

Application of behaviour change theories to food safety education in youth:

A scoping review

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Summary

- Youth are a key target audience for food safety education given their poor food safety knowledge, lack of food handling experience, and increased risk taking.
- Psychosocial factors, namely, perceived behavioural control, intention, and self-efficacy, were identified as key constructs to consider when designing and delivering food safety education for youth.
- Barriers that could impact youths' adoption of safe food handling behaviours, include: perceived susceptibility (invincibility), perceived severity, time, inclination, and peer pressure (social norms).
- Food safety education should target age groups or stages of development pre-habit formation, providing the greatest opportunity to instill desired healthy behaviours.
- Future food safety studies should base intervention design and questionnaires on behaviour change theories, and use a randomized control design that includes observational data with pre-/post and post-post testing to evaluate interventions.
- Building food handler knowledge and skills should result in increased perceived behavioural control, self-efficacy, and intentions to handle food safely for youth.

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Youth are a demographic not typically emphasised in food safety education programs. Rather, food safety messages are typically directed at vulnerable populations (the elderly, caregivers of the very young, and those who are immunocompromised) as well as commercial food handlers. This is particularly worrisome given youths' emerging roles in food handling and preparation, future roles as caregivers for children and the elderly, and the fact that the food industry is one of the most common youth employment opportunities (1). Among food handlers and consumers, youth tend to engage in riskier food handling practices, with hypothesized reasons including lack of food safety education, food handling role models, and food handling experience (2). Youths' lower food safety education levels, lack of experience and increased risk taking make them highly susceptible to making themselves and others sick. Thus they represent a unique population for food safety education.

Food safety education is most effective when it targets changing behaviours linked to foodborne illnesses (3). Personal hygiene, adequate cooking, and avoiding cross-contamination are identified as the key food safety emphases for youth and consumer food safety education efforts (1, 3, 4, 5, 6). Food safety education interventions have resulted in improved knowledge and behaviour measures (4, 5, 6), stressing the need to explore the inclusion of behaviour change theories (BCT) in food safety education.

BCT have been successfully applied to numerous public health initiatives including: predictors of physical activity, healthy eating, and being smoke-free (7); healthy food choices (8); and reducing second hand smoke exposure (9). The application of BCT in food safety education is still emerging, for example on focussing on food safety education effects on food

choice behaviours (10), hand hygiene behaviour (11), and the effectiveness of food safety interventions based on the Theory of Planned Behaviour (TPB) (12). Given the successful application of BCT in a wide range of public health initiatives aimed at changing behaviours, exploring the application of BCT more broadly in food safety education efforts is needed to guide and potentially improve future public health efforts. This review used the Arksey and O'Malley scoping review framework (13, 14; Appendix A) to research the application of BCT to food safety education efforts in youth, focussing on theories that explain health behaviour at the individual level (Appendix B).

Methods

A literature search strategy was developed in consultation with a university research library liaison. Behaviour change, food safety, population, and intervention were identified as the concepts used to organize search terms (Appendix C). Pubmed, Embase, Medline, CINAHL, PsychInfo, and Google Scholar were systematically searched. Reference lists and cited sources from selected studies were scanned to identify further studies for inclusion.

Studies were included if they met the following criteria: focused on food safety education and behaviour or practice; target population of high school students, first and second year college/university students, or grade 7/8 students; linkage to a BCT; qualitative or quantitative measures of effectiveness and applicability; primary research studies, systematic reviews and meta-analysis; and published in English. Studies were also selected if they met all other criteria but did not identify a BCT.

Results

In total, thirteen studies met the inclusion criteria (Appendix D). Publication dates ranged from 2004 to 2012. No Canadian based studies were identified as part of the review. Studies

included were from the United States, Australia, United Kingdom, and Asia (Japan and South Korea).

Behaviour change model and study design

Twelve of the thirteen studies identified at least one BCT, with three studies identifying two or more theories in their design. Where more than one theory was indicated the studies were categorized by the predominant theory used in the measurement tools and evaluation. Five out of the thirteen studies included a food safety intervention in their design with pre and post-intervention questionnaires (2, 5, 11, 12, 15, 16). Two of the studies used a prospective cohort design (17, 18), collecting demographic and baseline measurements at study onset and then collecting self-reported food behaviour practices one to four weeks later. The remaining six used a cross sectional study design, collecting food safety and behaviour measures through observations (12) focus groups (1) and self-reported questionnaires (2, 4, 5, 11, 15, 19, 20, 21).

Studies used four main BCTs: Theory of Planned Behaviour (TPB; 2, 12, 15, 17, 19; Appendix E), Transtheoretical (stages of change) model of change (TMC; 4, 11, 20, 21; Appendix F), Health Belief Model (HBM; 1, 5; Appendix G), and the Health Action Process Approach (HAPA; 18; Appendix G). The HBM and HAPA studies are presented together due to similarities in psychosocial factors measured, namely: self-efficacy, susceptibility, vulnerability, and severity. One study did not indicate the use of a BCT (16). Post intervention, Brown & Hermann (16) reported youth increased: hand washing before and after food handling, washing of fruits and vegetables, and using a clean knife and cutting board to prepare foods.

Theory of planned behaviour (TPB)

TPB based studies measured the psychosocial factors, attitudes, subjective norm, perceived behavioural control (PBC), and intention. Two studies, (17, 19) expanded the TPB by

including, risk perception and past behaviour, respectively. Four of the five studies based on the TPB were conducted by the same investigator. TPB factors (attitude, subjective norm, and PBC) significantly predicted 26 percent (12), 33 percent (15) and 66 percent (17) of college students' intention to prepare food hygienically. TBP with risk perception accounted for 60 percent of variance in safe food handling behaviour in Australian and UK high school students (19).

Transtheoretical (stages of change) model (TMC)

Three of the four studies that used the TMC measured both stages of change and self-efficacy (4, 11, 21). Takeda et al. (20) measured stages of change as well as beliefs related to severity and susceptibility. Most of the youth in the TMC studies were in the pre-action stages (precontemplation, contemplation, or preparation). Kim et al. (11) reported a strong influence between self-efficacy and proper hand washing scores.

Health Belief Model and Health Action Process Approach (HAPA)

HAPA studies included many psychosocial factors, namely: self-efficacy, perceived susceptibility, perceived severity, perceived threat, barriers, benefits, and cues to action (1, 5, 18). Haapala & Probart (5) reported high student self-efficacy scores, and low perceived susceptibility scores. While Byrd-Bredbenner et al. (1) found students lacked confidence in their food-handling knowledge and skills (low self-efficacy) but felt susceptible to foodborne illnesses. According to Chow and Mullan (18), Risk awareness vulnerability, severity, outcome expectancies and action self-efficacy statistically significant in predicting intention (30.8 percent of variance); while subjective norm and social support accounted for an additional 12.6 percent of variance, with only subjective norms being significant. Past behaviour accounted for additional 10.9 percent of variance. Barriers identified included lack of knowledge and food

handling experience, parents not present to act as role models, habits, lack of concern, and peer pressure (1).

Food Safety knowledge and experience

Overall, youth had low to moderate food safety scores (2, 4, 5, 12, 21). Youth had limited food safety experience, either working in the food industry or through health and nutrition courses (4, 21). The majority of youth reported some food handling responsibilities at home (4, 5, 21).

Discussion

The limited number of studies available and the variations in design, collection tools, and measurements made the Arksey and O'Malley (13) framework for scoping reviews an ideal methodology for conducting this review. The following is a summary of the reviewed literature and the identified gaps related to the application of BCT to food safety education in youth. Where appropriate research from other health issues has been used to fill in the gaps and strengthen the rationale for the inclusion of BCT in the development and evaluation of food safety education.

Theory of Planned Behaviour (TPB)

The BCT constructs attitude, subjective norm, and PBC significantly predicted youths intentions to prepare food hygienically (12, 15, 17, 19). The TPB has been used to explain variations in youth intentions and behaviours in other health issues, including: healthy eating (7, 22, 23), and tobacco and alcohol use (24, 25). According to Moan & Rice (25), past behaviour and PBC intention interaction account for 35 percent of the variance in smoking behaviour. Astrom (22) report that the TBP model significantly predicts sugar consumption in adolescents, with TPB factors accounting for 58 percent of the behaviour intention. A review of the

application of TPB to health related behaviours finds that about a third of variance in behaviour can be explained by the combined effect of intention and PBC (23).

Moan and Rise (25), report past behaviour to be another important factor in determining youths' intentions and actions towards health behaviours. Wong and Mullan (26) found past behaviour to be the strongest predictor of future behaviour when looking at breakfast consumption in undergrads. Mullan and Wong (17) report that TPB with past behaviour predicted 69 percent of variance in intention to prepare food safely, highlight the need to consider the role of past behaviours and habit forming activities when designing health promotion campaigns. Ideally, campaigns would be targeted at age groups or stages of development pre-habit formation. This would give the greatest opportunity to instill desired healthy behaviours, rather than working to change non-desirable behaviours. Based on this notion, youth should be a primary target for food safety education. Youth are starting to take on food handling duties, including snack (5) and meal preparation, yet they tend not to be the primary meal preparer and have limited food safety experience (4, 21).

Transtheoretical (stages of change) model of change (TMC)

The TMC has been shown to be a reliable method to investigate youth health behaviours including, exercise behaviour (27, 28), injury prevention (29), second-hand smoke exposure (9), consumption of carbonated beverages (30), and healthy eating and alcohol consumption (27). Buchanan & Coulson (30) found that as stage of change increases so does emphasis on positive aspects (increased confidence) versus the negatives (time involved) of the health behaviour. Precontemplators emphasize negative aspects of exercising while maintainers emphasize positive aspects. Buchanan & Coulson (30) also found that 55 percent of youth fit into pre-action stages. These findings are interesting and deserve exploration in relation to food safety education, as the

majority of youth in the food safety studies were also in the pre-action stages (precontemplation, contemplation, and preparation). Youth food safety education should include strategies to combat perceived barriers and negative feelings towards safe food handling behaviours. Counteracting negative concepts will help move students from pre-action stages to action and maintenance. Building food handling knowledge and skills should increase self-efficacy as youth gain confidence in their ability to perform the recommended behaviours.

Health Belief Model (HBM) and Health Action Process Approach (HAPA)

Self-efficacy is a key construct that appears across a number of food safety studies (1, 2, 4, 5, 18, 21, 31) as well as studies in other health related issues (8, 28, 30). Nigg & Courneya (28) report correlations between increases in self-efficacy, and stages of change, on both intentions to perform behaviour and on performance of behaviours.

The HBM, deals with the constructs of self-efficacy and perceived susceptibility and severity, which are similar to risk awareness, outcome expectancy, and action self-efficacy constructs of the motivational phase of the HAPA (32). Using the HBM, Haapala & Probart (5), found high scores for self-efficacy and severity of foodborne illness, but low scores for perceived susceptibility. Chow and Mullan (18) found that risk awareness, vulnerability, severity, outcome expectancies and self-efficacy accounted for 30.8 percent of the variance in intentions. For food safety behaviour to occur, people must feel susceptible to illness, have an incentive to take action, and feel competent (high self-efficacy) to carry out the action (31).

Barriers to food safety education in youth

There are a number of youth-based barriers that could impact the adoption of safe food handling behaviours, including perceived susceptibility (invincibility), perceived severity, time, inclination, and peer pressure (social norms). Youth appear to have low perceived personal

susceptibility to foodborne illness, (5), due to sense of invincibility, and not understanding severity of consequences (1). These findings are consistent with results of Milton and Mullan's (33) systematic review that indicates despite consumers' acknowledgement of the importance of food safety behaviours, they do not believe food-related illnesses are a common concern. If youth do not perceive themselves as susceptible to or recognize the potential severity of foodborne illness they may not be motivated to adopt safe food handling behaviours. Increasing knowledge about foodborne illness rates and severity, especially in domestic environments may help counter these misperceptions.

Implications for use of behavior change theory in food safety education

Milton and Mullan (33) recommend that food safety studies base intervention design and questionnaires on BCT. Studies should use a randomized control design that includes observational data gathering, and pre-/post and post-post (6 months out) testing to evaluate interventions short and long term impacts. Studies should also gather self-reported data on knowledge, behaviours and psychosocial factors including attitudes, subjective norms, PBC, and behavioural intentions. Future studies in youth food safety education should adopt the Milton and Mullan (33) study design and consider expanding it to include the constructs of self-efficacy, perceived susceptibility, perceived severity, and past behaviour. Researchers should strive to meet as many of the standards outlined above whenever possible. It should be noted that these recommendations are not advocating for the stoppage of survey and non-intervention based research. As demonstrated in this review there are significant findings and recommendations that can be taken from survey based research that can help direct the development, delivery and evaluation of food safety education in youth.

Limitations

As per the Arksey and O'Malley (13) framework this review did not include an evaluation of the quality of evidence presented in the studies selected. The scoping review permitted the inclusion of a wider range of study designs with and without interventions that might otherwise not have been captured in other reviews. Arksey and O'Malley (13) recommend a consultation stage (stage 6). Due to study design limitations consultation was not conducted in this review. Consultation is described as using stakeholders after summation of results (stage 5) to build evidence for the review, offer higher levels of meaning, provide content expertise, and perspective on findings (14).

Similar to the challenges reported by Milton and Mullan (33) in their systematic review of consumer food handling behaviours, behaviour changes in this review were rarely validated by checking actual behaviours through observation, instead they relied on self-reported questionnaires. Another challenge was the small number of articles that met selection criteria. The broad definition of youth, defined as students in high school, first or second year college or university, and grades seven and eight could be seen as a limitation. Individuals within this age range could have vastly different levels of maturity, psychosocial development, and food handling experiences. However, research showed these groups share many common psychosocial behaviours related to food handling and food safety behaviours. As well level of food handling experience and food safety knowledge were moderate to low across all three subsets of the youth demographic.

Conclusion

A number of constructs (psychosocial factors) measured in the various studies were identified in the review as being critical for consideration in food safety education, including:

self-efficacy, perceived severity, perceived susceptibility, and past behaviour. No Canadian studies were identified for review, demonstrating an opportunity for future Canadian research in the application of behaviour change theories in food safety education. Applicability of BCT in youth was strengthened by including research from other health-related issues namely: physical activity, healthy eating, alcohol use, and tobacco use. PBC and intentions are two variables that show significant correlations to behaviour in food safety and other health related literature. Educators need to strongly consider these variables when designing and delivering food safety education material to youth. In the TMC the majority of youth in the food safety studies were in the pre-action stages (precontemplation, contemplation, and preparation) (2, 4, 11, 21). This represents a clear opportunity to move youth from pre-action to action and maintenance stages. Educators also need to find ways to determine where food safety ranks as a priority for youth. If youth are not motivated to change, then all efforts are lost. Central to any successful food safety initiative will be the ability to increase individual self-efficacy, risk awareness, perceived susceptibility and severity, motivation, and knowledge. Building food handling knowledge and skills should increase self-efficacy and PBC as youth gain confidence in their ability to perform the recommended behaviours.

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Appendix A

Arskey and O'Malley scoping review framework

The Arksey and O'Malley (5) framework identifies six stages for conducting a scoping review:

Stage 1 – identify the research questions,

Stage 2 – conduct a literature search for relevant studies,

Stage 3 – select studies that fit research questions,

Stage 4 - chart the data from the studies,

Stage 5 – collate, summarize, and report results, and

Stage 6 – consultation with stakeholders.

Appendix B

Overview of behaviour change theories at the individual level

Theory of Planned Behaviour

The TPB began as the Theory of Reasoned Action (34). It is based on the assumption that intention to act is the most immediate determinant of behaviour (34). Intentions are thought to be influenced by three independent constructs (variables), perceived behaviour control (PBC), attitudes, and subjective norms (35). The PBC construct explains an individuals' perceived ease or difficulty in completing the desired behaviour. Attitudes are determined by the belief that a desired outcome will occur and that the outcome will be beneficial to health if a particular behaviour is followed (34). This is similar to the Health Belief Model's (MBM) concept of perceived benefits and barriers. Subjective norms relate to an individual's beliefs about what others think (34). The TPB predicts that a person will have strong intentions to adopt, maintain or change behaviour if they believe that the behaviour will be beneficial to their health, is socially desirable, and they feel social (peer) pressure to follow the behaviour (34).

Transtheoretical (stages of change) model of change (TMC)

The TMC was developed by Prochaska and DiClemente (34) to describe both the stages of change and processes of change common to most behaviour changes. TMC was initially applied to addictive behaviours (27). The theory is built on the notion that behaviour change is a process rather than an event (34). The concept that individuals have different levels of readiness and motivation to change is central to the theory (34). TMC identifies five stages of change: precontemplation (not considering change), contemplation (considering change), preparation (planning change), action (changing behaviour), and maintenance (keeping desired behaviour or avoiding undesirable behaviour). Studies have used the TMC, explain youth health-related

behaviour in a number of health promotion areas, including: exercise behaviour (28), injury prevention (29), second hand smoke exposure (9), and consumption of carbonated drinks (30). Burke et al. (27), demonstrate the validity of the model against a number of health related behaviours (diet, physical activity and alcohol drinking) in 18 year-old Australians. Clearly, the TMC has been shown to be a reliable predictive model for a wide range of youth health-related behaviours.

Health Belief Model (HBM)

The HBM was designed to explain health behaviours by better understanding individuals' perceptions and beliefs about health (34). The model is built on the premise that an individuals' health-related actions are based on the interaction of four elements: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers (34). The HBM has been expanded to include the concept of self-efficacy, the belief in one's own ability to successfully perform a behaviour (34). The HBM is used as a planning tool for health education programs, and has proven most useful when applied to preventive health behaviours such as screening and immunization (34). The model has proven less useful with more socially determined behaviours (alcohol, tobacco, and other drug use). This is mostly due to the fact that the HBM does not account for a person's attitudes, beliefs, social influences, or habitual behaviours (34).

Health action process approach (HAPA)

The HAPA is a model that incorporates action planning into health behaviour change (18). HAPA includes two stages: motivational and volitional. In the motivational phase intentions towards a health behaviour are influenced by risk awareness, outcome expectancy, and self-efficacy (32). This means if there is no perceived risk or the risk is not considered serious than the motivation to implement the behaviour decreases. The volitional phase looks at action

planning and bridging the gap between intention and behaviour. The greater the level of motivation based on risk awareness and outcome expectancy the greater the chance of the individual planning to implement the behaviour.

Appendix C

Literature search terms by concept

Concept	Search terms
Behaviour Change	“behaviour change” OR “behaviour change” OR “theory of planned behaviour” OR “theory of planned behaviour” OR “stages of change” OR “health belief model” OR transtheoretical OR “social learning” OR “social cognitive theory” OR “theory of reasoned action” OR “reasoned action” OR “social norm”
Food Safety	“food safety” OR “food safety education” OR “food handler” OR “food handler education” OR nutrition or “food and nutrition”
Population	“young adult*” OR youth OR adoles* OR teen* OR student* OR “high school” OR college OR university OR “middle school”
Intervention	Edcat* OR program* OR course* OR intervention* OR teach* OR curriculum* OR instruct* OR train*

Appendix D

Literature search results

Articles retrieved from database search:
CINAHL n = 375
Pubmed n = 358
Embase n = 325
Medline n = 440
PsychInfo n = 245
Total: n = 1743

Articles after duplicates removed
n = 445

Articles not meeting inclusion criteria based on title and abstract
n = 372

Articles full text examined
n = 73

Articles from database meeting selection criteria
n = 10

Articles from non-database sources
n = 3

Articles included for analysis
n = 13

Appendix E

Application of the Theory of Planned Behaviour in food safety education in youth

Study and Year	Country	PURPOSE/OBJ of Study	Target Population	Intervention	Psychosocial Factors measured	Food Safety Principles	Measurement Tools	Findings
Milton & Mullan, (12)	Australia	Explore the effectiveness of a food safety intervention.	First year psychology students (mean age =20.9) n = 45	Yes - computer based TPB food safety	Attitudes Subjective norm PBC Intention	Clean Separate	Food Safety Observational checklist TPB Questionnaire	Attitude, subjective norm, and PBC significantly predicted 26 % of participants' intention to prepare food hygienically. PBC only variable that predicted intention independently. Intervention resulted in significant change in youths PBC and behaviour.
Mullan et. al., (19)	Australia and United Kingdom	Investigate where the TPB with risk perception could predict safe food handling in a sample of adolescents from the UK and Australia	11 to 18 year olds in secondary school in UK and Australia. Mean age 13.7 years.	No	Attitudes Subjective norm PBC Intention Risk Perception	Cook, Clean, Chill, Separate, Sources of pathogens	TPB Questionnaire Food Safety Knowledge Questionnaire	TPB with risk perception accounted for 60 percent of variance in safe food handling behavior. Knowledge was not a significant predictor of intention or behaviour.
Abbot et. al., (2)	United States	Development and evaluation of food safety campaign directed at young adults.	University students 18-29 years of age.	Yes - 4 week food safety information campaign	Self-efficacy Stage of change Perceived barriers	Cook Clean Chill Separate	Pre and post intervention questionnaires	Focus groups and subject matter experts used to design campaign material. Stage of change progressed significantly post intervention moving closer to preparation. Food safety self-efficacy scores increased, except for handling of leftovers. Respondents reported increased proper hand washing post intervention.

Study and Year	Country	PURPOSE/OBJ of Study	Target Population	Intervention	Psychosocial Factors measured	Food Safety Principles	Measurement Tools	Findings
Mullan & Wong, (17)	Australia	Investigate the predictive ability of the TRA and TPB in food handling behaviours and to also consider the addition of past behaviour.	First year university students (mean age 19.5) n=109	No	Attitudes Subjective Norms PBC Behavioural Intention Past Behaviour Behaviour	General food handling behaviours (specific details not provided)	Online survey reporting on food hygiene behaviours over a four week period.	TPB predicted 66% of the variance in intention to hand handle food hygienically. Subjective norm a significant predictor of intention. PBC most significant predictor of intention. Past behaviour predicted 3% variance in intention but predicted 18% of actual behaviour. TBP with past behaviour predicted 39% of self-reported behaviour, leaves 61% unexplained illustrating intention-behaviour gap.
Mullan & Wong, (15)	Australia	Determine if interventions would lead to an increase in safe food handling behaviours, relative to a control group.	Undergrad students (mean age 19.9) n=184	Yes	Attitudes Subjective Norms PBC Behavioural Intention Past Behaviour Behaviour	Cook Clean Chill Separate	TPB Questionnaires and Listing of 6 most important food hygiene rules	TPB predicted 32.8% of variance in intention to prepare food hygienically. Past behaviour predicted a further 5.6% of variance. Intention and PBC predicted 14.5% of variance in behaviour. past behaviour accounting for an additions 3.6%.

Appendix F

Application of the Transtheoretical Model (stages of Change) of Change (TMC) in food safety education in youth

Study and Year	Country	PURPOSE/OBJ of Study	Target Population	Intervention	Psychosocial Factors measured	Food Safety Principles	Measurement Tools	Findings
Kim et. al., (11)	South Korea	"Determine how stages of change were affected by food safety education, focusing on hand hygiene and general food safety."	Middle school. Mean age 14.7 years.	Yes - three 30 minute education sessions.	Stages of change (action, contemplation, pre-contemplation) Self-efficacy	Hand hygiene Food borne illness proper food storage Definition of HACCP	Self-reported questionnaire.	Self-efficacy had the strongest influence on proper hand washing scores. Positive relationship shown between stage of change and proper hand washing score. Reported at home parental food safety instruction was significantly associated with proper hand washing.
Abbot et. al., (4)	United States	Examine the relationship between self-reported food-handling behaviors and cognitions of young adults to observed food handling-behaviors.	University Students 18-26 years of age. (mean age 20.7)	No	Stages of change (action, contemplation, pre-contemplation) Self-efficacy beliefs	Cook Clean Chill Separate	Food preparation observational checklist Home kitchen observation checklist Food safety self-reported behavior, psychosocial and knowledge Questionnaire	Participants were primarily in the pre-action stages (precontemplation, contemplation, and preparation. Mean best practices scores were low, students engaged in less than half of the recommended safe food-handling practices. Thermometer use was very low (probe and refrigerator). Having prior food safety knowledge predicted behaviors related to clean and chill.

Study and Year	Country	PURPOSE/OBJ of Study	Target Population	Intervention	Psychosocial Factors measured	Food Safety Principles	Measurement Tools	Findings
Byrd-Bredbenner et. al., (21)	United States	Assessment of self-reported risky eating behaviors.	College and University students, age range 17-26. (mean age 19.9) n=4,343	No	self-efficacy Stages of change	Cook Clean Chill Separate	Cross-sectional online food safety survey	Maintenance stage was significantly associated with higher behavioral scores when compared with precontemplation, contemplation, preparation and action stages. Men ate significantly more risk foods than women. Those who believed that food poisoning was a personal risk tended to eat fewer risky foods. Correlation between food safety knowledge and risky eating was statistically significant. Students who disagreed with severity and susceptibility statements reported increased risk-reduction behaviors.
Takeda et. al., (20)	Japan	Identify whether university students who have both food safety knowledge and beliefs perform risk-reduction behaviors.	University Students	No	beliefs - severity and susceptibility stages of change	Safety when buying foods Food-borne illness sources	Self-report questionnaire	Limited exposure to food safety education (course, certificate, job, etc). Strong feelings of self-efficacy, were between contemplation and preparation, were slightly positive that food-borne illness was a personal threat, overall had modest knowledge levels (mean 53.7 out of 89) Youth who believed food poisoning was a personal threat tended to eat fewer risky foods.

Appendix G

Application of the Health Belief Model (HBM) and Health Action Process Approach (HAPA) to food safety education in youth

Study and Year	Country	PURPOSE/OBJ of Study	Target Population	Intervention	Psychosocial Factors measured	Food Safety Principles	Measurement Tools	Findings
Health belief model								
Haapala & Probart, (5)	United States	"Assess the level of food safety knowledge, perceptions, and self-reported food-handling behaviours among middle school students."	Seventh and eighth grade students in Pennsylvania.	Yes - five week computer assisted food safety instruction	Self-efficacy Personal susceptibility Perceived severity	Cook Clean Chill Separate	Food handling perceptions and behavior questionnaires	Self-efficacy and severity scores were high, well perceived susceptibility scores were low. Food safety knowledge scores indicated only a fair level of food safety knowledge (avg 72% correct answers). Lower knowledge scores related to cooking and cleaning, compared to hand washing, checking foods, and chilling.
Byrd-Bredbenner et. al., (1)	United States	Establish baseline data regarding food-handling cognitions and responsibilities of middle schoolers.	Grade 6, 7 and 8 students. (mean age 12.6)	No	Perceived threat (susceptibility and severity benefits barriers self-efficacy cues to action	food safety and food poisoning prevention behaviours	Student, parental, and expert Focus groups	Threat - most felt susceptible and recognized potential severity of food-borne illnesses. Barriers to behaviors - parents not present, habits, lack of concern, lack of knowledge, peer pressure, experience. Self-efficacy - some expressed a lack of confidence in knowledge and skill. Attitude - felt safe food-handling would protect their health. Subjective Norm - felt parents modeling of safe behaviors was important, but parents not always present. Peers important, want to be like peers.

Study and Year	Country	PURPOSE/OBJ of Study	Target Population	Intervention	Psychosocial Factors measured	Food Safety Principles	Measurement Tools	Findings
Health Action Process Approach								
Chow & Mullan, (18)	Australia	Investigate whether the HAPA can be used to predict food safety behavior.	First year university students. (mean age 19.9, with 70.5% of respondents 19 years or younger)	No	Risk awareness - vulnerability and severity Self-efficacy Intention Past behaviour Subjective Norm	personal hygiene avoidance of cross contamination	Online two part questionnaire	Risk awareness vulnerability, severity, outcome expectancies and action self-efficacy statistically significant in predicting intention (30.8% of variance) Subjective norm and social support accounted for additional 12.6% of variance, only subjective norms being significant. Past behaviour accounted for additional 10.9%.