological or cultural factors.(164,165) Of the studies reviewed here, potential risks associated with consumption of unsafe food were not seen to be the most important factors in consumer decision making .(166, 167) It is not clear from the studies reviewed here if the risks and consequences of consumption of unsafe food had been communicated to consumers in a way to influence their purchases.

4.3 Consumer purchasing behavior

Perceived risk does not necessarily translate to purchasing. It is not clear whether and how food safety concerns affect purchasing behavior. Omari and Frempong's study (147) in Ghana, for example, noted that consumers were aware of and worried about the public health risks in "fast food" products, but these products were often more economical and easier to get. This theme is repeated in Ng et al.'s (146) study in Vietnam, Downs et al.'s (134) study in Myanmar, Marumo

and Mabuza's (67) study in South Africa, and Gupta et al.'s (50) study in India. Consumers in all these studies had correct perception of food-related health risks but noted their preference for convenience and price offered by street vendors or wet markets. This trade-off among food safety, convenience, and price warrants further exploration.

5. CONCLUSIONS

This scoping review examined cross-sectional studies, survey, qualitative, and mixed-method research, on consumers' perceptions and behavior related to food safety over the last five years.

In the studies reviewed here, we distinguished between consumer risk perceptions, which are personal beliefs and attitudes on safety of food, from KABB, which capture the formal food safety knowledge, attitudes, and practices. Most of KABB studies have focused on food handling and hygiene behaviors with a focus on practices related to food safety rather than examining how consumers perceive the consequences of unsafe food. Thus, in the last five years, the research has primarily conceptualized food safety practices but there is less research on the perceived gains or losses that consumers experience because of safe or unsafe foods or practices.

The emotions or emotional experiences related to unsafe food were explored in only a few of these cross-sectional studies. From those risk perception studies that assessed food safety consequences, gains/benefits, and losses as experienced by the consumer, there is some evidence to suggest that consumers make trade-offs between food safety criteria, price, and convenience.

Research is also lacking on how consumers communicate food safety needs to market actors (vendors or food safety regulators) or whether interventions that empower consumers to voice these benefits or losses have yielded demonstrable changes in vendor practices. This is an important area for future study.

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. Central to EatSafe's work is understanding and potentially shaping the motivations, attitudes, beliefs, and practices of consumers and food vendors. While EatSafe will undertake novel primary research on consumer and vendor motivations and practices, it is essential to ensure that this work is informed by and builds on what has already been done—both in terms of methods used and results obtained. As EatSafe designs consumer-based interventions for food safety and nutrition the following lessons emerging from this review.

In the literature since 2015, *food safety* appears to be conceptualized as a set of practices and is less often conceptualized as perceptions of risk. Risk perception would appear to be more aligned with examining consumers' motives, their gains or losses, and consequences associated with unsafe foods. Examining the risk perception literature found in this review will be relevant to designing and testing messaging strategies used in intervention design.

- Consumers in LMICs appear to be making trade-offs between food safety, price, and convenience. EatSafe will need to consider to what extent *food safety* creates consumer segments and if it limits consumer access to safe foods through higher prices or time costs. Thus, some further lines of inquiry or hypothesis that need to be explored in the next phase of EatSafe are:
    - Do immediate considerations of convenience and price outweigh the costs of unsafe food, the effects of which may or may not occur in the future?
    - Will consumers voice their desire for safer food if they feel that their choices are limited due to limited purchasing power?
    - Both consumer attitudes and emotional experiences may be highly relevant to engaging consumers on food safety. Consumer understanding of food safety consequences, gains/benefits, and losses from unsafe food may assist in understanding the trade-offs between food safety criteria, price, and convenience.
- EatSafe will need to gather socio-demographic evidence to test knowledge as one of several drivers of consumer behavior vis a vis food safety

EatSafe - Evidence and Action Towards Safe, Nutritious Food

Part II: The Vendor

SUMMARY

Vendors' willingness, motivation, and ability to ensure safe food is partly shaped by their knowledge, attitudes, and practices (KAP); understanding vendor perspectives is thus important when designing interventions to improve food safety. This is particularly relevant in LMICs, where most consumers purchase food from vendors in informal markets, where poor infrastructure, lack of regulatory oversight, and hot ambient temperatures, among other factors, can increase food safety risks.

This section of the review summarizes existing research on the perspectives and practices vis-à-vis food safety of vendors of food commodities in LMICs. Through a robust search, relevant studies examining vendor food safety KAP in informal markets across all food value chains were identified. Over 17,000 titles were screened, from which 84 relevant studies were identified. The relatively small number of studies indicates a large research gap on food safety among market vendors in LMICs. Of the shortlisted studies, most of them were of medium quality, conducted in or after 2015, and concentrated in urban and peri-urban Africa (especially East Africa), followed by South-East Asia. Most studies used a cross-sectional design with mixed methods (e.g., quantitative and qualitative analysis of vendors' KAP through interviews and observations), with a typical sample size of less than 50 individuals. The majority of the food vendors studied were women (except in predominantly Muslim countries like Bangladesh, where men were dominant) and were either illiterate or had attended/completed primary education. Common food value chains studied were dairy, meat (including bushmeat), and fruits and vegetables. Very few studies examined more than one type of commodity or value chain.

Food vendors' knowledge typically ranged from none to little, which was also evident from poor observed food handling and storage practices and operating in unsafe and unhygienic conditions. Poor compliance with existing food safety policies, laws, and regulations was evident in some cases; this was primarily due to either limited awareness of existing laws and regulations or limited knowledge of how to implement them. Vendor attitudes towards food safety were generally assessed as positive (i.e., vendors expressed willingness to receive food safety information or act to make food safer). No significant gaps were found between food safety knowledge and actual practices. Knowledge, attitudes, and practices, and gaps between food safety knowledge and actual practices, was not found to vary with the vendor's age, gender, type of product sold, or geography.

Vendors encountered challenges to implementing food safety practices at the vendor level (e.g., limited education, knowledge, or training on food safety), market level (e.g., inadequate infrastructure), and government level (e.g., stringent laws and regulations). Local government

staff were identified as key enabling actors, interacting with food market vendors to foster better food safety practices. However, it was noted that even when these actors tried to support food vendors, their initiatives posed additional challenges to food vendors. Initiatives mentioned to help increase food safety in informal markets included training food vendors on both handling practices and legal requirements; development of market infrastructure, laboratory facilities, and vendor-friendly food safety regulations; enhancing compliance with existing laws and regulations; involving market authorities; forming cooperatives among value chain actors; and advocacy.

1. BACKGROUND

Food vendors are among the most important members of the food system in LMICs (1). They play a critical role in food safety, especially in open-air informal "wet" markets, where the risk of food contamination is thought to be high. It is hypothesized that consumer-driven demand can be a critical driver of increased supply of safe foods in LMICs. However, the specifics of how much food safety concerns dictate consumer demands, particularly in the informal markets of the poorest countries, and how vendors might change food safety practices to meet these demands, is not well characterized across LMICs. Consumer demands likely vary by product and by country, as does consumer risk tolerance and knowledge of food safety issues. Vendors' priorities, and how much they value food safety as a consumer "selling feature," are largely unclear. While food safety certifications connected to foods sold by vendors in informal markets (e.g., certification of chicks bought by poultry farmers) have been launched in some countries, adoption has been slow (2). It is also not well known how vendors' knowledge, attitudes, and beliefs can drive their personal behaviors related to food safety, or how these behaviors might jeopardize or foster improved food safety.

A recent EatSafe scoping review of past studies on these questions in Nigeria found that most studies concluded that vendors' knowledge of food safety was generally good but that self-reported practices were worse, and that observed food safety practices were generally poor (3). This review also stressed that there was a need for future investigations into wet markets, a greater focus on the practices of vendors of fruits and vegetables, and more focus on understanding vendors' motivations, beliefs, and values placed on food safety, especially as they differ by cultural context and country. Food purchase and consumption are driven by social and cultural elements, which can impact the food hygiene and handling practices of vendors. Diets also vary widely between countries, and by culture and religion. Food safety issues may also disproportionally affect women, due to their generally higher level of risk through exposure.

Food safety hazards and practices will thus not necessarily be the same across countries, cultures, or genders; nevertheless, there will likely be commonalities and trends in past studies that can inform future work. Research on vendor knowledge, attitudes, beliefs, and practices in LMICs, however, appears to be both vast and fragmented; to our knowledge,

there has not been a previous scoping review investigating this topic specifically for market-based food vendors across multiple LMICs.

The aim of this review is to build on the work done in Nigeria by GAIN (2020) (3) and examine existing research on vendors' knowledge, attitudes, and practices across LMICs, particularly those in Africa and Southeast Asia. This review will add to the existing literature on the subject, helping to fill useful gaps. As part of the EatSafe project, it will serve as a reference on current practices and inform elements of the research methodology and eventual intervention design.

2. 2. METHODOLOGY

The method used is a scoping review, which allows for the assessment of emerging evidence, as a first step in research development. Scoping reviews provide an overview of a broad topic, in response to a more general question or questions, and through a broad exploration of the related literature. The exploration of the knowledge, attitudes, and practices of small-scale food vendors in LMICs is a subject that lends itself to this type of investigation, given its breadth and the diversity of potential research that could be carried out on the subject.

2.1. Objectives of the Review

This scoping review examines past research on vendor perceptions of food safety in LMICs. Specific questions that the review aimed to answer include:

> *1. What are the food safety knowledge, attitudes, and practices (KAP) of small-scale food market vendors selling food ingredients to consumers for home preparation in LMICs?*
>
> *2. What is the gap/difference between knowledge on food safety and actual practice?*
>
> *3. Does the gap/difference between knowledge and attitude on food safety and actual practice vary with gender, type of product sold, and geography?*
>
> *4. What are the markers (i.e., criteria for assessing food safety, direct or indirect) used to assess food safety among food market vendors?*[2]
>
> *5. What challenges (related to knowledge, attitude, and practices) are encountered by these small-scale food market vendors while implementing food safety measures?*

[2] It was originally planned to also assess the markers used for food safety by the vendors themselves, but insufficient information was found to answer this question in depth.

6. How have key enabling environment actors (e.g., local government; market or consumer associations) interacted with food market vendors to foster food safety practices or create a culture of food safety?

2.2. Geographic Focus

The scoping review covered all LMICs, as per the World Bank Global Index LMIC List 2020 (4). This includes the following countries:

Low-Income countries: Afghanistan, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Liberia, Madagascar, Malawi, Mali, Mozambique, Nepal, Niger, North Korea, Rwanda, Sierra Leone, Somalia, South Sudan, Syria, Tajikistan, Tanzania, Togo, Uganda, and Yemen.

Lower-Middle Income countries: Algeria, Angola, Bangladesh, Benin, Bhutan, Bolivia, Cameroon, Cambodia Comoros, Congo, Côte d'Ivoire, Cabo Verde, Djibouti, El Salvador, Egypt Arab Rep, Eswatini, Gaza, Ghana Honduras, India, Kenya, Kiribati, Kyrgyz Republic, Lao PDR, Lesotho, Mauritania, Moldova, Mongolia, Morocco, Federated States of Micronesia, Myanmar, Nepal, Nicaragua, Pakistan, Papua New Guinea, Philippines, São Tomé and Principe, Senegal, Solomon Islands, Sri Lanka, Tanzania, Timor-Leste, Tunisia, Ukraine, Uzbekistan, Vanuatu Vietnam, West Bank, Zambia, and Zimbabwe.

Nigeria would be included in the list of 'lower-middle income countries.' However, this review explicitly excluded Nigeria, as the subject of vendor (and consumer) food safety perceptions in Nigeria was already covered in another EatSafe review (3), and it would be inefficient to duplicate that work.

2.3. Definitions and Protocol

There were several key definitions that guided the search for studies and the determination of their relevance for inclusion. *Vendor* was defined as a person selling food (in the form of raw ingredients, as opposed to ready-to-eat foods) directly to consumers in a wet market, open air market, shop/kiosk, or other informal setting, such as a farmstead; some studies referred to these people as "retailers" or "sellers," but here "vendor" is used as a blanket term. *Market* was defined as a wet market (i.e., a market where fresh meat/fish and/or produce is sold), open-air market, or similar informal setting for selling food. These markets sometimes had a permanent site and/or structure from which individual vendors could operate, and sometimes did not. This specific focus, which excluded outlets like street vendors of ready-to-eat foods and supermarkets, was chosen to align to the focus of the EatSafe project.

Food safety *knowledge* covered the respondents' factual understanding of different food safety aspects, such as personal hygiene, cross-contamination, causes and symptoms of foodborne diseases, and time/temperature control, etc. *Attitude* reflected positions, opinions, beliefs, and ways of being (e.g., agreement or disagreement with the importance of various food safety practices related to aspects like handwashing, cross contamination, food handling, storage). *Practices* referred to the observable (though perhaps self-reported) actions of vendors on aspects such as personal hygiene, handwashing practices, food handling and storage practices, and treatment of food waste.

A detailed scoping review protocol was developed before the review was initiated, and the review followed this protocol as planned. The protocol was not registered on any external registry since it did not aim to assess the effectiveness or efficacy of any particular intervention.

2.4. Eligibility Criteria

The scoping review used the inclusion and exclusion criteria outlined in Table 1, below.

Table 3. Inclusion and Exclusion Criteria for the Scoping Review

Inclusion criteria	Exclusion criteria
Publication Year: 2000 to 2020 **Publication Language**: English **Publication types**: Published in a journal or on the website of certain global institutions and organizations. publications covering all food groups (such as cereals, legumes, fruits, vegetables, fats and oils, milk, meat, poultry, eggs, fish, sugar) **Included target groups**: food market vendors selling food ingredients for home preparation in informal markets (e.g. wet markets, open-air markets); butchers (if they were in or near an open-air market); small-scale dairy farmers, as it is common in developing countries for these farmers to sell milk directly to consumers (however, these farmers were only included if there was evidence in the study that this occurred); mixed shops that sell some ready-to-eat together with ingredients.	**Excluded publication types**: Blogs, newspaper articles and magazines, thesis publications, book chapters **Excluded target groups**: Restaurants/hotels; vendors preparing and selling ready-to-eat foods (i.e., street foods) unless they also sold ingredients; people involved in food production, harvest, storage, and transport (before the food reaches the market); consumers; supermarkets. **Excluded topics**: studies on packaged goods; studies which only looked at microbiological elements, and did not

Included topics: vendor KAP; vendor views on the enabling environment (regulations and policies, i.e. what is working and what can work better).	include any data on knowledge, attitudes, or practices of vendors; studies from Nigeria, as they had been previously reviewed.

2.5. Search Strategy

A structured search was undertaken in July and August 2020 using the following databases: Pubmed, Ovid Medline, and Google Scholar, accessed through the library services of Ryerson University, Canada or London School of Tropical Medicine and Hygiene, United Kingdom. Websites of the FAO, International Food Policy Research Center (IFPRI), International Livestock Research Institute (ILRI), WHO, World Trade Organization (WTO), and World Bank (WB) were also searched for relevant literature. Publications from international food safety conferences were also evaluated if they came up in the search. References cited in the good-quality papers identified in the searches (with quality determined as detailed later in this section) were also reviewed to identify additional relevant papers. Finally, Google Scholar was used to identify any subsequent papers citing the shortlisted papers/reports.

A set of predetermined search items were used to identify studies of relevance for answering all the research questions. This approach was similar to approach used by GAIN (2020) (3) and included the following search terms:

> Pub Med Search string: ((Food Safety[MeSH Terms]) OR (Foodborn*, or Food-born*, or Microb*, or Fertiliz*, or Herbic*, or Rodentic*, or Antimicrob*, or Enterovir*, or Histamin*, or Erysipelothr*, or Flie*, or Fly*, or Rodent*, or Bird*, or Fomite*, or Spoil*, or Contamina*, or Hygien*, or Coli*, or Salmonella*, or Noro*, or Campylobact*, or Monocytogen*, or Enterobact*, or Burnet*, or Brucel*, or Shig*, or Aflatox*, or Mold*, or Adulter*, or Lister*, or Lyster*, or Acrylami*, or Hazard*, or Pestic*, or Worm* or Virus* or Bacteri* or Cleanli*or Protoz* or Faec*, or Fec*, or Parasit*, or Helminth*, or *Toxi*, or Cronobact*, or Taeni*, or Tremat*, or Echino*, or Fasciolo*, or Heterophy*, or Metagoni*, or Starch*, or Protein*, or Pathogen*, or Zoono*, Nocardio* or Metal*, or Lead*, or Arsen*, or Mercur*, or Cadmi*, or Bovin*)) AND (Consum*, or Produc*, or Sell*, or Vendor*, or Market, or Shop*, or Men*, or Female*, or Adolesc*, or Gender* or Market* or Knowl* or Awaren* or Attitud* or Belief* or Opion* or Pract* or Priori* or Expect*) AND (LMIC)))
>
> Ovid Medline Search: “food safety” “vendor” AND LMIC
>
> Google Scholar Search: “food safety” “vendor” AND LMIC

The initial search used the term ‘LMIC’ (in acronym form), as specified above. The term “developing country” was also used as a search term instead of LMIC in all databases. Finally,

all PubMed, Ovid Medline, and Google Scholar searches were repeated with "LMIC" being replaced with each country name listed in the "Geographic Focus" section, above (e.g., "food safety" "vendor" and "India"). The first 100 titles (sorted by relevance in Google Scholar and PubMed) were reviewed for each country search and for the overall "LMIC" and "developing country" searches.

The search approach used for institutional websites was adapted slightly to each website, both based on the organization's focus and on the functionality of its search engine. The search terms were as follows:

- FAO food safety site - search term: LMIC
- IFPRI - search terms: "food safety" LMIC
- WHO - search terms: "food safety" [MeSH] + LMIC
- World Bank - search terms: "food safety" LMIC
- ILRI - search terms: "food safety"

For institutional websites, the first 100 titles (sorted by relevance) were reviewed for the FAO, IFPRI, and WHO. No relevance-sorting option was possible on the World Bank and ILRI websites, so the first 100 titles were screened without sorting for relevance.

2.6. Selection Strategy

The following data sources and types of evidence were included in this scoping review: quantitative and/or qualitative observational research, interventions, and reports and expert opinions from reputed international organizations containing new empirical evidence. For all publications identified via the search, the title was reviewed for relevance. If it passed the title-screening stage, the abstract (or summary) was reviewed for relevance and compliance with the inclusion criteria. For publications that passed the abstract-screening stage, the full-text publication was reviewed and either accepted or rejected, based on the eligibility criteria.

2.7. Data Charting Process

For those studies meeting the inclusion criteria, relevant information was extracted into a review template (Appendix VIII), which included the data items defined below. Single data entry was used to populate this template. Due to time constraints, no contact was made with authors of the publications to obtain more information.

Data was sought for the following items:

- Publication information (lead author, title, source (i.e., journal, organization), year published)
- Geographic focus area (country, state, or city)

- Study methodology (including study design, sampling methods, aspects assessed, laboratory data if available, sample size, and qualitative and quantitative data collection methods)
- Results
    - Vendor profile (as reported)
    - Customer profile (if included)
    - Enabling actors and actions
- Conclusions and recommendations
- Assessment of study quality
- Full reference for the study and any relevant links (e.g., website, DOI)
- Any additional comments

"Study Quality" was assessed according to completeness of information for answering the study questions and was categorized as Good, Medium, or Poor, based on the following criteria:

- Good: Evaluated >50 vendors, used random sampling, provided detailed information on vendor demographics, and has at least one of knowledge, attitude, and/or practices.
- Medium: Evaluated >10 vendors, using purposive sampling. Paper provided some information on vendor demographics, knowledge, attitude, and/or practices.
- Poor: Evaluated <10 vendors, no information on sampling, or provides no information on vendor demographics but some information on vendor knowledge, attitude, and practices.

2.8 Limitations

This scoping review has a number of limitations. First, although the reviewers methodically searched for results country by country, only the first 100 references for each search were reviewed for relevance. This meant that results for certain countries with more extensive research, such as India, may not have been sufficiently scrutinized. Second, this review only focused on LMICs, which excluded research done in upper-middle-income countries such as South Africa, Malaysia, or Thailand, where vendors may have a lot in common with vendors from some of the LMICs. Third, only papers written in English were reviewed, which may account for the limited studies found in non-English speaking countries (e.g., in Latin America). It would be worthwhile to do searches in other languages, such as French and Spanish. Fourth, data included in book chapters and PhD and master's theses were considered out of scope but may have contained useful information. Indeed, several theses were identified from Indian universities, which could help fill the apparent evidence gap on this topic for this populous country. Fifth, there was limited review of the reference lists of shortlisted publications, which could have yielded additional relevant studies. Sixth, publications involving multiple countries, although few, were not included. Finally, due to the

focus of the EatSafe project and the need to narrow scope, the review focused only on sellers of commodities in markets; this omitted street vendors of ready-to-eat foods, on which considerable research has been done and who might face similar constraints to improving food safety.

3. STUDY CHARACTERISTICS

3.1 Selection of Sources of Evidence

As summarized in Figure 1, the various search strategies, applied for all the included LMICs, yielded a total of 333,357 hits. Of these, the first 100 titles (sorted by relevance) for each search were screened; if fewer than 100 were identified in the search, then all titles were screened. This resulted in 17,483 titles being screened. Of these 17,483 titles, a total of 981 papers were selected for abstract screening based on the relevance of the title. Of the 981 available abstracts, a total of 135 publications were identified for full-text screening. The main reasons studies were excluded at the abstract-screening stage were: no focus on vendors' knowledge, attitudes, or practices related to food safety; no focus on LMICs; only examining vendors prepring ready-to-eat street foods (which were out of scope) and not raw foods; or only examining food safety through a microbiological lens. Publications for which no full-text version was available were also excluded. Of the 135 full-text articles screened, 51 were excluded. Reasons for exclusion and numbers excluded for each reason are specified in Figure 1, below.

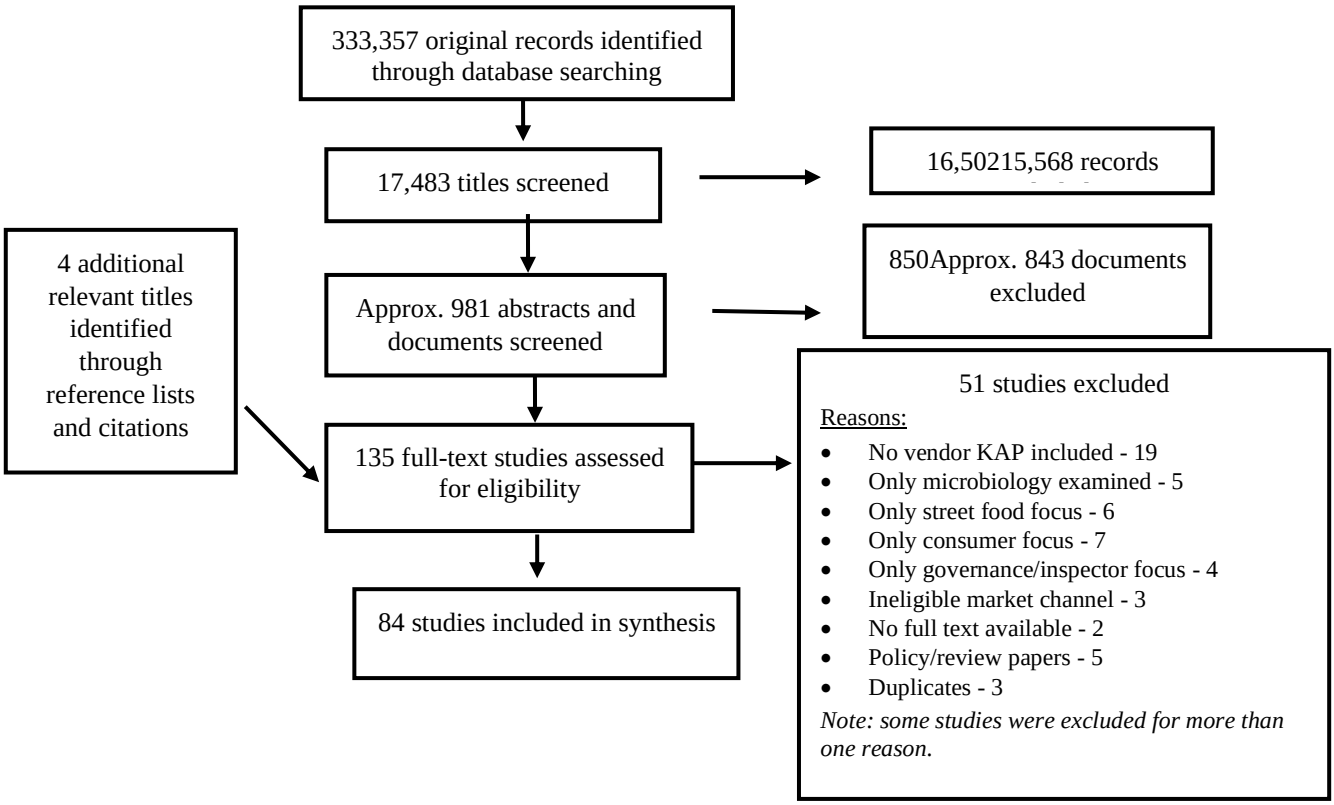

Figure 5. Summary of Search Process (Vendor Figure 1)

The review of reference lists of some of the 80 included studies uncovered an additional four relevant titles. This was not an exhaustive search and done for only some studies. The total number of studies included in the final review is thus 84. All 84 studies included are summarized in Appendix VIII.

The next sections summarize the main results of the review, providing summaries of the overall research trends as well as showcasing particularly interesting examples, illustrative of either main tendencies in the research or interesting exceptions to those tendencies.

3.2. Population and Locations Studied

Sample size

Five studies reported no information on sample size. Of the 79 studies that did, 23 studies had a sample size of less than 50 individuals (i.e., vendors, butchers, farmers); 13 studies had a sample size from 50-99, 16 studies a sample size of 100-199, four studies a sample size of 200-299, 12 studies a sample size from 300-499, and eight studies had a sample size of 500 or higher. Four studies evaluated food safety experts and/or policy makers, with an average sample size of ~20.

Types of respondents

The majority of the studies' respondents were solely vendors (49 studies), followed by producers who also sold to consumers (including dairy/poultry farmers, butchers, herdsmen, and livestock owners; 28 studies). Some studies also included the following as respondents (often in addition to vendors/producers): collectors, transporters, and traders (8 studies); public officers (policy makers, officers in charge of licensing, city council officers, livestock production officers, public health officers, veterinary officers, police officers, inspectors; 5 studies); consumers (4 studies); private-sector personnel (market chairpersons (1 study), retail management board (1 study), industry players (1 study)); and civil-society organizations, and academics (1 study). Five studies focused on markets themselves (e.g. live bird markets), as opposed to individual human subjects.

Respondents' Gender

Of 84 studies, 42 reported on the gender of the vendor(s). Of the 42 studies reporting gender, women represented the majority of respondents in most studies (26; 61.9%). Men represented the majority of vendors in 14 studies (30.9%), and two studies (4.8%) had a fairly equal split of male and female vendors. There did not appear to be regional differences in this trend between Africa and Asia.

Respondents' Age and Ethnicity

Only 30 of 84 studies reported the age of the vendors/individuals studied. In the majority of these studies (26 studies), the vendors were adults (i.e., between 18-60 years). The majority of the studies (69 of 84) did not provide any information on the ethnicity of the vendor. Of the 16 studies that did report the vendors' ethnicities, most (10 studies) found that the majority of the vendors were from ethnic castes and tribes; of those reporting on religion, four studies noted that the majority of the vendors were Muslim and two studies noted that the majority of the vendors were Hindu.

Respondents' Economic Status

Seventy-seven of 84 studies did not report any information on the economic status (e.g., average monthly income) of the vendor. Of the studies that did report on the economic status of the vendor, the typical average monthly income was around USD $100. It will be crucial to understand vendors' financial barriers to the adoption of improved food safety measures. Some useful examples of examining such topics include Kumar et al (2017) in Nepal (5), which sought to better understand how financial incentives to improve food safety practices motivated milk vendors, and Samaan et al (2012) in Indonesian market vendors (6).

Respondents' Education

Of the 34 studies that reported on education of the vendor, 17 studies found that the majority of the vendors were illiterate; in 11 studies, most vendors had attended and/or completed primary education and in six studies, most vendors had attended and/or completed secondary school.

Location and type of market

Sixty-three studies reported the vendors' area of operation (urban and/or rural). Of these, 31 studies (49.2%) were in urban areas and seven studies (11.1%) were in peri-urban areas; 17 studies (27.0%) were in both urban and rural areas, while eight studies (12.7%) were only in rural areas. Due to the inclusion criteria, it is unsurprising that the majority of the studies evaluated vendors operating in open-air/informal food markets (50 of 77 studies), but some studies also considered food safety at more fixed market sites, kiosks/small shops, and farms and butcheries where food was sold directly to consumers.

Value chain

The majority of the studies (73 of 84) looked at vendors in specific value chains (i.e., commodity categories). Most vendors assessed were operating in the dairy value chain (19 studies), followed by fruits and vegetables (17 studies), meat (16 studies), poultry (12 studies, including one study from Ethiopia that focused on eggs), and fish (5 studies). Few vendors assessed were operating in cereal or nuts value chains (2 studies each). The majority of titles and abstracts reviewed that related to studies of cereals and nuts were monitoring for aflatoxins or similar and did not include any demographic or KAP details on vendors; as such, they were not eligible for inclusion.

3.3. Design and Methods

Study quality

Using the "Study Quality" criteria defined above, 53 of the 84 studies (63.1%) were rated as medium quality, 18 (21.4%) were of good quality, and 13 (15.5%) were rated as poor-quality studies. A rating of "poor" does not necessarily mean that the paper poorly answered its own research questions, however, as the assessment of quality used here focused on the objectives of the present review, which were not necessarily the same as the focus of the individual papers. Some exceptions to the study quality criteria were made because of the very wide variety and types of studies identified, as not every study fell neatly into the predefined study quality categories. When determining this, a greater weight was given to random sampling, providing information on vendor demographics, and completeness of information on knowledge, attitudes, and/or practices.

Study Design

The majority (77 studies, 95.1%) used a cross-sectional design; among this group, multiple different methods were used: quantitative assessment of contamination via sampling (of the food, water, vendor, equipment, or environment) followed by laboratory analyses[3]; surveys with closed-ended questionnaires and/or an observation checklist; and qualitative approaches using interviews with open-ended questions, informal discussions, less structured observations, and/or focus group discussions.

[3] Such studies were included in the review only when accompanied by information on vendor KAP.

Sampling technique

Of the 84 studies included, 81 studies mentioned their sampling methodology, of which 35 studies used random sampling, 31 studies used purposive sampling, nine studies used convenience sampling, one study used snowball sampling, and five studies used a combination of various sampling techniques.

Study methodology

Of the 84 studies identified, 44 (52.4%) included laboratory assessments of either the food sold, the sale environment, or the vendor. The assessments were done for either bacteria, viruses, parasites, or chemical hazards such as aflatoxins. Seventy-six of the 84 studies included other quantitative assessments (i.e., surveys using closed-ended questionnaires and/or observation checklists). Fifty-three of the 84 studies included qualitative assessments (interviews using open-ended questions, observations, and/or focus group discussions).

Twenty-one of 84 studies used all three types of methods (i.e., laboratory assessments, other quantitative assessments, and qualitative assessments) to obtain a 360^0 view of food safety-related factors. For example, one interesting study from the Philippines (7) studied the vendors themselves as a hazard and included stool sampling to assess parasitic load. The study showed that vendors and slaughterhouse workers were actually prime agents for the fecal-oral transmission of intestinal parasitic infections to consumers, and overall prevalence of parasitic infection was high, at 90% of the study population.

Metrics and Measures

Standardized questionnaires and observation checklists that had been customized for the local context were used in majority of the studies. Surveys and interviews were typically done face to face, in markets using questionnaires and/or observation checklists, which were completed on paper in majority of the studies. Some studies combined questionnaires and/or observation checklists to provide a "food safety score." Khanal & Poudel (2017) (8), in a study of Nepalese butchers, prepared a semi-structured closed-ended questionnaire and observational checklist based on standard guidelines from Codex and FAO. Results were then coded and scored, and butchers were rated as having adequate, fair, or poor hygiene knowledge and practices based on the scores. Kumar et al (2017) in Nepal used an observational checklist to gather data to create a "food safety index," which then allowed the researchers to classify different farmers as low, medium, or high adopters of food safety measures (5). This further allowed the researchers to calculate the cost of adopting these measures for the farmer/vendor. Dang-Xuan et al (2019), examined risk factors associated with Salmonella in smallholder pig value chains in Vietnam using observational checklists to assess hygiene practices at both the farm and vendor level, allowing investigators to identify areas in which improvements could be made (9).

There were several examples of different ways in which technology can be used to facilitate food safety research in LMICs. For example, a study evaluating prevalence and risk factors in the chicken meat value chain of Nairobi, Kenya used an ***electronic questionnaire***, collected on tablets using Open Data Kit software. Separate farmer and vendor questionnaires were developed, covering the following themes: farm or vendor's environment and characteristics; management practices; biosecurity, health, or sanitary practices; and sourcing and selling of chickens/chicken products. Sites and samples were identified by scanning unique barcodes (10). ***Global positioning systems*** (GPS) were also used in some studies, for example, Kirino et al (2016) conducted a survey of informal milk vendors in Nairobi, Kenya and evaluated prevalence of aflatoxin in marketed milk (11). The geographical locations (GPS coordinates) of all the eligible retail outlets were recorded using GPS units. A distribution map was derived by marking the location of each visited vendor and used to visually analyze the spatial distribution of aflatoxin contamination. Survey location was also recorded using GPS units and linked to each questionnaire using a unique identification number. ***Advanced communication technology*** was also used in the study by Ahmed et al (2019) in informal settlements in Nairobi, Kenya (12). The study used participatory geographical information system tools, including food mapping using mobile apps and high-resolution community aerial views obtained via balloons to capture and contextualize local knowledge. The community mappers collected data on 660 vendors from 18 villages and situated that data on multi-layered geographic summaries of each settlement. The resulting data on hazardous areas in relation to food spaces and infrastructure provision allowed local communities to prioritize areas for regular cleanup activities and assisted with advocacy to improve the cleanliness of these places in cooperation with local authorities. The multiple visual representations of foodscapes thus helped to make local food vendors, and the risks they face, more visible (12).

Interventions. The review identified very few studies that reported on any type of intervention to improve food safety practices.[4] Samaan et al (2012) implemented a suite of measures to improve food safety in Indonesia. Interventions included training sessions, participatory consultations, and education sessions, as well as infrastructure changes accompanied by financial incentives. These interventions facilitated behavior change and the adoption of hygienic practices by market stakeholders (6). Alonso et al (2018) investigated a training program that had been launched a few years prior (2006-2008) to see if trained practices were upheld (13). The study reported on the Kenyan Training and Certification (TC) scheme, which was an approach to professionalizing the informal dairy sector as a way of supporting smallholder market access, safeguarding the supply of affordable nutritious food to the poor, and improving milk safety. It was designed as a mechanism to progressively upgrade the milk handling and hygiene practices of those operating in the informal dairy sector and help support their livelihoods and legitimization in the eyes of authorities. Traders who engaged in the TC scheme received training on milk quality and hygiene and business

[4] There were some interventions reported in theses, as well as some on street food vendors of ready-to-eat meals, both of which were out of the scope of this review.

skills, and in return received a certificate that facilitated access to a dairy license. Vendors valued the training not just for the food safety content but also for other elements of the program, such as business skills and learning traditional methods for value addition (e.g., making fermented milk, yoghurt, or cheese). It also reported that the timing and duration of the training were factors that greatly affected the ability of traders to attend. Traders suggested that the trainings should be modular, provided regularly, and at hours that do not conflict with business hours. Timing was also seen as the most important constraint on women's attendance, given that women face not only business-related time constraints but also household responsibilities (13) Across the studies uncovered in the review, certification programs were more common in meat value chains, but this did not seem to ensure better butchering or meat handling practices, as evidenced by Seesio et al (2009) in Lesotho (14).

4. SYNTHESIS OF EVIDENCE

4.1 Vendor Knowledge, Attitudes, and Practices

The 84 studies of vendor perspectives used a wide range of different indicators and metrics, making it quite difficult to quantitatively summarize results across all studies and infeasible to attempt a meta-analysis. As such, we describe main trends in results as well as particularly interesting insights or aberrant results.

4.1.1 Vendor knowledge

Knowledge of food safety was reported in 45 of 84 studies (53.5%). This was usually assessed through quantitative (close-ended questionnaires, 41 studies) or qualitative (face-to-face interviews with open-ended questions or focus group discussions, 28 studies) methods, or a combination of quantitative and qualitative approaches (24 studies). The results were analyzed in different ways, including merely summarizing the questionnaire responses and creating rankings or scores.

In the majority of the studies that reported knowledge (36 of 45, 80%), the average level of food safety knowledge of the vendors ranged from “no knowledge” to “low/poor/limited/some/little” (with the exact wording/threshold used varying by study). Only nine of 45 included studies (20%) reported vendors having “adequate” food safety knowledge. As an example, one study that evaluated the pork value chain in Vietnam used workshops to investigate the potential role of “nudging” on food safety behaviors and reported generally good food safety knowledge among vendors. However, it was not clear if the participants had been selected to participate because of higher food safety knowledge and/or if the vendors had previously had food safety training. Interestingly, many vendors in that study reported obtaining food safety information via Facebook, even though they viewed it as an unreliable source of information (15). A study from Indonesia trained poultry handlers

and sellers using WHO guidelines to reduce the spread of Avian flu; improvements to vendors' knowledge were reported after the intervention (6).

Where assessed, vendors' knowledge was generally not found to differ with age, gender, type of product sold, or geography (i.e., urban v. rural) meaning there was not one particular country or area that stood out as having vendors who were very knowledgeable or observing high food safety standards. Where studied, vendor knowledge was often found to differ by educational status, with poorly educated vendors generally having poorer food safety and hygiene knowledge. Some gender differences related to food safety trainings were also reported. One study in Kenya, for example, reported that almost half of men (42%) had received at least one food safety training, compared to a quarter of the women (26%) (13).

4.1.2. Vendor Attitudes

No information on vendors' attitudes towards food safety was reported in 66 of 84 publications. This is a significant research gap and is worth further investigation. Of the 18 studies that reported data on vendors' attitudes towards food safety, the majority (12 of 18 studies) reported a generally positive/good vendor attitude towards food safety (i.e., vendors expressed a willingness to receive more information on food safety or to comply with best practices). Only six studies reported a negative/poor vendor attitude towards food safety (e.g., vendors were not willing to receive information on food safety).

Attitude was assessed using direct and indirect approaches. For example, Tegegne & Phyo (2017) classified food safety attitudes as good or poor based on a set of questions, both factual and opinion-based questions (e.g., agreement with statements on whether regular training could improve meat safety and hygiene practices, or if safe meat handling to avoid contamination and diseases is part of meat handler job responsibilities) (16). Vendors had to answer questions with "agree", "disagree", or "don't know." The response was then coded as right or wrong, and a score was assigned accordingly. Food-handlers who answered 14 or more questions correctly were assessed as having "good" attitudes, whereas respondents who answered 13 or fewer questions correctly were assessed as having a "poor" attitude. Lindhal et al (2015) examined attitudes in a study focused on brucellosis among dairy farmers/vendors in Tajikistan (17). Attitudes were assessed based on willingness to receive more information on the disease and belief that family members were at risk. Of the 65 (of 279) respondents who had heard of brucellosis, only eleven believed some of their family members were at risk of contracting brucellosis, and every one of those considered the person in the household who was working most with the cows to be exposed to the highest risk. Musita et al (2019), in a study of potato vendors in Kenya, assessed vendor attitudes towards food safety by asking questions on food safety practices; poor vendor attitude towards food safety was reported based on the discrepancies between knowledge and

practices (e.g., even if vendors knew green potatoes were unsafe, they would sell them anyway) (18). As these examples indicate, "attitude" assessments are often hard to distinguish from assessments of "knowledge" or "practice."

Some studies also reported on linkages between food safety attitudes and cultural or consumer beliefs. Sanhoun et al (2020) (19) evaluated milk hygiene practices among both farmers and vendors in Cote d'Ivoire, and noted that for farmers from the Fulani ethnic group, there were common beliefs that "if milk was heated, cows' udders dry up and animals die" and that "raw milk brings more strength to milk farmers, vendors and consumers." Amenu et al (2019) found similar reluctance to pasteurize and/or boil milk among pastoral populations in Ethiopia because of the misconception that nutrients in the milk are destroyed when milk is boiled and "boiled milk is dead" (20). Majalija et al (2020) in Uganda reported that consumers preferred raw milk, as they believed that they had been drinking milk since they were children and it had not caused them any harm (21). There were also reports on deep-rooted traditions of eating raw meat and raw eggs in Ethiopia, for perceived medicinal values (22),(23). Similar beliefs were reported among consumers in Benin, where consumption of bush meat was seen to be healthy (24). These studies indicate that there are often strong cultural beliefs and traditions around certain foods, and that these cultural beliefs will have to be taken into consideration when implementing measures to support better food safety among vendors.

A study by Prinsen et al (2020) examined, through an emic approach, the food safety perspectives and viewpoints of butchers and cooked meat-sellers in Tanzania (25). It investigated meat sellers' meanings, sense of purpose, and their scope for undertaking actions to ensure food safety. This study examined the concept of agency—that is, recognition of people's own ability to resolve problems, to shape social events in particular ways, and to monitor and reflect upon their own and others' actions. The results reported some differences in attitude between urban and rural butchers. Both depended on veterinary inspections and inspection stamps to guarantee food safety, rather than their own hygiene practices (compared to restaurant owners, who relied more on their own practices). However, butchers in rural areas were more confident that future foodborne illness outbreaks would decrease than were butchers in urban centers, and generally were very positive towards food safety. The authors suggest this may be due to shorter supply chains for meat in rural areas (25).

Finally, a study by Alonso et al (2018) explored some of vendors' motivations for engagement in the dairy value chain, indicating how economic incentives and motivations can steer food safety-related decisions (13). Farmer/vendors reported that informal-sector (unpasteurized) dairy business was "profitable": there is a ready market and high demand, and it provides a daily income with higher margins than pasteurized milk. The informal nature of the sector also gave value chain actors more flexibility in their operations, allowing for more negotiation with producers compared to formal processors. Entering the dairy business was easy (having

cows makes selling milk an obvious business), demand was high, and producers could sell not only directly to consumers but also to traders who would then distribute milk to several shops. The study also reported that for women, the informal dairy sector allows them to start and grow a small, investment-free business. Women reported that a dairy business was more compatible with household and family demands, compared to other businesses (13). Thus, vendors saw many advantages to producing and selling unpasteurized dairy, despite potential food safety hazards.

4.1.3. Vendor Practices

76 of 84 studies (90.4%) reported vendor food safety practices. The assessment of practices was based on laboratory analysis combined with either self-reporting and/or observations (43 studies), self-reported and observed practices (17 studies), only self-reported practices (15 studies), or only observed practices (one study). The majority of the vendors evaluated were found to have inadequate and/or poor food safety practices. The practices considered were quite varied across the 76 studies but did share some common traits, such as poor vendor hygiene, unsafe food handling practices, unhygienic selling environments, and poor storage conditions. Examples of each are given in Box 1.

Overall, the studies illuminated many different examples of poor food safety practices among vendors. For example, vendors generally were found to be treating sick animals with veterinary drugs obtained over the counter without advice from veterinary officers (36). Animal husbandry was also poor, with vendors keeping a variety of different species in close proximity to each other (45), (47). This was especially common in poultry and bushmeat markets (36), (45). In many of the studies, mixing of different species of birds and other animals (in markets, or pens too close to other species) was commonly observed, increasing the risk of zoonotic diseases (45), (63). Similar practices were observed in some of the studied bush meat markets (30)[5],(64).

Vendors were also adulterating some foods by various means, such as smoking containers used for milk storage and transport (26), (65), adulterating milk with water (66), selling milk and meat from animals that had just been treated with antimicrobials (26), or using formalin and hydrogen peroxide in milk to minimize spoilage (48). There were also some examples of deliberate deception (e.g., mixing fresh or inspected meat with old or uninspected) (25). In a study of milk trading in Mali, it was found that due to unsafe handling practices among vendors, pasteurized milk actually ended up becoming re-contaminated with bacteria, so much so that it ended up with higher bacterial counts than the raw milk on sale (28). This study shows how poor handling practices can derail the food safety initiatives brought in to

[5] Much of the research in this area was aimed at discouraging the spread of Avian Influenza or Swine Fever, understanding the potential for zoonotic disease transmission in supply chains, or reducing the spread of antimicrobial resistance.

fix an issue. Use of contaminated water to wash or freshen produce was also found in a few studies (40), although sometimes the vendors did not have access to clean water (67).

Box 1: Examples of Practices Examined in the Studies

Poor vendor hygiene: untrimmed fingernails (26) (27); limited handwashing (usually assessed with reference to key moments recommended for handwashing, such as after toilet use, handling money, or slaughter) (28), (29), (30),(31); drying hands with dirty cloths after washing (9); no hand disinfectant used (29), (32); washing hands with unsafe water (33); limited use of existing sanitation facilities (34); no health certificates or invalid health certificates (35); handling food with bare hands (34); rare use of personal protective equipment (PPE, e.g., for handling meat) or infrequently washing PPE (36),(37); working while ill (38), (39); having dirty clothes (35), wearing jewelry on hands, ears, and other body parts(33),(35), (37).

Unsafe food or livestock handling practices: Fruits and vegetables not being washed frequently or washed and splashed with poor-quality water with minimum or no use of disinfectant (40), (41), (68); a common balance used weighing different kinds of fruits (42); unclean utensils and/or equipment used for food handling (35), (43), (44); using the same equipment for handling different types of meat (35); no sorting of foods (e.g., fresh versus stale, sick animal versus healthy animal) (45); no screening for diseases before sale (of meat) (46); inappropriate use of veterinary drugs (36); keeping different species in close proximity (45); (47); adulterating foods (26), (48); and deliberate deception (25).

Unhygienic selling/market environment: No/limited separation of foods/sick animals (e.g., different meats sold next to one another, wild animals traded with domestic animals (49) (50); no/limited market fencing (in a poultry market); limited market disinfection (51); selling uncovered food in markets, with no packaging (52); selling near garbage, toilets etc. (52); selling food exposed to flies and dust (34), (53) ; having food displayed on the floor (44), (68); selling food in unsafe packaging material (e.g. permeable, old newspaper, dirty bags) (36), (54), (55); using no dedicated vehicle for food transport (18) and poor tracing of supply (56).

Poor storage conditions: Unclean and/or inappropriate plastic containers used to store food at ambient temperature and/or wet conditions (19), (57), (58), (59), (60), (61); use of plastic sacks (42); storing food on the floor (55); no isolation pen or quarantine for sick animals (26), (36); housing lactating animals in enclosures full of manure (26).

Food waste management is crucial for food safety, but food waste management practices were only reported in 23.8% of studies (20 of 84), and often only in passing. Many studies reported poor waste disposal practices, such as irregular disposal of waste by market and/or other authorities and unsafe disposal of meat off-cuts and entrails (14), (40), (68). In one study, vendors complained that the authorities did not take waste away (50). Flies were also cited as being present in markets (34), (40), (69). Infrastructure needed for proper food waste management, such as sewage and water systems, was often lacking. Indeed, lack of refrigeration, or lack of electricity to run refrigeration, was also a major challenge that vendors in several of the studied informal markets faced (28), (63), (70), (71). Addressing this will be a barrier for successful implementation of future food safety interventions.

4.2. Demographic Differences and Gaps in Practices

Where assessed, vendors' practice was generally not found to differ with age, gender, type of product sold, or geography (i.e., urban v. rural). However, there were some exceptions. For example, a study assessing the predictors of risk factors for spread of avian influenza viruses by poultry handlers in live bird markets in Uganda (63) reported some variations among handlers. Handlers of different sexes had different rates for non-recommended practices like confining larger numbers (more than 20) of birds in a single cage and selling other livestock species alongside poultry (both of which were more common among women) or sharing poultry equipment (which was more common among men). The practice of selling other livestock species alongside poultry was found to vary substantially among respondents of the different age groups, with only 41.4% (167/403) of the adults compared to 61.9% (13/21) of the adolescents doing so.[6] Considering education, a significant association between the education level of vendors and the parasitic contamination rate of the produce they were selling (indicating their food safety practices) was reported in a study in Ethiopia (72).

The most in-depth exploration of gender issues as relates to food safety among vendors comes from Kenya (13). This study of Kenyan milk vendors reported that women faced some unique challenges in terms of ability to transport milk safely. Female study participants reported that women were less likely to own motorbikes or know how to ride a bicycle. Similarly, requirements for using metal cans for milk transportation posed specific challenges for women, as women considered the metal cans too big and heavy for them. Also, given that most household responsibilities fell disproportionately on women, they had less available time to travel to farms to source milk. These limitations on their mobility forced them to rely on middlemen or farmers to bring the milk to them. Men's higher mobility, in contrast, meant that they could source their milk directly from the farmer, getting a better deal and reaping higher profits. Women also reported that, compared to men, they were more likely to be cheated by the suppliers, such as by being given less milk than paid for or given milk of lower quality. Also, middlemen were reported to be more likely to accept the blame for such misconduct when in front of male buyers rather than female buyers (13). However, female participants were the only ones able to articulate the links between clean milk and health and the only ones reporting to find satisfaction in having met customers' needs by providing good-quality milk for mothers and children. This confirms the existence of potentially important gendered aspects to food safety, even if these did not emerge from most of the studies.

The studies show there is no clear gap between food safety knowledge and actual practices; knowledge was generally found to be poor, while practices were generally also found to be poor. A gap between food safety knowledge and actual practices within a given population, however, could be assessed in 40 of 84 studies. No significant differences between food safety knowledge and actual practice were reported in 38 of these 40 studies, again primarily

[6] No information was reported on whether any of these relationships were statistically significant.

because both knowledge was low and practices were poor, whereas two studies reported differences between food safety knowledge and actual practice. One of these studies was from Lesotho (14), where the majority of vendors/butchers were trained in meat hygiene by the staff of the National Directorate of Veterinary Public Health and were aware of meat inspections and why they were carried out. However, observations of informal slaughter indicated that personal hygiene, the hygiene of the environment during slaughter, and the dressing of carcasses were deficient. Except for four commercial butcheries linked to supermarkets, slaughterers did not wear protective clothing or wash their hands, as toilet facilities were inadequate and even where water-based sewage systems were available, no handwashing basins were seen. Another study from Uganda (21) reported that most of the milk vendors and operators of mobile milk vendor centers within the milk supply chain studied were aware of the dangers of transporting milk in non-food-grade containers, particularly those made of plastic. Further, 75% were aware of the regulations and requirements for proper transportation of milk using metallic cans. However, this regulation was generally ignored, and poor handling and transportation practices, including collecting milk in plastic cans, were reported.

No significant differences in the gap between knowledge, attitude, and actual practices were reported related to age, gender, type of product sold, or geography, largely because few studies assessed differences between knowledge, attitude, and actual practices as related to gender, age, value chains and geographies.

4.3. Markers used to assess, measure and/or describe food safety

Assessment of vendors' food safety practices was primarily done using indirect markers, as noted in Table 2. Some of these were common across all value chains, and some were specific to a particular value chain.

Table 4. Indirect Markers of Food Safety Used in the Study

Food Safety Metrics (all value chains)	Food Safety Metrics (specific value chains)		
	Meat, Fish, and Poultry	Milk	Cereals
Personal: • Personal hygiene (e.g., wearing clean clothes, taking a shower before work, hand washing) • Stopping their activities if suffering from diarrhea or typhoid fever	Personal: • Use of personal protective equipment Food: • Disinfection of markets • Fencing and gates for live bird markets • Checking quality of fish before buying (from other traders) by examining the general	Food: • Cleaning the udder of the cow • Straining milk with a cheesecloth • Using preservation methods like smoking, boiling or addition of formalin and hydrogen peroxide to minimize spoilage	Food: • Sorting • Drying • Sieving

Food: • Washing food products before display • Visual inspections (e.g., removing meat impacted by lead shot prior to sale) • Cleaning vending places and equipment during activities or at the end of the day • Using plastic storage containers • Separating various food types • Displaying produce at least 1 m above the ground using mats and not exposing the product to sunlight • Managing waste in separate rubbish bins Market Infrastructure: Permanent market structure, source of electricity, access to running water, concrete floor	appearance, color, odor, stomach fullness, and thickness of back muscles • Isolation pens for sick animals • Separate chopping boards (or tables) and knives for cutting of meat and organs • Isolated area used for the slaughter of live birds • Using ice to keep fish at a consistent temperature • Vaccination • Not allow a buyer to come within 1 meter of the products • Screening pigs for African Swine Fever before sale • Freezing slaughtered birds	• Refrigeration • Testing the quality of milk when receiving or sourcing it using lactometer	

4.4. Challenges Faced by Vendors & Enabling Environment Factors

The small-scale food market vendors covered in the studies found in this review encounter a number of challenges while implementing food safety measures. Forty-five of 84 studies reported specific challenges, as summarized in Table 3.

Table 5. Challenges Encountered by Food Vendors

Vendor level	Market level	Government level
• Inadequate food safety knowledge and training • Lack of clarity on the type of test needed to obtain a medical certificate • Low awareness of relevant policies and standards • Financial constraints (e.g., high cost and frequency of obtaining medical certificates, high cost of food safety trainings and certification programs, food safety equipment (e.g., aluminum cans, cold chain) being unaffordable for most small-scale vendors) • Gender discrimination (e.g., results of [Alonso et al 2018]) (19) • Weak vendor organizations and lack of an effective forum at which vendors could make their views heard	• No permanent access to clean and potable water • Other infrastructure challenges (e.g., lack of toilets, electricity, or cold storage; space constraints; no waste disposal facilities; no or non-permanent buildings; lack of investment in waste management; limited processing facilities; poor roads) • Unfair competition with untrained traders, and thereby reduced incentives for vendors to implement food safety practices • Harassment, corruption, and unfair decisions by government officers • Lack of awareness of food safety issues among consumers	• Stringent, complex, and unclear food safety standards, and multiple and costly licenses and procedures for obtaining them, which are not widely known • Regulations are fragmented or do not align with the reality of informal markets or gender roles (e.g., adherence to requirements for using metal cans for milk transport poses a specific challenge for women, as women consider metal cans too big and heavy for them to carry) • No specific standards in some areas (e.g., the addition of binders to feed; regulations for hygiene, zoning, or workflow for live bird markets), no licensing system for informal markets • Weak governance and enforcement of standards (e.g., lack of consistent food safety monitoring, only *ad hoc* engagement of food safety institutions (often in response to a problem), inadequate inspections, limited government oversight, or erratic application of existing laws and regulations) • Weak relationship or limited rapport between food safety authorities and food vendors due to minimal delivery of services (e.g., one vendor studied stated that “inspection officers take samples but do not give feedback”) • Government officials lack credibility as reliable sources of information in many countries • Lack of laboratories that can measure contaminants in food • Inadequacy of funds for infrastructure improvements and regulatory enforcement

Considering the enabling environment, 50 of the 84 studies (59.5%) referred to potential enabling environment factors that could influence food safety, either positive or negative. For example, certain enabling environment actors, such as local government staff, were noted as having interacted with food market vendors to foster optimal food safety practices and create a culture of food safety. Some national governments do have comprehensive food safety policies (e.g., the Kenya National Food Safety Policy 2013), aligned food safety standards for some value chains (e.g., milk safety standards for East Africa), or detailed and prescriptive precautionary measures laid out for some value chain actors (e.g., butchers) (25). While these are positive measures, and some studies noted there were improvements (73), more remains to be done to facilitate food safety in LMICs (74), (75). Government (national, regional, and municipal) and other duty-bearers (such as market management) were often negatively mentioned for not providing the tools to facilitate better food safety in the following ways:

- Not establishing a proper code of food safety practice (34)
- Not developing comprehensive food safety laws or laboratories (70)
- Limited attention to the improvement of hygienic practices or to providing basic infrastructure necessary for food safety (e.g., clean water, electricity) (12), (45), (76)
- Lack of an overarching coordination mechanism or agency to coordinate matters of food safety and food loss (75)
- Inadequate extension services and inadequate food safety training and awareness-raising for vendors on existing policies, standards, laws, and regulations (27), (77)
- Poor enforcement of existing standards and policies (13)
- Developing overly bureaucratic and confusing regulations (13), (48), (78)
- Not developing master plans for allocating specific areas within markets to specific value chain activities, such as poultry separation in live bird markets (47)
- Not regulating veterinary fees, which caused them to be expensive (2)
- Charging high fees for certification and licensing programs (2), (13)
- Not supporting vendors livelihoods (79)

Poor compliance with existing food safety policies and regulations was widely reported, either due to limited awareness of existing laws and regulations or limited ability to implement them. Some studies reported a general lack of trust of government officials (15), (80). Regulatory burden was also an issue. For example, in one study from Nepal (5), smallholder milk farmers complied with only 64% of regulations, on average, as after that point profitability started to be affected; in a business with small margins, this compliance load was found to be prohibitive. Alonso et al, (13), in a study of the dairy sector in Kenya, noted that regulations can also have a negative impact by creating unfair competition among vendors. The informal dairy sector includes different types of businesses, with different levels of legal

compliance. Licensed milk bars and corner-shops co-exist with unlicensed shops and street and mobile vendors, creating unfair competition. Licensed dairy businesses had higher running costs due to the need to adhere to regulatory standards (e.g., rent of adequate premises, cold chain services, utilities, licenses, and taxes) than did unlicensed traders. The study reported that unlicensed traders were more susceptible to harassment by authorities and might see their equipment and milk confiscated; they were also better able to escape the notice of inspection teams, as they operate outside of office hours or are mobile and can easily slip away when inspection teams appear in an area. On the other hand, licensed traders registered with authorities are subject to continued inspections and are at higher risk of facing consequences for noncompliance with requirements. Overall, regulatory activities seemed to have limited impact on the unlicensed traders. The study reported that traders generally did not oppose the existence and enforcement of regulations but wanted to see regulations applied fairly to all vendors (13). This highlights the importance of putting in place context-sensitive and equitable regulation and enforcement structures.

4.5 Summary of Findings

The studies included in this scoping review used a wide range of methodologies to assess vendors perceptions and practices related to food safety.

The studies that specifically investigated vendor KAP in relation to food safety were few (11 of 84) and predominately used a combination of qualitative methods, such as in-depth interviews and focus group discussions, as well as quantitative methods, such as surveys and observation checklist (9 studies). Generally speaking, this scoping review found that a combination of qualitative and quantitative methodologies was much more effective for collecting data on vendor perceptions than only one of the methodologies alone. An ideal approach might thus be a study that combined qualitative interviews with microbiological sampling and vendor observations by a third party, perhaps used before and after an intervention as an evaluation.

Considering results, in general, many studies covered in the review examined knowledge, and they generally found that food safety knowledge levels were low. Very few vendors reported having any formal food safety training, and very few food training intervention studies were reported. Vendors generally had low education levels, and many were illiterate, which makes designing education and training programs challenging.

Practices are also well characterized in the literature. Almost every study included in this review reported on food safety practices of vendors, either through observations or self-reports (e.g., questionnaire surveys). Generally, vendors' food safety practices were poor and show an overall lack of vendor food hygiene across all value chains (e.g., poor general cleanliness; limited washing of hands, utensils, and/or fruits and vegetables). Indeed, inadequate washing emerges as the most common and most potentially "fixable" practice to improve food hygiene among vendors in LMICs. This lack of general hygiene occurs for many

reasons, primarily lack of access to clean water at the market and lack of knowledge about disease transmission (38) (81). These underlying causes will thus need to be addressed in order to improve hygiene.

In contrast, few studies investigated beliefs, attitudes, or motivations in depth. In terms of motivations, one of the obvious motivators emerging from the review was income/livelihoods, which are likely particularly important for women, who have fewer options for employment other than food vending (as reflected in the high proportion of women vendors found in this review, 69%). However, little research examined this issue in depth.

Regarding the enabling environment for food safety, the results of the review suggest that governments need to be pragmatic when writing regulations to ensure they will actually be achievable in the field and not pose an undue regulatory burden. Copying regulations from other countries is often impractical, although there is no harm in looking to other countries for guidance(5), (32). Finally, in reviewing the 84 studies, not one mentioned sharing results with the participants, which is necessary for enabling them to act on the findings. Future research should aim to remedy this by disseminating results among the studied vendor population.

Many evidence gaps were evident from this review. First, there is a dearth of research on food market vendors' perceptions in some LMICs. Most studies identified in this review took place in Sub-Saharan Africa, particularly East Africa. Limited evidence on vendors' perceptions of food safety was available for Asian countries, with research being concentrated in only a few countries (Vietnam, Lao PDR, and Indonesia). Similar evidence gaps were found for LMICs in the Middle East (Syria, Yemen, West Bank and Gaza), South Pacific (Micronesia, Kiribati, Solomon Islands, Papua New Guinea, Timore Leste, Vananatu), and Central and South America (Bolivia, Nicaragua, El Salvador, Honduras). This does not imply that food safety issues are not important in these countries, or that food safety practices there are particularly better or worse; instead, the lack of research (outside of that on street food vendors) shows the topic to be an area ripe for future investigation.

There is a surprising lack of studies on this topic from India and Pakistan; the majority of studies from these countries identified through searches focused on street food vendors, which were not included in this review. Only one relevant paper was identified for India, which looked at milk farmers/ vendors and had a primarily economic focus, examining cost of compliance with food safety measures in Bihar state (38). Similarly, only one study was found from Tajikistan (also examining dairy) (23), with no studies found from Uzbekistan, Kyrgyzstan, or Afghanistan.

Food safety attitudes or food safety "cultures" within markets. is not well documented. For example, no information on vendors' attitudes towards food safety was provided in 66 of 84 publications (78.5%). Where information on attitudes was included, definitions of "attitudes"

and how they differed from “knowledge” or “practice” were often unclear. Most studies examined practices without probing to understand the “why” behind the observed practices. Investigating food safety attitudes of vendors is an area for future research, as “positive attitude” can be crucial for the success or failure of future food safety interventions (82). New research techniques using best practices from the fields of behavior change science would be novel and welcome contributions to the limited research in this area.

Similarly, few studies investigated cultural beliefs in depth; instead, content on beliefs typically emerged as an artifact of the investigation, and generally appeared in a side comment from a participant (19) (26). There are often, however, strong traditions around certain practices, such as eating high-risk foods like raw meat or eggs, or bush meat. These cultural beliefs may be a barrier (or motivator) to implementing food safety measures, and more research to better understand them is warranted.

A very large number of studies identified in the initial searches were not included in the review, as they only assessed the microbiological quality of food samples without evaluating the associated ‘human’ factors driving the results, such as vendor KAP. Some did however do a cursory look at practices, and those that did at least try and collect some data are included for reference in the Annex I such as (44), (83). This indicates a lost opportunity for more integrated research. While many studies suggested that more training on food safety is needed, research on the effectiveness of current training programs in LMIC market contexts is scarce. No randomized control trials or other rigorous studies were found evaluating improvements in KAP among LMIC market vendors receiving training, providing limited information on the most effective ways to reach this disparate group.

Moreover, only 11 out of the 84 studies (14.3%) reported on all three elements examined here: knowledge, attitudes, *and* practices. In most of these cases, attitude was interpreted via answers to questionnaires, rather than probing them deeply (6), (5), (7), (22), (18), (19), (26), (26), (35), (50), (84). Most of these studies focused on how knowledge linked to practices, with attitudes given only cursory treatment. As stated previously, more studies focusing on attitudes, an important element of behavior change, are needed, as knowledge alone rarely translates into improved practices. Understanding and leveraging motivations behind behavior change (one element of “attitude”) can lead to improved attitudes; for example, in some countries, vendor reputation works like a “brand” to drive increased business (e.g., in Vietnam (15)). No study was found, however, that explicitly looked at how vendors’ perceptions of customers’ motivations incentivize them to improve food safety, indicating another important research gap. Very few studies evaluated interactions between vendors and consumers.

This review also identified few studies that investigated the sources of food vendors’ food safety information. A few studies, such as Lindhal et al (2015) in Tajikistan (17), did report on vendors’ preferred methods to receive information, but this is likely to vary by country, market type, education level of the vendor, and other factors. For example, another study

(15), in Vietnam, reported that vendors received most of their information from Facebook but that vendors did not believe it was a credible source of information. Altogether, there is not enough research on food safety information sources to be able to advise on potentially effective ways to communicate food safety messages, marking another area for future research.

Limited research is available that examines interactions between vendors and government officials. In many studies, government agents were not seen as a credible source of information by vendors (15). In other cases, vendors perceived high costs of compliance with regulations, as was found in Kumar et al (2020) in India and Nepal (12), (5), indicating a need for reassessment of regulations with the perspective of small food businesses and vendors in mind. Government agents also reported that they often did not feel confident in their food safety knowledge (85). Training government agents alongside vendors may lead to common understanding of food safety knowledge and build a common understanding of hygiene requirements and policies.

Finally, research using a "gender lens" to examine food safety KAP is limited and needs more attention. Few studies reported on differences in food safety KAP between the sexes or the motivations or reasons for these differences. Challenges faced by the different genders in ensuring safe food is in an important area to research, to ensure that interventions are equitable.

5. CONCLUSIONS

This review of perceptions of food safety among market food vendors in LMICs identified few studies, despite screening over 17,000 titles, with research completely lacking for the majority of LMICs. Of those studies that were identified, only 11 reported on all of knowledge, attitudes, and practices of vendors, and even fewer reported on interventions to improve KAP. Informal markets of LMICs are incredibly important sources of food and livelihoods for lower-income, often vulnerable people, yet they appear to be subject to little regulatory oversight and are often strained by poor infrastructure, such as clean water and sanitation facilities, inconsistent electricity, and poor waste management as well as gender-related barriers. Food safety interventions that seek to improve the knowledge, attitude, and practices of vendors will need to address these barriers.

Based on the results of this scoping review, we can make certain recommendations for future research and programing (see box, next page). First, training of vendors must be culturally appropriate and should offer some skills that can help their business's profitability. It may be necessary to also train up-chain actors (e.g., farmers) in certain value chains (e.g., milk), as products may be contaminated before reaching the vendor and many farmers also act directly as vendors. Second, it is important to develop market infrastructure such as improved electricity, water and sanitation facilities, veterinary services, and cold storage. Similarly,

financing facilities should be created to help vendors buy equipment, such as coolers and milk pasteurization equipment, which vendors report to be prohibitively expensive.

From a research perspective, it will be important to address the evidence gaps described above, including differences in perspectives between genders and to better understand vendors' beliefs and attitudes. This would also include exploring how vendor reputation can be used as an incentive for behavior change and how market authorities can be engaged to better facilitate behavior change and bring about improved food safety practices.

Recommendations for the Design of Future Studies and Interventions within EatSafe

EatSafe aims to generate 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. Central to EatSafe's work is understanding (and potentially shaping) the motivations, attitudes, beliefs, and practices of consumers and food vendors. While EatSafe will undertake novel primary research on consumer and vendor motivations and practices, it is essential to ensure that this work is informed by and builds on what has already been done—both in terms of methods used and results obtained. Based on the results of this review, we recommend EatSafe consider the following in the design of its methods and interventions going forward:

- Based on research elsewhere, it can be expected that vendor knowledge on food safety in EatSafe target markets will be low. Interventions should thus aim to raise this if sufficient vendor knowledge is needed for intervention success.
- Literacy and education levels of food vendors tend to be limited and it is expected that vendor formal training and knowledge on food safety in EatSafe target markets will be low. EatSafe interventions will need to take this into account.
- Food safety and hygiene practices of food vendors in EatSafe countries can also be expected to be generally poor. This is likely at least partly due to infrastructure-related constraints, which will need to be addressed to improve food safety in a long-term, sustainable way.
- The topic of attitudes, beliefs, and motivations, and cultural determinants that shape of them, has been under-covered in prior research on food vendors and food safety in LMICs; this topic should be considered within EatSafe in developing interventions.
- Understanding where vendors source food safety information should be evaluated for each market in which EatSafe works. Preferred methods to receive information are likely to vary by country, market type, and education level of the vendor.
- Research that jointly examines consumer and vendor perceptions, and research that examines sources of information on food safety and trust in them, will also be particularly valuable in identifying relevant and culturally appropriate interventions and to fill gaps in existing knowledge.
- Gender issues related to food safety also remain under-studied and deserve attention within EatSafe.
- Qualitative methodologies have been found to generally be more effective for collecting useful data on vendor perceptions and should thus be included within EatSafe research.
- EatSafe should aim to disseminate its results among the studied vendor population in order to foster community engagement and provide information that vendors may be able to use to improve their food safety practices.

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APPENDICES

APPENDIX I: Consumer Study 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 S4 (Cont'd)	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 S2 (Cont'd)	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: Consumer Cross-Sectional Survey Studies Summary

Author(s), Title, Journal, Year	Theory	Summary	Study Design	Results	Location	Sample
Alimi, B. A., Oyeyinka, A. T., Olohungbebe, L. O.. Socio-economic characteristics and willingness of consumers to pay for the safety of fura de nunu in Ilorin, Nigeria. Quality Assurance and Safety of Crops & Foods. 2016	None	Primary data collected through structured questionnaires was used to assess safety perception and willingness to pay premium (WTP) for fura and nunu food products.	Cross-sectional survey	Safety and health were primary motivators for WTP, with income being the only significant demographic variable that influenced WTP in regression analysis. Safety perception, income and education were all found to be correlated with WTP	Nigeria	N=205 consumers
Allan, P. D., Palmer, C., Chan, F., Lyons, R., Nicholson, O., Rose, M., Hales, S., Baker, M. G. Food safety labelling of chicken to prevent	None	A cross-sectional survey of consumer knowledge of safe chicken preparation and expectations for content and design of raw chicken labels in	Cross-sectional survey	Overall, participants scored high on topics such as thoroughly cooking raw chicken (99%). Participants also felt it was "essential" for labels to contain information such as the correct handling of chicken (70%). When choosing between test labels, most chose a brightly colored label (71%), with the "current" label chosen the least often (<1%). Out of 45 current labels examined in the study, the average content score was 1.7 out	Wellington, New Zealand	N=401 adults

campylobacteriosis: Consumer expectations and current practices. *BMC Public Health.* 2018		New Zealand. Current labels on raw chicken products were also examined.		of 5, and the average display score was 1.8 out of 5.		
Al-Sheyab, N. A., Obaidat, M. M., Bani Salman, A. E., Lafi, S. Q. Toxoplasmosis-Related knowledge and preventive practices among undergraduate female students in Jordan. *Journal of Food Protection*. 2015.	None	A cross-sectional survey of female undergraduate university students in Jordon, which covered the topics of general knowledge, risk factors, symptoms and timing of infection, prevention knowledge, and preventative behaviors related to toxoplasmosis.	Cross-sectional survey	Very few participants knew about the cause of toxoplasmosis, its potential presence in cat feces, contaminated water and undercooked meats, or its association with miscarriage and/or sterility in women. Also, they indicated poor practices when handling and eating raw and undercooked meat and herbs.	Jordon	N=1,390 female undergraduate university students
Alsayeqh, A. F. Foodborne disease risk factors among women in Riyadh,	None	A cross-sectional survey of women from Riyadh, Saudi Arabia covering topics	Cross-sectional survey	Results indicated a risk for foodborne disease through improper food handling temperatures (45.28%), inadequate cooking (35.47%), cross-contamination (32.23%), and unsafe food sources (22.39%). Additionally,	Riyadh, Saudi Arabia	N=785 women

Saudi Arabia. *Food Control.* 2015. **Alsayeqh, A. F.** Foodborne disease risk factors among women in Riyadh, Saudi Arabia. *Food Control.* 2015. (Cont'd)		including food shopping, food storage, cleaning, cooking and consumption behavior, and knowledge of foodborne diseases.		those who claimed to have food safety knowledge were not supported by their reported behaviors.		
Aluh, D. O., Nworie, K. M., Aluh, F. O.. Food safety knowledge and self-reported practices among adolescents in rural secondary schools in Nigeria. *Int J Adolesc Med Health.* 2019.	None	A cross-sectional study using self-administered questionnaires that were given to secondary school students in Nigeria to review their knowledge and practice of food hygiene.	Cross-sectional survey	Both the mean percentage knowledge score (75.79%) and the mean practice score (82.48%) were high. There was also one noted demographical impact, with knowledge scores being lower in students whose mothers had low education.	Kogi State, Nigeria.	N=259 secondary school students
Alzoubi, H. M., Abu-Helalah, M. A., Al-Zu'bi, A. Y., Al-Ma'aitah, O. Z., Dalbah, T. A., Alshraideh, H. A., Aqel, A. A. Food	None	A cross-sectional study using a questionnaire given to university students in Jordan,	Cross-sectional survey	The mean times participants reported eating at a restaurant was around 3.69 times a week. The biggest thing they took into consideration when eating at a restaurant was hygiene (82.7%). Around half believed restaurant workers always/often wear gloves (51.5%), and half also reported experiencing at least	Jordan	N=1,161 university students

safety perception and practices among university students in Jordan. *Journal of Pure and Applied Microbiology.* 2015.		evaluating their eating behavior, food safety knowledge and food safety practice, focused on eating at restaurants.		one symptom of food poisoning after eating out (53.7%). Eighty-two and a half percent of those with symptoms were confirmed by a doctor that the symptom was due to food poisoning, but few reported it to authorities (4.1%).		
Asiegbu, C. V., Lebelo, S. L., Tabit, F. T. The food safety knowledge and microbial hazards awareness of consumers of ready-to-eat street-vended food. *Food Control.* 2016.	None	A cross-sectional survey of street vendor consumers, administered via face-to-face interviews, around safety knowledge based on microbial hazard awareness.	Cross-sectional survey	The majority of consumers were black males younger than 35, who were unmarried, literate, and in the lower income group. The highest reasons for buying from street vendors included affordability, availability and convenience. Sixty percent of participants indicated they were aware of the possibility of becoming sick and/or because of street-vendor food but were not deterred from buying and eating it in the future. Over 70% had not heard of the names of many of the most common forms of bacteria related to food borne illness.	Johannesburg municipality, South Africa	N=402 adults
Auad, L. I., Ginani, V. C., Leandro, E. S., Stedefeldt, E., Nunes, A. C. S., Nakano, E. Y., Zandonadi, R. P.. Brazilian food truck consumers'	Risk-benefit consumer decision making model	Cross-sectional study to discern Brazilian food truck consumers' profiles, choices, preferences and food safety perceptions	Cross-sectional survey	Consumers (30%) indicated that taste was the most important factor in choosing a food truck. Poor vehicle hygiene was the most commonly indicated factor for not selecting a food truck (30%). Factors that were deemed important when eating at a food struck were food hygiene (78%) and vendors' personal hygiene (80%). Importance in food safety hygiene differed significantly by age and	Brazil	N=133 food truck consumers

profile, choices, preferences, and food safety importance perception. *Nutrients.* 2019				presence of children. Younger participants and those without children had the highest food safety importance perception scores.		
Ayaz, W. O., Priyadarshini, A., Jaiswal, A. K. Food safety knowledge and practices among Saudi mothers. *Foods.* 2018.	None	A cross-sectional survey study of mothers in Saudi Arabia, assessing knowledge of food storage and handling, kitchen facility usage and maintenance, personal hygiene, and food poisoning.	Cross-sectional survey	Mothers generally had adequate knowledge of personal hygiene (passing rate 83.8%) and food poisoning (passing rate 78.5%) with moderate knowledge of food storage (passing rate 64.9%) and kitchen facility usage and maintenance (passing rate 66.5%). Participants had poor knowledge of food handling (passing rate 30.4%). Knowledge and practice improved with level of education.	Saudi Arabia	N=979 mothers
Baptista, R. C., Rodrigues, H., Sant'Ana, A. S.. Consumption, knowledge, and food safety practices of Brazilian seafood consumers. *Food Res Int*. 2020	None	Online cross-sectional study assessing consumers' frequency of seafood consumption, safety practices associated with seafood handling, and perception of	Cross-sectional survey	The survey revealed a relatively high level of knowledge and practices around hygiene related to seafood preparation, but a lack of safe practices related to cooking time and storage temperature. Respondents showed a low level of knowledge about risks related to seafood consumption. Those between the ages of 23-59, those with high income, higher education levels, and families with no children were more likely to have meals in restaurants compared with other groups. Higher income individuals are more likely to consume	Brazil	N=962 seafood consumers

		risks associated with seafood.		seafood regularly. Males presented a higher risk than females in regard to food safety practices and knowledge. Individuals 23-59 were less likely to believe that they would get sick from consumption of raw seafood compared to older generations.		
Bou-Mitri, C., Abdessater, M., Zgheib, H., Akiki, Z.. Food packaging design and consumer perception of the product quality, safety, healthiness and reference. *Nutrition & Food Science.* 2020.	None	A cross-sectional, interviewer-administered survey study of consumers at a grocery store in Lebanon, covering the impact of the packaging design on consumers' perception of the food quality, safety, healthiness and their preference to buy.	Cross-sectional survey	Participants indicated that packaging should "protect the food" (54.9%) and be safe (52%). At point-of-purchase, consideration of expiration date (46.1%) was higher than that of price (21.6%). The packaging chosen as the most important, healthiest, and most frequently bought was vacuum packed followed by tinned for cheeses, and glass bottles for juice. Those who valued safety as the most important part of packaging preferred transparent packaging. Most felt nutrition and health claims on packaging were some of the most important informative cues (87%) and were willing to pay more for better packaging (73.1%).	Lebanon	N=547 adults
Bouranta, N., Psomas, E., Vouzas, F. The effect of service recovery on customer loyalty:	Developed original conceptual framework	Interview administered cross-sectional survey assessing the impact of consumers'	Cross-sectional survey	Consumers' perceived food safety partially mediates the effect of a company's service recovery and customer loyalty. There was a significant positive relationship between a company's service recovery and consumers' perceived food safety. Service recovery had a	Greece	N=836 adults

The role of perceived food safety. *International Journal of Quality and Service Sciences.* 2019.		perceived food safety and a company's service recovery and customer loyalty.		direct and positive effect on consumer loyalty. The relationship between customers' perceived food safety and customer loyalty was more pronounced among individuals who are married and who have children.		
Chamhuri, N., Batt, P. J. Consumer perceptions of food quality in Malaysia. *British Food Journal.* 2015.	None	A cross-sectional survey study of consumers at a shopping mall in Malaysia. Focused on quality cues used by consumers when purchasing fresh meat, fruits, and vegetables.	Cross-sectional survey	The cue most associated with quality was freshness. Others included price, cleanliness, and Halal. Analysis identified food safety as the most important construct in consumers' evaluation of quality for meat, fruits and vegetables.	Klang Valley region, Malaysia.	N=544 adults
Cheng, Y., Zhang, Y., Ma, J., Zhan, S.. Food safety knowledge, attitude and self-reported practice of secondary school students in Beijing, China: A cross-sectional	None	Cross-sectional survey of secondary school students in Beijing assessing knowledge, attitudes and practices related to food safety.	Cross-sectional survey	Overall knowledge was high (42% of all respondents had 'high' knowledge). Knowledge of food safety was significantly associated with demographic characteristics including region, school type and residence type, as well as alcohol and tobacco use. Attitudes related to food safety varied with 17% regarding Chinas' food safety as 'good' and 53.6% regarding it as 'worrying'. Ninety-five percent worried about food safety of food from small restaurants and street food	Beijing, China	N=4,220 Students

study. *PLoS ONE.* 2017				peddlers despite 69.4% saying the 'often' or occasionally purchased food from these sources.		
Courtney, S. M., Majowicz, S. E., Dubin, J. A. Food safety knowledge of undergraduate students at a Canadian university: Results of an online survey. *BMC Public Health.* 2016.	None	A cross-sectional study of undergraduate students in Ontario, Canada. A survey was used to assess food-related factors such as cooking frequency, prior education or experience with food handling/preparation, and knowledge of food handling/preparation.	Cross-sectional survey	Average knowledge score was 56%. Some knowledge results were increased in students who reported currently handling food while working or volunteering. Around 70% of students knew the correct way to wash hands, with the majority of wrong answers choosing hand sanitizer. Hand washing knowledge was lower in students who worked/volunteered in hospitals. Results were generally higher in students in the Faculty of Science, who were older, and who cooked more frequently.	Ontario, Canada	N=485 undergraduate students
Dagne, H., Raju, R. P., Andualem, Z., Hagos, T., Addis, K. Food safety practice and its associated factors among	None	A community-based, cross-sectional study of mothers who are food-handlers in	Cross-sectional survey	Good food safety practices were found in 49.6% of participants. Food safety practice was associated with education, food safety knowledge and attitudes towards food safety	Debarq Town, Ethiopia	N=423 mothers

mothers in debarq town, Northwest Ethiopia: Community-based cross-sectional study. *BioMed Research International.* 2019. 2019		Debarq Town, Ethiopia				
Dang, A. K., Tran, B. X., Nguyen, C. T., Le, H. T., Do, H. T., Nguyen, H. D., Nguyen, L. H., Nguyen, T. H., Mai, H. T., Tran, T. D., Ngo, C., Vu, T. T. M., Latkin, C. A., Zhang, M. W. B., Ho, R. C. M.. Consumer preference and attitude regarding online food products in Hanoi, Vietnam. *International Journal of*	None	A cross-sectional, interviewer-administered survey study assessing consumer behavior, concerns and preferences regarding online food products	Cross-sectional, survey	A majority (81.3%) reported using the internet to search for food products. Participants identified convenience (69.1%) and price (59.3%) as factors influencing internet use. Only 37.7% believed information on food safety provided online. Most consumers were concerned about food labels containing expiration dates (51%) and brand (22.2%). Participants who were female, highly influenced by online relationships, and had difficulty doing activities of daily living were most likely to look for food products online.	Hanoi, Vietnam	N=1,736 consumers

Environmental Research and Public Health. 2018.						
de Andrade, M. L., Rodrigues, R. R., Antongiovanni, N., da Cunha, D. T.. Knowledge and risk perceptions of foodborne disease by consumers and food handlers at restaurants with different food safety profiles. *Food Res Int*. 2019	None	A cross-sectional study using a validated checklist and structured questionnaire to evaluate the knowledge, risk perception and optimistic bias of food handlers and consumers in restaurants.	Cross-sectional survey	Consumers demonstrated optimism bias in their comparison of their perception of food borne disease (FBD) risk attributed to themselves and to peers. A direct effect of this optimism bias on FBD risk was observed in in multivariate analysis, suggesting that bias may lead to greater risk of FBD.	Brazil	N=64 food handlers N=265 consumers
Demircan, V., Celik Ates, H., Sarica, D., Cavdar, N. Determination of consumers' consciousness level on food safety: Case of Isparta,	None	An interviewer-administered survey of families in Isparta, Turkey assessing consumers' awareness of food safety.	Cross-sectional, survey	A majority of participants had heard of the concept of food safety (57.8%) though a greater majority (86.2%) were unaware of quality control and food security systems. The factor rated most important by consumers when purchasing food was "hygiene at the place where the purchased products are produced".	Isparta, Turkey	N=384 consumers

Turkey. *Scientific Papers-Series Management Economic Engineering in Agriculture and Rural Development.* 2018						
Dickie, R., Rasmussen, S., Cain, R., Williams, L., MacKay, W. The effects of perceived social norms on handwashing behaviour in students. *Psychol Health Med.* 2018.	Social Norms Theory	A cross-sectional survey study of university students in Scotland, assessing handwashing frequency and perceptions of peer handwashing	Cross-sectional survey	Handwashing was higher in female students. Most students believed they washed their hands more than their peers, and perception of peer handwashing was associated with participant behavior.	Scotland	N=255 university students
Esfarjani, F., Hosseini, H., Khaksar, R., Roustaee, R., Alikhanian, H., Khalafi, M., Khaneghah, A. M., Mohammadi-Nasrabadi, F..	None	A cross-sectional study of women's household food safety practices and food insecurity in Tehran, Iran using a tri-	Cross-sectional survey	A majority (56%) of households reported food security. Mild (29%) moderate (12%) and severe (3%) food insecurity was found in the remainder of households. Pertaining to food safety practices: 37% of households had desirable food safety practices, 33% had acceptable and 29.5% had weak according to the Home Food Safety Practice Questionnaire (HFSQ). In structural equation modeling, food	Tehran, Iran	N=630 women

Home Food Safety Practice and Household Food Insecurity: A Structural Equation Modeling Approach. *Iranian Journal of Public Health.* 2019		sectional questionnaire administered face-to-face with trained interviewers		insecurity was strongly and inversely associated with food safety practices.		
Evans, E. W., Redmond, E. C.. Older Adult Consumer Knowledge, Attitudes, and Self-Reported Storage Practices of Ready-to-Eat Food Products and Risks Associated with Listeriosis. *J Food Prot.* 2016	None	A cross-sectional study using a self-completed, computer-assisted personal interview (CAPI)of older adult consumers' knowledge, attitudes and self-reported practices regarding ready-to-eat (RTE) food products in the UK	Cross-sectional survey	A majority (79%) reported positive attitudes towards refrigeration, though 84% were unaware of the 5°C recommended temperature and 65% self-reported never checking temperature. Seventy-five percent reported using use-by dates to indicate safety and 62% reported always checking dates. Sixty-seven percent reported beliefs that is was safe to consume food past use-by dates. Eighty-four percent reported consuming RTE foods past the recommended 2 days post opening.	Cardiff, Wales	N=100 older adults
Evans, E. W., Redmond, E. C. Food Safety Knowledge and	None	A cross-sectional study of patients receiving chemotherapy	Cross-sectional survey	Participants reported awareness of food safety practices, but the reported behaviors indicated unsafe practices around	United Kingdom	N=121 patients receiving chemotherapy

Self-Reported Food-Handling Practices in Cancer Treatment. *Oncol Nurs Forum.* 2018.		and their caregivers in the United Kingdom. Used a self-administered questionnaire to assess food safety knowledge and self-reported food handling behaviors.		temperature control, handwashing, safe cooking, and adherence to use-by dates.		N=51 family caregivers of patients receiving chemotherapy
Evans, E. W., Redmond, E. C. Older adult consumers' attitudes and perceptions of risk, control, and responsibility for food safety in the domestic kitchen. *J Food Prot.* 2019.	None	Online cross-sectional study of adults in south Wales to determine perceived risk, control, and responsibility associated with food safety	Cross-sectional survey	Participants perceived themselves as having lower food safety risks than other people, and as having greater levels of personal control and responsibility. Low levels of risk were correlated with high levels of control. Those over eighty years old perceived higher levels of risk and lower levels of control and responsibility. Overall, older adult consumers expressed perceptions of invulnerability, optimistic bias, and the illusion of control regarding food safety.	South Wales, United Kingdom	N=100 adults over 60
Fagnani, R., Eleodoro, J. I., Zanon, E. O.. Milk-borne infections awareness and the health status	None	A cross-sectional online study utilizing an online survey of milk consumers in Brazil assessing their	Cross-sectional survey	The majority (98%) reported purchasing dairy products from supermarkets. Roughly half of respondents were aware or illegal milk and dairy products, and 54% of those reported consuming them (81% fresh cheese, 32% ripened cheese, 24% fluid milk.) The majority (90%) were aware of the risks associated with	Brazil	N=468 dairy consuming internet users

of consumers: An on-line survey. *International Dairy Journal.* 2019.		health status and awareness of milk-borne infections		consuming illegal milk or dairy. Of those who were aware that zoonotic diseases can be spread by milk, 44.9% were able to correctly identify a pathogen carried in milk. In regression analysis, knowledge of milk-borne disease was inversely associated with experiences of abdominal pain.		
Freivogel, C., Visschers, V. H. M.. Understanding the underlying psychosocial determinants of safe food handling among consumers to mitigate the transmission risk of antimicrobial-resistant bacteria. *Inter J Environ Res Public Health.* 2020	Health Action Process Approach (HAPA), Theory of Planned Behavior (TPB)	An online cross-sectional examination of psychosocial factors related to consumers' safe food handling behaviors utilizing a self-reporting questionnaire.	Cross-sectional survey	In hierarchical regression analysis, positive outcome expectancy and self-efficacy significantly predicted safe food handling behaviors. The intention to adopt safe food handling behaviors was most significantly associated with risk perception, positive outcome expectancy, and most significantly, self-efficacy. In mediation analysis, coping, planning, and action control partially mediated the intention-behavior relationship regarding safe food handling. Negative experiences with antimicrobial resistance demonstrated a small but significant effect on adopting safe food handling behaviors, while negative experiences with food poisoning did not.	Switzerland	N=665 food preparers
Godínez-Oviedo, A., Sampedro Parra, F., Machuca Vergara, J. J., Gutiérrez González, P.,	None	A cross-sectional online survey study of adults living in the central region of Mexico. Assessed food	Cross-sectional survey	The food groups of fruits and vegetables were the most consumed and were the most related to perception of Salmonella exposure. Refrigeration was the most common method of food storage (42.2% to 90.8%). Most consumers reported always washing their hands before preparing food (86.4%), but	Central region of Mexico	N=1,199 adults

Hernández Iturriaga, M. Food Consumer Behavior and Salmonella Exposure Self-Perception in the Central Region of Mexico. *J Food Sci.* 2019.		consumptions habits of the five food groups, food handling practices, and self-perception of Salmonella exposure.		some reported using the same cutting board (16.9%) and knife (13.0%) on more than one product without cleaning. Those with the highest risk from food handling practices were men, people aged 20 to 24, and people aged 60 to 64. Perception of exposure to Salmonella was associated with education level and current gastrointestinal disease.		
Green, E. J., Knechtges, P. L. Food safety knowledge and practices of young adults. *J Environ Health.* 2015.	None	A cross-sectional study of undergraduate college students in the United States, using an online survey. Assessed food safety knowledge and perception of risk for foodborne illness, as part of a required health course.	Cross-sectional survey	Participant's food was most often prepared at on-campus dining facilities. Most (72%) felt they were "unlikely" or "very unlikely" to be at risk for foodborne disease. The mean food safety knowledge score was 43%.	United States	N=786 undergraduate college students
Gupta, V., Khanna, K., Gupta, R. K.. A study on the	Theory of Planned Behavior (TPB)	A cross-sectional study using a location intercept	Cross-sectional survey	Risk and benefit perception of consumers are interrelated and responsible for their changes in attitudes towards the street foods. In exploratory factor analysis, a six-factor	Delhi, India	N=586 consumers

street food dimensions and its effects on consumer attitude and behavioural intentions. *Tourism Review*. 2018		approach of the risk and benefit perceptions of street food consumers.		solution with four risk factors and two benefit factors was found that explained 70.05% of the total variance. In structural equation modeling, perceived risks and benefits explained 35.1% of the variance in attitude; perceived risks, benefits and attitudes explained 49.4% of the variance in behavioral intention.		
Han, G., Liu, Y. Does information pattern affect risk perception of food safety? A national survey in China. *Int J Environ Res Public Health.* 2018**.**	None	A cross-sectional study using a face-to-face survey of adults in China, assessing the relationship between perceptions of food safety, primary information sources, and demographics.	Cross-sectional survey	Information sources had a high impact on risk perception. A higher perception of risk was associated with younger people, those in urban areas, those without cohabitation experience, and those who use social media. Older residence and those who rely on face-to-face communication had the lowest perception of risk.	China (National survey)	N=4,068 adults
Hanson, J. A., Hughes, S. M., Liu, P. Use of Health Belief Model variables to examine self-reported food handling	None	A cross-sectional study of adults at a tailgate event, using a face-to-face questionnaire assessing the relationship	Cross-sectional survey	Perceived severity of illness was associated with safer sanitation behaviors and weakly associated with exposure to safe food handling media cues, but was not associated with safe food handling educational cues. Around half of participants reported never or seldom seeing information about foodborne illness or ways to handle food in newspapers,	Southern United States	N=128 adults

behaviors in a sample of U.S. adults attending a tailgate event. *J Food Prot.* 2015.		between Health Belief Model variables and self-reported food handling behaviors, perceived threat of foodborne illness, and food handling cues to action.		magazines or store displays, and also never or seldom read the "safe handling instructions" on raw meat packages.		
Hartmann, C., Hubner, P., Siegrist, M. A risk perception gap? Comparing expert, producer and consumer prioritization of food hazard controls. 2018.	None	Cross-sectional mailed survey, assessing individuals' perception of risk associated with a wide variety of items, mostly related to food.	Cross sectional survey	Experts differed from consumers and producers in assigning a higher priority to listeria in foods and hygiene control in restaurants. Producers and consumers assigned higher risk to products used to treat plants, such as pesticides and herbicides, as well as GMO traces in food and animal feed. Application of nano-silica in food was ranked higher by producers and consumers than by experts. Consumers' and producers' rankings were highly correlated with one another, while the rankings of experts were significantly different from consumers and producers.	Switzerland	N=422 (41 experts, 138 producers, 243 consumers)
Henke, K. A., Alter, T., Doherr, M. G., Merle, R. Comparison of consumer	None	A cross-sectional study with online panel of consumer knowledge of	Cross-sectional survey	Sixty-eight percent of respondents had heard of *Campylobacter,* 20.2% had heard but did not know how to prevent it, while 11.5% knew how to prevent it. Of those who had heard of *Campylobacter*, 52.5% knew it was	Germany	N=1,008 consumers

knowledge about Campylobacter, Salmonella and Toxoplasma and their transmissibility via meat: results of a consumer study in Germany. *BMC Public Health.* 2020		*Campylobacter, Salmonella* and *Toxoplasma,* through use of an online panel of consumers.		transmissible through meat. Knowledge and age were positively associated. Consumer knowledge on *Salmonella* and *Toxoplasma* were superior to that of *Campylobacter* with the consumer being most informed about *Salmonella.*		
Henley, S. C., Stein, S. E., Quinlan, J. Characterization of raw egg and poultry handling practices among minority consumers Identification of unique practices. *British Food Journal.* 2015.	None	A cross sectional phone study of poultry-handling practices, and other handling and purchasing practices, of minority consumers utilizing a culturally themed survey developed from focus groups.	Cross-sectional survey	African Americans were more likely to perceive raw pork as a risk for bacteria caused illness (88.2%) compared to Caucasians (76.9%) Asians (74.5%). Hispanics (45.1%) had a significantly higher risk perception for tofu. Asian consumers were less likely to perceive risk for raw chicken (59%). African Americans reported preparing pork at lower rates than Asians and Caucasians. Asian and Hispanic respondents reported lower rates of ownership of meat thermometers relative to African Americans and Caucasians. Caucasians were less likely than respondents of other races/ethnicities to purchase live poultry. This trend was also observed for purchasing eggs at room temperature.	Philadelphia, PA	N=428 consumers

Hull-Jackson, C., Adesiyun, A. A. Visitor Perceptions of Food Safety and Sociodemographic Determinants in Barbados, West Indies. *J Food Prot.* 2018	Theory of planned behavior, information integration theory, protection motivation theory	A descriptive, cross-sectional survey study of tourists and their perceptions of food safety in Barbados administered at two ports: Grantly Adams International Airport (GAIA), and Bridgetown Cruise Terminal (BCT).	Cross-sectional survey	Both sets of respondents at the GAIA and BCT had positive food safety perceptions (75.8% and 99.4% respectively), and a low frequency of foodborne illness (6% and 0.6%). Differences between the two samples emerged: Among the GAIA sample, 82.3% were influenced by vendor hygiene practices while 66.5% surveyed at BCT were not. Ethnicity was significantly associated with perceptions in both groups. Age was also a significant predictor of risk perception in among GAIA participants with older age predicting greater risk perception. Among BCT participants, education was the only significant predictor of concerns about hazards with greater education predicting greater concern.	Barbados	N=398 tourists (240/158, GAIA, BCT).
Iqbal, M., Choiriyah, N. A., Setyorini, I. Y.. Evaluating nutrition students' knowledge of food safety in Indonesia: Multi-strata comparison review. *Annals of Nutrition and*	None	A cross-sectional study using a random clustering sample assessing Indonesian nutrition students' knowledge of food safety by education strata (associate degree,	Cross-sectional survey	Though not significant, bachelor's degree students demonstrated higher knowledge than associate degree students. Out of 10 items, the only two items answered correctly by a majority of all students were the safe cooking temperature, and safe food storage temperature.	Indonesia	N=482 nutrition students

Metabolism. 2019		bachelor's degree, and a second bachelor's degree group)				
Ishwar, S., Dudeja, P., Shankar, P., Swain, S., Mukherji, S.. 'Jago Grahak Jago': A cross-sectional study to assess awareness about food adulteration in an urban slum. *Med J Armed Forces India.* 2018	None	A cross-section study utilizing a community-based sample of residents of an urban slum.	Cross-sectional survey	The majority (96%) were aware that milk can be adulterated. Awareness of adulteration of other foods ranged from roughly 20-50%. The most common indicator used to assess quality when purchasing groceries was checking the seal, followed by the expiration date. None of the respondents reported checking either the Food Safety Standards Authority of India (FSSAI) logo or Agmark logo. 43% had reported purchasing adulterated food at least once in the past six months.	India	N=100 consumers
Issa, M., McHenry, M., Issa, A. A., Blackwood, R. A. Access to safe water and personal hygiene practices in the Kulandia refugee camp (Jerusalem).	None	A cross-sectional study of adults living in the Kulandia refugee camp in Jerusalem. Used an anonymous survey to assess safe water and personal hygiene practices.	Cross-sectional survey	Lower rates of diarrheal illness were associated with having water piped into the home (62%), proper hand washing and adequate soap availability (58%), consideration of vendor cleanliness (51.3%), having access to healthcare professionals (15.6%), and higher income, higher level of general education and higher level of health hygiene education.	Jerusalem	N=96 adults

Infect Dis Rep. 2015.						
Kang, H. J., Lee, M. W., Hwang, I. K., Kim, J. W.. Development of Safe Food Handling Guidelines for Korean Consumers. *J Food Prot.* 2015.	None	A cross-sectional study of the safe food handling practices of Korean parents of school-aged children and an evaluation of food handling guideline leaflet	Cross-sectional survey	Respondents reported a desirable shopping order that prioritized selecting perishable items such as milk, meat, and fish last. Regarding safe food handling practices, only 48% reported using soap during handwashing. Despite knowing the risks of contamination, 58% reported using the same cutting board and knife for raw and cooked food. The largest proportion (37.4%) reported using the refrigerator to thaw food. Regarding leftovers, 47.2% said they keep soup in the refrigerator after boiling, while 32.1% said they keep it at room temperature after boiling. The safe food handling leaflet was piloted to a subsample of 50 parents. Evaluations were largely positive with a large majority saying the leaflet was easy to understand (94%) useful (94%).	Seoul, South Korea	N=417 Parents of elementary school children
Katiyo W, de Knock HL, Coorey R, Buys EM. Assessment of safety risks associated with handling chicken as based on practices and knowledge of a group of South	None	Online survey assessed consumers': self-reported practices when handling raw chicken from retail to the home, knowledge of factors affecting	Cross-sectional survey	More than half (55%) incorrectly handle raw chicken when purchasing and 44% incorrectly thaw frozen raw chicken. Roughly one third (31%) do not correctly handwash before and after (36%) handling raw chicken. Most participants had moderate or poor (72%) knowledge levels about factors impacting chicken meat safety and most (62%) reported moderate or poor safety practices. Consumers ≥ 40 years old had greater knowledge and	South Africa	N=863 South African consumers

African consumers. *Food Control*. 2019		the safety of raw chicken, concerns about safety risks linked to handling chicken meat in and out of the home, and sociodemographic characteristics.		followed more safety practices than those ≤ 40 years old.		
Kosa, K. M., Cates, S. C., Bradley, S., Chambers, E. th, Godwin, S.. Consumer-reported handling of raw poultry products at home: results from a national survey. J Food Prot. 2015. 78:180-6	None	Cross-sectional survey administered online nationally among adult grocery shoppers, assessing food safety practices when handling raw poultry at home.	Cross-sectional survey	The majority of consumers who prepared raw poultry reported washing their hands after handling the raw product (90%), separating raw poultry in plastic bags before putting it in their shopping cart (76.3%), and washing or swapping out dishes used to prepare raw poultry (97.1%). Sixty-two percent of consumers reported owning a food thermometer and of those, 73.2% reported using it the last time they cooked a turkey, and 56.7% when cooking whole chickens. The majority of consumers safely store raw poultry (70.6-94.4%) and cook poultry per USDA cold storage guidelines (90.5-92.8%). Based on the findings, education to improve consumer handling practices for raw poultry is needed.	United States	N=1,504 adult grocery shoppers
Low, W. Y., Jani, R., Halim, H. A., Alias, A. A., Moy,	None	Online survey assessed demographics,	Cross-sectional survey	Moderate food safety knowledge scores were reported. Students were most knowledgeable about personal food hygiene and least	Kuala Lampur, Malaysia	N=1,178 tertiary students (n=

F. M.. Determinants of food hygiene knowledge among youths: A cross-sectional online study. *Food Control*. 2016.		food safety knowledge, food safety attitudes and food practices. The results reported food safety knowledge exclusively. Areas for knowledge improvement were identified, and recommendations about future educational programs are provided.		knowledgeable about symptoms of foodborne diseases. Older students (≥30 years old) were significantly more knowledgeable on causes of foodborne diseases. Females were more knowledgeable than males. Science students reported the highest knowledge. Gender, level of study, field of study and father's education level are significant predictors on overall knowledge of food hygiene. Food safety education is recommended.		496 art students, n=440 science students, n=242 technical students)
Luo, X., Luo, L., Liu, H., Xiao, Y., Yu, X., Hou, X., Zeng, H., Zhang, F., Zhang, Y., Zhao, Y.. Needs survey of food safety intervention through we-media: A cross-	None	Cross-sectional survey assessing food safety knowledge, attitudes, and practices among students from nursing, education and medical colleges.	Cross-sectional survey	Education students scored the highest on food safety attitudes and practices. More than 70% were concerned or very concerned about pesticide residues in vegetables and 80% of students were willing to improve their knowledge of food safety and to change their inappropriate food safety practices.	Chongqing, China	N=3454 college students

sectional survey among junior educational and Medical University students in Chongqing, China. *Annals of Nutrition and Metabolism*. 2019.						
Ma L, Chen H, Yan H, Wu L, Zhang W. Food safety knowledge, attitudes, and behavior of street food vendors and consumers in Handan, a third-tier city in China. *BMC Public Health.* 2019.	None	The study explored food safety knowledge and attitudes of vendors and consumers of street food as well as the food handling practices.	A cross-sectional survey and checklist for food handling behaviors	On average consumers were appropriately knowledgeable about food safety. In general, younger consumers were more knowledgeable than older consumers. Food vendors, however, had on average lower food safety knowledge scores than consumers. Food vendors who had a university education had significantly greater food knowledge scores. Greater income and education level were associated with greater food safety attitudes. Vendors practiced personal protective behaviors such at not wearing jewelry, but barely half separated raw food from cooked food and only 1/3 used soap when washing dishes.	Handan, China	N= 100 street vendors N= 240 consumers N=90 streeet vending stalls
Majowicz, S. E., Diplock, K. J., Leatherdale, S. T., Bredin, C. T.,	None	Self-administered cross-sectional survey assessing	Cross-sectional survey	Of students who reported handling food for a job, less than half (45.1%) had ever taken a course in food preparation or handling and for those who were not currently handling food	Ontario, Canada	N=2860 high school students

Rebellato, S., Hammond, D., Jones-Bitton, A., Dubin, J. A.. Food safety knowledge, attitudes and self-reported practices among Ontario high school students. *Can J Public Health*. 2016.		food safety knowledge, attitudes and self-reported practices.		related to their work, it was even lower (32.5%). Knowledge was low related to food refrigeration, kitchen cleaning, hand washing, and cooking temperature. A majority (56.1%) reported always washing hands with soap and warm running water before preparing or handling food, or after working with raw meat or chicken (76.7%).		
Marumo O, Mabuza ML. Determinants of urban consumers' participation in informal vegetable markets: Evidence from Mahikeng, North West province, South Africa, and implications for policy. *South African Journal of Economic and Management Sciences.* 2018.	None	This study aimed to understand perceptions of informal vegetable markets and the factors that influence decisions about whether or not to shop from formal or informal vegetable markets.	Cross-sectional survey	Food quality and safety and convenience and bargaining opportunities were the preeminent principal components of informal vegetable market engagement. Households were more dependent on informal markets if they had more family members who were unemployed or had no income. The older the head of household, the stronger the preference for informal vegetable markets. Having fewer household members who received primary education was related to increased preference for formal vegetable markets. More wealth was associated with a stronger preference for formal markets.	Mahikeng Local Municipality, North West Province South Africa	N=230 households (head of household participated)

Mascarello G., Pinto, A., Parise, N., Crovato, S., Ravarotto, L. The perception of food quality. Profiling Italian consumers. *Appetite*, 2015.	None	Cross sectional survey collected through computer assisted telephone interviewing assessing the qualities that Italian consumers consider important when assessing food quality.	Cross sectional survey	A probit model that accounted for demographic and perception related factors as explanatory variables used to identify main factors that influence vegetable market preferences. Key factors are discussed. It is also determined that informal vegetable markets are a key component of urban markets for multifaceted reasons. Thus, policy changes are needed to ensure the safety of the food sold in these markets. Four clusters of consumers were identified but only two were numerically substantial, so only those were used to conduct analysis. The two groups were defined as: cluster 1 (those who assess the quality of a food product mainly according to criteria associated with the organoleptic sphere, 76.2%), cluster 2 (those whose selection criteria are mainly related to the food's place and methods of production, 20.4%). Cluster 1 consisted of mostly employed individuals, where Cluster 2 consisted mostly of retirees. Cluster 2 also consisted of more students, though there were not a large number of students in the study overall. Those living in the North West were more likely to fall into Cluster 1, whereas those living in the North East were more numerous in Cluster 2. No significant difference was found in terms of gender, age, and education. Cluster 2 had more individuals	Italy	N=1000 consumers

				showing poor level of food safety knowledge. Approximately 1/3 of consumers in Cluster 1 shop for food every day, whereas ¼ of consumers in Cluster 2 shop for food every day.		
Maughan, C., Chambers, E. Iv, Godwin, S., Chambers, D., Cates, S., Koppel, K.. Food Handling Behaviors Observed in Consumers When Cooking Poultry and Eggs. *J Food Prot.*	None	This survey study of consumers in Canakkale found that people believe fruits and vegetables are tainted with hormones, pesticides, fertilizers and may be genetically modified.	Cross-sectional survey	Consumers think of hormones, pesticide and fertilizer residue and genetically modified organisms similarly and that they all pose a threat to food safety. Consumers view physical attributes of food similarly but see quality, freshness, and traceability of foods as unique.	Canakkale Province in Turkey	N=166
Milazzo, A., Giles, L. C., Zhang, Y., Koehler, A. P., Hiller, J. E., Bi, P.. Factors Influencing Knowledge, Food Safety Practices and Food Preferences During Warm Weather of	None	Cross-sectional survey administered online, hard copy, or through telephone interview assessing food safety knowledge and practices and their relationship	Cross-sectional survey	Socioeconomic status was not significantly associate with unsafe food and personal hygiene practices or knowledge. Twenty-five percent reported unsafe personal and food hygiene practices and 25% had poor knowledge about high-risk foods for foodborne infection. Forty-four percent of participants consumed high-risk foods on a warm day. Approximately half of respondents did not know what the correct refrigerator temperature is, and women were twice as likely to know the correct setting.	South Australia	N=183 individuals who had cases of Salmonella or Campylobacter infection

Salmonella and Campylobacter Cases in South Australia. *Foodborne Pathog Dis*. 2017.		with socioeconomic position.				
Mirzaei, A., Nourmoradi, H., Zavareh, M. S. A., Jalilian, M., Mansourian, M., Mazloomi, S., Mokhtari, N., Mokhtari, F.. Food Safety Knowledge and Practices of Male Adolescents in West of Iran. *Open Access Maced J Med Sci*. 2018.	None	Cross-sectional survey assessing food safety knowledge and practices.	Cross-sectional survey	Adolescents who graduated from high school, with more educated parents, with employed parents, and in a good economic situation had higher levels of knowledge about food hygiene. However, high levels of food safety practice were only found in adolescents with household mothers and in adolescents with a good family economic status.	Ilam City, Iran	N=380 males aged 13-19
Muhammad I, Choiriyah NA, Yunita SI. Evaluating nutrition students' knowledge of food safety in	None	Cross-sectional survey using a cluster sampling method to assess food safety knowledge of students who major in	Cross-sectional survey	A majority of the food safety questions were answered incorrectly. Topics most often answered incorrectly included safe storage practices, safe food consumption principles, food-borne disease principles, handling food at risk of food-borne disease-causing microbes, subjects at risk of food-borne disease, safe food processing, preparation,	Indonesia	N=482 students

Indonesia: Multi-strata comparison review. *Pakistan Journal of Nutrition.* 2018.		nutrition and have completed a course on food safety using a biodata and food safety survey.		and contamination prevention of animal sourced foods. There were no significant differences found within the sample.		
Mullan, B., Allom, V., Sainsbury, K., Monds, L. A.. Examining the predictive utility of an extended theory of planned behaviour model in the context of specific individual safe food-handling. *Appetite*. 2015.	Theory of Planned Behavior	Online cross-sectional survey assessing food-handling behaviors: cooking, hand washing, keeping food at the correct temperature, avoiding unsafe foods	Cross-sectional survey	Rates of safe food-handling behaviors were relatively high (77-90%). There was a strong correlation between Theory of Planned Behavior variables and all four behaviors as well as habits. It appeared that moral norm was an important predictor of intention to engage in each of the four behaviors. Similarly, habit strength was an important predictor of each of the behaviors and moderated the relationship between intention and behavior for the behavior of avoiding unsafe food.	Australia	N=170 college students who regularly handle and cook food
My, N, Rutsaert P, Van Loo EJ, Verbeke W. Consumers' familiarity with and attitudes towards food quality certifications for rice and vegetables in	none	Cross-sectional survey on urban consumers' familiarity with food quality certifications and food choice decision making as it concerns health, food safety, and eco-	Cross-sectional survey	Participants were considerably unfamiliar with food quality certifications. Consumers unfamiliar with food quality certification had lower awareness of sustainability, food safety, good agricultural practices, and organic food as compared to those with knowledge of food quality certification. Perceived importance of environmental outcomes of food choice and food safety was associated with attitudes towards rice and vegetables. Perceived importance of health eating was positively	Can Tho and Ho Chi Minh, Vietnam	N=500 consumers

Vietnam. *Food Control.* 2017.		friendliness specifically about rice and vegetables.		associated with attitudes about high quality rice but not vegetables.		
Nan X, Verrill L, Kim J. Mapping sources of food safety information for U.S. Consumers: Findings from a national survey. *Health Commun.* 2017	None	The authors sought to understand where U.S. consumers obtain information about food safety and how these information sources are related to sociodemographic characteristics and food safety risk perceptions on the 2010 FDA Food Safety Survey.	Cross-sectional survey	Consumers mostly obtained food safety information from the TV and radio; the internet was an uncommon source. However, younger people were more likely to use new media. Females and those with more education used a greater variety of information sources. Asian Americans were more likely to use internet sources and Hispanics were more likely to use interpersonal sources. African Americans turned to social media, the Internet, and TV for information sources. Using social media and friends for information about food safety was associated with less perceived susceptibility to food borne illness compared to newspaper, healthcare providers, government websites, cooking classes, and teachers.	United States	N=4,568 consumers
Nguyen ATL, Tran BX, Le HT, Le XTT, Do KN, Do HT, Vu GT, Nguyen LH, Latkin CA, Ho CSH, Ho RCM.	None	Cross-sectional survey through face-to-face interviews to understand the knowledge,	Cross-sectional survey	Most respondents had good knowledge of handling of raw and cooked food and the proper environment practices when processing food. However, only a third understood the correct environmental requirements to maintain food safety. When	Hanoi, Vietnam	N=1740 customers

Customers' Knowledge, Attitude, and Practices towards Food Hygiene and Safety Standards of Handlers in Food Facilities in Hanoi, Vietnam. *International Journal of Environmental Research and Public Health.* 2018.		attitudes, and practices of consumers with regard to the practices of food facilities.		determining where to eat, consumers reportedly mostly considering perceived hygiene and safety of the food as the most important consideration. Only a modest portion of participants disclosed reporting unhygienic food practices to agencies potentially because of a belief that making such reports would be a waste of time. People who worked white collar jobs were more knowledgeable about food handler practices than those working lower class jobs. While participants were fairly knowledgeable about food handling, there were clear knowledge gaps about the environmental requirements to safely prepare food.		
Niyaz, O. C., Demirbas, N.. Food Safety Perceptions of Fresh Fruits and Vegetables Consumers. *Journal of Tekirdag Agriculture Faculty-Tekirdag Ziraat Fakultesi Dergisi.* 2018.	None	Survey with consumers in 7 districts in Canakkale, Turkey to determine perceptions of food safety of fresh fruits and vegetables using social determinants of health and multi-dimensional scaling analysis.	Cross-sectional survey	Consumers believed that fresh fruits and vegetables include hormones, pesticides, fertilizer remains and GMOs that are harmful and make food less safe.	Canakkale, Turkey	N=166

Obande D, Young I. Safe food refrigeration knowledge, attitudes, and practices of university students. *British Food Journal.* 2020.	None	Survey to understand food storage knowledge and safe refrigeration practices of college students living in residence halls.	Cross-sectional survey	Participants had good knowledge of general safe food storage. White participants scored the highest on knowledge scores of safe food storage. Those born outside of Canada had more positive attitudes toward food safety than Canadians. Overall, participants had inadequate knowledge about appropriate refrigeration temperatures and poor practices about checking the temperatures of refrigerators were observed. Students also incorrectly associated smell with determining whether food was safe to eat.	Canada	N=93 students
Odeyemi OA, Sani NA, Obadina AO, Saba CKS, Bamidele FA, Abughoush M, Asghar A, Dongmo FFD, Macer D, Aberoumand A. Food safety knowledge, attitudes and practices among consumers in developing countries: An international	None	Survey assessed the food safety knowledge, attitudes, and practices of consumers from developing countries in Africa and Asia were compared.	Cross-sectional survey	Generally, participants from Asian countries had greater food safety knowledge than participants from African countries. Cameroonian participants had the least food safety knowledge compared to Ghanaian and Nigerian participants. Likewise, Iranian participants had the lowest food safety knowledge compared to Malaysian and Pakistani participants. Many participants were unaware of the relationship between food borne illness and leaving food at room temperature.	Iran, Jordan, Malaysia, Pakistan, Ghana, Cameroon, Nigeria	N=453 (n=265 from Africa, n=188 from Asia)

survey. *Food Res Int.* 2019						
Opara, P., Alex-Hart, B. & Okar, T. Hand-washing Practices Amongst Mothers of Under-5 Children in Port Harcourt, Nigeria. *Paediatrics and International Child Health*. 2017.	None	Cross-sectional study used to collect data on hand-washing practices amongst mothers of children under 5 after defecation or cleaning an infant's perineum to prevent childhood mortality caused by diarrhea and Pneumonia in Port Harcourt, Nigeria.	Cross-sectional survey	Handwashing with soap and water (HWWS) by mothers in Port Harcourt is weak due to varying factors like educational status, lack of sanitation infrastructures, perceived motivation, and hand-hygiene practices in public places. Generally, 64 (41.6%) mothers regularly washed their hands with soapy water in a container, 30 (19.5%) used soap and running water, and 60 (38.9%) used only water, either running or in a container. 82 (53.2%) and 70 (45.5%) reported always washing their hands before preparing their infant's food and before feeding their infants. With hand-hygiene practices in public places after cleaning a child's perineal area, 30.5% (n=47) of mothers choose to clean their hands with baby wipes, 27.9% (n=43) wash with water carried along for child's use, and 17.5% (n=27) wait to clean their hands at home. However, mothers' fear of being judged or embarrassed about poor handwashing practices may have slightly skewed the results.	Port Harcourt, Nigeria, West Africa	N= 154 mothers (ages 20 to 44)
Paden, H., Hatsu, L., Kane, K., Lustberg, M., Grenade, C., Bhatt, A., Pardo,	None	Self-administered cross-sectional survey with cancer patients	Cross-sectional survey	Food safety risk perception, food safety attitudes, and food safety behaviors were not contingent on cancer type. The majority of the sampled population (70.2%) understood the dangers of foodborne pathogens. However,	United States	N= 288 patients

D. D., Beery, A., & Ilic, S. Assessment of Food Safety Knowledge and Behaviors of Cancer Patients Receiving Treatment. *Nutrients*. 2019.		receiving treatment form three cancer clinics in Columbus, Ohio, USA to assess their food safety behaviors, attitudes, risk perceptions, and food acquisition behaviors.		49.4% were oblivious of their higher susceptibility due to their weak immune system. Approximately 87.4% expressed optimism about sanitation practices. Food safety knowledge scores were overall low among cancer patients; the average score was 74.77 ± 12.24% (average ± standard deviation). Many participants (46.3%) engaged in high-risk behaviors such as consuming fruits and vegetables after removing damaged parts, and 84.9% did not cook alone.		
Pang, J., Chua, S. W. J. L., & Hsu, L. Current Knowledge, Attitude and Behaviour of Hand and Food Hygiene in A Developed Residential Community of Singapore: A Cross- Sectional Survey. *BMC Public Health*. 2015.	None	Interviewer-assisted cross-sectional study among the residents of a residential area in Singapore to determine the current knowledge, attitude and behaviors of hand and food hygiene, as well as to establish the potential risk factors of diarrhea in an	Cross-sectional survey	The results indicated good knowledge and attitude towards hand washing and food hygiene among the residents with the majority of the sampled population (92.5%) reporting washing their hands multiple times in a day. Seventy-one percent reported washing their hands with soap, and 6.3% used alcohol-based disinfectants four or more times in a day. Similarly, 96.3 % agreed that washing hands with soap effectively reduces the spread of diseases. However, 87.9% stated they only wash their hands when their hands are physically dirty. Only 75% of participants reported completing all eight steps to proper handwashing. Everyone reported washing their raw food properly before cooking, and 94.2% check the expiration date on the food	Singapore	N= 240 residential units consented and & 18 rejected participation out of 1,156 units invited

		area where clean water and soap are easily available and affordable.		packaging before purchasing or cooking the food.		
Petrescu DC, Vermier I, Petrescu-Mag RM. Consumer understanding of food quality, healthiness, and environmental impact: A cross-national perspective. *International Journal of Environmental Research and Public Health.* 2020	None	The authors aimed to understand social, environmental, and qualitative food ques that that impact purchasing food. Belgian and Romanian consumers most commonly cite quality of food as something of great importance when making decisions about food.	Cross-sectional survey	Consumers were most focused on food quality. Attributes such as appearance, freshness of food, and taste were most commonly cited as how people appraised their food. The emphasis on food quality was related to health and concerns about environmental protection.	Belgium and Romania	N=797 (n=441 Belgians, n=356 Romanians)
Phillips, R. M., Vujcic, J., Boscoe, A., Handzel, T., Aninyasi, M., Cookson, S. T.,	None	Cross-sectional survey of female heads of households assessing	Cross-sectional survey	Nearly all households had soap available and reported water was available "always" or "sometimes". Exposure to handwashing promotion was reported by 85% of respondents. Rinsing hands with water alone	South Sudan	N=600 female heads of households

Blanton, C., L, S. Blum, Ram, P. K.. Soap is not enough: handwashing practices and knowledge in refugee camps, Maban County, South Sudan. *Confl Health*. 2015.		handwashing knowledge, access, and behaviors as well as observations of handwashing behaviors.		was more commonly observed (80%) verses handwashing with soap and water (7%) before eating and before cooking (72.3% vs 23%). After using the toilet, 46% were observed washing hands with soap while 38% rinsed with water.		
Qekwana, D. N., McCrindle, C. M. E., Oguttu, J. W., Grace, D.. Assessment of the occupational health and food safety risks associated with the traditional slaughter and consumption of goats in gauteng, South Africa. *Inter J Environ Research Public Health*. 2017.	None	Cross-sectional survey of individuals involved in the slaughter of goats to assess the occupational health and food risks associated with the practice.	Cross-sectional survey	A high proportion (62.64%) did not wear protective clothing during slaughter. Slaughtering was mainly conducted by males (99%). Forty-four percent or practitioners only changed their clothing that they wore during slaughtering when they got home. Up to seven people may be involved in the slaughter. In 77.5% of cases, the health status of the person performing the slaughter was not known. Meat inspection was not practiced by any of the respondents. Throughout the slaughter process, the same knife was used by individuals (84.3%) and the knife was only cleaned when soiled (84.7%). Fifty-two percent processed the carcass and cooked the meat immediately. The majority (80%) consumed the meat within 30 minutes of cooking.	Tshwane, South Africa	N=105 individuals involved in the slaughter of goats (as a spectator or participant)

Ruby GE, Abidin Ufuz Lihan S, Jambari NN, Radu S. A cross sectional study on food safety knowledge among adult consumers. *Food Control.* 2019.	None	The knowledge of food safety among consumers who handle food safety at home was assessed.	Cross-sectional survey	Consumers had good food safety knowledge as well as personal hygienic practices like handwashing. They also identified the link between foods that are at high risk of causing food borne illness and cross-contamination. Although, participants often did not correctly identify correct temperatures to safely store food. A majority of participants correctly identified symptoms of food borne illness. A regression found that being female and having advanced education predicted higher food safety knowledge scores. Compared to participants over the age of 50, participants between 30-39 were the more knowledgeable. Similarly, families with 3 or more children were considered to have good knowledge about food safety as were those who reportedly preparing food in the home daily.	Sibu, Sarawak, Malaysia	N=623 consumers
Ruby GE, Abidin Ufuz Lihan S, Jambari NN, Radu S. Predicting intention on safe food handling among adult consumers: A cross sectional study in Sibu district,	Theory of Planned Behavior	Structural equation modeling was used to predict the intention of consumers towards safe food handling at home.	Cross-sectional survey	Constructs of the Theory of Planned Behavior that were included consisted of attitude, subjective norm, perceived behavioral control. Findings suggest that subjective norm was the strongest predictor of intention to safely handle food whereas attitude about and knowledge of food safety were the weakest factors that determined food safety. Models that account for demographic variation are warranted and could possibly explain examined relationships. The theory	Sibu, Sarawak, Malaysia	N=623 consumers

Malaysia. *Food Control.* 2019(b).				accounted for roughly 34% of the variance in the positive influence of attitude, subjective norm, and perceived behavioral control as it concerns intention to safely handle food in the home. The largest influence on attention was subjective norm (i.e., familial expectation of safety). Perceived behavioral control was also a significant predictor of intention, thus it is recommended that interventions that focus on the ease of health protective behaviors that can reduce food borne illness are developed. Knowledge was also positively associated with attitudes towards food safety, despite attitude only accounting for a modest portion of the variance of intention to safely handle food.		
Samapundo S, Thanh TNC, Xhaferi R, Devlieghere F. Food safety knowledge, attitudes and practices of street food vendors and consumers in Ho Chi Minh city, Vietnam. *Food Control.* 2016.	None	The authors aimed to understand the food safety knowledge, attitudes, and practices of street food vendors and consumers.	Cross-sectional survey	Consumers had greater food safety knowledge than vendors although nearly one fifth of consumers had poor food safety knowledge scores (comparable to 90% of vendors who had poor food safety knowledge). Among consumers, youth was associated with greater food safety knowledge as was greater educational level. Again, among vendors, educational level was associated with food safety knowledge with lower levels of education being associated with lower levels of food safety knowledge. The large majority of vendors received no food safety training. This was reflected by the	Bing Thanh, Thu Duc, District 3, District 8, in Ho Chi Minh City, Vietnam	N=160 (n=120 consumers, n=40 street food vendors)

Samapundo S, Thanh TNC, Xhaferi R, Devlieghere F. Food safety knowledge, attitudes and practices of street food vendors and consumers in Ho Chi Minh city, Vietnam. *Food Control.* 2016. (Cont'd)				unsanitary working conditions in which food was prepared. Generally, consumers were knowledgeable about food safety practices. However, food vendors were not, and this reflected in the problematic observations regarding food handling practices and unhygienic facilities. Food safety training for food vendors is greatly needed.		
Sanlier, N., Baser, F. The Relationship Among Food Safety Knowledge, Attitude, and Behavior of Young Turkish Women. *J Am Coll Nutr*. 2020	Theory of Behavior Change	Cross-sectional interview administered survey of young women (20-25 years old) in Ankara, Turkey assessing food safety knowledge, attitude, and behavior.	Cross-sectional survey	The study aimed to reveal the mediating role of attitude between knowledge and behavior. Correlations among food safety knowledge, attitude, and behavior were all statistically significant. The paths from knowledge to attitude and from attitude to behavior were both strong, which was in line with the author's hypothesis. The implication is that encouraging food safety attitude by increasing knowledge might be an appropriate target for behavior change.	Ankara, Turkey	N=1,219 young women (ages 20-25)
Sanlier, N., Sezgin, A. C., Sahin, G.,	None	Self-administered survey of	Cross-sectional survey	Male subjects had higher street food preference scores (86.3 +/- 6.1) than females (80.3 +/- 12.2). University students (86.2 +/-	Turkey	N=847 high school and

Yassibas, E.. A study about the young consumers' consumption behaviors of street foods. *Cien Saude Colet*. 2018.		students assessing street food preferences.		7.5) preferred consuming street foods more than high school students (77.4 +/- 12.1). There was a statistically significant negative correlation between street food consumption and education level as well as age. Although young consumers knew that street food was easily contaminated, that vendors do not pay attention to hygiene, that street foods are raw or not cooked well, they prefer this food for its cheapness, satisfaction, taste, variety, fast service, and because it is consumed by most people.		university students
Senkham, K., Hongsranagon, P., Havanond, P.. Knowledge, attitude, and practice towards the campaign "eat hot food, use serving spoon, and always wash your hands" among food consumers in Chulalongkorn University canteens, Bangkok,	None	Cross-sectional survey to assess the knowledge, attitude and practice towards the campaign “Eat hot food, use serving spoon, and always wash your hands”	Cross-sectional survey	Overall, respondents had “high level of knowledge” (70.8%), “neutral attitude” (58.4%), and “fair practice” (71.2%) toward the campaign. Almost all respondents (98.8%) knew that diarrhea is caused by eating unclean food or contaminated water. Most knew that eating cooked food can help prevent food and water borne diseases (96.3%). Occupation and income per month were associated significantly with knowledge toward the campaign. Education, occupation and income were associated significantly with attitude toward the campaign. Age, education, occupation and income were significantly associated with practices following the campaign. There was a significant association between knowledge an attitude, attitude and practice, while no	Bankok, Thailand	N=430 adults

Thailand. *J Health Research*. 2015.				significant association between knowledge and practice.		
Sithole, M. I., Bekker, J. L., Mukaratirwa, S.. Consumer knowledge and practices to pork safety in two Taenia solium cysticercosis endemic districts in Eastern Cape Province of South Africa. *BMC Infect Dis*. 2020.	None	Interview administered survey of heads of households in Eastern Cape Province, South Africa, assessing consumer knowledge and practices related to disease (Taenia solium), storage, and cooking safety related to pork consumption.	Cross-sectional survey	The study revealed that more men were responsible for meat purchasing compared to women. The majority of study participants identified pork as an important part of their diet (73.1%). Over half (54.2%) agreed that pork infected with T. soium cysts could be harmful et 57.3% were unable to identify T. solium cysts in pork when slaughtered at home. The majority (69.5%) trusted the pork they purchased from butcheries, very few (less than 10%) were aware of legal requirements in regard to food preparation, slaughter, and disease control. While most consumers (88.7%) kept pork in the refrigerator, only 11.3% used a freezer to store pork. Approximately 80% of participants preferred well-cooked pork, mostly due to the belief that cooking kills germs (43.6%).	Eastern Cape Province, South Africa	N=361 heads of households.
Sternisa, M., Mozina, S. S., Levstek, S., Kukec, A., Raspor, P., Jevsnik, M.. Food safety knowledge, self-reported practices and attitude of	Grounded Theory	Interview-administered survey of Slovenian consumers, assessing knowledge, awareness of the microbiological risk, and self-	Cross-sectional survey	The majority of respondents were women (66.1%) and overall, women were more aware of the health risks associated with improper poultry meat handling than men. Respondents with lower educational attainment and seniors were less aware of risks associated with improper poultry handling. The majority of respondents (90.9%) check poultry meat for freshness but 44% do not pay attention to the origin of the poultry	Slovenia	N=560 consumers in grocery stores.

poultry meat handling among Slovenian consumers. *British Food Journal*. 2018.		reported practices in poultry handling during purchase, transport, and preparation in the home.		meat. Respondents generally had good knowledge about proper food handling, cross-contamination, the importance of cooking to prevent disease. Large majority (84.2%) showed sufficient knowledge of the heat treatment of poultry. Almost half agreed that the follow instructions for poultry meat preparation if they are included. Only 57.8 % stated that poultry meat in retail can be contaminated with harmful microorganisms. Questions regarding Campylobacter had a low response rate, indicating insufficient knowledge. The majority (95.9%) were unaware of poultry meat contamination with Campylobacter.		
Stratev, D., Odeyemi, O. A., Pavlov, A., Kyuchukova, R., Fatehi, F., Bamidele, F. A.. Food safety knowledge and hygiene practices among veterinary medicine students at Trakia University, Bulgaria. *J Infect*	None	Online survey of veterinary students to assess food safety knowledge, attitudes and practices.	Cross-sectional survey	Generally, food safety knowledge, practices, and attitudes were high, though some practices were lower than was desirable such as 44.4% of participants dishing out food with unprotected hands, 22.2% washing eggs before cooking or frying them, 54.4% storing raw chicken separately from other food. Food safety knowledge was positively influenced by years of study, but no differences were seen based upon age or gender.	Bulgaria	N=100 undergraduate veterinary medicine students

Public Health. 2017.						
Suth, M., Mikulka, P., Izso, T., Kasza, G. Possibilities of targeting in food chain safety risk communication. *Acta Alimentaria*. 2018.	None	Interview-administered survey of pedestrians in 11 locations in Hungary to assess consumers' risk perception and risk avoidance in order for more efficient, targeted risk communication.	Cross-sectional survey	Age, gender, and income were found to play a significant role in assessments of the importance of food safety. Older adults and women tended to place greater importance on food safety. Individuals with higher income perceived changes in general food safety in the country more favorably. Four clusters were established based upon distribution of the data: Disinterested youngsters (more likely to be male (57.7%), youngest group, underperformed in basic knowledge, overperformed in advance knowledge, not regularly informed about food safety issues, internet users), Conscious elders (mostly female (58.7%), older group with lowest education and income level, gather information on food safety for the household but lowest level of knowledge, fond of cooking, television watchers), Food adepts (high food safety knowledge, low shopping and household awareness, mostly men (57.5%), large percentage (30%) between the ages of 30-39, highly educated with high income levels, internet users), Soul of the family (high basic knowledge, low complex knowledge, conscious behavior in shopping and household, majority female (62%), and	Hungary	N=1003 Hungarian consumers

				most between 40-50 years old, heterogeneous education levels)		
Syahira, B. Z, Huda, B. B, Mohd Rafee. Factors associated with level of food safety knowledge among form four students in Hulu Langat District, Selangor. International *Journal of Public Health & Clinical Sciences*. 2019.	None	Self-adiministered survey assessing food safety knowledge and practices.	Cross-sectional survey	While the majority knew that they should inspect food before eating it and wash hands after coughing and sneezing, only 29.6% responded correctly to the statement that washing hands under only running water is able to remove bacteria and only 42.4% knew that it is not enough for food handlers to clean their hands with a cloth prior to handling food. The majority (74.4%) did not know that chilling or freezing food does not eliminate germs. Overall knowledge ranged widely and was highest among Malays (compared to other ethnicities), individuals with higher education, children of food workers, and individuals who had experienced food poisoning.	Selangor, Malaysia	N=610 secondary school students
Tabrizi, J. S., Nikniaz, L., Sadeghi-Bazargani, H., Farahbakhsh, M., Nikniaz, Z. Determinants of the food safety knowledge and practice among Iranian consumers A	None	Interview administered survey of Iranians to assess food safety knowledge and practices as well as the association between food safety knowledge and	Cross-sectional survey	Overall percentage mean score for knowledge and self-reported practices was 77.66 and 70.77 percent, respectively, which were considered good. The majority of consumers were aware of food safety rules, but there were many gaps in their knowledge and practices that could lead to food-borne illnesses. Age and education were not found to play a significant role in food knowledge and practice scores. Women had significantly better scores than men, married individuals had significantly better scores than single	Iran	N=1,500 Iranian consumers

population-based study from northwest of Iran. *British Food Journal*. 2017.		practices with socio-demographic characteristics		individuals, and people living in urban settings had significantly better food knowledge and practice scores than those in rural settings.		
Thaivalappil, A., Papadopoulos, A., Young, I.. Intentions to adopt safe food storage practices in older adults an application of the theory of planned behaviour. *British Food Journal*. 2019.	Theory of Planned Behavior	Online survey of independent living older adults (60+) who prepared food regularly and who were living in Canada to assess food safety knowledge, TPB components (attitudes, subjective norms, perceived behavioral control and behavioral intention) and self-reported habitual behaviors.	Cross-sectional survey	Knowledge and safe food handling behavior outcomes were not reported in this study. The study found that all TPB antecedents were predictors of behavioral intentions except attitudes, which was only a significant predictor of intentions to safely thaw meats. Respondents had similar attitudes towards storing leftovers and thawing meat safely in the refrigerator. They had similar subjective norms related to storing leftovers for an adequate amount of time. Some TPB constructs were significantly different between two behaviors. Participants exerted greater behavioral control over storing leftovers compared to thawing meats. They had significantly different intentions to perform safe storage of leftovers compared to thawing meats. Gender and past safe leftover storage behavior both predicted intentions to store leftovers within recommended guidelines. Women were more likely to have stronger intentions to store leftovers than men.	Canada	N=78 older adults (60+) who live independently and cook regularly.

Tomaszewska, M., Trafialek, J., Suebpongsang, P., Kolanowski, W.. Food hygiene knowledge and practice of consumers in Poland and in Thailand - A survey. *Food Control*. 2018.	None	Cross-sectional survey of randomly selected individuals in public spaces to assess food poisoning knowledge, and self-reported hygienic food preparation practices in the home.	Cross-sectional survey	In regard to food poisoning knowledge, Polish consumers provided significantly better responses than Thai consumers on seven questions and Thai consumers provided significantly better responses to three questions. Overall scores were slightly higher for Polish consumers. In Poland, women showed significantly greater knowledge than men whereas in Thailand the difference was not significant. In Thailand, younger consumers were more likely to answer knowledge questions correctly whereas in Poland, older consumers had higher knowledge scores. In Poland those with higher education scored better on knowledge, but in Thailand there was no significant difference based on education. In both countries, women scored better with respect to food hygiene practice than men. While in both countries knowledge was influenced by food hygiene practices, there was a greater degree of correlation between Thai consumers' knowledge and their food hygiene practices.	Poland & Thailand	N=600 consumers (300 from Poland, 300 from Thailand)
Traversa, A., Bianchi, D. M., Astegiano, S., Barbaro, A., Bona, M. C., Baioni, E., Rubinetti, F.,	None	Online survey assessing consumer's knowledge of the main foodborne agents and dietary regimen	Cross-sectional survey	The majority of users were aware of the outbreak associated with frozen berries and precautionary treatment to prevent hepatitis A. Less than half recognized pesto as the food matrix involved in botulism outbreaks though the majority were familiar with the bacterium responsible for botulism and the main foods	Italy	N=191 IZSalimenTO (Experimental Zooprophylactic Institute of Peidmont, Liguria and Valle

Aliberti, E., Palazzo, C., Gallina, S., Decastelli, L.. Consumers' Perception and Knowledge of Food Safety: Results of Questionnaires Accessible on IZSalimenTO Website. *Ital J Food Saf*. 2015.		during pregnancy.		associated with infections. About half of consumers identified honey as a risk to infants, ¾ knew of the risk of Salmonella associated with raw eggs, and about ¾ believed that vegetables and fruits washed with sodium bicarbonate is able to inactivate Toxoplasma. Only a small portion of people knew of the cheeses that are considered to be a risk for pregnant women.		d'Aosta) website users.
Tutu, B. O., Hushie, C., Asante, R., Egyakwa-Amusah, J. A.. Food safety knowledge and self-reported practices among school children in the Ga West Municipality in Ghana. *Food Control*. 2020.	None	Cross-sectional survey of students to assess food safety knowledge and food safety practices.	Cross-sectional survey	Aside from age and grade level, there were no significant differences observed among various demographic characteristics in regard to knowledge and safety practices. Food safety knowledge was seen as inadequate (mean score: 64.1%) while food practice scores (mean score: 80.4%) was seen as appropriate. The majority (70%) report washing hands before eating while food storage practices were seen as poor. There was a significant positive relationship between food safety knowledge and practices. The majority (68.3%) of students look for cleanliness and (59.4%) neatness when assessing which food vendors to purchase from.	Ghana	N=1343 students (ages 7-21)

Wang, S. S., Shan, L. J., Wang, X. L., Wu, L. H.. Consumer's risk perception of foodborne diseases and high-risk food safety practices in domestic kitchens. *International Food and Agribusiness Management Review*. 2019.	None	Interview-administered survey assessing consumers' risk perception and behaviors regarding foodborne diseases.	Cross-sectional survey	Knowledge of pathogens among respondents varied widely but even for those who knew of two or more foodborne pathogens, knowledge was superficial. Sixty-eight percent of respondents always washed cutting boards after cutting meat and more than half stated that they always separate raw and cooked food during storage and handling. Sixty percent of respondents had eaten undercooked meat or seafood. Gender, age, marital status and education were not associated with perceived risk, but family income was positively associated with perceived risk.	China	N=834 adult consumers
Zhang, J. P., Cai, Z. Y., Cheng, M. W., Zhang, H. R., Zhang, H., Zhu, Z. K.. Association of Internet Use with Attitudes Toward Food Safety in China: A Cross-Sectional Study. *Inter J Environ Research Public Health*. 2019.	None	Using data from the Chinese Social Survey (2013-2015), this study assesses the association between Internet use and individuals' food safety evaluations.	Cross sectional survey	There was a significant association between internet use and food safety evaluation (Food safety evaluation: "How do you evaluate food safety in the current society?") whereby greater internet use led to lower food safety evaluation. Individuals with a college education as well as individuals below a senior high school level, women, and urban residents were significantly more concerned about food safety.	China	N=9536

Zhou, X., Zhang, Y., Shen, C., Liu, A., Wang, Y., Yu, Q., Guo, F., Clements, A. C. A., Smith, C., Edwards, J., Huang, B., Soares Magalhães, R. J.. Knowledge, attitudes, and practices associated with avian influenza along the live chicken market chains in Eastern China: A cross-sectional survey in Shanghai, Anhui, and Jiangsu. *Transbound Emerg Dis*. 2019.	None	Interview-administered survey used to assess knowledge, attitudes, and practices on avian influenza (AI) virus among chicken farmers, chicken vendors and consumers.	Cross-sectional survey	The average knowledge, attitudes and practices (KAP) scores of chicken farmers were higher than that of chicken vendors. Females and older people had significantly lower overall KAP scores than males and younger people, though women had better practice scores than men. Respondents with secondary education had lower attitude scores toward AI compared with those with primary school and below. It is suggested that further analysis is necessary and that interventions aimed at improving food safety should target all stakeholders involved.	Eastern China	N=274 (95 chicken farmers, 104 chicken vendors, and 75 market consumers)
Zyoud, S., Shalabi, J., Imran, K., Ayaseh, L., Radwany, N., Salameh, R., Sa'dalden, Z.,	None	Interview-administered survey conducted with parents in primary	Cross-sectional survey	Significant modest positive correlations were found between respondents' knowledge and attitude scores regarding food poisoning, knowledge and practice scores regarding food poisoning, and attitude and practice scores regarding food poisoning. Respondents with a	Palestine	N=412 parents (92.7% mothers)

Sharif, L., Sweileh, W., Awang, R., Al-Jabi, S.. Knowledge, attitude and practices among parents regarding food poisoning: a cross-sectional study from Palestine. *BMC Public Health.* 2019.		healthcare centers to assess food safety knowledge, attitudes, and practices.		higher education level and who live in a city were the only factors significantly associated with higher knowledge scores. Attitude improved as educational level increased and income level increased. Those of female gender and employed were statistically significantly associated with higher satisfactory hygienic practices in relation to the prevention of food poisoning.		

Appendix III: Consumer Qualitative Studies Table

Author(s), Title, Journal, Year	Theory	Summary	Study Design	Results	Location	Sample
Araújo, J. A. M., Esmerino, E. A., Alvarenga, V. O., Cappato, L. P., Hora, I. C., Silva, M. C., Freitas, M. Q., Pimentel, T. C., Walter, E. H. M., Sant'Ana, A. S., Cruz, A. G.. Development of a Checklist for Assessing Good Hygiene Practices of Fresh-Cut Fruits and Vegetables Using Focus Group Interviews. *Foodborne Pathog Dis.* 2018	None	Themes derived from four focus groups conducted with academics and professionals within food safety and security were used to develop a checklist for good hygiene practices (GHP)	Moderator-guided focus group study	Focus groups were used to generate 28 items separated in six blocks: water supply; hygiene; health and training; waste control; pest control; packaging and traceability; and hygiene of facilities and equipment	Brazil	N=28 participants N=4 focus groups
Behrens, J. H., Vedovato, G. M., Cervato-Mancuso, A. M., Bastos, D. H. M.. Social representations of safety in food services. *Food*	Theory of Social Representation	A qualitative study using guided in-depth interviews to assess perceptions of safety, knowledge of	Guided in-depth interviews conducted with semi-structured questionnaires.	Interviewees reported concern about hygiene and good practices with a focus on hazards of a chemical or biological nature. Some consumers expressed greater concern with access to food resulting from economic constraint. Generally, consumers	Brazil	N=66 interview with consumers

Research International. 2015		food borne diseases and self-involvement in the food production chain		expressed a passive role in the food production chain.		
Chavez, J. Y. A., Ghosh, S., Rogers, B. L., Shively, G., Baral, K., Webb, P.. "Molds attack rice-but we don't know what to do". A Qualitative study of farming families' perceptions of food safety in Banke, Nepal. *FASEB Journal.* 2016	None	A qualitative study utilizing semi-structured focus groups to determine definitions of food safety and community perceptions of mold/fungus infestations among farmers.	Qualitative focus groups separated by gender	Problems related to food safety and crop storage emerged in focus groups. The main problems noted were pests and disease, overuse of pesticides, unpredictable weather, lack of agricultural inputs (seeds), lack of adequate knowledge of farming techniques, and problems with infrastructure (irrigation, storage, etc.). Strategies to improve food safety emerged as well: ensuring crop safety from pre-harvest to storage, safeguarding/cleaning crops before consumption, and properly processing moldy crops through sun drying, disposal or producing alcohol.	Nepal	N=7 focus groups N=73 participants (40/33, women/men)
Chiu, Y. C., Yu, S. H. Everyday strategies for handling food safety concerns: a qualitative study of distrust, contradictions, and helplessness among	Risk/Benefit Analysis Model	A qualitative study utilizing in-depth interviews to discern strategies for handling food safety concerns	Semi-structured in-depth interviews and field notes	Thematic analysis revealed that women perceive collusion between government and business as a primary cause of food safety scandals. Despite this mistrust, women also indicated a reliance on food labels and certification when making food purchasing decisions.	Taiwan	N=39 women

Taiwanese women. *Health Risk & Society*. 2019						
Crovato, S., Mascarello, G., Marcolin, S., Pinto, A., Ravarotto, L.. From purchase to consumption of bivalve molluscs: A qualitative study on consumers' practices and risk perceptions. *Food Control.* 2019.	Grounded theory	An exploratory qualitative focus group study to discern consumer perceptions of risk and practices surrounding purchasing and consuming bivalve meat at home.	Qualitative, in-depth, interviewer guided focus groups	The most frequently mentioned factors were reason for preparing bivalves at home; where bivalves are purchased; elements guiding when consumer purchase of bivalves; bivalve preparation, cooking and storage; risks associated with consuming raw bivalves; and consumer categories who are most at risk. Practices mentioned with the greatest frequency were: storing/washing bivalves in salty water; preparing them immediately; keeping for at most one day refrigerated, covered with a damp cloth; and eliminating any that do not open after cooking.	Italy	N=4 focus group N=42 participants
Dastile, L. S., Francis, J., Muchenje, V.. Consumers' Social Representations of Meat Safety in Two Selected Restaurants of Raymond Mhlaba Municipality in the Eastern Cape, South	None	A qualitative analysis of semi-structured questionnaire-assisted focus group assessing consumers' social representations of meat safety	Qualitative semi-structured focus group guided by a closed and open-ended questionnaire.	Hygiene at the place of purchase of meat and freshness of meat emerged as the primary concerns. Significant concern about the safety of meat was also expressed. Relatively low concern about food borne disease was noted, however the importance of hand washing during meat preparation and hygiene during meat processing were important to consumers.	South Africa	N=43 focus groups N=251 participants

Africa. *Sustainability* . 2017						
Devaney, L. Good governance? Perceptions of accountability, transparency and effectiveness in Irish food risk governance. *Food Policy*. 2016. 62:1-10	None	A qualitative study of perceptions of good food governance utilizing natural focus groups	Qualitative focus groups using a flexible topic guide conducted with a non-probability sample	Participants expressed a need for food safety responsibility to be distributed across a range of actors. A significant degree of uncertainty regarding the food risk governing structures was expressed. This was interpreted as a general lack of accountability and transparency on behalf of the food risk governance.	Republic of Ireland	N=8 focus groups N=49 Consumers
Diplock, K. J., Jones-Bitton, A., Leatherdale, S. T., Rebellato, S., Hammond, D., Majowicz, S. E.. Food Safety Education Needs of High-School Students: Leftovers, Lunches, and Microwaves. *J School Health.* 2019.	None	19 in-depth interviews were conducted with food safety educators to identify the areas of food safety education that are important for high school students to learn.	Qualitative in-depth interviews with experts.	The interviewed experts identified four educational areas that need to be addressed including: how to safely handle food, how to keep themselves and kitchens clean, information about illness causing microorganisms and specific tips about keeping food out of the danger zone.	Ontario Canada	N=19
Dolgopolova, I., Teuber, R., Bruschi, V.. Consumers' perceptions of functional foods: trust and food-neophobia in a cross-cultural	None	Eight focus groups with Russians and Germans about functional foods were conducted and comparisons	Focus groups	Participants from both countries shared in distrust related to health benefits of products as well as marketing material about products. Soviet history likely influences the Russian distrust of formal institutions whereas	Russia and Germany	N=59

context. *International Journal of Consumer Studies.* 2015.		between countries were made. Findings suggest that both Russian and Germans are distrustful of their sources of food, but the source of the distrust differs by cultural nuances.		German distrust stems from food scandals and specific institutions.		
Elsey, H., Manandah, S., Sah, D., Khanal, S., MacGuire, F., King, R., Wallace, H., Baral, S. C.. Public health risks in urban slums: Findings of the qualitative 'healthy kitchens healthy cities' study in Kathmandu, Nepal. *PLoS ONE.* 2016.	None	A tri-part qualitative study was conducted with Napalese women to understand their perceptions of health risks as it related to kitchens. Women were well aware of the many risks at varying eco-social levels and identified health protective factors as well. Findings can inform	Semi-structured interviews, observation, and participatory workshops	Various health issues were identified by the women related to respiratory and gastrointestinal health as well as burns and other injuries. Stress was highlighted as a threat to wellness. Social capital was identified as a protective factor.	Kathmandu, Nepal	N=21 women interviewed N=69 workshop participants

		intervention development.				
Haque, I. T., Kohda, Y. Understanding the impact of social determinants of health in street food safety: a qualitative study in Bangladesh. International *Journal of Health Promotion and Education*. 2020	None	Qualitative methods included interviews, and focus group discussions to assess barriers to health information and adequate knowledge across street food vendors who did and did not participate in a street food safety intervention and well as costumers to develop a model of understanding the role of social determinants of health in food safety.	Structured questionnaires, interviews, and focus group discussions	Four key social determinants of health were identified including social and political environment, physical and working environment, lower socio-economic status, and education. A conceptual model situated these determinants within a model to improve health in the street food vendor sector.	Khulna City, Bangladesh	N= 40 vendors N= 20 customers
Hosseini, H., Khaksar, R., Esfarjani, F., Mohammadi, F.,	None	Twelve focus groups found that among Iranian	Focus groups	Eight themes emerged: sanitization of hands is important for personal hygiene, low knowledge about boiling times for	Iran	N=96

Roustaee, R., Alikhanian, H.. Home food safety knowledge and practices among Iranian: A qualitative study. *Clinical Nutrition.* 2015.		households there was confidence in strategies to prevent cross contamination, but this did not equate to protective behaviors. Areas for education were identified.		raw milk and canned foods, low knowledge about temperature storage and distribution of food in refrigerators, keeping unwashed food in refrigerators, defrosting frozen meat at room temperature, separation of sanitized cutting board for vegetables and raw meat, incorrectly disinfecting vegetables and improperly reheating food.		
Kendall, H., Kuznesof, S., Dean, M., Chan, M. Y., Clark, B., Home, R., Stolz, H., Zhong, Q. D., Liu, C. H., Brereton, P., Frewer, L.. Chinese consumer's attitudes, perceptions and behavioural responses towards food fraud. *Food Control. 2019*	None	Seven focus groups were conducted to understand how Chinese consumers viewed food fraud in order to better understand implications of food policy.	Focus groups	Key themes were that food fraud threatened the safety of food, there are barriers to obtaining authentic and safe food, there exist consequences for the consumer of fraudulent food, and that there are several risk relieving strategies people engage in because of the lack of control people have over their food authenticity.	Beijing, Guangzhou, and Chengdu China	N=42
Nizame, F. A., Leontsini, E., Luby, S. P., Nuruzzaman, M., Parveen, S., Winch, P. J., Ram, P.	Integrated Behavioral Model for Water, Sanitation and	Qualitative methods were used to assess hygiene practices during	Semi-structured observations; video observations; in-depth interviews; focus group discussions.	Almost none of the participants washed hands with soap and few with water during food preparation event. Though half reported the importance of	Bangladesh	N=55 (n=24 female caregivers, n=29 male heads of households)

K., Unicomb, L.. Hygiene Practices During Food Preparation in Rural Bangladesh: Opportunities to Improve the Impact of Handwashing Interventions. *Am J Trop Med Hyg*. 2016.	Hygiene (IBM-WASH)	food preparation of caregivers within rural Bangladeshi villages.		washing hands, they tended to only recognize the importance if hands were visibly dirty, and they saw their hands as being washed in water when they were washing utensils. Some expressed that lack of time, or cost of soap, as barriers to washing hands. Water sources were generally located away from food preparation areas.		
Passos, J. A., de Freitas, M. D. S., Santos, L. A. D., Soares, M. D.. Meanings attributed to healthy eating by consumers of a street market. Revista De Nutricao-Brazilian Journal of Nutrition. 2017.	Phenomenology	In depth interviews were conducted with consumers who frequently visited the targeted street market to gather information about their thoughts and behaviors related to healthy eating and food safety.	Qualitative interviews; participant observation	The meaning of healthy eating is something that interviewees revisit daily and related to their life experiences. Disease, aging, media reports, and learning new information from health care professionals influenced shifts in perceptions of healthy and safe foods. Generally, healthy foods were represented by fruits and vegetables, by practices considered hygienic, and by sensations such as pleasure and satiation provided by eating.	Bahia, Brazil	N=7 consumers
Songe, M. M., Hang'ombe, B. M., Knight-Jones, T. J., Grace, D.. Antimicrobial Resistant Enteropathogenic Escherichia coli and	None	Semi-structured interviews with randomly selected traders and consumers assessing their feelings related to the presence	Semi-structured interviews	All consumers said they would prefer to buy fish from a trader that employed an intervention such as the use of chlorinated water to disinfect the fish stalls, which could help to reduce the number of flies. Four consumers in Mongu said that the presence of	Zambia	N=30 consumers (20 in Lusaka, 10 in Mongu) N=20 traders

Salmonella spp. in Houseflies Infesting Fish in Food Markets in Zambia. *Int J Environ Res Public Health*. 2016.		of large numbers of flies at fish stalls.		no flies would be suspicious, as perhaps an indication that the fish had been treated with harmful chemicals. All traders complained that flies shorten the shelf-life of their fish and give the impression of an unhygienic product. Many asked for help in getting rid of flies and there were mixed feelings about nets. Some liked the idea as a deterrent from flies getting to their fish, but others thought they could be a turn off to customers.		
Telligman, A. L., Worosz, M. R., Bratcher, C. L.. A qualitative study of Southern U.S. consumers' top of the mind beliefs about the safety of local beef. *Appetite.* 2017.	Theory of Planned Behavior/Reasoned Action	Interviews using closed and open-ended questions assessing food safety beliefs about local beef.	Structured Interviews	Beef safety was not a top-of-mind concern for a majority of participants. Customers believed local beef was safer because they have greater knowledge about the product, and it does not involve as much shipping. Consumers believe that locally processed meat comes from smaller operations which is more likely to meet U.S. regulatory standards.	Alabama, USA	N=275 beef consumers
Tiozzo, B., Mari, S., Ruzza, M., Crovato, S., Ravarotto, L.. Consumers' perceptions of food risks: A snapshot of the Italian Triveneto area. *Appetite*. 2017.	None	Focus groups assessing food risk perceptions of people who were responsible for buying food for their family.	Focus Groups	Quality was linked to freshness and local origin. Most participants identified fresh foods (fruits, vegetables, meat, fish), eggs, and food contaminated with chemicals as risky. Consumers expressed concern about expired, deteriorated or poorly preserved food. Interviewees expressed a	Italy	N=45 consumers N=4 focus groups

				preference for Italian foods. Participants gave little attention to organic verses genetically modified food and opinions were varied. People preferred smaller shops or to buy directly from small producers. Large-size fish, farm animals, and fish slices are generally avoided as they are considered the most dangerous. Choice of food largely depended on the amount of time they had at their disposal: having less time meant more frozen foods, for example. Consumers were skeptical of the hygiene of canteens/cafeterias. Television was the most frequently used source of food safety information, followed by magazines.		
Tonkin, E., Coveney, J., Meyer, S. B., Wilson, A. M., Webb, T.. Managing uncertainty about food risks - Consumer use of food labelling. *Appetite*. 2016.	Adaptive Theory	Semi-structured in-depth interviews gathering information about consumers' main themes of shopping considerations, use of labelling, comparison of labelled and	In-depth semi-structured interviews	Participants defined quality in terms of risk, better quality products being lower risk. Parents were the most risk averse. Some consumers focus on a specific risk like a food allergy but are otherwise not as concerned with food risk. Participants were generally little concerned with issues of food spoilage, having confidence in the food system managing them. Food labelling was seen as a symbol of the food	Austrailia	N=24 consumers

		unlabelled products, and trust in the food system.		system having managed traditional risks and a tool for consumers to manage perceived risk.		
Tonkin, E., Wilson, A. M., Coveney, J., Meyer, S. B., Henderson, J., McCullum, D., Webb, T., Ward, P. R.. Consumers respond to a model for (re)building consumer trust in the food system. *Food Control*. 2019.	None	Food incident scenarios were presented to participants and discussion and debate ensued, in order to assess the strategies that participants suggest food actors use to address the issue.	Qualitative public deliberation study	Public opinion was consistent with the best practice model for food system actors to use in the event of a food incident and to assist in rebuilding trust of consumers. Some suggestions made for food actors to maintain consumer trust after an incident include: openness and transparency, providing statements from local health governing bodies, testing, having independent oversight, and providing information to consumers.	Austrailia	N=15 Austratilian adults
Wills, W. J., Meah, A., Dickinson, A. M., Short, F.. 'I don't think I ever had food poisoning'. A practice-based approach to understanding foodborne disease that originates in the home. *Appetite*. 2015.	Grounded Theory	Multiple qualitative methods were implemented to investigate and interpret domestic kitchen practices to provide insight about how the domestic setting might influence food safety.	Kitchen tour and mapping exercise; photography and photo-elicitation; observation and video-observation; informal interviews; diaries and scrapbooks.	Household kitchens were used for a range of non-food related activities and food work extends beyond the boundaries of the kitchen. The youngest children, oldest adults and pets, all had agency in the kitchen. Households derived logics and principles about food safety in terms of rules of thumb about “how things are done” including using senses and experiential knowledge when judging whether food is safe to eat.	England	N=20 households

Zhu, H. Y., Jackson, P., Wang, W. T.. Consumer, anxieties about food grain safety in China. *Food Control*. 2017.	None	Semi-structured interviews assessing consumer anxiety related to food grain safety.	Semi-structured interviews	Consumers expressed worry about the production and processing safety of food grains. Anxiety is amplified by social media reports of food scandals, polluted ecological environments, food-related chronic disease and cancer, concerns about food system governance and lack of knowledge and ability to identify grain quality. Consumers feel better when identifying grain quality themselves, choosing foreign grains and paying close attention to reports about unsafe food.	China	N=142 consumers

APPENDIX IV: Consumer Cross-sectional Mixed-Methods Studies Table

Author(s), Title, Journal, Year	Theory	Summary	Study Design	Results	Location	Sample
Almansour, M., Sami, W., Al-Rashedy, O. S., Alsaab, R. S., Alfayez, A. S., Almarri, N. R.. Knowledge, attitude, and practice (KAP) of food hygiene among schools'	Knowledge Attitudes and Practices (KAP) Model	**Quant:** A self-administered survey was used to assess knowledge, attitudes and self-reported practices **Qual:** Direct observation was additionally used to assess practices	An observational, cross-sectional study utilizing a stratified random sample of male primary, intermediate and high school students	Food hygiene knowledge was higher among high school compared to primary students. Attitudes towards food hygiene were primary school students compared to intermediate. Among all students, 88.4% responded hands should be washed before eating, 89% washed hands after eating raw meat, 82.7% washed their hands with soap after eating, 88.9% said the	Saudi Arabia	N=377 students (same sample used in observation)

students' in Majmaah city, Saudi Arabia. *J Pak Med Assoc*. 2016				expiration date should be checked before purchasing food.		
Badar, H., Ariyawardana, A., Collins, R.. Capturing Consumer Preferences for Value Chain Improvements in the Mango Industry of Pakistan. *International Food and Agribusiness Management Review.* 2015.	None	**Quant:** A three section questionnaire designed to assess (1) consumption preferences (2) buying preferences (3) mango attribute preferences	Mixed methods with focus groups informing the development of a consumer questionnaire	Hierarchical cluster analysis was conducted using questionnaire responses and three clusters emerged: (1) Mango Lovers (2) Value Seekers (3) Safety Conscious. Mango Lovers (34.45%) were motivated exclusively by attributes of the mangos themselves and not price or safety attributes. Value seekers (44.44%) were notable in that they were more concerned about the certification status of mangos relative to other clusters. They also purchased mangos in greater quantity. Safety Conscious (21.11%) differed in that they had higher mean score on health and safety items relative to another cluster. They were lighter consumers overall and preferred traditional retailors as they source for mangos	Pakistan	N=450 Consumers
		Qual: Five focus groups conducted with consumers to explore consumer value attributes of mango		Focus group results are not discussed.		N=5 focus groups (Focus group N not reported in text)
Bigson, K., Essuman, E. K., Lotse, C. W.. Food Hygiene Practices at the Ghana School	None	**Quant:** A questionnaire was used to assess hygiene practices and water source	A descriptive, cross-sectional study combining observational	It was observed that the majority of students did not wash hands with soap and running water. Most schools under observation did not have hand washing facilities. Hygienic conditions under	Ghana	N=600 students N=60 teachers N=60 kitchen staff (same sample used in observation)

Feeding Programme in Wa and Cape Coast Cities. *J Environ Public Health*. 2020		**Qual:** Observation and unstructured interviews for used to assess hygiene practices and facilities	data, unstructured interviews and questionnaires using a random sample of students, teachers and kitchen staff	which food was prepared was reported as good or fair according to students. The personal hygiene practices of kitchen staff were observed to be generally good. More than 50% of pupils had some complaint regarding meals served in school (partially cooked, presence of foreign material, unappealing color, etc.)		
Chidziwisano, K., Tilley, E., Malolo, R., Kumwenda, S., Musaya, J., Morse, T.. Risk Factors Associated with Feeding Children under 2 Years in Rural Malawi-A Formative Study. *Int J Environ Res Public Health*. 2019	None	**Quant:** Surveys, Checklists and microbio assays were used to assess risks associated with poor hygiene practices **Qual:** Structured observations were used for additional assessment of practices associated with risk for disease, followed by in-depth interviews	A mixed-methods cross-sectional, observational study with microbio assays	Food prepared for immediate consumption was found to pose minimal health risk. Certain poor hygiene practices were associated with increased risk (non-use of soap, improper storage temperature). Utensils were not found to be a primary source of contamination. Check list and structured observation revealed similar results: that handwashing did not occur during critical times, i.e. during food preparation.	Malawi	N=30 households for checklist observations, N=80 households for structured observations, N=323 for questionnaire N=20 for microbio sampling
Chidziwisano, K., Slekiene, J., Kumwenda, S., Mosler, H. J., Morse, T. Toward complementary	None	**Quant:** Cross-sectional study of households with female caregivers of children ages 6 to 24 months living in rural Malawi. Used a survey to assess "factor blocks": Risk,	Mixed-methods cross-sectional survey and observational study	Rates of washing utensils was higher in those with adequate water in the household. Keeping utensils elevated was higher in those with animals, dish racks, and who perceived that other people in the village were also	Masache, Ngowe/Ngabu and Maseya, Malawi	N=323 household with female caregivers of children aged 6 to 24 months.

food hygiene practices among child caregivers in rural Malawi. *Am J Trop Med Hyg.* 2019.		attitude, normative, ability, and self-regulation factors. **Qual:** Observed three behaviors: Washing utensils with soap, keeping them in an elevated area, and washing hands at appropriate times		elevating their utensils. Hand washing was higher among those with higher literacy, with hand washing facilities, and with a higher perceived risk of diarrhea. It was also lower in those who felt the soap was expensive and that hand washing was time consuming.		
Dang-Xuan, S., Nguyen-Viet, H., Meeyam, T., Fries, R., Nguyen-Thanh, H., Pham-Duc, P., Lam, S., Grace, D., Unger, F.. Food Safety Perceptions and Practices among Smallholder Pork Value Chain Actors in Hung Yen Province, Vietnam. *J Food Prot.* 2016.	None	**Quant:** Questionnaire assessing general information on pig procurement and slaughtering process. **Qual:** Focus groups assessing perception of pig diseases, food safety, and food safety practices.	Mixed-methods, cross sectional study utilizing structured questionnaires, observation checklist, focus group discussions, and key informant interviews	Slaughterhouse owners knew more about pig diseases affecting food safety and quality than pork sellers and consumers. However, there were considerable misperceptions surrounding zoonotic and foodborne disease among them. Workers frequently wore boots, but not uniforms or aprons. According to slaughterhouse workers, there are no specific regulations or standard operating procedures in the slaughterhouse, but they operate with informal rules, where they learn safe handling from more senior workers. Approximately half of the pork sellers transported the carcass or pork to be sold at pork shops by themselves via motorbike. None of the sellers stored	Hung Yen Province, Vietnam	N=3 Slaughterhouse owners N=25 (10 slaughterhouse workers; 15 pork sellers.

				pork in cooled cabinets or covered the pork. Most sellers did not use gloves to handle the pork, but they always wore aprons. Sellers used cloths to wipe and clean meat, table or equipment but also used their bare hands to handle pork and equipment.		
		Qual: Interviews assessing: community member's perceptions of the advantages and disadvantages of having slaughterhouses in the area; consumer's criteria for selecting pork, perceptions on pork-bone diseases, and food safety; veterinary staff and public health staff perceptions of their responsibilities, food safety management and collaborations.		All three public health officers interviewed stated that their responsibilities were for "cooked food" while raw meat was under the veterinary authorities' responsibilities. Veterinary staff mentioned a gap between existing legislation and inspection practices for pork safety surrounding transportation, slaughterhouses, markets, and raw meat handling and processing. Inspection legislation mainly applied to big or medium slaughterhouses or markets, whereas small or private butchers were not inspected frequently. Consumers assumed that less safe pork originates from sick or dead pigs and may have a bad smell or have a wet feel when touched. Most consumers knew of at least one pig disease affecting food safety. Community members emphasized some advantages of having slaughterhouses near their homes, such as providing jobs and providing fresh pork nearby. A disadvantage for		N=24 (N=9 community members; N=9 consumers; N=3 veterinary staff; N=3 public health staff)

				community members included noise, but all stated that they have become accustomed to the noises associated with the slaughterhouse. Some mentioned smell, water pollutions and the spread of animal diseases as disadvantages of living near a slaughterhouse.		
Downs, S. M., Glass, S., Linn, K. K., Fanzo, J.. The interface between consumers and their food environment in Myanmar: an exploratory mixed-methods study. *Public Health Nutrition.* 2019	None	**Quant.**: A combination of market and consumer surveys assessing the types, quality and price of foods at markets; as well as food preferences of consumers	Mixed methods with focus group results informing survey development and study locale.	Consumer surveys revealed a preference for fruits, vegetables and red meat compared to processed snack foods. Market surveys revealed that fresh, minimally processed foods were available at all markets that were assessed.	Myanmar	N=22 market surveys N=400 Consumer surveys
		Qual.: Semi-structured focus group to determine preference, purchasing and consumption patterns, and beliefs about how food environs have changes		Focus groups indicated that range of available food has increased over time, while quality had decreased, particularly the physical appearance, organoleptic quality and taste. Health was primarily associated with concept of food safety, though there was an overall lack of knowledge of what foods were healthy. Food safety was often associated with adulteration either through chemical preservatives or pesticides.		N=1 Focus group

Esfarjani, F., Hosseini, H., Mohammadi-Nasrabadi, F., Abadi, A., Roustaee, R., Alikhanian, H., Khalafi, M., Kiaee, M. F., Khaksar, R.. Development of a Home Food Safety Questionnaire Based on the PRECEDE Model: Targeting Iranian Women. *Journal of food protection.* 2016.	PRECEDE model	**Quant**.: The HFSQ was reviewed by expert panel and then women completed the questionnaire. Statistical testing demonstrates the HFSQ was sufficiently developed. **Qual.**: Focus groups with women and electronic data base review informed the development of the Home Food Safety Questionnaire (HFSQ).	Focus groups and a panel review board informed HFSQ development as well as cross-sectional survey testing of the instrument.	The resulting product of the methods is a valid and reliable measure of home food safety among Iranian women.	Iran	N=96 focus group participants N= 10 panel members N=320 survey participants
Evans, E. W., Redmond, E. C. An assessment of food safety information provision for UK chemotherapy patients to reduce the risk of foodborne infection. *Public Health*. 2017.	None	**Quant.**: Food related information resources were reviewed to assess the inclusion of food safety information for chemotherapy patients. **Qual.**: Interviews were conducted with patients and family caregivers to explore food-related experiences during chemotherapy treatment.	Content analysis of online patient information. In-depth semi-structured interviews	Online food-related patient information resources failed to highlight the increased risk of foodborne infection and an emphasis on the importance of food safety for patients during chemotherapy treatment. Many patients indicated awareness of immunosuppression during treatment and thought they reported practicing caution to reduce the risk of communicable diseases by avoiding crowded spaces, food safety was	United Kingdom	N=15 patients and caregivers N=45 food related information resources for chemotherapy patients

				reported to be of minimal concern during treatment and the risk of foodborne infection was often underestimated.		
Franklyn, S., Badrie, N. Vendor Hygienic Practices and Consumer Perception of Food Safety during the Carnival festival on the island of Tobago, West Indies. *International Journal of Consumer Studies*. 2015.	None	**Quant**.: Surveys assessed Carnival goers' level of consumption and purchase of street food, awareness of food safety, self-reported foodborne illness.	Cross-sectional survey; Observational check-list; interviews	More than half of Carnival goers purchased food at Carnival events (57.3%). Twenty-five percent purchased from specific vendors and 46% purchased from vendors who displayed food badges. Forty-three percent of consumers indicated that food was not purchased at Carnival events. Fifty-eight percent of consumers had seen or read food safety articles in local newspapers during the Carnival season. Ninety-six percent were aware of the possible transmission of pathogens, and almost half reported being affected by foodborne illness throughout their lives (49.3%). Younger consumers were more aware of foodborne illness transmission. There were significant associations between education and awareness of hygiene practices and were more likely to report foodborne illness formally.	Tobago, West Indies	N=150 consumers
		Qual.: Observation of and interviews with Carnival vendors to assess food safety and hygienic practices.		The majority of vendors were stationary (78%) and acquired more than 5 years of experience (44%). The most common food sold was hot dogs. The majority displayed valid food badges (74%), appeared outwardly		N=50 vendors

Franklyn, S., Badrie, N. Vendor Hygienic Practices and Consumer Perception of Food Safety during the Carnival festival on the island of Tobago, West Indies. *International Journal of Consumer Studies*. 2015. (Cont'd)				clean (88%), used aprons (54%), hair covering (70%), and had clean unpainted nails (98%). Most (78%) handled money while serving. Most foods were appropriately displayed (92%), stored (86%), and covered (90%). The majority of vendors failed to clean utensils (68%), 48% were unable to access any water, 76% had access to garbage bins, and 82% had access to nearby toilet facilities. Overall, 14% of vendors' overall environment appear to be visually very clean, 50% appeared to be fairly clean, and 36% appeared poorly cleaned.		
Hill, J., McHiza, Z., Puoane, T., Steyn, N. P.. The development of an evidence-based street food vending model within a socioecological framework: A guide for African countries. *PLoS One*. 2019.	Socio-Ecological Model	**(Phase 1) Quant**.: Cross-sectional survey assessing vendors' operations and food items and consumers' purchases and nutrition knowledge.	Cross-sectional surveys	The results of this portion of the study were published elsewhere and not mentioned in this paper.	South Africa	N=1047 consumers N=831 food vendors
		(Phase 2) Qual.: Interviews and focus groups with staff from the Western Cape Department of Environmental Health and Department of Economic Development. Questions pertained to regulations, bylaws, and policies that relate to street food vending, certification, business and hygiene	In-depth Interviews & Focus Groups	Participants gave the most attention to legislation, regulations and bylaws which street food vendors should adhere to in order to run a legally compliant operation. Environmental health and hygiene were of concern to officials. Consumer and vendor education were identified as the greatest challenges affecting the street food vending operations.		N=22 government officials

Hill, J., McHiza, Z., Puoane, T., Steyn, N. P.. The development of an evidence-based street food vending model within a socioecological framework: A guide for African countries. *PLoS One*. 2019. (Cont'd)		requirements, and support available for vendors. **(Phase 3)**: Data was integrated from surveys, focus groups, and interviews into main themes and components which would contribute to the development of a street food vending model. Focus groups were conducted among street food vendors to assess the acceptability and practicalities of the proposed model.	Focus groups	All participants agreed to the relevance, acceptability, and feasibility of including the components of the Street Food Vending Model, including nutrition, hygiene, safety, business and operational aspects of street-food vending.		N=28 food vendors (Four Focus Groups)
Kendall H, Naughton P, Kuznesof S, Raley M, Dean M, Clark B, Stolz H, Home R, Chan MY, Zhong Q, Brereton P, Frewer LJ. Food fraud and the perceived integrity of European food imports into China. *PLoS One*. 2018	Theory of Planned Behavior	**Quant.**: A survey explored factors influencing intention to purchase infant formula, scotch whisky, and olive oil from Europe.	Mixed methods: Seven focus groups were conducted to inform a quantitative survey with comparisons made between economically developed tier 1 cities (Beijing & Guangzhou) and economically	Guangzhou participants expressed greater hazard concerns. Food fraud resulted in the development risk-relieving strategies and preference for internationally sourced food because of a lack of trust in Chinese food.	Beijing, Guangzhou, Chengdu China	N= 850 survey respondents (n=284 Beijing, n=283 Guangzhou, n=283 Chengdu)

Kendall H, Naughton P, Kuznesof S, Raley M, Dean M, Clark B, Stolz H, Home R, Chan MY, Zhong Q, Brereton P, Frewer LJ. Food fraud and the perceived integrity of European food imports into China. *PLoS One*. 2018 (Cont'd)		**Qual.**: Focus groups assessed perceptions of food fraud including risk to consumer, trust of food source, and strategies to ensure the integrity of purchased food. Focus group findings informed the development of a conceptual model that was tested via structural equation modeling using quantitative survey data. Chinse consumers trusted international food sources over domestic supply chains. Targeted communication is needed to improve Chinese trust in domestic food supply chain.	developing tier 2 cities (Chengdu).	Focus group findings: persistent link between food fraud and food safety with greatest risk concerns about long-term cumulative impacts on health of youth. Consumers acknowledged that cities with most vulnerable populations receive the least regulatory attention regarding food fraud and safety. Greater confidence was displayed for international rather than domestic supply chains. To cope with perceived risks, consumers developed risk relieving strategies such as seeking food from Europe.		N = 7 focus groups, n = 42 participants
Lagerkvist, C. J., Okello, J. J., Karanja, N.. Consumers' mental model of food safety for fresh vegetables in Nairobi A field experiment using the Zaltman Metaphor Elicitation Technique. *British Food Journal*. 2015.	None	**Quant**: Survey to assess pre/post involvement in relation to food safety.	Survey	Results do not appear to have been documented	Nairobi	N=40 consumers
		Qual: Participants' photographs used to assess consumers' mental models in relationship to food safety of vegetables in traditional markets in Nairobi. 1.5-2-hour interviews with participants so that they could tell stories	Photos taken by participants related to food safety, Interviews	Participants had positive and negative connotations related to their thoughts and feelings associated with food safety. Negative thoughts include fear of death or illness from fruits or vegetables because of lack of food safety, as well as sadness associated with food that may not be safe to eat, and thoughts of poverty arise from		

				thinking about food safety. Positive notions of happiness and independence were expressed as the feelings associated with the ability to buy safe vegetables. Many associated safe foods with the ability to work and provide for their family.		
Lando AM, Bazaco MC, Chen Y. Consumers' Use of Personal Electronic Devices in the Kitchen. *J Food Prot.* 2018	None	**Quant**: Data were derived from the 2016 FDA Food Safety Survey and focus groups. **Qual:** Focus groups	Data derived from the 2016 FDA Food Safety Survey Cross-sectional survey. Eight focus groups were also conducted.	Findings suggest that participants are generally aware of the threat PEDs pose in the kitchen, yet do not take proper precautions like handwashing to avoid contamination during food preparation. Interventions are needed to address this gap between knowledge and practice. Nearly half of those who prepared food used PEDs. Findings reveal that consumers acknowledge their PEDs (especially cellphones) are likely contaminated, yet do not report taking the appropriate precautions while cooking to protect themselves from contaminants on PEDs. Instead, consumers were more likely to wash their hands after touching cooking ingredients.	United States of America	Focus group N= n=73 participants Survey N=4,169
Levine, K., Yavelak, M., Luchansky, J. B., Porto-Fett, A. C. S., Chapman, B.. Consumer	None	**Quant**: Cross-sectional surveys	Cross-sectional survey and four focus groups used to better understand	Respondents identified the appropriate risks associated with photographic scenarios posed in the survey. However, there was a significant difference in risk	United States (focus groups conducted	N=1,041 survey participants N= 39 focus group participants

Perceptions of the Safety of Ready-to-Eat Foods in Retail Food Store Settings. *J Food Prot.* 2017		**Qual**: Focus groups with adults	consumer perceptions of safe food handling practices in consumer settings like grocery stores.	perceptions between photographic scenarios of actual risky events compared to photographic scenarios of events only perceived to be risky. Focus group findings confirmed this divide between reality of risk and consumer perception of risk.	in California)	
McWilliams, R. M., Hallman, W. K., Senger-Mersich, A., Netterville, L., Byrd-Bredbenner, C., Cuite, C. L., Sastri, N.. Food Safety Practices of Homebound Seniors Receiving Home-Delivered Meals. *Topics in Clinical Nutrition*. 2017.	None	**Quant:** Food inventories and home kitchen safety audits were used to assess food safety knowledge, behaviors, environments, and in-home food supplies among home-bound seniors **Qual:** Direct observation, face-to-face interviews were used to assess food safety knowledge, behaviors, environments, and in-home food supplies among home-bound seniors.	A mixed method, cross-sectional study, using direct observation in combination with quantitative data collected through use of inventories, checklists	Lack of food safety knowledge was noted: 32% of seniors were unaware of how long perishable food items could be left unrefrigerated, and 35% were unsure or unaware of how long cooked meat, fish, eggs, etc. were safe to keep in the refrigerator. Poor kitchen conditions contributed to lack of food safety including vision problems, inadequate freezer/refrigerator temperatures, and cleanliness of kitchen appliances.	Iowa, New Jersey, South Carolina, Arkansas, California, USA	N=725 adults over 60 years old.
Mkhungo, M. C., Oyedeji, A. B., Ijabadeniyi, O. A.. Food safety knowledge and microbiological hygiene of households in selected areas of Kwa-Zulu Natal,	None	**Quant:** An observational study using data obtained from structured face-to-face interviews to assess knowledge and food safety practices combined with microbio sampling.	A mixed method, cross-sectional study combining questionnaire data with microbio assays	The majority (72%) were unaware of the temperature of their freezers. Improper thawing, packaging and improper handling were all observed as practices with high risk of cross contamination with meat. Roughly 20% of respondents indicated checking expiration dates on meat before purchase. The most commonly reported methods for thawing meat	South Africa	N=50 survey respondents

South Africa. Ital J Food Saf. 2018				was dipping it in tap water (40%) followed by leaving out on a kitchen surface (28%)		
		Sampling: Microbio sampling of raw foods and contact surfaces were used to assess		Microbio assays revealed presence of pathogenic agents in both raw food samples, contact surfaces, and utensils.		N=2,500 samples (50 per household)
Mumma, J. A. O., Cumming, O., Simiyu, S., Czerniewska, A., Aseyo, R. E., Muganda, D. N., Davis, E., Baker, K. K., Dreibelbis, R.. Infant Food Hygiene and Childcare Practices in Context: Findings from an urban information settlement in Kenya. *Am J Trop Med Hyg*. 2020	None	**Qual/Quant**: Structured observations and in-depth interviews were used to assess childcare, food preparation and feeding practices	A qualitative study utilizing both in-depth interviews and direct observation	The main findings included observation of behaviors that are associated with food contamination. Namely, hand feeding infants as well as storing food for extended periods of time. Food prepared by mothers in the morning was often fed to infants by other caregiver later in the day after reheating but was never observed being reheated to boiling point.	Kenya	N=28 mothers, and N=29 nonmaternal caregivers
Ng, H. M., Vu, H. Q., Liu, R., Moritaka, M., Fukuda, S.. Challenges for the Development of Safe Vegetables in Vietnam: An Insight	None	**Quant**.: Additional semi-structured questionnaires were used to assess consumer trust and purchasing behavior relative to safe vegetables	A descriptive, cross-sectional study combining primary data collected through in-depth	Safe vegetables were found to encompass only 10-15% of produce in modern retailers compared to conventional vegetables. Low price was revealed as a problem facing safe vegetable farmers. Confusion resulting from mixed messages about food poisoning incidents reported in mass	Vietnam	N=250 surveys with consumers

into the Supply Chains in Hanoi City. *Journal of the Faculty of Agriculture Kyushu University*. 2019.			interviews and semi-structured questionnaires	media was implicated in creating distrust and worry about vegetable safety.		
		Qual.: Qualitative in-depth interviews were conducted with Vietnamese agricultural stakeholders to assess "safe vegetable" production		Survey results indicated that only 20% of consumers who know about safe vegetables purchase them regularly.		N=44 in-depth interviews with local government, managers, distributors, farmers and consumers
Omari, R., Frempong, G.. Food safety concerns of fast-food consumers in urban Ghana. *Appetite.* 2016	None	**Quant**: A face-to-face, open ended questionnaire was administered to fast food patrons	Mixed methods design with emergent themes from focus groups used to develop a consumer questionnaire administered to a non-probability sample of fast-food consumers	Findings revealed that fast food consumers were concerned with food safety hazards in the form of pesticide residue on vegetables, excessive use of artificial flavoring, bacterial contaminants, contamination transferring from plastics, and unhygienic conditions where food is sold and prepared. Concern was also expressed for specific diseases such as cholera, typhoid, zoonotic influenzas and typical food-borne diseases. Male respondents indicated more concern about general food safety and younger participants expressed greater concern about typhoid exposures.	Ghana	N=419 fast food consumer questionnaires
		Qual: Three focus groups were used to evaluate consumer opinions on food safety issues. Themes were subsequently used to develop an open-ended questionnaire				N=3 focus groups of 12 participants each
Ravarotto, L., Crovato, S., Mantovani, C., D'Este, F., Pinto, A., Mascarello, G..	None	**Quant**.: Cross-sectional survey assessing eating habits and perception of microbiological risk	Cross-sectional survey administered via face-to-face	One hundred, twenty-three students who had lived outside of their family home for at least six months conducted a survey. Most (97.6%) reported cooking at least three times per week	Italy	N=123 university students studying agrarian and veterinary science

Reducing microbiological risk in the kitchen: piloting consensus conference methodology as a communication strategy. *Journal of Risk Research*. 2016.			interviews and focus group	and a majority (75.4%) cooked every day. Of students who shopped for groceries, 75% always or often read the label when purchasing an item for the first time. Less consideration was given to storage instructions than to best-before date and origin. On a scale from 1-10, the average judgement of the possibility of contracting a food borne infection was 4.5. The majority (67%) believed there was a higher probability of contracting foodborne infection from food served in a public eating place than from food prepared at home.		
Ravarotto, L., Crovato, S., Mantovani, C., D'Este, F., Pinto, A., Mascarello, G.. Reducing microbiological risk in the kitchen: piloting consensus conference methodology as a communication strategy. *Journal of Risk Research*. 2016. (Cont'd)		**Quant**: Survey assessing satisfaction and usefulness of food safety conference among university students.		Three conferences were held in which first students discussed and debated with one another about food safety. They then interacted with experts based upon the previous conversation with their peers. The discussion between students and experts led to the production of food safety guidelines. Two weeks after the conference, students filled out an online questionnaire on satisfaction. Overall, students found the conference interesting (mean score=8.24/10), Ninety-seven percent of students found the conference very or quite useful. Most (70.6%) found that the conversation with experts was the most engaging part of the conference.		N=34 university students

Ravarotto, L., Crovato, S., Mantovani, C., D'Este, F., Pinto, A., Mascarello, G.. Reducing microbiological risk in the kitchen: piloting consensus conference methodology as a communication strategy. *Journal of Risk Research*. 2016. (Cont'd)		**Qual.**: Focus group assessing behavior in the kitchen and microbiological risk associated with meat.		Generally, two specific practices were not considered to be a potential source of risk for young people: thawing meat and its storage after cooking. Checking times and temperatures during cooking was deemed to be a waste of time.		N=8 university students studying agrarian and veterinary science
Samapundo, S., Climat, R., Xhareri, R., Devlieghere, F. Food safety knowledge, attitudes and practices of street food vendors and consumer in Port-au-Prince, Haiti. *Food Control*. 2015.	None	**Quant:** Cross-sectional survey assessing food safety knowledge and attitudes of street food vendors and consumers.	Mixed method study: cross-sectional survey; observational checklist	Vendors had significantly higher food safety knowledge scores than consumers, but the majority of people in both groups had average food safety knowledge. Vendors who self-reported that they had received some training in food safety had a significantly higher level of food safety knowledge and attitudes than untrained vendors. Consumers had average food safety attitudes, and those with less education had higher scores than those with higher levels of education. There were significant differences based on location, with those in Delmas and Port-au-Prince having higher scores than consumers from Petion-ville. Ninety-five percent of vendors had at	Haiti	N=240 (N=160 consumers; N=80 vendors)

Samapundo, S., Climat, R., Xhareri, R., Devlieghere, F. Food safety knowledge, attitudes and practices of street food vendors and consumer in Port-au-Prince, Haiti. *Food Control*. 2015. (Cont'd)				least an average food safety attitude score and had significantly higher food safety attitude scores compared with consumers. The majority of consumers and vendors (89.4-100%) did not know that Hepatitis A, Salmonella, and S. aureus were foodborne pathogens. The majority of vendors and consumers did not know the groups of people who were most at risk of foodborne diseases and the importance of reheating food to fight against foodborne diseases.		
		Qual: Food handling observation checklist assessing food safety practices of street food vendors.		In the observational part of the study, 60% of vendors had flies or animals around their stall, 65% did not have access to potable water. The majority served food with bare hands and did not wash their hands after handing money. Seventy percent of vendors did not keep pre-cooked food at an appropriate temperature.		N=20 street food vendors
Sillence, E., Hardy. C., Medeiros, L. C., & LeJeune, J. T. Examining Trust Factors in Online Food Risk Information: The	Staged Model Approach	**Quant**: Eye tracking of milk consumers capturing their initial attention and first impressions and trust scores associated with viewing different websites.	Mixed method study including eye tracking of milk consumers along with focus groups and interviews	Introductory text was seen to be a significant feature of the homepage in terms of setting out the message, direction and tone of the website. Websites with higher negative first impressions ratings had low overall trust scores.	United Kingdom	N=33 consumers

Case of Unpasteurized or 'Raw' Milk. *Appetite*. 2016.		**Qual**: Participants first looked at websites with different milk safety messages. They completed a logbook for each site. Afterwards they engaged in a guided group discussion or interview and two weeks later, a follow-up telephone interview.	with milk consumers.	Messages perceived as more trustworthy are those presenting a balance of risks and benefits, information via a range of clearly accessible, vivid evidence formats, which express both the authorship credentials of the site and the personal and social relevance of the materials to the reader.	United Kingdom, United States	N=41 consumers

Vlasin-Marty, K., Ritter-Gooder, P., & Albrecht, J. A. Food Safety Knowledge, Attitudes, and Behaviors of Native American Families with Young Children: A Mixed Methods Study. *Journal of Racial and Ethnic Health Disparities*. 2016.	Health Belief Model	**Quant**: Cross-sectional survey with Native American consumers **Qual:** Focus groups with male and female Native American consumers.	Convergent parallel mixed method design: Food safety knowledge survey administered prior to 8 focus groups discussions using a focus group script.	Participant demographics: Among the sample participants (n=102) 55 (54%) were unemployed, 55 (54%) lived on tribal land/reservation, 87 (86%) had a secondary education. For some questions there was a significant difference between those living on or off the reservation. The average score on the knowledge survey was 62.2 %. 85 % (n=87) knew how to wash fresh fruits and vegetables. Seventy-seven percent knew how to correctly wash hands after changing a diaper. Twenty-four percent knew how to clean kitchen counters before preparing food and 51% (n=52) knew how to properly wash their hands. Eighty-six percent knew the harmful effects of E. coli to children kidneys, and 89% knew raw eggs can cause food poisoning for vulnerable populations. The following four themes were discovered in the focus groups: food can make one sick, I am not in control when others handle food, I know how to safely prepare foods for my family, and I do not have time or best equipment for food safety.	USA	N = 102 (Native American consumers) Participants recruited via survey pilot test = 38 Participants recruited via focus group = 66 Females = 83 Males = 19

Wertheim-Heck, S. C.O. & Raneri, J. E. A Cross-disciplinary Mixed-Method Approach to Understand How Food Retail Environment Transformations Influence Food Choice and Intake Among the Urban Poor: Experiences from Vietnam. *Appetite*. 2019.	Social Practice Theory	**Quant**: Data derived from census and household practice surveys over two years. **Qual**: Shopping trip observation and interviews.	Multi-year cross-disciplinary nutrition and social practices study to understand how food retail environment transformations (food supermarkets) influence food choice and intake among the urban poor who rely heavily on traditional fresh food vending structures like markets and street vendors. Balanced sequential quantitative-qualitative mixed-method design.	Census surveys on food retailing proved that there are more informal markets (wet-markets and street retail outlets) than supermarkets. Ninety percent of households still preferred to shop at informal markets. The 24-h dietary recall showed no significant difference in dietary quality across the different strata and diet quality was minimal. The quantitative knowledge and attitudes survey proved that consumers have a basic understanding of nutritional concepts. Interviews indicated many consumers know the importance of consuming fresh and safe vegetables. The variety of fresh fruits and vegetables was similar in both supermarkets and informal markets. However, supermarkets offered a variety of processed foods and wet markets lacked visual food safety claims and certificates. Also, convenience retail channels accounts for 67% of all food outlets. Produce in modern chain-stores offered 62% fresh vegetables and mom-and-pop stores offered only 2%.	Vietnam	N = 1,426 2017 Census: N = 563 2017 Household Practice Survey: N = 400 2017 Household Nutrition Survey: N = 347 2017 Sub-sample Repeat: n = 60 2018 Shopping Trips: N =14 2018 Multi-generation Household Study: N =14 2018 Multi-generation household interviews: N = 28

APPENDIX V: Consumer Studies by Type and Country

COUNTRY	Surveys	Qual	Mixed Methods	TOTAL
ASIA				
Jordon	2			2
Saudi Arabia	2		1	3
Malaysia	5			5
China	7	2	1	10
Vietnam	4		3	7
Turkey	5			5
Iran	3	1	1	5
Indonesia	2			2
India	2			2
Israel	1			1
Korea	1			1
Singapore	1			1
Thailand	1			1
Palestine	1			1
Lebanon	1			1
Nepal		2		2
Taiwan		1		1
Bangladesh		2		2
Pakistan			1	1
Myanmar			1	1
AFRICA				
Nigeria	3			3
South Africa	5	1	2	8
Ethiopia	1			1
Sudan	1			1
Ghana	1		2	3
Zambia		1		1
Malawi			2	2
Nairobi			1	1
Kenya			1	1
EUROPE				
United Kingdom	3	1	1	5
Italy	2	2	1	5
Ireland		1		1
Russia/Germany		1		1
Germany	1			1
Greece	1			1
Scotland	1			1
Switzerland	2			2
Belgium/Romania	1			1
Slovenia	1			1
Bulgaria	1			1
Hungary	1			1
NORTH AMERICA				
Canada	4	1		5
United States	6	1	4	11

Mexico	1			1
Barbados	1			1
Haiti			1	1
SOUTH AMERICA				
Tobago, West Indies			1	1
Brazil	4	3		7
AUSTRALIA				
Australia	3	2		5
MULTI CONTINENT				
Asia/Africa	1			1
Europe/Asia	1			1
Europe/North America			1	1

APPENDIX VI: List of Consumer Studies by Study Objective and Focus

SURVEYS (n=84)		
Study Objective	**Study Focus**	**Citation**
Perceptions of food safety 17.9%	• Fura and nunu food products in Nigeria • Seafood consumption • Food safety cues used when purchasing food • Online food products • Milk • Food additives and contaminants • Campylobacter, Salmonella, Toxoplasmosis • Qualities important to assess food quality • Food additives and contaminants and traits of food safety • Food safety of rice and vegetables • Food safety of fresh fruits and vegetables • Perceptions of food quality and relationship to safety • Slaughtering of goats • Risk perception and risk avoidance of foodborne disease • Risk perception of foodborne disease	1. Alimi et al. 2016 2. Baptista et al. 2020 3. Chamhuri et al. 2015 4. Dang et al. 2018 5. Fagnani et al. 2019 6. Hartmann et al. 2018 7. Henke et al. 2020 8. Mascarello et al. 2015 9. Maughan et al. 20?? 10. My et al. 2017 11. Niyaz and Demirbas, 2018 12. Petrescu et al. 2020 13. Qekwana et al 2017 14. Suth et al., 2018' 15. Wang et al. 2019 16. Evans and Redmond, 2019
General food safety KABB (adults) (23.8%)	• Chicken prep and raw chicken labels • Shopping and storage behavior and knowledge	1. Allan et al. 2018 2. Alsayeqh et al. 2015 3. Demircan et cl. 2018 4. Freivogel et al, 2020

General food safety KABB (adults) (23.8%) (Cont'd)	• Awareness of food safety and factors deemed important • Factors related to food handling behaviors • Food safety KABB and self-perception of salmonella exposure • Poultry handling, purchasing of minorities • Purchasing behavior related to food safety • Personal hygiene in refugee camp • Raw Chicken handling and knowledge • Raw chicken handling and knowledge • Food safety KABB • Food safety behaviors • Food safety KABB • Food safety KABB • Food safety KABB at home • Food safety KABB at home • Food safety KABB poultry purchasing, transport • Knowledge and behavior • Food poisoning knowledge and food preparation • Knowledge of foodborne risks during pregnancy	5. Godinez-Oviedo et al. 2019 6. Henley et al. 2015 7. Ishwar et al. 2018 8. Issa et al. 2015 9. Katiyo et aol. 2019 10. Kosa et al. 2015 11. Milazzo et al. 2017 12. Mullan et al. 2015 13. Odeyemi et al. 2019 14. Pang et al. 2015 15. Ruby et al., 2019 16. Ruby et al. 2019(b) 17. Sternisa et al. 2018 18. Tabrizi et al. 2017 19. Tomaszewska et al. 2018 20. Traversa et al. 2015
General food safety KABB (children/adolescents/teens) 7.1%	• Knowledge and food hygiene practice, secondary schools • KABB food safety • KABB of food safety • KABB food safety in high school students • Food safety KABB in males • Food safety KABB	1. Aluh et al. 2019 2. Cheng et al. 2017 3. Low et al. 2016 4. Majowicz et al. 2016 5. Mirzaei et al. 2018 6. Tutu et al. 2020
General food safety KABB (university students or young adults) 15.5%	• General knowledge of foodborne illness and transmission; behavior • Eating behavior, food safety knowledge, behavior • Food safety KABB • Handwashing frequency • Food safety KABB • Knowledge of food safety • Food safety KABB • Food safety knowledge in nutrition majors	1. Al-Sheyab et al. 2015 2. Alzoubi et al. 2015 3. Courtney et al. 2016 4. Cain et al. 2018 5. Green and Knechtges, 2015 6. Iqbal et al. 2019 7. Luo et al. 2019 8. Muhammad et al. 2018 9. Obande and Young, 2020 10. Sanlier and Baser, 2020 11. Sanlier et al. 2018

	• Food storage knowledge • Food safety KABB in young women • Food safety KABB in young consumers • Food safety KABB in vet students • Food safety KABB	12. Stratev et al., 2017 13. Syahira et al. 2019
General food safety KABB (older adults) 2.4%	• Food safety KABB with ready to eat food products • Food safety	1. Evans and Redmond, 2016 2. Thaivalappil et al. 2019
General Food Safety KABB (special populations) 2.4%	• Food safety KABB Cancer patients on chemo • Food safety risk perception, attitudes, behaviors in cancer patients	1. Evans and Redmond, 2018 2. Paden et al. 2019
Consumer food safety KABB in connection to street vendors/markets/restaurants 11.9%	• Food safety knowledge, microbial hazard awareness • Food safety perceptions and preferences of street food • Risk perception and knowledge food handlers and consumers in restaurants • Perceptions of street food safety • Tourist perceptions of food safety in ports • Food safety KABB in consumers, street vendors • Perceptions of informal food markets and factors that influence purchasing and food safety • Customer KABB about food facilities • Customer and vendor KABB • Chicken customer, farmer and vendor knowledge about avian flu virus	1. Asiegbu et al. 2016 2. Auad et la. 2019 3. de Andrade et al. 2019 4. Gupta et a l. 2018 5. Hull-Jackson et al. 2018 6. Ma et al. 2019 7. Marumo and Mabuza, 2018 8. Nguyen et al. 2018 9. Samapundo et al., 2016 10. Zhou et al. 2019
Mothers/Caregivers food safety KABB 9.5%	• Knowledge of food storage and handling; personal hygiene and food poisoning risks • Food safety knowledge and attitudes • Food safety practices at home • Food handling practices in parents • Hand washing practices • Hand washing practices	1. Ayaz et al. 2018 2. Dagne et al. 2019 3. Esfarjani et al. 2019 4. Kang et al. 2015 5. Opara et al. 2017 6. Phillips et la. 2015 7. Sithole et al., 2020 8. Zyoud et al. 2019

	• Knowledge and practice related to disease and cooking • Food safety KABB	
Food safety information sources and perceptions 8.3%	• Perceptions of food labels and packing; relationship to beliefs about food safety • Perceived food safety and customer loyalty • Relationship between sources of information on food safety perceptions • Sources of information and food safety handling at tailgates • Information sources on food safety and relationship to demographics • KABB to media campaign • Food safety evaluation and association with Internet use	1. Bou-Mitri et al. 2020 2. Bouranta et al. 2019 3. Han et al. 2018 4. Hanson et al. 2015 5. Nan et al. 2017 6. Senkham et al. 2015 7. Zhang et al. 2019
QUALITATIVE STUDIES (n=22)		
Study Objective	**Study Focus**	**Citation**
Expert opinion on food safety for consumers 9.1%	• Develop food safety hygiene checklist • Areas of food safety education important to learn in school	1. Araujo et al. 2018 2. Diplock et al. 2019
General food safety KABB (adults) 9.1%	• Understanding of food borne diseases and self-involvement in food chain • Domestic kitchen interpretation through diaries to assess food safety KABB	1. Behrens et al. 2015 2. Wills et al. 2015
Perceptions of food safety 50%	• Definitions of food safety and perceptions of mold/fungus infestations • Consumer perceptions of risk of purchasing and consuming bivalve meat • Perceptions of meat safety • Perceptions of trust in food sources • Perceptions of health risks related to kitchens • Perceptions of mistrust in food and strategies used to identify and cope • KABB of consumers of a street market on what “healthy eating” means	1. Chavez et al. 2016 2. Crovato et al. 2019 3. Dastile et al. 2017 4. Dolgopolva et al. 2015 5. Elsey et al. 2016 6. Kendall et al. 2019 7. Passos et al. 2017 8. Telligman et al. 2017 9. Tiozzo et al. 2017 10. Tonkin et al. 2019 11. Zhu et al. 2017

	• Perceptions of safety of local beef • Food risk perceptions in food purchasers • Food incident scenarios and consumer opinion on risk and response • Perceptions of grain safety	
Food safety information sources and perceptions 13.6%	• Perceptions of trust for food safety and purchasing decisions in women • Perceptions of good food governance • Use of information sources to make purchasing decisions about food safety and trust of the food system	1. Chiu and Yu, 2019 2. Devaney 2016 3. Tonkin et al. 2016
Consumer food safety KABB in connection to street vendors/markets/restaurants 9.1%	• Barriers to health information and knowledge in customers and street vendors • Feelings related to presence of flies in fish market in consumers and traders	1. Haque et al. 2020 2. Songe et al. 2016
Mothers/Caregivers food safety KABB 9.1%	• Behaviors and knowledge of prevention of cross contamination in home kitchens • Caregiver hygiene practices	1. Hosseini et al. 2015 2. Nizame et al. 2016
MIXED-METHODS (n=25)		
Study Objective	**Study Focus**	**Citation**
General food safety KABB (adults) 4%	• Personal electronic devices in kitchen	1. Lando et al. 2018
General food safety KABB (children/adolescents/teens) 8.0%	• Food safety KABB among male school students • Hand washing in students and observation of available facilities in schools	1. Almansour et al. 2016 2. Bigson et al. 2020
Perceptions of food safety 8.0%	• Consumers related to the perception of safety of mangoes • Perceptions of European products and food safety/food fraud	1. Badar et al. 2015 2. Kendall et al. 2018
Mothers/Caregivers food safety KABB 24%	• Behaviors in home related to food safety • Behaviors of female caregivers in home related to food safety • Input on Food safety questionnaire to assess home behavior	1. Chidziwisano et al. 2019 2. Chidziwisano et al. 2019 (b) 3. Esfarjani et al. 2016 4. Mkhungo et al. 2018 5. Mumma et al. 2020 6. Vlasin-Marty et al. 2016

Mothers/Caregivers food safety KABB 24% (Cont'd)	• Household hygiene and food safety • Food safety preparation and child feeding practices • Food safety KABB of food preparer in Native American families	
Consumer food safety KABB in connection to street vendors/markets/restaurants 40.0%	• Safety perceptions and practices in pork food chain actors, including consumers • Perceptions of food quality and safety of food in markets – consumer and market • KABB of food safety in those attending Carnival and vendors • Consumer food safety and nutrition knowledge, government officials and food vendors perceptions of certification etc. • Perceptions of food safety of vegetable in traditional markets. • Perceptions of safe food handling practices in grocery stores • Perceptions to assess consumer trust of vegetables and stakeholder assessment of food chain production • Consumer perceptions of safety of "fast food" in Ghana • Food safety perceptions of consumer and street food vendors; observation of vendors • Food retailing and association with food safety, food choice and behavior	1. Dang-Xuan et al. 2016 2. Downs et al. 2019 3. Franklyn et al. 2015 4. Hill et al. 2019 5. Lagerkvist et al. 2015 6. Levine et al. 2017 7. Ng et al. 2019 8. Omari and Frempong 2016 9. Samapundo et al. 2015 10. Wertheim-Heck et al. 2019
Food safety information sources and perceptions 8.0%	• Food related information sources in people on chemotherapy • Eye tracking of attention and impressions from website use on milk safety	1. Evans and Redmond, 2017 2. Sillence et al. 2016
General food safety KABB (older adults) 4.0%	• Home kitchen safety and KABB in home-bound adults	1. McWilliams et al. 2017
General food safety KABB (university students or young adults) 4.0%	• Perceptions of food safety, eating habits and microbiological risk in vet, ag and university students	1. Ravorotto et al. 2016

APPENDIX VII: Studies including Consumers and Vendors

Citation	Location	Focus	Results
Surveys			
Asiegbu et al. 2016	South Africa	Food safety knowledge, microbial hazard awareness	Use of street food – most males, less than 35. Used street food for affordability, availability and convenience. 60% award of risk but not deterred. 70% did not know names of common food bacteria related to illness.
Auad et la. 2019	Brazil	Food safety perceptions and preferences of street food	Choose street food for taste. Factors affecting choice of truck were food hygiene, vendor personal hygiene. Those who were younger and without children had highest food safety importance perception scores.
de Andrade et al. 2019	Brazil	Risk perception and knowledge food handlers and consumers in restaurants	Both food handlers and consumers felt foodborne illness was less likely to occur to them compared to their peers. 61.7% of food handlers and 59% of consumers got food safety knowledge questions correct.
Gupta et a l. 2018	India	Perceptions of street food safety risks and benefits and behavior intention according to Theory of Planned Behavior	Perceived risk factors of hygiene of vendor/food and health/environment risks were most important; benefits were convenience and value. Risks better drive intention and to lower risk perception, vendors would need to provide food information through menu labeling and address hygiene.
Hull-Jackson et al. 2018	Barbados	Tourist perceptions of food safety in ports	Tourists generally has positive food perceptions of two major ports (airport and cruise terminal), although more respondents at the airport reported importance of vendor hygiene.
Ma et al. 2019	China	Food safety KABB in consumers, street vendors	Consumers knowledgeable about food safety, but vendors had lower food safety knowledge scores than consumers. Only half of vendors indicated they separate raw food from cooked and only 33% used soap when washing dishes.
Marumo and Mabuza, 2018	South Africa	Perceptions of informal vegetable food markets and factors that influence purchasing and food safety	Food quality, safety and convenience were main reasons for wanting to use informal vegetable markets. More likely in households with more family members, and when head of household is unemployed and has lower education level.
Nguyen et al. 2018	Vietnam	Customer KABB about food facilities	Most respondents had good knowledge of handling of raw and cooked food and proper environment practices when processing food. Perceived hygiene and food safety were most important considerations when eating out. Most had never reported unhygienic food practices because of the belief that it was a waste of time.

Samapundo et al., 2016	Vietnam	Customer and vendor KABB	Consumers had greater food safety knowledge than vendors (80% vs. 10%). Age and education related to better knowledge. Vendors did not have food safety training and most places were unsanitary.
Zhou et al. 2019	China	Chicken customer, farmer and vendor knowledge about avian flu virus	Knowledge, attitudes and practice scores were higher for farmers than vendors. Female vendors and those who conducted slaughter was higher. Consumers who bought chicken at least once a month had better risk awareness compared to those buying more frequently and female consumers were more knowledgeable than males.
Qualitative			
Haque et al. 2020	Bangladesh	Barriers to health information and knowledge in customers and street vendors	Interviewed and did focus groups with vendors who had and had not had food safety training and consumers. Looked at KABB related to their social determinants. Findings show need to address things like health literacy to address gaps in knowledge and understanding, despite training.
Songe et al. 2016	Zambia	Feelings related to presence of flies in fish market in consumers and traders	Consumers indicated they prefer to buy fish from trader that used chlorinated water to disinfect stalls, although some felt not having any flies would be suspicious, meaning fish had been treated with harmful chemicals. Traders said flies shorten the shelf-life of fish and give impression of it being unhygienic.
Mixed-Methods			
Dang-Xuan et al. 2016	Vietnam	Safety perceptions and practices in pork food chain actors, including consumers	Slaughterhouse owners knew more about pig diseases and food safety than pork sellers and consumers. Observation showed that workers did not wear uniforms or aprons and did not think there were specific regulations or SOP. Pork transported via motorbike; sellers did not store in cooled cabinets or cover. Gap between existing legislation and practices.
Downs et al. 2019	Myanmar	Perceptions of food quality and safety of food in markets – consumer and market	Health was associated with concept of food safety; perception that adulteration of food either through chemical preservatives or pesticides made food less safe.
Franklyn et al. 2015	Tobago, West Indies	KABB of food safety in those attending Carnival and vendors	57% indicated they had bought street food during carnival; 25% only from specific vendors they "trusted" and 46% if they displayed a food "badge". Observation of vendors indicated most were outwardly clean and displayed and stored food appropriately. However most failed to clean utensils and almost half did not have access to running water.
Hill et al. 2019	South Africa	Consumer food safety and nutrition knowledge, government officials and	Consumers, governmental officials and vendors were included to develop a street food vending model that would include regulations and bylaws to address hygiene and safety.

		food vendors perceptions of certification etc.	
Lagerkvist et al. 2015	Nairobi	Perceptions of food safety of vegetable in traditional markets.	Consumers were provided cameras to take pictures of things they associated with food safety, including foods and vendors. Positive emotions were associated with the ability to buy safe vegetables and safe food was associated with the ability to work and provide for the family.
Levine et al. 2017	United States	Perceptions of safe food handling practices in grocery stores	Respondents identified appropriate risks from photographic scenarios, however there was a significant different in risk perceptions between the scenarios and actual risky events when compared. There is a divide between reality of risk and consumer perception of risk.
Ng et al. 2019	Vietnam	Perceptions to assess consumer trust of vegetables and stakeholder assessment of food chain production	Only 20% of consumers who knew about safe vegetables purchased them regularly, mostly because of cost. Vendors said price and confusion in messaging about safety in the media created distrust in consumers and worry about vegetable safety.
Omari and Frempong 2016	Ghana	Consumer perceptions of safety of “fast food” in Ghana	Consumers concerned about food safety hazards in “fast” food from pesticide residue, artificial flavoring, bacterial contaminants and plastics, as well as hygiene where food is sold.
Samapundo et al. 2015	Haiti	Food safety perceptions of consumer and street food vendors; observation of vendors	Vendors had higher food safety knowledge than consumers and reported some training in food safety. Consumers in larger urban centers had higher knowledge. However, neither knew that Hepatitis A, Salmonella and S. aureus were foodborne pathogens. On observation, 60% of vendors had flies or animals around the stall and 65% did not have access to potable water. Most served food with bare hands and did not wash hands after handling money. 70% did not keep pre-cooked food at appropriate temperature.
Wertheim-Heck et al. 2019	Vietnam	Food retailing and association with food safety, food choice and behavior	More informal markets than supermarkets, although variety of fresh fruits and vegetables were similar. Wet markets lacked visual food safety claims and certificates. 90% of consumers preferred to shop at informal markets and most knew the importance of consuming fresh and safe vegetables.

Summary of Geographies of consumer-vendor studies: Vietnam – 5 studies; South Africa – 3 studies; Brazil – 2 studies; China – 2 studies.

Asia: India 1, Bangladesh 1, Myanmar 1; Africa: Zambia 1, Nairobi 1, Ghana 1; N America: US 1, Haiti 1, Barbados 1; S America: Tobago

Appendix VIII: Vendor Studies Summary Table

Author(s), Title, Journal, Year	Summary	Study Design	Results	Location	Sample size
Ahmadi S, Maman S, Zoumenou R, Massougbodji A, Cot MGlorennec P and Bodeau-Livinec F (2018)Hunting, Sale, and Consumption of Bushmeat Killed by Lead-Based Ammunition in Benin Int. J. Environ. Res. Public Health 2018, 15, 1140	Examined process from hunting to consumption of bush meat, from the perspective of preventive measures. Few sellers acknowledged removing the meat impacted by lead shot prior to sale.	Cross sectional	The findings, suggest that the hunting, sale, and consumption of bush meat killed by Pb-based ammunition are common and well-known in this setting. As there is no safe level of Pb exposure in humans, serious attention of the public health authorities and researchers are required in this regard.	Benin	8 bush meat sellers

Marc K, Philippe S, Eustache H, Boniface Y, Sohounhloue Dominique S, Souaïbou F (2014) Microbiological Quality of Smoked Mackerel (Trachurus trachurus), Sold in Abomey-Calavi Township Markets, Benin. Journal of Microbiology Research 2014, 4(5): 175-179	Examined microbiological quality of smoked T. trachurus sold to consumers and a survey in 4 major Abomey-Calavi township markets to assess the processing and selling conditions for T. trachurus. Lack of hygienic practices for the smoking, storage and sale of T. trachurus. All fish were hot smoked without gutting, drying or salting of the fish. About 95% of the producers reported using well water that had not been tested for microbiological quality. In general, the production and sale of fish were done in environments that were not sanitary. Fish were most likely washed with compromised quality water, sold in the open air without packaging, sometimes near piles of garbage and toilets with a large presence of flies around the fish. Thus, 28% of vendors were in an unhealthy environment, 19% used uncleaned equipment, 21% of the vendors were not themselves clean, garbage was present close to 19% of the fish stalls, flies were present at 26% of the fish for sale, and toilets were only available to about 12% of vendors. All vendors were outside with fish left open with no	Cross sectional	Producers and vendors were not following good hygiene practices for the smoking, storage and sale of T. trachurus.	Benin	42 fish sellers

Akoachere JFTK, Tatsinkou BF and Nkengfack JM (2018) Bacterial and parasitic contaminants of salad vegetables sold in markets in Fako Division, Cameroon and evaluation of hygiene and handling practices of vendors. Akoachere et al. BMC Res Notes (2018) 11:100	Examined bacteriological and parasitological quality of salad vegetables, antimicrobial sensitivity of bacterial isolates, and hygiene and preservation practices of vendors. Hygiene and vegetable preservation practices of vendors were poor. Hand washing with soap was practiced by 23.3%. Washing of vegetables was practiced by 35.0% amongst which 38.1% used stream water. None of the vendors transported vegetables to the market or sold them under controlled temperature conditions. Vegetables were placed on dirty bags during sale. Unsold vegetables were kept in the market (55.0%) or left in the backyard of their houses (45.0%).	Cross sectional	The majority of the participants did not practice good hygiene thus increasing the chances of contamination. Transportation to the market was under unhygienic and uncontrolled temperature conditions. Thus there is an urgent need to sensitize vendors on good hygiene and preservation of vegetables, and the public on proper washing and sanitization of vegetables prior to consumption.	Cameroon	60 vendors

Sanhoun AR, Traore´ SG, Gboko KDT, Kirioua J, Kurt F, Otaru N, et al. (2020) Traditional milk transformation schemes in Cote d'Ivoire and their impact on the prevalence of Streptococcusbovis complex bacteria in dairy products. PLoS ONE 15(5): e0233132	General hygiene was poor. Milk was not filtered by producers and collectors and was often stored in inappropriate containers. Hand and utensil washing was infrequent. A small proportion of vendors heated the milk to boiling temperatures. However, the heat-treated milk was still sold at ambient temperatures (31.5˚C) by the majority of vendors. Only approximately 1/3 of vendors sold their milk refrigerated. Vendors kept the milk raw only on specific demand by customers.	Cross sectional	This study provided the first dairy production system assessment and Sii/SBSEC prevalence determination for Northern Coˆte d'Ivoire, the main dairy producing area of Cote d'Ivoire. The dairy production system featured limited compliance with good manufacturing practice and had high bacterial counts. It was a value chain study and as so much of the milk that the vendors receive is poor quality it was worth while characterizing this as future interventions just targeting vendor won't likely make milk much safer until this is fixed.	Cote D'Ivoire	Producers 30, collectors 30 and milk vendors 13

Kabwang R, Kitwa M,, Melin P,Daube G, De Mol P,and Mukeng A. Kaut3Risk factors associated with retail meat vendors in Lubumbashi, Democratic Republic of Congo African Journal of Food Science 13(11) pp. 248-260,	Examined food safety risk factors associated with retail meat sales in Lubumbashi, Congo D.R via interviews and direct observations. There was a poor practices toward basic hygiene rules such as hand washing and body hygiene among meat vendors in Lubumbashi. Only 32.7% of meat vendors washed their hands after using toilet facilities, 13.6% after the goat slaughter process and 0% after handling other products such as money and live animals. Only 39% of vendors used clean water to clean their vending sites and, 53.3% their utensils. Besides, 29.7 and 47% used wastewater to clean their vending places and utensils, respectively. Some vendors (19.6%) performed a dry cleaning of their vending places with brush; others (26.1%) used cloth to wipe their utensils at the end of daily activities. Concerning personal hygiene, 61.3% of vendors were aware of taking a shower before they leave home to go for their activities, and 88.7% wore clean clothes. Thirty-nine per cent (39.9%) were wearing hand jewels and watch, and 74.4% were carrying their mobile phones. In the	Cross sectional	Attitude, practices, and lack of food safety knowledge in meat handling, improper slaughtering processes, poor environmental and personal hygiene, inadequate storage of food and lack of potable water were identified as major risk factors which may contribute to various contamination of meat sold at retail outlets in Lubumbashi. Local government, as well as regulatory authorities, may support informal markets by recognizing them as a part of the economy. However, they should provide regulation and control to ensure food safety of meat vended at a retail outlet, and thus reduce the risk toward public health. Local administration should provide primary facilities such as adequate vending places where minimal services are provided like potable water, energy, tile-flooring outlets, coated walls and waste management. Each point of meat sale should be equipped with a basic hygiene appliance containing a refrigerator if possible, with transparent displays to facilitate the customer's choice. Storage warehouses in the market must be equipped with refrigerators or freezers to ensure better storage of meats. Local authorities should provide conventional goat's slaughterhouses	DRC Congo	168 meat vendors

	case of diseases, 24.4 and 30.4% were willing to stop their activities if they suffer respectively from diarrhea or typhoid fever. None had a health certificate, and only 15.4% were interested in a voluntary screening of diseases. Gender and type of activity did not reveal any difference in practices. In the market, meats were directly displayed on concrete stalls or wooden table, or directly on the floor. Plastic, cardboard, old newspaper or other materials were used as a tablecloth. There were no scopes to avoid insect or dust during the display. Vendors used knives, metal saw, axe and machete to cut the meat into small pieces weighing 50 to 120 g. All the handling processes were achieved with bare hands. Sometimes, meats of different species, fish and vegetables were sold by a single vendor without a proper separation. In the market, clean and unused polythene bags were used for packaging. There is no formal abattoir in Lubumbashi dedicated to goat slaughter. In general, goats were slaughtered in		and request minimal training in goat slaughtering for those who are involved in this practice. Furthermore, the local government should raise awareness of the threat of improper practices in meat/food handling and set up control measures to oversee meat vending activities in markets and streets. For instance, vendors must be licensed before they practice their business; and they should undergo medical screening for transmissible diseases. Meat vendors should be aware of the role they play in the transmission of foodborne illnesses. Finally, an educational program and food safety training should be considered for persons dealing with meat and street food. The cost/benefit of the educational program in good hygiene practice during meat/food handling is more economical than dealing with consequences of foodborne diseases due to lack of knowledge in food handling.		

Fasanmi OG, Ahmed, SSU, Oladele-Bukola MO, El-Tahawye AS, Ahmed R. Elbestawy AR,Fasina FO (2016) An evaluation of biosecurity compliance levels and assessment of associated risk factors for highly pathogenic avian influenza H5N1 infection of live-bird-markets, Nigeria and Egypt Acta Tropica 16 4321–328	Biosecurity compliance level and risk factor assessments in 155 LBMs was evaluated in Nigeria and Egypt through the administration of a 68-item biosecurity checklist, scored based on the modifications of previous qualitative data, and analyzed for degree of compliance. Claims of hand disinfection after slaughter were significant risk factors while mandatory routine disinfection of markets, fencing and gates for live bird market and hand washing after slaughter were protective factors for and against the infection of Nigerian and Egyptian LBMs with the HPAI H5N1 virus. Almost all the LBMs complied poorly with most of the variables in the checklist, but pathways to improved biosecurity in the LBMs existed. Policy and regulation-related biosecurity compliance were poor in all the LBMs in Egypt. Egypt (vs Nigeria) performed significantly better in compliance with control of presence of wild birds, control of presence of pests, less other non-avian animals traded in the market, less wild animals traded in the market, mandatory routine disinfections of the markets	Cross Sectional	This study compared food safety practices in Nigeria and Egypt. Only Egypt stats are recorded in the spreadsheet, and the paper has captured a lot of information on practices. LBM operators play a critical role in the disruption of transmission of H5N1 virus infection through improved biosecurity and participatory epidemiology and multidisciplinary approach is needed. The use of participatory epidemiology using multidisciplinary task team is highly recommended to enable the LBM operators adopt biosecurity measures. Government legislation should include bottom-up approach and surveillance (active, passive and risk-based) and sero-monitoring should be a routine exercise at the LBMs.	Egypt	80 LBMs

Eltholth M, Fornace K, Grace D ,Rushton J, Häsler B (2015) Characterisation of production, marketing and consumption patterns of farmed tilapia in the Nile Delta of Egypt / *Food Policy 51 131–143*	The aim of this study was to characterize production, marketing and consumption patterns of farmed tilapia. More than 70% of the retailers did not know if their fish supplier was licensed or not. A high proportion (62%) check the quality of fish before buying by examining the general appearance, color, odor, stomach fullness and thickness of back muscles. They usually transport tilapia in plastic boxes with ice (87%), without ice (11%) or in water tanks with oxygen supply for live fish (2%). Most retailers (79%) clean their crates and other storage equipment on a daily basis. However, only 9% used disinfectants. Most retailers (87%) sold fish directly to consumers. Interviewers' observations for retailers showed that `50% of retailers had a permanent structure, a source of electricity, access to running water, a concrete floor, separate rubbish bins and clean cloths. More than 50% used plastic storage containers.	Cross sectional	There are many potential sources for contamination of farmed tilapia with different pollutants along the production chain due to some current practices, low level of hygiene and lack of monitoring systems at farms, transporting and retailing. However, there was high awareness of hygiene and safety and many good practices along the value chain, despite limited awareness of international standards. Public health may be promoted by creating an awareness of hygienic handling and healthy cooking of tilapia.	Egypt	100 Retailers

Abd-Elaleem R, Bakr WMK, Hazzah WA, Nasreldin O(2014) Assessment of the personal hygiene and the bacteriological quality of butchers' hands in some abattoirs in Alexandria, Egypt *Food Control* **41** 147-150	Evaluation of butchers regarding their bacterial hand contamination and hygienic practices. Evaluation of the hygienic practices of the 50 butchers revealed that daily hand wash was performed by 40 (80%) butchers at the beginning of the day, where 15 (37.5%) out of those used soap andwater,16 (40%) used tap water only, while 9 (22%) used unclean basin water. Paper towels were used by 16 (40%) butchers for hand drying, while 11(27.5%) butchers dried their hands by their clothes and 13 (32.5%) butchers let their hands wet. Regarding protective clothes, 15 butchers (30%) put aprons while 8 butchers (16%) used gloves and gumboots, respectively. It was found that none of butchers cleaned aprons daily, while 12 (24%) butchers cleaned it once/week and 3 (6%) butchers cleaned it twice/week. By inspection of health certificates, out of 50 butchers, 23 (46%) had health certificates of which 9 (39.13%) were valid.	Cross sectional	There is an immediate need for health education of butchers about the proper hygienic practices they should follow	Egypt	50 butchers

Gemeda BA, Amenu K, Ulf Magnusson U, Dohoo I, Hallenberg GS, Alemayehu G, Desta H and Wieland B (2020) Antimicrobial Use in Extensive Smallholder Livestock Farming Systems in Ethiopia: Knowledge, Attitudes, and Practices of Livestock Keepers *Front. Vet. Sci*. **7:** 55	Knowledge, attitude, and practice (KAP) of smallholder livestock owners regarding antimicrobial use, residue, and resistance in three agro-ecological zones and production systems in Ethiopia. Around 21.7% of the respondents had a tendency of keeping leftover antimicrobials at home, as they might be useful in the future. Regarding practices related to antimicrobial use large proportion of the respondents reported that they commonly consumed milk and meat from animals that had just been treated with antimicrobials, although they assumed it might not be good for human health. The majority of pastoralists reported this practice. Overall, the majority of the respondents (70%) administered antibiotics as advised, but 72.3% of pastoralists administered antibiotics by not following through the full treatment course: "until the animal cured," "until package empty," "as long as they can afford," "one time treatment or continuously over extended period." All pastoralists self-administered antibiotics to their animals without any laboratory	Cross sectional	The need for interventions to increase knowledge among smallholder farmers to improve the way antimicrobials in general and antibiotics in particular are used in these settings is confirmed. In addition, professional involvement, supervision, and guidance can also lead to more efficient antimicrobial use by smallholder livestock owners.	Ethiopia	379 smallholder livestock owners (households)

	diagnosis. About 98% of pastoralists had good practice with regard to care of expired veterinary drugs, which they either disposed of by burying or returning to the vendor. Indeed, during data collection, 97% of the pastoralist households did not have any expired antimicrobial at hand. Half of the respondents (50%) reported to have an isolation pen for sick animals and 40% indicated that they would allow animals currently receiving treatment to immediately freely graze with other animals without quarantine. Only 9% of the respondents implemented proper practices regarding disposal of dead animals, either through burial or incineration. The majority (97.5%) of the pastoralists and 4% of respondents from each of the highland and lowland mixed crop production systems revealed consumption of dead animals				

Getaneh Alemu G, Nega M, Alemu M (2020)Parasitic Contamination of Fruits and Vegetables Collected from Local Markets of Bahir Dar City, Northwest Ethiopia Research and Reports in Tropical Medicine 2020:11 17–25	Data on sociodemographic characteristics of vendors and factors associated with contamination of fruits and vegetables were collected using a structured questionnaire. About 200 g of fruit and vegetable samples were processed for parasites. Fruits and vegetables sold by vendors having untrimmed fingernails, displayed in a bucket with water and without washing were at higher risk of parasitic contamination	Cross sectional	Public health sector should create awareness among farmers, vendors and consumers about safe cultivation, transportation, handling and consumption of fruits and vegetables. Periodic screening of on-market fruits and vegetables should be done.	Ethiopia	112 vendors
Alemu G, Mama M, and Siraj M (2018) Bacterial contamination of vegetables sold in Arba Minch Town, Southern Ethiopia. BMC Res Notes 11: 775	A structured questionnaire was used to capture data about factors associated with parasitic contamination of vegetables in the marketing phase. Selected vegetables were purchased and processed for examination of parasitic contamination. Vegetables were not washed before display and were displayed on the floor, though these practices were not associated with the increased microbial load.	Cross sectional	Local public health sector should establish a system for continuous monitoring of contamination of vegetables sold at local markets. The public health sector should also advocate to the community not to consume vegetables without adequate washing or proper cooking	Ethiopia	347 vegetable samples

Sahile S, Legesse T, and Teshome Z (2019) Bacteriological Quality Assessment of Fresh Lettuce and Tomato from Local Markets of Gondar, Ethiopia. Journal of Academia and Industrial Research (JAIR) 8 (1) 1-10	Examined bacteriological quality of fresh lettuce and tomato and handling practice of retailers. Vendors pack and store the fruits in plastic sacks, in baskets usually made from woven grasses, and in wooden crates. Almost none of the respondents used plastic crates. Regarding the handling practices of retailers the result of this study showed that all the respondents (100%) have prolonged the shelf-life of unsold fruits and vegetables by moistening with water than using refrigeration. Vendors did not wash vegetables before sale or containers used for keeping vegetables. All retailers used a single common balance for weighing different kinds of fruits; this may result in cross contamination. They lacked sanitary practices and personal hygiene was not observed. The displaying area for fruits and vegetables were found to be Unhygienic. Feces of animals like donkeys and humans were observed just around the displaying sites. Swarms of flies were also common.	Cross sectional	Food producers, distributors and vendors are responsible for ensuring that their products meet all applicable food safety requirements protecting fruit/vegetable displaying sites from fecal contamination and containers used for displaying, transportation and storage facilities are kept clean and dry.	Ethiopia	45 vendors

Abayneh M, Tesfaw G, Woldemichael K, Yohannis M and Abdissa A(2019) Assessment of extended-spectrum βlactamase (ESBLs) – producing Escherichia coli from minced meat of cattle and swab retailer shops in Jimma town, Southwest Ethiopia BMC Infectious Diseases 19:897	Assess presence and antimicrobial susceptibility patterns of ESBLs - producing E. coli isolates from minced meat and environmental swab samples at meat retailer shops. 80 swab samples taken from butcher's hand, knives, chopping board and protective clothing. Checklist was used to assess hygienic status of butcher shops and practices meat handlers. Poor hygienic status of butcher shops and unhygienic practice of meat handlers were observed. Only 36.4% of the floors were made of concrete ceramic and only 33% of the floors were free of cracks. 81.8% of the butcher shops had ceiling however only 30.7% of them were properly finished and free of dusts. Only 8% butcher shops had insect and dust proof shelf for meat display and only 19.3% of them were having smooth and easily washable chopping board for cutting of meats. Only 34.1% of butcher shops used clean knives and clean meat hanger. Only 10.2% of them wore clean protective clothing during meat handling. None of the butchers had taken any	Cross-sectional	Strategies should be planned and implemented to improve the knowledge and practice of butchers about handling and processing of meat.	Ethiopia	168 minced meat and swab samples

Amenu K, Wieland B, Szonyi B and Grace D (2019) Milk handling practices and consumption behavior among Borana pastoralists in southern Ethiopia. Journal of Health, Population and Nutrition 38:6 1-12	Assess the hygienic milk production, processing and consumption practices, and behaviors of Borana pastoralists: milk handling practices, perceptions of quality and safety of milk, including perceived criteria for good milk, awareness of milk-borne diseases, and perception towards milk boiling practices. Unhygienic conditions in handling milk and milk products, smoking of milk containers (which may help reduce microbial growth), there was no attempt by the pastoralists to remove dirty matter from the udder before milking. Hand milking was used, and the persons milking the animals were observed not to wash their hands before milking or between milking of different animals in a herd. Lactating animals were housed in kraals full of manure. Borana pastoralists often use traditional containers for milking, storage, or transportation of milk. They had also started using other containers such as plastic jerry cans for milk transport or storage. Both traditional containers and plastic jerry cans are difficult to	Cross Sectional	It is important to promote hygienic handling practices of milk and closely engage with local communities to improve their understanding of milk safety to facilitate change in practices. Educating pastoralists on good milk production practices should be given priority. One of the ways to do this could be by strengthening the integration of milk hygiene in research and development programs as an entry point for behavioral change towards the safe handling and consumption of milk and milk products.	Ethiopia	40 women

Alemu G, Mama M, Misker D and Haftu D (2018) Parasitic contamination of vegetables marketed in Arba Minch town, southern Ethiopia BMC Infectious Diseases 19:410	Examined level of bacterial contamination and associated factors among vegetables marketed. Vegetables were not washed before display and were displayed on the floor, though these practices were not associated with the increased bacterial contamination	Cross sectional	Public health sector should work on safe transportation, handling and utilization of contamination prone vegetables as well as continuous screening of on-market vegetables.	Ethiopia	347 vendors

Disassa N, Sibhat BMengistu S, Muktar Y and Belina D (2017) Prevalence and Antimicrobial Susceptibility Pattern of E. coli O157:H7 Isolated from Traditionally Marketed Raw Cow Milk in and around Asosa Town, Western Ethiopia Veterinary Medicine International Volume 2017, Article ID 7581531	Examined hygienic practices during milking, handling, storage, transportation, duration of transportation, and storage of the milk by the stakeholders and their knowledge regarding diseases associated with milk, in order to assess the associated risks. Well water used by vendors for cleaning purposes and only water was used for washing milk handling equipment's . Sanitary practices were followed sometimes. Some vendors used plastic containers to store the milk which was transported over 5 hours from the source of origin.	Cross sectional	Most of the milk supplied to the consumer in the town was managed under poor hygienic conditions at ambient temperatures with poor levels of sanitation in plastic containers. Most of the stakeholders were managing the raw milk with limited awareness and knowledge on milk contamination and on the public health impact of milk-borne pathogens. The sources of E. coli in the raw cow milk may be from contaminated udders, contaminated water, poor sanitation practices, contaminated containers, and milk handlers themselves. Since the milk is managed at an ambient temperature, high microbial populations can be reached within short period of time.	Ethiopia	178 farmers and 202 vendors

Tegegne HA, Phyo HWW (2017) Food safety knowledge, attitude and practices of meat handler in abattoir and retail meat shops of Jigjiga Town, Ethiopia. J PREV MED HYG; 58: E320-E327	Determined food safety knowledge, attitudes, and practices in abattoir and retail meat shops. The food-handlers' safety practices were below acceptable level. It was found that almost no respondents (98.9%) maintained food safety practices. 69.2% of respondents eat and drink and 65.9% smoke at their work place. Almost no (98.9%) meat handlers use gloves during meat processing. Most of the respondents do not use aprons (55%), hairnet or cap (62.6%) and mask (98.9%) while doing their work. Concerning sanitizer use, 79.1% respondents do not use any sanitizer to wash utensils such as knives, hooks cutting boards and the floor surface as well. Most of the handlers (86.6%) did not wash hands after smoking, coughing, and sneezing.	Cross-sectional	Majority of the meat handlers were illiterate (30.8%) and primary school leaver (52.7%), and no one went through any food safety training except one meat inspector. Knowledge of food borne pathogens was extremely low. Though most of the meat handler have basic understanding and good attitude about personal hygiene, hand washing and proper cleaning, they did not translate into strict food hygiene practices. Thus, there is need for continuous education and hands on training for meat handlers that can enhance good safety practices through better understanding and positive attitude.	Ethiopia	91 meat handlers

Bekele F, Tefera T, Biresaw G and Yohannes T (2017) Parasitic contamination of raw vegetables and fruits collected from selected local markets in Arba Minch town, Southern Ethiopia. . Infectious Diseases of Poverty 6:19 1-7	Assessed level of parasitic contamination of fruits and vegetables sold and associated factors. A pre-tested semi-structured questionnaire was used for collecting data on factors associated with parasitic contamination of fruits and vegetables such as: status of the produces [washed before display or not, freshly collected or stayed more than one day, source of water used for washing, educational status of the vendors]. Data on means of display and type of the market were recorded by simple observation. Majority (79.6%) of the products were not washed before display. The analysis revealed that 35%, 48.3%, and 28.6% of the produce washed by pipe water, well water, and river water was contaminated with at least one parasite species, respectively.	Cross-sectional	Effort should be made by the relevant bodies to reduce the rate of contamination of products with medically important parasites by educating the vendors and the community	Ethiopia	360 fruits and vegetable samples and 196 vendors

Kemal J, Sibhat B, Menkir S, Beyene D (2016) Prevalence, assessment, and antimicrobial resistance patterns of Salmonella from raw chicken eggs in Haramaya, Ethiopia *J Infect Dev Ctries* 2016; 10(11):1230-1235.	Assessed levels and patterns of antimicrobial resistance of Salmonella from chicken eggs and assess consumers' raw egg consumption and farmers' handling practices. The questionnaire administered to farmers and egg consumers indicated that 28% of the respondents had a preference for raw egg consumption, while 72% disliked eating raw eggs. The habit of washing eggs before consumption was also investigated, and the results showed that 90.7% did not have the habit of washing eggs, and the other 9.3% had this habit only when the eggs become extensively dirty. Egg-keeping practices of respondents showed that 57.3% used open containers such as baskets, cartons, and trays, while 42.7% of the respondents kept eggs together with different cereal crops and coffee	Cross sectional	Salmonella contamination of eggs in Haramaya area was low, with an overall prevalence of 2.7%. However, people consumed raw and cracked eggs in the area, indicating a lack of awareness of zoonosis. The presence of Salmonella contamination in local chicken eggs is of public health concern, as these are the most widely available and used egg types. Therefore, the public should be made aware of risks associated with consumption of raw chicken eggs and raw eggs cracked during storage and transportation.	Ethiopia	300 egg samples and 75 farmers (egg sellers) and consumers

Tadele Amentie, Mitiku Eshetu, Yoseph Mekasha and Ameha Kebede (2016) Milk postharvest handling practices across the supply chain in Eastern Ethiopia. Journal of Advanced Veterinary and Animal Research 3 (2), 112-126.	*Negative vendor practices:* Do not stop milk handling while showing disease symptoms, exposed to risk factors while handling milk, use hands to remove physical hazards to remove from milk and do not protect milk from being exposed to coughing and sneezing. All traders use plastic containers for milk handling, milk handling equipment's were commonly washed (though just once) using warm water, and sand, however, in most cases they were not properly protected from risk factors after washing. Some vendors use water from non-tap sources, though majority of them did not treat water before use for hygiene purposes. Smoking milk equipment's was common, with minimum protection of milk containers and cups used for milk delivery. *Positive vendor practices:* Washes hands before starting milk handling, although only cold water was used for hand washing.	Cross sectional	Milk handling practices performed across the supply chain in the study area were unhygienic and therefore suggested the need for improving hygienic practices. There is an interesting chart providing demographic differences between consumer and vendors. Most of the milk producers, informal collectors, and informal traders were illiterate. Consumers were approx. 50% less likely to be illiterate and generally had a higher level of education (primary and/or secondary). Neither consumers or milk producers/collectors/vendors had any kind of food safety training, but consumers rated higher on general food safety practices than the other groups.	Ethiopia	160 milk producers, 54 milk collectors and transporters, 152 vendors and 160 consumers

Tafesse F, Desse G, Bacha K and Alemayehu H(2014) Microbiological quality and safety of street vended raw meat in Jijiga town of Somali Regional State, southeast Ethiopia. African Journal of Microbiology Research. 8 (48) 3867-74	Assessed microbial quality and safety of street vended raw meats. A questionnaire was used to assess the profile of 33 street vendors. The sanitary condition of the vending environment was poor. The samples were held in a temperature range of 17.5-27.5°C. The sanitary condition of the vending environment was poor as it was dusty and full of remains of slaughtered animals such as bones, horn, head and other body parts. House flies were also very prevalent throughout the vending area and even on the raw meats displayed for sale by street vendors. It was also observed that the raw meats were displayed uncovered for more than 6 h for sale at ambient temperature on a table or a carton which would be used again and again. All food handlers have a basic task to maintain a high degree of personal cleanliness and observe hygienic and safe food handling practices. Only 67% of the vendors had relatively good personal hygiene with respect to cleanness of their cloths and visible body parts. None of raw meat street	Cross sectional	Majority of raw meats considered in this study had high microbial load and in some cases, even pathogens were isolated. Time/temperature abuse during vending on the street or cross contamination due to improper handling of meat or inappropriate vending practices or a combination of these factors might contribute to the presence of high microbial counts. Furthermore, the absence of clean potable water and receptacles, and also the poor sanitary condition of the vending area revealed inadequacies concerning quality and safety of the meats analyzed in this study. Training and inspections are important. Moreover, provision of basic infrastructures and establishment of code of practice for the sector are also recommended.	Ethiopia	33 street vendors

Gaye M, Iyekowa O, Anthony A, Mendy M, Ntomchukwu CC, Oyelakin O (2020) Asessment of Levels of Exposure to Biogenic Amines – A Gambia Case Study. *African Journal of Chemical Education* 10 (1) 97-106	Assessed potential exposure to biogenic amines from meat and fish. Fish was dried out in the open air, or salted or sold fresh, many store fish in salt water in scrap refrigerators, which can promote the creation of biogenic amines. Meat is delivered from the slaughterhouse and kept for 3-4 days, with refrigeration and cold water to keep it fresh. vendors complained about erratic electricity.	Cross sectional	The following recommendations were provided : I) ban imported chicken which stays too long in storage, 2) educate on food handling practices and 3) that The food authority of the country, Food Safety and Quality Agency, establishes a fully equipped laboratory sophisticated enough to conduct proper analysis of biogenic amines and by default other hazards.	Gambia	498 of which 447 were vendors of fish, meat or yoghurt.

Washabaugh JR, Olaniyan OF, Seckac A, Jengc M, Bernstein RM (2019) Milk hygiene and consumption practices in the Gambia. Food Control 98: 303–311	Examined bacterial contamination of milk and hygienic practices. Milking buckets were only cleaned by one herdsman and they did not use soap to do so. Only 2 reported straining milk with a cheesecloth before providing to vendors, but they did not wash the cheesecloth. All vendors stored milk in plastic buckets. 67% of vendors reported washing containers, but 32% reported washing with water only. Only three vendors reported refrigerating the milk. Observed levels of handwashing was low.	Cross sectional	The potential for milk contamination by pathogenic bacterial species, could have negative effects on consumer health. First, there is a dearth of hygienic measures implemented at any stage of the milk production chain, with an absence of handwashing or regular sanitary measures in place. Additionally, over 90% of raw cow's milk samples exceeded the acceptable threshold for concentrations of EB in food products. The factors affecting milk bacterial quality in this region are dynamic and complex, it is important to that food quality and safety are evaluated from both a biological and cultural perspective when forming the basis of community-level intervention and management programs.	Gambia	31 milk vendors and 12 herdsmen

Resnick D, Sivasubramanian B (2020) Negotiating the Social Contract in Urban Africa Informal Food Traders in Ghanaian Cities *IFPRI Discussion Paper* 01938	Examined key factors supporting or preventing food traders from following food safety measures	Cross sectional	For the full sample of traders, and particularly for inside traders, simply paying taxes is associated with a reduction in trust. However, across all five samples, paying the requisite fees to authorities and being able to identify a benefit in return enhances trust in the relevant local government.	Ghana	~12 policy makers and 1200 informal traders
Oduro-Yeboah C, Ackah NB, Akonor PT, Amponsah SK, Mboom FP (2020) Food safety knowledge and practices among fresh coconut vendors. *Scientific African* 8 e00392	Assessed food safety knowledge and practices of fresh coconut vendors. Positive: Nearly 72% intimated that they wash their hands in between servings and about 73% wash their paring knives and scoops in between servings or after use. A few vendors had water stored in handy buckets or gallons at their vending sites. Negative: Polybags used to sell water and fresh coconut are kept together with the raw coconuts. Washing and sanitizing fruits not widely practiced, though nuts were washed with a solution of alum to maintain freshness, prevent discoloration and make them attractive.	Cluster Randomized	Good sanitary practices and other public health and food safety advocacy may be adopted to complement the knowledge of vendors.	Ghana	104 vendors

Antwi-Agyei P, Peasey A, Biran A, Bruce J, Ensink J (2016) Risk Perceptions of Wastewater Use for Urban Agriculture in Accra, Ghana. PLoS ONE 11 (3): e0150603.	Examined knowledge and awareness of wastewater use for crop production, its related health risks, and adoption of health protective measures by market salespersons. Health indicators like clean environment, and how well produce had been displayed were lower priority for consumers. Domestic consumers of produce seemed satisfied with how produce was displayed, and the general sanitation at vending sites.	Cross sectional	In order to reduce health risks, interventions that could more directly impact benefits (especially economic benefits) to salespersons and consumers of salad crops should be promoted, rather than relying on health promotion and awareness. These interventions could include credit scheme support, and also the award of safety certificates to vendors who comply with prescribed risk reduction measures including good hygienic practices at markets. Interventions are likely to be successful if they are implemented in a participatory manner to involve government, at-risk groups and other major stakeholders.	Ghana	80 market vendors in central markets

Antwi-Agyei P, Cairncross S, Peasey A, Price V, Bruce J, Baker K, et al. (2015) A Farm to Fork Risk Assessment for the Use of Wastewater in Agriculture in Accra, Ghana. PLoS ONE 10(11): e0142346.	Microbial assessment of soil, water and vegetables. Market vendors were observed on where and how they displayed, sold and stored their produce, and any methods of treating produce. In addition, general sanitation, including refuse, open drains, visible feces, defecation areas as well as the presence of flies were observed. Although 68% of market vendors reportedly washed their vegetables (lettuce and carrots) before sales, observation of vendors 'washing practices at markets showed that washed water for produce was used without changing it for an average of 22 minutes, and the washed water was always dirty. At markets, at least 80% of produce were sold within 24 hours, but in some cases could be stored for 48 hours for lettuce, and 84 hours for cabbage before sale. Majority of the vendors had concreted vending sites, displayed produce >1m above the ground using mats, did not expose the product to sunlight, did not cover the product, stored produce >25 degree, stored for an average time of 10 hours before selling.	Cross sectional	Use of untreated wastewater poses significant risks for produce contamination at the farm level, but its role in influencing consumer risks at markets remains unclear. Salad produce was faecally contaminated at all entry points of the food chain, with street salad being the most contaminated. Key risk factors identified included farm soil contamination, use of wastewater for irrigation, poor food and environmental hygiene, produce storage time and temperature, and operating without a hygiene permit.	Ghana	Three central markets (Makola, Agbobloshie and Kaneshie) for sample collection (500) and vendors (market) for observations and interviews

Amponsah-Doku F, Obiri-Danso K, Abaidoo RC, Andoh LA, Drechsel P, and F.Kondrasen (2010) Bacterial contamination of lettuce and associated risk factors at production sites, markets and street food restaurants in urban and peri-urban Kumasi, Ghana. *Scientific Research and Essay.* 5 (2), pp. 217-223,	Examined bacterial levels (E. coli and Enterococci) on market lettuce leaves and refreshing water samples, assessed perception of health risks by vegetable sellers at market sites. Observed use of cane baskets, dirty cover clothes and fertilizer sacks as carrying and transporting receptacles for the lettuce and the storage of the produce under tables and on the market floor.	Cross sectional	Wastewater used as refreshing water in markets could be the main contributors to lettuce contamination and that education on use of effective de-contamination or washing methods before selling and eating will contribute to reducing the risk associated with the consumption of such contaminated foods.	Ghana	3 market sites including vegetable sellers, 24 food vendors
Zhang LX, Koroma F, Fofana ML, Barry AO, Diallo S, Songbono JL, Stokes-Walters R, Klemm RD, Nordhagen S, and Winch PJ (2020) Food Security in Artisanal Mining Communities: An Exploration of Rural Markets in Northern	Food hygiene practices were not explicitly investigated in this paper as it had a food security focus. Although vendors expressed positive attitudes to food safety- lack of infrastructure at the markets and poor waste disposal was a hindrance to achieving good practices.	Cross sectional	Not reported	Guinea	20 vendors

Kiambia S, Ononoa JO, Kang'ethea E, Abogea GO, Murungi MK, Muinde P, Akokob J, Momanyi K, Rushton J, Fèvre EM, Alarcon P (2020) Investigation of the governance structure of the Nairobi dairy value chain and its influence on food safety. *Preventive Veterinary Medicine* **179** (2020) 1-15 105009	Reduced food safety practices e.g. selling raw milk to low income consumers due to lack of access to pasteurization services and consumers demanding low price, use of non-food grade plastic containers, some traders cleaning the containers with hot water and soap, using preservation methods like addition of formalin and hydrogen peroxide to minimize spoilage, adulterate milk through addition of margarine, water, antibiotics and flour.	Cross sectional	Information on retail practices, challenges encountered provide indications to decision-makers of potential governance areas that could help improve efficiency and food safety along the dairy value chain.	Kenya	~15 Retailers (including road side vendors, kiosks etc.) and ~29 public officers (Kenya Dairy Board officers in charge of licensing, city council officers, livestock production officers (LPOs) and public health officers (PHOs))

Birgen BJ, Njue LG, Kaindi DM, Ogutu FO, and Owade JO(2020) Determinants of Microbial Contamination of Street-Vended Chicken Products Sold in Nairobi County, Kenya. International Journal of Food Science. Volume 2020, Article ID 2746492, 8 pages	Most vendors operate under unhygienic conditions. Microbial results revealed that raw portions of chicken had the highest contamination with all the four tested microorganisms. The predictors of E. coli contamination were the presence of pests and flies, unclean vending place, vending environment littered with waste, washing of hands by the vendor, and lack of appropriate clothing among the vendors. Only 33% of the vending places were sheltered while 60.0% of them were not clean. Lack of clean clothing (60%), lack of appropriate clothing for food preparation (47%), and long nails with visible dirt of some vendors increased chances of cross contamination	Cross sectional	There is a need to regulate the informal food processing and marketing channels, besides trainings, infrastructural development, and code of practice and inspections which are recommended in order to enhance the quality and safety standards of street-vended chicken products.	Kenya	15 vendors, and swabs of the equipment and work surfaces and chicken

Kang'ethe EK, Muriuki S, Karugia J, Guthiga P and Kirui L(2019) Report on: Prioritization of Food Safety Issues in the Dairy and Horticulture Value Chains, Kenya. ILRI, Nairobi	Examined food safety issues in dairy and horticulture. High microbiological hazards due to poor hygiene practices and unsuitable conditions along the commodity value chains.	Cross sectional	Build capacity of value chain actors on: - I) improvements in good agricultural practices at primary production, ii) hygienic handling practices and iii) regulators on enhanced enforcement of food safety standards. Infrastructural (transportation and cooling facilities) development to enhance speedy delivery to markets with minimum cross contamination and spoilage.	Kenya	28 Industry players and Experts
Kang'ethe EK, Muriuki S, Karugia J, Guthiga P and Kirui L (2019) Scoping Study Report on: National Food Safety Architecture of the Horticulture Value Chain, Kenya. ILRI, Nairobi	A questionnaire and literature review assessed institutional arrangements, food legislations and policies, regulations and standards, harmonization of national and international standards, codes of hygienic practice, food control laboratories, inspection, extension and advisory, food safety at primary production and processing, and food loss. Poor handling practices, poor grading, and failure to comply with specific limits were observed.	Cross sectional	Create an overarching agency to coordinate the food safety issues, develop food control laboratories (public and private) in rural areas, increase awareness of parasitic hazards and pesticide residues.	Kenya	Questionnaires administered to a team of experts from CSOs, academia and public sector institutions

Musita CN, Okoth MW, and Abong GO(2019) Postharvest Handling Practices and Perception of Potato Safety among Potato Traders in Nairobi, *Kenya International Journal of Food Science* Volume 2019, Article ID 2342619	Potatoes take 1-3 days on the market 47% of potatoes are exposed to sunlight during transport, potatoes are left out overnight. Some traders stored potatoes for up to a month. More than half of the potatoes on the market are exposed to unfavorable temperature and light conditions as seen through the direct exposure of the tubers to sunlight. Bruising and sprouting are some of the factors that contribute to increased levels of glycoalkaloids in potatoes; hence potatoes that are sprouting or have been bruised should not be consumed but only 2% of traders threw away such potatoes. The remaining traders either sold bruised or sprouting potatoes directly to consumers at a lower price or sold them to restaurants or other vendors of French fries.	Cross sectional	Potato consumers in Nairobi may be experiencing long term exposure to Glycoalkalyoid toxins due to buying of greening, bruised, or sprouting potatoes for home consumption or consuming of potato products such as French fries from restaurants or roadside vendors who use greening, bruised, or sprouting potatoes sold to them by the traders to make these potato products. It is important that all potato traders be continuously sensitized and educated on the health effects of glycoalkaloids and proper postharvest handling of potatoes to prevent continued consumer exposure to these toxins. Farmers and transporters of the tubers to the market should also be included in the sensitization activities. In addition, the Nairobi County Government should channel resources towards building permanent stalls that have proper storage places with proper protection against the sun to prevent against direct exposure of potatoes to the sun.	Kenya	100 potato vendors from 5 markets

Ahmed S, Haklay M M, Tacoli C, Githiri G, Dávila JD, Allen A, Fèvre EM (2019) Participatory mapping and food-centred justice in informal settlements in Nairobi, Kenya. Geo: Geography and Environment. 1-21 e00077.	Food vendors near waste dumping sites inevitably their food are likely to be exposed to poor environmental conditions, Food sold by vendors on stalls located to main roads is likely to get soiled and exposed to contaminated water and sludge from open drains and open sewage. Around a quarter of the 161 vendors surveyed in the three settlements did not use sheds to sell their produce. These vendors run additional daily risks to their health from exposure to heat from the scorching sun and to heavy rains. Without adequate storage facilities, the food they sell is more likely to suffer from spoilage. spend, Food vendors use water sparingly, which means food quality and food safety are often compromised as washing produce and cooking pans, and even personal hygiene, including hand-washing, involve the additional cost of water.	Cross sectional	Food vendors need more food safety training to improve their hygiene practices and cover more ground towards strategic partnerships with the Nairobi County government (formerly City Council) to organize frequent clean-up exercises around disposal sites and sewerage lines, and to arrange community awareness campaigns to designate waste disposal sites, improved water provision, sanitation and lighting, as well as communal storage and refrigeration facilities.	Kenya	660 vendors

Alonsoa S, Muunda E, Ahlberg S, Blackmore E, Grace D (2018) Beyond food safety: Socio-economic effects of training informal dairy vendors in Kenya. *Global Food Security* 18: 86–92	Most vendors used at least one way of testing the quality of milk when receiving or sourcing it. The most being a lactometer (device to measure the density of the milk and detect water-adulterated milk). Most traders reported using at least one preservation method for the milk they sell, most common method was boiling. Less than half kept their milk in a refrigerator, and none reported adding chemical substances such as antibiotics or hydrogen peroxide. Most traders kept their milk in plastic containers. There were no gender differences in these patterns.	Cross sectional	Initiatives aimed at engaging and improving practices of operators in the informal sector could deliver benefits in multiple aspects. People operating businesses in the informal sector are looking for opportunities to improve their business, improve milk quality and safety and reduce spoilage. So a training that supports traders to achieve this should have buy-in from informal operators and provide an entry point to work with informal markets. Trainings that teach good hygiene practices and help traders identify and demand good quality milk can contribute to having safer and higher quality milk in the markets, although sustaining these effects in the long-term will require new approaches to training that reinforce knowledge overtime, and the creation of opportunities for operators to gradually upgrade their practices and facilities, for example through access to credit. Making women-specific adjustments to the trainings and capacity building in general would ensure that women are brought on board, contributing to equity and maximizing health and food security outcomes	Kenya	~16 (4 FGDs, number of participants ranged from 5 to 8 in the male groups and from 3 to 7 in the female groups) + 67 vendors

Carron M, Chang YM, Momanyi K, Akoko J, Kiiru J, Bettridge J, Chaloner G, Rushton J, O'Brien S, Williams N, Fèvre EM, Hasler B (2018) Campylobacter, a zoonotic pathogen of global importance: Prevalence and risk factors in the fast-evolving chicken meat system of Nairobi, Kenya. *PLoS Negl Trop Dis* 12(8): e0006658.	Assessed prevalence of Campylobacter spp. in Nairobi's small-scale chicken farms and meat retailers, and to identify potential risk factors associated with its presence in those sites. Chicken feces were collected using one pair of boot socks per farm, and 3 raw chicken meat samples were purchased per retailer for microbial analysis. A questionnaire-based survey on sanitary, sourcing and selling practices was conducted at each site for risk factor identification. Using display material not easy to clean and selling defrosted meat was associated with increased odds of bacterial contamination.	Cross sectional	The open nature of both small-scale broiler and indigenous chicken production practices with low biosecurity, hygiene and informal transactions, likely plays a role in compromising food security. While gradual improvement of farm biosecurity is recommended, risk factors identified suggest that consumer education and enforcement of basic food safety principles at the retailer end of the food continuum represent key targets for risk reduction in informal settings.	Kenya	171 farm premises and 53 retailers

Kang'ethe EK, Muriuki S, Karugia J, Guthiga P and Kirui L (2018) Scoping Study Report on: National Food Safety Architecture of the Dairy Value Chain in Kenya. *ILRI, Nairobi.*	A detailed questionnaire sought information on institutional architecture; policy environment; hygiene practices; regulations and standards; harmonization with international standards; inspection; extension and advisory services; food control laboratories; causes of food safety and food loss concerns; food safety at primary production and processing; food loss reduction; and the engagement of stakeholders across the board. The questionnaire was supplemented with a desk review of literature. The food safety issues raised were microbial and chemical hazards, which were mainly due to failure to observe hygienic handling practices.	Situation analysis	The food control institutional architecture in Kenya is inadequate for effective and efficient delivery of food safety services. The many players charged with the responsibility are disjointed, uncoordinated and poorly governed. It is necessary to put mechanisms in place to enhance the institutional and policy environment for food safety. The institutions charged with food safety mandates have legal mandates but lack an overarching coordination mechanism and a unified policy framework to guarantee effectiveness and efficiency in discharge of their mandates. The sector is served by several food control laboratories (public and private) which are located in large urban centers. Consequently, their services are not easily accessible to smallholder farmers who produce the bulk of the milk serving the domestic market and which may be a foodborne illness risk.	Kenya	15 food safety experts in the dairy value chain

Brown LH, Alonso S, Lindahl J, Varnell H, Hoffman V, and Grace D (2018) Regulatory Compliance in the Kenyan Dairy Sector: Awareness and Compliance among Farmers and Vendors. *IFPRI PROJECT NOTE* | DECEMBER 2018	Examined awareness and compliance with dairy standards in Kenya and investigate the conditions of milk sold in Kenya by sampling dairy products across informal and formal market traders in Nairobi County. Low compliance to regulations (~70% of those involved in selling milk were unaware of at least some regulations is of concern). Milk (majority) was stored in plastic containers, milk was neither refrigerated nor cooled.	Cross sectional	Increase producers' and vendors' awareness of regulations, offer them practical training on how to comply, educate consumers on the importance of milk safety through mass media campaigns and outreach by community health workers; routine product sampling and strengthen penalties for non-compliance.	Kenya	96 dairy farmers and traders

Nyokabi S, Birner R, Bett B, Isuyi L, Grace D, Güttler D & Lindahl J (2017) Informal value chain actors' knowledge and perceptions about zoonotic diseases and biosecurity in Kenya and the importance for food safety and public health. Trop Anim Health Prod (2018) 50:509–518	Assessed knowledge of zoonoses and adoption of biosecurity measures by livestock and milk value chain actors. Four categories of biosecurity measures were investigated: personal, environmental, food safety and animal health. Animal blood sample analysis for Brucella antibodies. Milk and Meat: Low levels of adherence to food safety standards, low adoption and use of PPE. Traders did not refrigerate meat or milk overnight, despite the risks of quick spoilage or deterioration of quality in the hot and humid study area. Unhygienic handling of containers used for transporting milk and meat boxes, exposing them to dust, flies and other sources of contamination. No actors reported sterilizing their containers after or before use, and many reported washing them using soap/detergent powders and untreated water from irrigation canals Meat: Low adoption of biosecurity measures, never undergone mandatory medical checkups required for food handlers (only butchers and slaughterhouse	Cross sectional	Participation in livestock value chain activities is dictated by gender. Men participate more in livestock and meat value chain activities, while women participate more in the milk value chain activities. However, while few men participated in the milk value chain, a small number of women were meat traders, butchers or transporters. There was a gendered dimension, evidenced by markedly different participation in value chains and lower adoption rates and knowledge levels among female actors. Cultural and religious practices were shown to play an important role in exposure and transmission of diseases, influencing perceptions and attitudes to risks and adoption of biosecurity measures.	Kenya	154 value chain actors (livestock traders, milk traders, abattoir workers and transporters), 119 (traders, butchers and slaughter house workers)

	workers reported regularly receiving medical check-ups as a prerequisite for being granted a working certificate/permit). Female actors reported lower rates of annual medical examination and lower adoption rates of use of personal protective equipment's (PPE), Untreated water was frequently used for cleaning and washing, and water was purchased from vendors who had sourced it from irrigation canals when slaughterhouse water tanks were empty. Meat was hung in the open, without protection from dust or flies. Butchers reported selling meat wrapped in old newspaper and/or wrapped in polythene first then an old newspaper. Animal health biosecurity measures observed by livestock traders included spraying livestock for vector control, isolating livestock at the market, inspecting livestock at the markets, quarantining livestock at the markets and reporting when livestock died at the market. When animals died, the actors reported that they burned the carcass, buried the carcass, reported livestock death immediately to vet and disposed the carcass in the				

	open (for scavengers to eat). Some reported that they used (consumed) the dead animal. Livestock traders reported treating sick animals with veterinary drugs obtained over-the-counter, often without advice from veterinary officers. Some traders and livestock keepers used medicine intended for humans to treat sick animals. In cases where the market committee (managerial group selected by traders) detected sick animals (through visible symptoms), animals were treated by a veterinary officer and the owner was advised to take them back home until the disease was gone. However, there was no strict enforcement of this directive, and therefore, best practices regarding treatment and isolation of sick animals were not observed by all actors. Milk: Traders stored milk in plastic containers. Milk was sold packaged in polythene paper or in recycled plastic bottles which were not properly cleaned or sterilized. Although some vendors kept milk in open containers, it was more commonly kept in closed				

Ondieki GKOmbui JN, Obonyo M, Gura Z, Githuku J, Orinde AB, Gikunju JK(2017) Antimicrobial residues and compositional quality of informally marketed raw cow milk, Lamu West Sub-County, Kenya, 2015. The Pan African Medical Journal 28 (Supp 1):5	Assessed compositional quality of milk, antimicrobial residues in milk, Factors associated with poor compositional quality of marketed raw cow milk among farmers and vendors. Farmers and vendors were using a herbal substance with a local name “mpingo” which they applied by smoking the inner side of wooden milk handling containers, to serve as a milk preservative.	Cross sectional	There is need to routinely test marketed milk, intensify public health education regarding milking and good milk handling practices, train farmers on strict adherence to antimicrobial use and withdrawal periods and impose stiffer penalties on those adulterating milk.	Kenya	152 vendors and 207 farmers
Sverdik, A (2017) Promoting Food Security, Safe Food Trading, and Vendors’ Livelihoods in Informal Settlements: Lessons from Nairobi. Urban Zoo Policy Brief. June 2017	Conducted community-led mapping, focus group discussions (FGDs), and surveys of food vendors in informal settlements.	Cross sectional	In addition to holistic upgrading initiatives, food vendors may benefit from greater recognition by food security advocates, informal worker organizations, and slum-dweller groups. If vendors are incorporated into broader urban food-system strategies,	Kenya	1,670 vendors

Kirino Y, Makita K, Grace D and Lindahl J (2016) Survey of Informal Milk Retailers in Nairobi, Kenya and Prevalence of Aflatoxin MI in Marketed Milk. African Journal of Food Agriculture Nutrition and Development 16:3 11022-11038	Assessed aflatoxin contamination status in marketed raw milk and associated risk factors in peri-urban Nairobi. Structured questionnaires were filled in by face-to-face interviews with all retailers. Small portions of milk were purchased from each respondent and tested for aflatoxin. In the kiosks and grocery stands, milk was stored at room temperature in transparent plastic jugs of approximately three-to-four-liter capacity and displayed in front of the shops so that customers could recognize it on sale from outside. The dairy shops, called “milk bars”, kept their milk in refrigerated tanks. The mobile vendors transported and sold their milk outdoors in metal or plastic containers	Cross sectional	It is important to understand processes which can influence aflatoxin concentration in milk along the value chain, and could orient governmental strategies to ensure supply of safe milk. Even though education of the general public has been impeded by limitations, such as funding and human resources, basic information about aflatoxin and its risk factors should be accumulated and provided. Additionally, milk retailers may be a subset of the population particularly at risk. The milk consumption by retailers’ households in this study was above 900 ml per person per day, which corresponds to more than 300 liters per year and is	Kenya	350 milk retailers

McCarron M, Munyu P, Chenga PY, Manga T, Wanjohi C, Moena A, Mounts A, Katz MA(2015) Understanding the poultry trade network in Kenya: Implications for regional disease prevention and control, Preventive Veterinary Medicine 120 321–327	A standardized questionnaire was administered to each type of actor. Questionnaires addressed frequency, volume, and geography of trade, as well as biosecurity practices. Of the markets visited, only one had an isolated area used for the slaughter of live birds.	Cross sectional	Education on preventive activities, biosecurity practices, and awareness of avian influenza could be targeted in key locations in order to maximize their effectiveness in reaching important players in the poultry trade network. Education on investigation, control, containment and reporting of poultry die-offs could be targeted in those same areas	Kenya	380 respondents, 51% backyard farmers, 24% middlemen and 25% market traders

Mutegi C, Wagacha M, Kimani J, Otieno G, Wanyama R, Hell K, Christie ME (2012) Incidence of aflatoxin in peanuts (Arachis hypogaea Linnaeus) from markets in Western, Nyanza and Nairobi Provinces of Kenya and related market traits. *Journal of Stored Products Research* 52 118-127	Investigated peanut market characteristics and their association with levels of aflatoxin in peanuts. Data were collected from vendors in various market outlets using a structured questionnaire. Packaging material significantly influenced the amount of aflatoxin in the product, with the majority (68%) of peanut samples that were stored in plastic jars having >10 mg/kg of aflatoxin. Polyvinyl chloride (PVC) and propylene bags were the most common packaging materials for different peanut products. However, preference for packaging material was dependent on the peanut product. Whereas shelled and podded raw nuts were commonly packaged in propylene bags, PVCwas the preferred material for roasted and fried peanuts, while peanut butter was commonly packaged in plastic jars. There was negligible packaging of peanuts in jute bags. Peanut vendors used five crop protection measures aimed at maintaining quality and managing pests. Sorting was the most common (58%) measure, while drying (20%) and sieving (16%) were also widely practiced. Almost a third of the vendors did not use any measures to	Cross sectional	Awareness creation at all levels of the peanut value chain, especially for end consumers, in order to enhance the understanding of the benefits of purchasing/consuming low risk products. Recommend regulatory approaches and education campaigns.	Kenya	1263 vendors

	maintain quality and avoid pests. The floor of peanut storage structures in the three study regions was either made of mud (60%) or concrete (40%), while a negligible proportion was made from wooden material. The majority of the stores were dusty with no windows for ventilation. Sixteen percent of the structures were infested with insects, with Nairobi being the worst affected. One out of eight stores was characterized by poor lighting and a musty smell. Over 70% of all storage structures were poorly ventilated and dusty. Post-harvest handling practices were insufficient in controlling contamination and in some cases, have worsened contamination levels.				

Lewis L, Onsongo M, Njapau H, Schurz-Rogers H, Luber G, Kieszak S, Nyamongo J, Backer L, Dahiye AM, Misore A, DeCock K, Rubin C, and the Kenya Aflatoxicosis Investigation Group (2005) Aflatoxin Contamination of Commercial Maize Products during an Outbreak of Acute Aflatoxicosis in Eastern and Central Kenya *Environmental Health Perspectives*: 113 (12) 1763-7	Maize was wet at the time of purchase and storing under wet conditions	Cross sectional	Public health efforts to interrupt aflatoxin exposure during an aflatoxicosis event must include both an assessment of aflatoxin contamination within the regional market distribution system and replacement of contaminated market products. Therefore to effectively prevent future outbreaks of aflatoxicosis, establishment of long-term interventions such as a comprehensive food safety program must be implemented. These interventions must target both market vendors and local farmers in order to prevent or minimize future aflatoxicosis outbreaks and reduce long-term exposure to aflatoxins	Kenya	65 markets and 243 maize vendors

Seeiso TM and McCrindle (2009) An investigation of the quality of meat sold in Lesotho JS.Afr.vet.Ass. 80(4): 237–242	Assessed microbiological contamination of meat, and lack of meat hygiene inspection. Observations of informal slaughter indicated that personal hygiene, the hygiene of the environment during slaughter and the dressing of carcasses, were deficient. Except for the 4 commercial butcheries linked to supermarkets, slaughter men did not wear protective clothing or wash their hands, as ablution facilities were inadequate and even where waterborne sewage was available, no hand basins were seen	Cross sectional	This study examined butchers and slaughterers, not vendors per se, but as some butchers were also vendors it was included. The study found that despite regulations, the lack of formal abattoirs in Lesotho, means that Illegally slaughtered carcasses are not being inspected by trained personnel to ensure that the meat offered for sale to the general public is free of diseases and parasites. High microbiological counts found in the study confirm this. Since the closure of the abattoir in 2003 due to financial issues, steps should be taken to investigate cost-effective models or international donors, to make meat inspection a profitable reality.	Lesotho	44 butchers (some also vendors) of formal and informal butcheries

Lazaro J, Kapute F, Rochelle, Holm RH (2019)Food safety policies and practices in public spaces: The urban water, sanitation, and hygiene environment for fresh fish sold from individual vendors in Mzuzu, Malawi. Food Sci Nutr.7: 2986–2994	The aim of this study was to review national acts and policies and local regulations focused on fresh fish sold at open-air markets or by mobile vendors and to further examine the water, sanitation, and hygiene environment that may impact food safety. Only three of the four markets had any water access for vendors. Of these, the two markets with piped water had safe water whereas the Zolozolo Market was using a shallow well which had E. coli levels of 450 cfu/100 ml. All vendors stored water in a container for use throughout the day to sprinkle over the fish with their bare hands to keep them from drying out. Mobile vendors stored water in a 1- or 2-L plastic bottle. Market-based vendors stored it in a 5- to 20-L metal or plastic bucket. Only two markets (Chibavi Market and Mzuzu Central Market) had working sanitation facilities (pour flush, urinal, or a room containing a flush toilet piped to a septic tank) for customers and vendors, and although both had a handwashing station with water, there was no soap present. One other market, Area 1B, had some sanitation infrastructure, but there	Cross sectional	Three key opportunities were identified: (a) Regulatory framework including informal markets and mobile vendors; (b) Safe water, clean and functional toilets, and handwashing stations with soap at every market; and (c) Foodborne disease education for vendors.	Malawi	45 vendors

	was a plumbing blockage at the time of data collection, rendering it nonoperational. Where there were sanitation facilities present, the vendors (8/10) generally reported using them, though this was contrary to our researcher observations of a mean of one person per hour using each sanitation facility. The sanitation facilities were designed for a higher level of use than was observed. The vendors used bicycles and public transport (local minibuses and taxis) to transport fish; in no case was a vehicle dedicated for food transport reported to be used. only three vendors (3/25), all operating at the Mzuzu Central Market, used ice and not necessarily enough to keep all fish at a consistent temperature. No vendors actually monitored the temperature; no thermometers were present or used by vendors. When using ice, vendors reported getting it from a shop within the market area; they did not make their own ice. For the mobile vendors, fish were not covered with block ice, a sunlight barrier, or a dust barrier.				

Bonfoh B, Wasem A, Traoré AN, Fané A,Spillmann H, Simbé CF, Alfaroukh IO, Nicolet J, Farah Z, Zinsstag J (2003) Microbiological quality of cows milk taken at different intervals from the udder to the selling point in Bamako (Mali) Food Control 14 495–500	Examined milk hygiene and contamination sources, including total microflora (TC, Enterobacteriaceae, S. aureus, and yeast/moulds). Poor hygiene was observed both at the farm and at the vendor in terms of lack of handwashing and soap, using unsanitary containers, unsanitary cloths, mixing milk between multiple containers, lack of refrigeration facilities, and use of water from the well in Bamko which is often contaminated. In the modern system the bacterial count was actually higher, but the milk was boiled so it is assumed safer. however, due to the unsanitary filters and containers it was subjected to it was recontaminated.	Repeated measures	The number of containers used in the milk chain was the main source of contamination. High ambient temperatures coupled with general lack of refrigeration and poor standard of hygiene means that the milk, which often contains a large number of bacteria, acidifies on its way to the market. This was one of the few studies found which had a repeated measures design, even though the sample size was small. Recommendations are clean municipal water sources at markets, a broad microbiological assessment, the establishment of milk hygiene standard, and information to the producers and consumers about the	Mali	3 (one selling milk from a traditional farm, one semi modern farm and one from a modern farm, sampling repeated at three different time points).

Nishimwe K, Wanjuki I, Karangwa C, Darnell R, Harvey J (2016) An initial characterization of aflatoxin B1 contamination of maize sold in the principal retail markets of Kigali, Rwanda. Food Control 73 574-580	Assessed aflatoxin B1 (AFB1) in maize, and associated vendor perceptions. A questionnaire given to vendors was used to determine if gender and education level of vendors, origin of maize and awareness of aflatoxins had any significant effect on AFB1 level in collected samples.	Cross sectional	All vendors declared that they are unaware of aflatoxins and their consequences. These findings reveal the need to both enforce and update existing SPS relating aflatoxins in Rwanda, and for education programs to raise awareness amongst stakeholders and their capacity to reduce aflatoxin risk.	Rwanda	228 vendors

Stevens A, Kaboré Y, Perrier-Gros-Claude JDMillemann Y, Brisabois A, Catteau M, Cavin JF, Dufour B (2006) Prevalence and antibiotic-resistance of Salmonella isolated from beef sampled from the slaughterhouse and from retailers in Dakar (Senegal) International Journal of Food Microbiology 110: 178–186	Assessed Salmonella levels in beef, and vendor characteristics and practices. Very few vendors were reported to have good personal hygiene, none of the vendors in the itinerant markets wore protective equipment. Storage and transport temperatures were not optimal, likely due to lack of refrigeration.	Cross sectional	This study primarily assesed Salmonella occurrence, with limited details on vendor attitudes and practices. It found the following in the markets it surveyed 1) a very high Salmonella prevalence in retail beef; 2) contamination at the slaughterhouse is amplified by poor hygiene practices and secondary contamination from resident flora; 3) a high rate of resistance to antibiotics but a low rate of multiresistance; 5) the emergence of multi-resistant strain of Salmonella in retail beef. This is the very first data about meat contamination by Salmonella in the sub-saharian area.	Senegal	199 vendors from various types of markets

Prinsen G, Benschop J, Cleaveland S, Crump JA, French NP, Hrynick TA, Mariki B, Mmbaga BT, Sharp JP, Swai ES, Thomas KM, Zadoks RN, and Linda Waldman (2020) Meat Safety in Tanzania's Value Chain: Experiences, Explanations and Expectations in Butcheries and Eateries. *Int. J. Environ. Res. Public Health* 17, 2833 1-19	Assessed knowledge, attitudes and reported practices of operators of butcheries and eateries with regards to meat safety in an urban and in a rural environment. Operators of butcheries relied more on official inspections. Deliberate deception (mixing fresh or inspected meat with old or uninspected)	Cross sectional	There is awareness of the inspection stamps as a measure of food safety. Local authorities enforcing policies in a resource-poor context may explore the potential for more efficient or even solicited inspections, by building on the finding that meat inspections add commercial value, particularly meat sold in butcheries. Preoccupation of inspection with visible abnormalities suggest a lack of awareness around invisible pathogens originating from healthy animals' gastrointestinal tracts. Rural operators and urban operators may, quite possibly, respond differently to policy interventions because of their different expectations of the future.	Tanzania	64 operators

Häsler B, Msalya G, Garzac M, Fornacec K, Eltholth M, Kurwijila L , Rushton J, Grace D Integrated food safety and nutrition assessments in the dairy cattle value chain in Tanzania. *Global Food Security* 18: 102–113	The aim of this scoping study in Tanzania was to identify opportunities for nutritional and food safety benefits from cow milk. Farmers reported that veterinary medicines were frequently given to cattle, and a majority did not discard milk during or after treatment. Less than half of the producers boiled milk, although sale of fermented milk, made by spontaneous fermentation of raw milk, was common. Cattle management was characterized by low levels of biosecurity, hygienic practices and disease control. Vaccination was used by less than the half of the producers. Almost all respondents hand milked their cows; 11% of respondents did so without cleaning the udder. Cattle was in contact with other animals, there were no footbaths present, no uniform or security shoes were worn by the workers, there was no separate designated area for the storage of milk, the floor in the dairy area was not clean, no training was available for the producers and there were no incentives or punishments for good and bad performance.	Cross sectional	Efforts to upgrading the dairy value chain in Tanzania should focus on a multi-intervention, multi-sectorial approach to promote food security and food safety simultaneously.	Tanzania	156 producers and 157 consumers

Nonga HE, Ngowi HA, Mdegela RH, Mutakyawa E, Nyahinga GB, William R, Mwadini MM (2015) Survey of physicochemical characteristics and microbial contamination in selected food locally vended in Morogoro Municipality, Tanzania BMC Res Notes 8: 727 1-10	Assessed physicochemical characteristics and microbial quality of raw milk, fruit juice and fish and hygiene of food containers, personnel and the vending environment. Raw milk sold was adulterated with water, Raw fruit juice was stored in dirty containers and sold under unhygienic environment.	Cross sectional	The physicochemical characteristics of food vended in Morogoro Municipality were of poor quality. The food had high bacterial contaminations. This situation poses health risks to the public and losses to food vendors due to spoilage. Stakeholders in food value chain should be educated on safe production and good hygienic practices. Routine quality and safety assessment of locally vended food, inspection of selling premises and regular health checkup of the personnel involved in food vending industry should be instituted.	Tanzania	Not reported for vendors

Majalija S, Tumwine G, Kiguli J, Bugeza J, Ssemadaali MA, Kazoora HB, Muwanguzi EN, Nantima N and Tuyiragize R (2020) Pastoral community practices, microbial quality and associated health risks of raw milk in the milk value chain of Nakasongola District, Uganda. Pastoralism: Research, Policy and Practice 10:3	Assessed the milk handling practices, the bacterial quality and the associated health concerns of raw milk along the informal milk value chain. The quality of raw milk was affected by poor hygienic, handling and transportation practices. Hand milking was carried out mainly by men (92.5%), of whom only 7.5% routinely washed hands before, 25% rarely or never washed hands while 42.5% cleaned their hands on the skin of cows. Most milkers (50%) used a rod referred to as enkoni to restrain the calf while milking. Milk was collected from the farm mainly by M2Vs (80%) using motorcycles (70%) and in plastic cans (75%). The most frequently used milk adulterant was water (75%); others include flour (cassava), herbs and chemicals. Scores of 11 practices affecting the quality of raw milk were ranked, of which 8 (73%) had scores of 3–5 that indicated poor quality of milk. Cleaning milkers' hands on the skin of cows and poor hygiene of the milking environment were scored 5, while unhygienic mobile milk-collecting centers and dirty water used to wash milking utensils scored	Cross sectional	The raw milk contaminated with antibiotic drug-resistant bacterial pathogens is of public health concern. Thus, measures to improve the quality of milk need to be designed for the pastoral community in Nakasongola district.	Uganda	40 farmers, vendors

Kirunda H, Mugimba KK, Erima B, Mimbe D, Byarugaba DK and Wabwire-Mangen F (2014) Predictors for Risk Factors for Spread of Avian Influenza Viruses by Poultry Handlers in Live bird markets in Uganda. *Zoonoses and Public Health*, **62:**334–343	Examined the influence of socio-demographic characteristics of poultry handlers: age, sex, religion, educational background, level of income, location of residence and region of operation on 20 potential risk factors for introduction and spread of Avian Influenza in Live Bird Markets. Never frequently washed hands, never wore protective clothing, Never disinfected returned troughs, Shared equipment, Sold other livestock species, Stored feed in open containers, Feed/water provided were dirty, Never cleaned troughs and cages, Cages were stacked, Never separated sick birds, Never separated birds by species, Never quarantined new birds, Never kept records, >20 birds in a cage, Allowed buyer <1 meter away. Sex of poultry handlers was not a significant predictor for the risky hygiene and management practices for introduction and spread of AI viruses in LBMs. Despite the absence of significant statistical relationships, there were some variations among handlers of different sex involved in confinement of larger numbers (more than 20) of birds in a single cage, selling of other livestock species alongside poultry and sharing	Cross sectional	Several sociodemographic characteristics of bird handlers are predictors for risky practices. This information would be very useful in development of strategies for prevention and control of AI disease outbreaks in the country.	Uganda	39 live bird markets & 424 poultry handlers

	of poultry equipment. While up to 83.4% of the female bird handlers confined more than 20 birds in a single cage, only 57.1% of the male counterparts had this practice. Selling of other livestock species alongside poultry was more in female (57.1%) than male respondents (41.7%). Conversely, 34.6% of the male shared equipment compared to only 14.2% of the female bird handlers. There was no significant scientific correlation between age of poultry handlers and practices that could pose increased risk for introduction and spread of AI viruses in the study LBMs. Among the 20 study risky practices, only the practice of selling other livestock species alongside poultry exhibited substantial variation among respondents of the different age groups. Only 41.4% (167/403) of the adults compared to 61.9% (13/21) of the adolescents with the practice.				

Siamupa C & Saasa N & Phiri AM (2018) Contribution of market value chain to the control of African swine fever in Zambia *Trop Anim Health Prod* **50:** 177–185	The aims of the study were to identify market value chain-related factors that were associated with ASF outbreaks and assess why these outbreaks are becoming frequent despite control measures being put in place. Only 50% of farmers had their animals screened for ASF before sale. Traders used different modes of transport depending on its availability in the area such as bicycles, wheelbarrows, ox carts, and vehicles while at times they walked the pigs to the market. The traders had no knowledge of whether pig owners disinfected them or not. The same transport was used to collect pigs from more than one household or from one farm to another. The purchased pigs were not tested for ASF before movement though some farmers got movement permits from the police to show that the animals were not stolen but legally theirs.	Cross sectional	Improving biosecurity; sensitizing farmers, traders, and all stakeholders in the pig value chain on ASF prevention and control; reinforcement of staff at checkpoints; and regulation of pig markets are some of the ways in which future outbreaks can be prevented. Government should create a favorable business environment with incentives that attract private sector investment in the pig value chain. Enforcing regulations, ensuring quality input supply, pork quality assurance, and standards are some of the critical roles that the government should do. Such market environments would provide better incentives and improve pig production	Zambia	15 traders (and Farmers, district veterinary officers, veterinary assistants, police officers, and veterinary staff manning veterinary checkpoints, abattoir and processing plant managers, meat inspectors, market chairpersons)

Bumbangi NF, Muma JB, Choongo K, Mukanga M, Velu MR, Veldman F, Hatloy A, Mapatano MA (2016) Occurrence and factors associated with aflatoxin contamination of raw peanuts from Lusaka district's markets, Zambia. Food Control 68: 291-296	Determined the levels of aflatoxins in raw peanuts sold in Lusaka district's markets as well as identified factors associated with increased presence.Vendors used opened permeable packaging, stored peanuts after the daily selling under the raised concrete surface or on the selling shelves and stored raw peanut on the market for more than 15 days. Although none of these practices were associated with the presence of aflatoxin in raw peanuts.	Cross sectional	A market vendor's awareness through education campaigns on practices which reduce the AF contamination in peanuts should be conducted. Further, a human exposure assessment to AFs through consumption of peanuts need to be carried out in order to determine the public health impact caused by AFs to the Zambian population.	Zambia	No information given on the number of vendors interviewed

Songe MM, Hang'ombe BM, Knight-Jones TJD and Grace D (2016) Antimicrobial Resistant Enteropathogenic Escherichia coli and Salmonella spp. in Houseflies Infesting Fish in Food Markets in Zambia Int. J. Environ. Res. Public Health, 14, 21	Assessed fish vendors' and consumers' perception of flies that beset food markets in Zambia, and interest in interventions to reduce their numbers. Identified if flies carry important pathogenic bacteria on their bodies, and subsequently if these bacteria carry resistance genes to commonly used antibiotics, which would indicate problems in eradicating these pathogens. 20 consumers in Lusaka and 10 consumers in Mongu said they would prefer to buy fish from a trader that employed an intervention, such as the use of chlorinated water to disinfect the fish stalls, which could help reduce the number of flies infesting the fish. However Four of the ten consumers in Mongu (40%) pointed out that a complete absence of flies might mean that the trader had treated their fish with chemicals that reduce flies but could be harmful to humans and hence an absence of flies might be a deterrent.	Cross sectional	Findings in this study further justify the semi-structured interviews respondents' concern over the poor sanitary conditions and lack of formal refuse collection facilities which would serve as breeding grounds for disease-causing organisms in the markets. Also, flies are a menace to fish traders, Both fish traders and consumers would greatly appreciate an intervention, such as the use of nets, against flies at fish stalls as a practical way of addressing the underlying causes of compromised food safety. The conflicting views of consumers that too many flies are a deterrent to purchase- but that no flies may also be a deterrent as it implies overuse of chemicals -	Zambia	30 consumers and 40 vendors from two markets

Knight-Jones TDJ, Hang'ombe MB, Songe MM, Sinkala Y and Grace D (2016) Microbial Contamination and Hygiene of Fresh Cow's Milk Produced by Smallholders in Western Zambia. Int. J. Environ. Res. Public Health 2016, 13, 737	Assessed safety of smallholder fresh cow's milk by observation and sampling of milk along the value chain from milking to point-of-sale and storage. Milking was done by hand into a plastic, wooden or metal container and then poured into a plastic (three farmers, 33%) or metal (six farmers, 67%) container that could be sealed, mostly through a muslin cloth or a sieve (8/9 farmers, 89%), which was always rinsed between cows. Unlike plastic buckets and containers, metal buckets and containers were designed for handling milk or food. Although contamination of the pooled herd milk with cattle hair was not seen, some visible dirt contamination was observed for 5/9 (56%) farms. Handwashing at milking was not done, though those who washed hands did not use soap and water was untreated surface water from the wetlands which was also used to rinse milking equipment. The milk was typically transported by bicycle in high ambient temperatures without refrigeration until reaching the point-of-sale (journey times of 30–120 min), where it was sold	Cross sectional	On-farm milk heating options should also be assessed. In this under-developed setting, options for improving milk safety are limited. However, sustainable methods of milk pasteurization should be investigated as a microbial kill-step is needed to mitigate upstream contamination.	Zambia	9 farmers

Farhana Z, Sutradhar N, Mustafa T, Naser MN (2020) Food Safety and Environmental Awareness of Street Food Vendors of the Dhaka University Campus, Bangladesh. *Bangladesh J. Zool.* **48(1):** 171-178	Assessed vendor food safety practices: handwashing, covering food from dust and flies, level of past formal training in food safety, use of soap in cleaning hands/utensils, and environmental awareness. Also investigated consumers attitudes to food safety. 86% of vendors handle foods with bare hands and 56.82 % vendors wash their hands in clean water each time before handling of food. 54% of vendors covered their foods from dust. Most of the vendors (86.36%) do not cover their utensils. Fifty nine percent vendors clean used utensils with bucket water but without soap. All the food vendors use tap water for preparing food, cleaning utensils and as drinking water.	Cross sectional	More oversight and enforcement and waste disposal from 'management' is needed. There is lack of knowledge of food safety among food vendors/handlers.	Bangladesh	44 food vendors (mix of street food (32) and fruit and vegetable vendors (12)), 54 consumers on a university campus.

Moyen N, Ahmed G, Gupta S, Tenzin T, Khan R, Khan T, Debnath N, Yamage M, Pfeiffer DU and Fournie G (2017) large-scale study of a poultry trading network in Bangladesh: implications for control and surveillance of avian influenza viruses BMC Veterinary Research (2018) 14:12	Examined poultry vendor practices in relation to zoonotic infectious disease. Vendors were asked about their trading practices in the week preceding the interview: number of poultry sold to other poultry traders or consumers, number of poultry bought, types and locations from which poultry were sourced. Informants were asked about their trading practices in the week preceding the interview: number of poultry sold to other poultry traders or consumers, number of poultry bought, types and locations from which poultry were sourced.	Cross sectional	Poultry types need to be discriminated in order to understand the way in which poultry trading networks are shaped, and the level of risk of disease spread that these networks may promote. Knowledge of the network structure could be used to target control and surveillance interventions to a small number of LBMs	Bangladesh	849 poultry traders, no consumers

Khan MSI, Sayeed A, Akter A, Md Azharul Islam and Sharmin AkterFood safety and hygiene practices of vendors during chain of street food production in Barisal city. *Food Safety and Health*. **1 (1):** 57-65.	Assessed hygiene and sanitation practices of vendors, such as handwashing, washing of utensils, storage practices, sources of water used in food preparation, and habits during illness.	Cross sectional	The study provides socio-demographic status and safety practices of street food vendors in Barisal city area. Vendors are not completely ignorant of the basic food hygiene practices, but the following areas need attention - like source of drinking water, food preparation water, hand washing, reused leftover food, selling during sickness etc. Food-handling training and education, awareness programs, enforcement of government regulations and infrastructure may improve the safety for street foods.	Bangladesh	91 vendors - mostly street food but some natural food.

Sayeed MA, Smallwood C, Imam T, Mahmud R, Hasan RB, Hasan M, Anwer SM, Rashid MH, Hoque MA (2017) Assessment of hygienic conditions of live bird markets on avian influenza in Chittagong metro, Bangladesh Preventive Veterinary Medicine **142**: 7–15	Assessed avian influenza virus presence, and potential risk of spreading via poor hygiene practices. Majority of stalls were cleaned 1x day (75%) but 54% only used water not detergent. 86% of markets had a supply of water. Not strictly food safety, but hygiene practices are relevant.	Cross sectional study	A majority of poultry stalls were retail stalls performing slaughtering of poultry supplies by multiple vendors. The vendors themselves frequently had basic levels of education (Class I–IX) showing the ability to read Bengali text. Most stalls had unsanitary conditions including mud floors, lack of quarantined space for sick animals, contamination of residential wild birds, use of water only for cleaning, holding unsold birds overnight, and poor waste disposal. The prevalence of Avian influenza virusat LBM and stall level was 40% and 20. It is recommended to increase public awareness through education, supply	Bangladesh	290 vendors, 40 markets

FAO. 2009. Assessment of poultry markets and sellers in 25 Provinces and Cities of Cambodia. Prepared by Khieu Borin, Pok Samkol and Olaf Thieme. AHBL - Promoting strategies for prevention and control of HPAI. Rome.	The objective of the study was to characterize bird markets and develop a user-friendly database with market characteristics to help government institutions and other organizations concerned to manage and support of the poultry sectors and other subsectors. This is done in order to assess risks for spread of Avian Flu (H5N1). None of the licensed sellers were producers, but unlicensed sellers were often producers. Only 7.5 percent sellers separated their animals by species, especially chickens and ducks. Among poultry sellers, 47.1 percent freeze leftover slaughtered birds for the next day. People handling slaughtered poultry did not use or were not instructed to use masks and gloves for protection. These are the people most vulnerable to AI risk because they handle poultry from many sources, which could include sick animals. Consumers trust the inspection certification program for pigs and cattle, but this does not exist for poultry.	Cross sectional	Not reported	Cambodia	305 poultry meat and eggs sellers, licensed and unlicensed. Most were licensed.

Kumar A, Ashok K. Mishra, Sunil Saroj, Vinay K. Sonkar, Ganesh Thapa, Pramod K. Joshi (2020) Food safety measures and food security of smallholder dairy farmers: Empirical evidence from Bihar, India. Agribusiness 36: 363–384	Assessed adoption of food safety measures such as handwashing by smallholder farmers. Investigated current practices when it came to milking such as udder, equipment and environmental cleaning practices. Only 27% of dairy farmers wash their hands before milking each dairy animal. Most households use normal water alone to wash their hands, and only 9.7% use soap, disinfectant, or both. About one-sixth of the dairy farmers dry their hands before milking, a practice that is expected to reduce the transmission of infection. Less than 10% of the households dry the udder after washing, which reduces the probability of milk contamination and udder or teat infection (mastitis). In more than 43% of the cases, additives are used to facilitate milking—mostly oil or ghee. Such additives are considered a source of potential contamination and are not recommended. Tools were washed only 44% of the time.	Cross sectional	This is a modelling study on FSM and dairy farmers, many of whom sell milk directly to consumers. There are associations that bear exploring but must be not completely thought of causal. Governments, extension agencies, and NGOs should promote drivers of milk safety measures, including livestock training and awareness of food safety. Any incentives and policy designs that increase herd size and improve housing conditions for animals (i.e., concrete flooring) can positively influence the adoption of milk safety measures.	India	684 dairy farmers, many marginal or landless, with approximately 1.5 animals each

Samaan G, Hendrawati F, Taylor T, Pitona T, Marmansari D, Rahman R, Lokuge K, Kelly PM (2012) Application of a healthy food markets guide to two Indonesian markets to reduce transmission of "avian flu" Bull World Health Organ 2012;90:295–300	Assessed bird handling practices in relationship to avuan influenza H5N1 spread. Poultry vendors rejected face masks and goggles because they made them feel too hot when worn during poultry slaughter. The use of plastic aprons increased after the intervention.	Intervention-application of the WHO guidelines in two markets to introduce infrastructure and behavior change using participatory approaches. The 10 control measures	Combining infrastructural changes with behavior change interventions is critical to guideline implementation. Participatory approach involving monthly consultations and educational sessions can facilitate the adoption of safe food-handling practices and sanitation. Market authorities assumed important leadership roles during the interventions and this helped shift attitudes towards regulation and market maintenance needs. There was significant ongoing monitoring by officials and researchers, and incentives were provided to the vendors by the government in terms of free energy. Involving stakeholders upfront was important.	Indonesia	34 poultry vendors (start) 29 poultry vendors (end), 2 live bird markets

Samaana G, Gultomb A, Indriani R, Lokugea K, Kelly PM (2011) Critical control points for avian influenza A H5N1 in live bird markets in low resource settings. Preventive Veterinary Medicine 100 71–78	Survey focused on documenting the poultry workflow steps, equipment used including personal protective equipment, knowledge and attitudes on avian influenza, and hygiene practices. Use of personal protective equipment was limited with only 11 (29.7%) workers wearing boots and 11 (29.7%) wearing aprons. Cages in each stall were overcrowded with birds and they were placed in close proximity to work surfaces. Study teams observed feathers and feces transfer from inside the cage to work surfaces when birds flapped around inside cages. None of the workers reported using soap or detergents when cleaning work surfaces and only 7 (18.9%) used soap to clean knives and defeathering equipment. The majority of vendors (n = 32, 86.5%) reported cleaning chopping boards several times per day and the others cleaned the boards once at the end of trade (n = 5, 13.5%). One-third (n = 11, 29.7%) of vendors did not know or gave incorrect symptoms of AI infection in birds	Cross sectional	Not reported	Indonesia	37 bird vendors and 3 market managers

Pruvot MKhammavong K, Milavong P, Philavong C, Reinharz D, Mayxay M, Rattanavong S, Horwood P, Dussart P, Douangngeun B, Theppangna W, Fine AE, Olson SH, Robinson M, Newton P (2019)Toward a quantification of risks at the nexus of conservation and health: The case of bush meat markets in Lao PDR. Science of the Total Environment 676: 732–745	Assessed zoonotic disease and food safety risk of bush meat consumption. Wildlife consumers indicated a high risk (28.1%), low risk (22.5%), and no risk (16.9%) towards consumption and handling of bush meat, while the majority (32.6%) did not know. Males had lower risk perception, and there was no significant effect of education level on the perceived risk. When focusing specifically on their knowledge of any disease transmitted from wildlife to humans, 36.3% of respondents indicated that they were aware of such risk, the level of education significantly increased this proportion. “bird flu” was the most frequently cited. Other health risks frequently cited included chemicals and formalin, related to rumors that some wildlife vendors inject formalin into carcasses to keep them longer. Injuries from handling animals, and 5% of respondents indicated that people having high blood pressure should not consume wildlife.	Conceptual risk analysis model composed of mixed methods, primarily questionnaires, interviews and observations of bush meat vendors and consumers.	100% of the interviewed bush meat vendors were female. Not much data was collected on food safety practices of these vendors, but attitudes towards this type of trade, knowledge of potential zoonotic risks, and some demographics were collected. Law enforcement and regulators seem ineffective in enforcing regulations.	Lao PDR	35 vendors, 182 consumers

Greatorex ZF, Olson SH, Singhalath S, Silithammavong S, Khammavong K, Fine AE, Weisman W, Douangngeun B, Theppangna W, Keatts L, Gilbert M, Karesh WB, Hansel T, Zimick S, O'Rourke K, Joly DO, Mazet JAK (2016)Wildlife Trade and Human Health in Lao PDR: An Assessment of the Zoonotic Disease Risk in Markets. PLoS ONE 11(3): e0150666	Examined zoonotic disease risk in wildlife markets. Handwashing was seldom observed, cleaning of tables was rarely seen. Butchering practices were poor, and bush meat and other meat kept in close proximity, increasing the risk of zoonotic disease transmission	Observational study	The data on the volume and species of wildlife and biosafety found in markets in Lao PDR demonstrate that there are significant opportunities in certain markets for wildlife, and any zoonotic pathogens they carry, to come into contact with humans. Food hygiene and safety knowledge is low based on observed practices. Enforcement could be stronger.	Lao PDR	Not reported

Khanal G, and Poudel S, (2017) Factors Associated with Meat Safety Knowledge and Practices Among Butchers of Ratnanagar Municipality, Chitwan, Nepal: A Cross-sectional Study.Asia Pacific Journal of Public Health 2017, Vol. 29(8) 683–691	Examined butchers' knowledge of meat hygiene. A total of 54 (47.4%) respondents had a satisfactory level of practice on meat hygiene according to their scoring system. None of the respondents acquired an adequate level of knowledge and practice	Cross sectional	Majority of butchers in Ratnanagar were unaware of the hygiene aspects of meat handling exposing them and the public to threats of meat-borne diseases. Having a side job, poor education, workload, and structure of shop were the determinants of knowledge and practice levels in meat hygiene. These components must be taken into consideration while preparing the policy and plan for meat hygiene guidelines. Proper registration and licensing of the meat shops should be made mandatory by the municipal authority and only those who have undergone a proper training on meat hygiene should be permitted to work as butchers.	Nepal	114 butchers

Kumar A, Thapa G, Roy D, Joshi PK (2017) Adoption of food safety measures on milk production in Nepal: Impact on smallholders' farm-gate prices and profitability. Food Policy 70: 13–26	Assessed adoption of food safety practices as per Nepal code of practice for dairy industry. Milk Hygiene and animal health practices according to the dairy industry code of practice. There are 42 metrics measured. 64% of these were adopted. One concerning feature was that farmers continued to sell milk if animal was sick.	Cross sectional	The average cost of compliance was estimated to be Rs 1.99 per liter of milk. On average, farms adopted 64% of all FSM. The adoption of FSM related to hygienic milking and milk storage was better than those associated with adoption of those related to animal health. Having a larger family and a larger herd size also influenced adoption of FSM. Routine inspection and provision of information on FSM may be useful.	Nepal	809 smallholder farmers

Paudel M, Acharya B and Adhikari M (2013) Social determinants that lead to poor knowledge about, and inappropriate precautionary practices towards, avian influenza among butchers in Kathmandu, Nepal *Infectious Diseases of poverty* 2:10	Assessed butchers' knowledge and hygiene practices relevant to avian influenza H5N1. Use of masks, gloves, apron and boots, hand washing after touching raw meat, presence of a hand washing facility, and cleaning of utensils were considered good practice. Other measures related to controlling AI spread. These measures were scored,	Cross sectional	There are significant and widespread food safety gaps among theses butchers. Stakeholders are required to consider and target butchers in future prevention and preparedness programs. Respondents <25 years' and 'butchers with primary education 'should be especially targeted with educational activities relating to AI	Nepal	120 butchers in Kathmandu

Vizon KCC, Battad ZG, Castillo DSC (2019) Contamination of food-borne parasites from green-leafy vegetables sold in public markets of San Jose City**,** Nueva Ecija, Philippines. *J Parasite Dis* (Oct-Dec 2019) 43(4):651–657	Assessed vendors' knowledge and awereness of contamination of vegetables with food borne parasites including helminths and protozoa. Cabbage and chinese cabbage were washed with tap water or groundwater before display. The tap water comes from the public water supply. Lettuce was not washed to keep the outer leaves from deteriorating. Vegetables that fell to the ground were sometimes washed. Only 1 of the nine vendors refrained from work if they were sick. Handwashing was done with tap water.	Cross-sectional, repeated measures study design	Green leafy vegetables, particularly chinese cabbage were heavily infested with parasites. Limited knowledge and awareness regarding diseases caused by contaminated vegetables were also observed from the surveyed vendors. Recommend increase in public information and monitoring on food safety by local government units.	Philippines	9 vendors from 3 wet markets.

Lirio GAC, Labana RV, Bernardo IRA, Bernarte RP, Dungca JZ, Nissapatorn V(2018) Survey of Intestinal Parasites Including Associated Risk Factors Among Food Vendors and Slaughterhouse Workers in Metro Manila, Philippines 4th International Research Conference on Higher Education, KnE Social Sciences, pages 493–505.	Examined vendors' personal hygiene and intestinal parasites presence. Most vendors washed their hands before meals, cut their nails frequently, owned a private toilet, Washed hands after toilet. The majority of participants ate raw and unwashed fruits and vegetables, ate street foods and drinks. Most participants did not eat raw meat, and approximately 50% drank tap water. Despite this, 82 of the 91 participants were infected with parasites.	Cross sectional	Intestinal parasites are endemic. 82 of the 91 participants were infested, with men being more likely to be infected than women..	Philippines	50 (food vendors - included food vendors and street food vendors- numbers not specified) and 41 butchers/slaughterhouse workers.

Lindahl E, Sattorov N, Boqvist S, Magnusson U (2015) A Study of Knowledge, Attitudes and Practices Relating to Brucellosis among Small-Scale Dairy Farmers in an Urban and PeriUrban Area of Tajikistan. PLoS ONE 10(2):e0117318.	Assessed KAPs related to brucellosis. Households with a history of reported Brucellis infection among humans, cattle, sheep or goats were equally inclined to sell and consume unpasteurized dairy products as those who had not had the infection within the household or who had never heard of the disease. Showing that knowledge of the disease did not always lead to good practices. 81 % would contact a veterinarian if an animal was sick, and most used gloves if dealing with aborted tissue material.	Cross sectional	Knowledge of brucellosis is poor among the dairy farmers in the urban and peri-urban area of the capital city in Tajikistan. Several known high-risk behaviors were common self-reported practices among the farmers. Such behaviors were consumption of unpasteurized dairy products and not wearing gloves when dealing with cows having an abortion or with aborted materials veterinarians appear to be enabling actors and credible sources of information.	Tajikistan	441 farmers, 76 of which sold direct to consumer.

Thinh NT, Grace D, Hung PV, Huyen LTT, Hung NV, Sinh DX, Nga NTD, Luong NT, Huyen NTT, Ngoc TTB, Phuc PD and Unger F (2020)Food safety performance in key pork value chains in Vietnam. ILRI research brief 94 May	Assessed food safety KAP of value chain actors. Many consumers lacked trust in actors along the value chain and were the least trusting of all the interviewed stakeholders. Consumers also raise major concerns towards inappropriate use of antibiotics and banned veterinary residues, high levels of microbial contamination, and spoiled products. However, these concerns are mainly linked to chemical hazards.	Cross sectional	There was misperception of various value chain actors regarding threats on human health from chemical hazards as opposed to biological hazards. Most actors believe that producers should be the most responsible for the safety of pork. It is recommended to strengthen communications so actors focus on the most important risks, Tailor risk communication messages to make them relevant to the location of value chain actors and types of pork value chains, and Prioritize TV and local radio when disseminating food safety messages to consumers.	Vietnam	542 informant interviews that includes traditional, modern, street food and canteen vendors. Details not provided

Hennessey M, Kima S, Unger F, Nguyen-Viet H, Dang-Xuan S, Nguyen-Thib T, Häsler B (2020) Exploring the potential of using nudges to promote food hygiene in the pork value chain in Vietnam Preventive Veterinary Medicine 181 105003	Investigated the use of nudges to support food safety interventions in the pork value chain in Vietnam in order to change value chain actors food safety behaviors and reduce risk of FBD esp. Salmonella. Authors state there is distrust in government regulatory systems and poor motivation amongst PVC actors cited as reasons for the limited progress.	Cross sectional	Given that pork value chain actors working around Hanoi and Hung Yen Province were found to be particularly influenced by the potential of their *reputation* to act as an incentive, consider their peers and veterinarians as trustworthy messengers, and are affected by the type of visual media used to display information, these nudge aspects should be given careful consideration in the design of future food safety interventions and research to assess their effectiveness. Money was another incentive that was highly motivating.	Vietnam	132 questionnaires were completed with a variety of pork value chain actors, reflecting a response rate of 80%. Canteen workers were the main group to be underrepresented (target sample size n = 28, achieved sample n = 8).

Dang-Xuan S, Nguyen-Vieta H, Pham-Duc P, Unger F,Tran-Thia N, Grace D, Makita K (2019) Risk factors associated with Salmonella spp. prevalence along smallholder pig value chains in Vietnam. *International Journal of Food Microbiology* 290: 105–115	Assessed Salmonella prevalence along the pork value chain and control practices. Approximately half the shops were located in the area of the market for selling pork. Flies were present on 53%of pork stalls. 40% of vendors had access to tap water at the shops. The shop was next to sewerage or drain in 63% of cases. In 47% of cases the same cloth was used for wiping hands and wiping pork. various types of surfaces were used for the counter and as cutting boards.	Cross sectional, repeated measures	Presence of flies, and having a stall near a drain were risk factors for higher salmonella load. Salmonella was found throughout the value chain.	Vietnam	72 pig farms, 13 slaughterhouses, and **217 pork shops**

McCain AK, Vu PTT, Tran TTM, Le MVV, Nguyen DH, Broadway PR, Guillen LM, Brashears MM, Donaldson JR, Schilling MW and Dinh TTN (2015)Influence of Market Setting and Time of Purchase on Bacterial Counts and Prevalence of Salmonella and Listeria in Pork in Vietnam. Agric. Food Anal. Bacterial. 5: 166-182	This study monitored the prevalence of Salmonella, Listeria, E. coli and total aerobic bacterial loads in meat and poultry products. Researchers investigated sampling timing and occurrence at different types of markets. Physical barriers among meat products and consumers were used only in Supermarkets and indoor markets. 33.3% of SM and IM vendors used covered display cases- but not at all time points. This variation in meat display was observed across various supermarkets and indoor markets in the current study. No Outdoor Market vendor covered pork during sampling time. Gloves and hairnets were not worn by outdoor or indoor market vendors, but sometimes worn by supermarket vendors at different time periods. Refrigeration was present at supermarkets but not indoor or outdoor markets. Bacterial counts on pork however were similar across all markets.	Cross sectional	Bacterial counts in supermarkets was the same as open and indoor markets. Observations such as covered display use and use of PPE occurred at different frequencies at different times of day and observed food safety practices may change over the course of the day. The current study, together with a previous report of microbiological baseline of retail beef, emphasizes the need of regulations, control of hazards, and education to improve the safety of meat products in Vietnam	Vietnam	Not reported

Tram NT and Dalsgaard A (2014) Water used to moisten vegetables is a source of Escherichia coli and protozoan parasite contamination at markets in Hanoi, *Vietnam Journal of Water and Health* 12:4 896-900	Assessed Cryptosporidium, Giardia, and E. coli risk from water used to splash vegetables by traders in Hanoi. All traders recorded splashing vegetables with tap water obtained either from the market or from their private home. Most traders kept water in a bucket at their vegetable stall for all day use. To keep vegetables moistened, vegetables were mainly submerged in a bucket (66.0%) or traders used the wetted vegetables to splash water on other vegetables (30.5%). On several occasions traders were observed to use their hands for scattering water onto vegetables, either by pouring water onto their hands using a plastic bottle with small holes in the cap or by dipping the hands in a water bucket. No details were collected on hand washing. Traders washed the plastic buckets typically once a month without the use of soap (70.5%) and some traders never cleaned them (18.5%)	Cross sectional	Current practices are spreading microbiological risk at the markets through poor hygiene practices and unsafe water. The findings of protozoan parasites in splashing water are a food safety hazard. Urgent action is needed to educate traders and the responsible authorities to improve sanitary conditions at markets in Hanoi and elsewhere in less developed countries, to improve food safety and protect public health.	Vietnam	Only % are stated, but 200 splashing water samples were collected from buckets used by traders. So assume around 200 traders.

Wertheim-Heck SCO, Spaargaren G, Vellema S (2014) Food safety in everyday life: Shopping for vegetables in a rural city in Vietnam. Journal of Rural Studies 35:37-48	Examined food safety as it relates to shopping and food selection in wet markets; assessed what elements drive trust, or factors of largest concern. Also investigated why consumers in Viet Tri do not embrace the supermarket modernization of the fresh-food system as an appropriate solution for their apparent and serious food-safety concerns, and how they manage food safety concerns when shopping in wet markets. No direct measure of food safety was carried out in this paper, which reported on a number of interviews. Vendors seem to pass the responsibility of 'safe' vegetables back to farmers. In trying to regulate food safety, retailers rely on personal experience and expertise in supplier selection: "I can't be sure whether suppliers (mostly farmers) are honest or not, but I can only rely on their honesty." (Interview #18) Retailers tend to prefer suppliers with whom they maintain a longer-term relation and with whom they haven't experienced any complaints from consumers on food poisoning, stomachache, diarrhea and vomiting, thus far. Consumers in Vietnam are highly concerned about food safety and	Cross sectional	Food safety is a well-recognized concern for vegetables. Concern about pesticides and fertilizer residues are much higher than microbiological risk factors vegetables. Small scale producers are more trusted because they are not 'mass produced'. Trust in food safety is built on vendor/consumer relationships and vendor/farmer relationships. Within the wet-market setting both providers and retailers and street-vendors and consumers apply different repertoires for generating trust in vegetables. Certification programs do not appear to be working despite these food safety pesticide concerns. Understanding why traditional trust relations survive under	Vietnam	Various cohorts interviewed: sales information: 8 wet market retailers 3 street vendors and a shop manager. Retail structure- management board of 4 wet markets were interviewed. 75 vendors- participated in the retail census to understand assortment of vegetables.

	often relate it not to bacterial disease but to contamination by chemicals. Given aforementioned consumer' tendency to relate experienced foodborne illnesses to excessive agrochemical residues on the vegetables they consumed, they will blame the retailer for selling unsafe vegetables, even when consumers' own unhygienic food handling practices might have induced the health problem. Two interviewed retailers reported to be confronted with consumer complaints. As a consequence, both stated to have become reluctant in sourcing vegetables from unknown suppliers even when insufficient supplies of regular suppliers would urge them to do so.		the increasing treats and anxieties generated by food-safety scandals. Traditional regulators appear to have little ability to moderate some of these trust concerns when it comes to food safety.		

Merino A, Hoan NV, Ayuda A, Desarrollo I (2011) Review of selected (fish) marketing chains and arrangements" in Quang Nam and Thua Thien Hue Provinces. Regional Fisheries Livelihoods Programme for South and Southeast Asia (GCP/RAS/237/SPA) Field Project Document 2011/VIE/3.	Assessed practices in the fresh anchovy supply chain. Handlers use chilled sea water or salted water, even if they are going to sell or process in less than four hours. Fishers and collectors sort anchovy by size when packing it into chilled sea water in plastic drums of 20-25 kg capacity. Hygiene and sanitary conditions for preserving and handling fresh anchovy could be improved but this is not a priority for the anchovy value chain, as there is no loss of fish quality or value because of handling. Trade is rapid and anchovies are processed or sold to final consumers on the day they are caught. The lack of cold storage facilities forces fishers to trade quickly. Fishers lose negotiation capacity, but not quality.	Observational study- it's a value chain report	Hygiene and sanitary conditions of the marketed fish can be improved by providing more training to involved agents, development of cold storage facilities, and better sharing of information.	Vietnam	Not reported

Ifft J, Otte J, Roland-Holst D, and Zilberman D (2008) Poultry Market Institutions and Livelihoods: Evidence from Vietnam. Rural Development Research Consortium Research Report RR Nr. 08-02	The objective of this work, and the larger project from which it originates, is to improve understanding about how markets can act as catalysts for rural poverty alleviation. Food safety was not the focus of the survey- but as this study captured data on vendor demographics, it was included. Slaughterhouse facilities exist in the markets with discreet operators. A few slaughterhouse operators also was a vendor. 2/3 of the live bird vendors only sell live chickens. They do not sell slaughtered chickens. The companion consumer survey indicated that household buyers at all income levels are very discerning about poultry and poultry products. They exhibit distinct preferences for fresh meat from local varieties, and are willing to pay substantial premia for this. In response to these demand-side forces, vendors devote 59% of their inventory to local bird types, 32% to industrial chicken, and 9% to crossbred birds. No details were provided about food safety expectations but it can be implied it is expected and high due to prices commanded.	Cross sectional	Not reported	Vietnam	66 commune traders, 88 wholesale traders, 200 live bird market traders