



Review article

Factors associated with food safety: An integrative review

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ABSTRACT

This integrative review focused on factors associated with food safety in home kitchens. Six factors were found to be associated with food safety including knowledge, gender, age, education, perceived risk and perceived control, and attitude are discussed. Due to gap of knowledge on food safety education, further research is needed to implement plans to address the above factors.

Key words: Integrative review, Food safety, Foodborne illness

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บทความปริทัศน์

การทบทวนวรรณกรรม: ปัจจัยที่เกี่ยวข้องกับความปลอดภัยทางอาหาร

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บทคัดย่อ

การทบทวนวรรณกรรมครั้งนี้มุ่งเน้นปัจจัยที่เกี่ยวข้องกับความปลอดภัยทางอาหาร พบว่ามีปัจจัยที่เกี่ยวข้องกับความปลอดภัยทางอาหาร 6 ด้าน ได้แก่ ความรู้ เพศ อายุ การศึกษา การรับรู้ความเสี่ยงและการควบคุม และทัศนคติ จึงมีความจำเป็นที่จะต้องมีการศึกษาแนวทางการพัฒนาโปรแกรมส่งเสริมความปลอดภัยทางอาหารโดยคำนึงถึงปัจจัยทั้ง 6 ด้านดังกล่าว

คำสำคัญ: การทบทวนวรรณกรรม, ความปลอดภัยทางอาหาร, ความเจ็บป่วยเนื่องจากอาหาร

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Introduction

Food and Agriculture Organization of the United Nation (FAO) and the World Health Organization (WHO) defined the term “food safety” as the assurance that food will not cause harm to consumer when it is prepared and/or eaten (Codex Alimentarius, FAO/WHO, 2009)¹. Foodborne illness is a significant global health problem. World population increased from 2.5 billion in 1950 to 6.1 billion in year 2000. It is estimated to reach 9.1 billion in the year 2050, forcing an increase in production that contributes to food security, accessibility to sufficient food and nutritious food. Consequently, leading to new development. Such as Genetically Modified Organisms (GMOs) and increase use of pesticides. Causes of foodborne illness include viruses, bacteria, parasites, biological toxin, pesticide residues, chemical and heavy metals.^{2,3,4,5} Foodborne diseases cause 50-87% of illnesses in various countries⁶. In the year 2010, a study reported that foodborne illnesses have effects on approximately 82 million cases annually in the U.S.⁷ Thailand experienced foodborne Botulism in 2006 and 2012^{8,9} and Cholera in 2010¹⁰. Foodborne outbreaks not only affect health and well-being of people, but also have economic consequences in both individuals and the nation⁴.

Factors related to foodborne illness include large-scale production and distribution of food, globalization of the food supply, food consumption outside of the home, microbial

genomic diversification/ emergence of new pathogens and growing population of at-risk consumers (children, people who have a weak immune system, older and pregnant women)¹¹. “Food safety” is an essential public health issue for all countries. It is a key concept that is applied to total food chain called “farm to table” or “farm to fork”. Thus, the process of production, transportation, store, preparation and consumption should be clean^{12,6,13}.

Home kitchens are primary location in which foodborne outbreaks can occur¹⁴. The home is a residence consisting of various ages and health statuses such as infant, pregnant women, older adults and immunocompromised persons¹⁵. Clayton and Griffith (2003)⁶ showed that 50-87% of reported foodborne disease outbreak in various countries were associated with home. Therefore, factors associated with food safety in home kitchens should be explored.

Aim

The aim of this integrative review is to describe factors associated with food safety in home kitchens. The results will be helpful for guiding future intervention and providing guidance for developing home food safety program.



Methods

This integrative review included non-experimental and qualitative literature involving evidence-based practice in nursing and other disciplines.

Literature search procedure

The literatures were search from PubMed, EBSCO, Elsevier, Science Direct, Springer Link and ProQuest. The search was performed during September - December 2013. Review focus on research papers published in English. The search terms included: food safety, food safety and home, factors and food safety practice, food safety behaviors and home, food safety education and home, control food safety and home, attitudes and food safety, socio-demographics and food safety, tradition and food safety.

Inclusion and exclusion criteria

Studies used quantitative, qualitative, or mixed methods published in peer-reviewed journals. The experimental research was excluded. The literatures published between 2003

and 2013 were included. As for the setting, studies related to home kitchen that involve purchase material, transfer, storage, preparing, cooking and serving were included. Professional food handler was excluded.

Data analysis

Methods of data analysis were developed according to Whittemore and Knalf (2005)¹⁶. The literature review focused on the following research question: "What are factors associated with food safety in home kitchens?" The data analysis included data reduction, display, comparison, correlation, prediction, and conclusion-drawing and verification. The first step of analysis, the literature was divided into three categories: quantitative, qualitative and mixed methods. The literatures were extracted by study aim (purpose), population, design, results and limitation. The second step of analysis, the data were extracted from each source as presented in Table 1.

Table 1. Summary of the studies.

Author and year	Study aim	Sample and setting	Variable	Findings
1.Ovca, & Jevsnik, 2009 ¹⁷	To examine food safety knowledge and practices, with an emphasis on maintenance of a cold chain.	116 consumers, aged 21-81 years in Ljubljana and surrounding areas in Slovenia	knowledge and keeping food in cold chain	The term "cold chain" is not well known among consumers and foods were kept at inappropriate temperature. Consumers did not know the temperature of their domestic refrigerator. Consumers should first be educated and warned about the potential risks resulting from their incorrect food-handling practices.
2.Shapiro et al., 2011 ¹⁸	To examine perceived behavioral control and predict compliance with safe home food preparation practices.	544 participants, aged 18-92 years in USA	Dependent variables: hand washing and food thermometer use. Independent variables: Age, Gender, Perceived behavioral control.	Participants were concerned with proper hand washing behaviors more than food thermometers use. Age also positively predicted hand washing behaviors but data did not show significantly stronger intention compared to females younger than 30. For male, attitude and perceived control were significant predictors of behavioral intention, but subject norm was not. For female, perceived risk, subjective norm and perceived control predicted the intention to wash hands. Perceived control was the strongest predictor of behavioral intentions for both hand washing and food thermometer use.
3.Jevsnik, Hlebec, & Raspor, 2008 ¹⁹	To examine the relationship among and between age, gender and food safety behavior.	1030 participants, in different parts of Slovenia	age, gender and food safety behavior (such as check date of durability, clean hand, protect hair with net, clean knife, storage	More women were aware and responsible for consumer of food safety than men. Women more often checked the date of durability than men and younger respondents (<30 years of age) significantly more often checked the date of durability than older respondents. The majority of respondents (67.8%) never checked the temperature in



Table 1. Summary of the studies (Continued).

Author and year	Study aim	Sample and setting	Variable	Findings
3.Jevsnik, Hlebec, & Raspor, 2008 ¹⁹ (Continued)			food after shopping, the refrigerator temperature in a store)	retail cold chain unit. More than half of the respondents (55.1%) were aware of the correct temperature in retail refrigerator unit. About 45.1% of respondent preparation sequence for meat or salad such as washing salad first, followed by meat. Almost 44% of respondents did not know the temperature in their refrigerator. Most respondents (86%) wash their hands prior to food preparation. The respondents (42%) believe that there is a strong possibility of poisoning when using the same knife for cutting cooked raw meat.
4.Anderson, Verrill, & Sahyoun, 2011 ²⁰	To compare the food safety perceptions and practice of older and younger adults and determine the associations with demographic characteristics.	1,317 participants aged 60 years and over from the U.S. Food and Drug Administration's 2006 Food Safety Survey, USA	Independent variables: age, gender, income, education, food safety perception Dependent variable: food safety practice	Women washed their hands all the time before preparing food more than men. Women were more likely to have a built-in refrigerator thermometer than men. Adults aged 60 years and over were more likely to follow recommended food safety practices than younger counterparts. Income and education had very similar associations with food safety perceptions. Food safety risk perception and food safety practice had strongly positive association.

Table 1. Summary of the studies (Continued)

Author and year	Study aim	Sample and setting	Variable	Findings
5. Zorba, & Kaptan, 2011 ²¹	1) To describe the food safety perceptions and practices of consumers living in Canakkale, Turkey. 2) To examine effects of gender, age and education status on consumer behavior.	2,000 randomly selected respondents older than 15 years living in Canakkale, Turkey	gender, age, education status, food safety perception, food safety practice	About 82.8% of respondents always pay attention to expiration date but 41% of them cannot understand anything from the ingredient list. Buying packaged food, women were more concerned about expiration date and ingredient lists than men. Participants older than 24 years paid significantly more attention to ingredient list and expiration date than younger respondents. Results show significantly positive relationship between shopping at supermarkets and educational status. People with lower educational levels were more willing to buy food from bazaars than those with high school and higher educations. Men consumed more street seller food than women. Men had significantly more knowledge about the correct temperature at refrigerator than women. Age and knowledge had significantly positive relationship. Participants aged 15 to 24 years had sufficient knowledge of food safety issue. Participants older than 24 years were more interested in food safety issues than men and younger consumers.



Table 1. Summary of the studies (Continued)

Author and year	Study aim	Sample and setting	Variable	Findings
6. Bas et al., 2012 ²²	To describe knowledge, attitudes, and practice about food safety in adolescents.	2074 randomly selected adolescents from Turkey.	Knowledge, attitudes, food safety practice	The food safety knowledge of adolescents was positively correlated with food safety attitude, education level of mother, education level of father and age of participants. Food safety attitude and practices scores of adolescents were positively correlated with their education level, education level of mother and age. More than 50% of the adolescents had negative attitude and disagree with washing hand with soap and water before eating food and 75% did not wash their hands before preparing and eating food and after contacting with animals. More than half of adolescents share their plates and cups with others.
7. Hearty et al., 2007 ²³	to examine self-perceived healthy eating behaviour and to determine how these perceptions differ according to dietary, lifestyle and socio-demographic correlates, among a representative sample of Irish adults.	1256 adults aged 18-64 years from Irish, Ireland	self-perceived healthy eating behavior, attitude toward healthy eating behavior, macronutrients, fibre and fruit and vegetable intake	Men aged 18-35 years, from the lowest social class and with primary level education, were most likely negative attitude toward their healthy eating behavior. Female who are increasing age, higher social class, tertiary education, non-smokers, lower body-weights and increased recreation activity were associated with protective factor for having a negative attitude towards their healthy eating behaviour. An increased intake of breakfast cereals, vegetables, fruit and poultry dishes were associated with protective factor for negative attitudes towards their healthy eating behavior,

Table 1. Summary of the studies (Continued)

Author and year	Study aim	Sample and setting	Variable	Findings
7. Hearty et al., 2007 ²³ (Continued)	To investigate Turkish consumers' knowledge of food safety.	183 adult women (18-49 years old) living in Istanbul, Turkey.	Education, socioeconomic status, food safety knowledge.	while an increased intake of high-calorie beverages was associated with risk factor.
8. Abbot et al., 2009 ²⁴	To examine the relationship between food safety self-reported food-handling behaviors and cognitive of young adults to observed food-handling behaviors.	153 young adults (18-26 years) attending a major American university, USA	food safety self-reported behaviors, psychosocial aspect of food safety, knowledge, food preparation observation, home kitchen observation	Young adults reported positive food safety beliefs and high food safety self-efficacy. The knowledge scale of group at greatest risk of foodborne disease and cross-contamination prevention self-report behavior scale tended to be significant predictors of actual food preparation behaviors. They have least knowledge about common food sources of food-borne pathogens. About 97% of young adult did not use a thermometer to safe cooking animal protein in appropriate temperature. Refrigerator temperature was higher than 40 F. Only 39% of young adults reported washing their hands with soap and water all time before they began preparing food.



Table 1. Summary of the studies (Continued)

Author and year	Study aim	Sample and setting	Variable	Findings
9. Redmond, & Griffith, 2004 ²⁵	To determine consumer perceptions of personal risk of food poisoning and personal control and responsibility for microbial food safety.	100 adults aged 16 years and over in New South Wales, Australia	perceptions of risk, perceptions of personal control, personal responsibility for food safety	The study shows that a positive correlation between personal controls for food safety and perception of control others have over their food safety during food preparation. A positive correlation between personal responsibility personal control food safety and perception of control other people have during their food preparation but negative correlative with perceived risk of illness after consuming self-prepared foods. No correlation between socio-economic group (SEG) and perceptions of risk, control and responsibility or respondent demographics. However, age group and perceived of risk of illness after consuming self-prepared food have negative correlation. The younger respondents had an increased perception of risk and older respondents were associated with decrease perception of risk of illness. Personal responsibilities for food safety and age group have positive correlation. Younger respondents felt less responsible for their own food safety than older respondent. They found that significant differences were identified between male and female perceptions of personal risk after consuming self-prepared food and perception of responsibility. Female considered themselves to have total responsibility for food safety than men.

Table 1. Summary of the studies (Continued)

Author and year	Study aim	Sample and setting	Variable	Findings
10. Karabudak et al., 2008 ²⁶	To investigate Turkish consumer's knowledge about purchase, storage, preparation, and serving in the domestic kitchen.	1090 voluntary subjects (18 year of age or older) who were selected randomly from households in Ankara, Turkey	Education, socioeconomic group, purchase, storage, preparation, cooking, and serving	Education and socioeconomic group were significantly related to the attention that consumers paid to their meat purchases. University graduates were more aware of the cholesterol content in meat than less educated ones. No significant relationship between consumer's education or socioeconomic status and food safety behavior regarding the transport of meat or the travel time to home after meat purchase. Approximately 60.6% of consumers did not know or had never measured the temperature where their meat was stored. They found that the first and second socioeconomic groups and primary school level were most likely to store meat incorrectly. There was significant relationship between education level and using soap for hand washing. High school level or university level were more likely to use soap than the primary or secondary level. There was significant difference between the consumer's education level and the propensity to wash a chopping board between the preparation of raw meat and vegetables. Most consumers (84.7%) never used a thermometer to check the internal temperature of a large piece of meat during its cooking.



Table 1. Summary of the studies (Continued)

Author and year	Study aim	Sample and setting	Variable	Findings
11. Sanlier, 2009 ²⁷	To determine the food safety knowledge and practices of the young and adult.	1461 voluntary consumers aged 14-19 years defined as "young" and 20 years and over defined as "adult" in the districts of Ankara, Turkey	Age, food safety knowledge and food safety practices	Approximately 88.1% of young consumers prefer to taste milk while 82.8% of adult prefer to look at its expired date. A significant relationship between the answers given to such questions and age, education status. 74.3% of young consumers and 82% of adult consumers always wash their hands before preparing and eating food at home. A significant relationship between young and adult consumer in terms of practice. Knowledge scores and food handling scores of adult consumers are higher than the scores of younger consumers and the relationship between them is significant.
12. Langiano et al., 2012 ²⁸	To define food safety and risk perception of foodborne diseases in the private home setting and identify specific behaviour during food purchase, storage and preparation.	624 consumers (18 years or older) in Latium, Italy	Age, gender, marital status, educational level, occupation	Consumers do not know about the effect of foodborne pathogens on foods. About 65% of consumers buy food from the supermarket/shopping center. A secondary level or blue-collar workers with low level education purchase fruit and vegetables at roadside vendors. The consumer who have graduate, housewives and married couples were the most correct behavior. High-risk behavior of improper safety rules were influenced by socio-demographic factors, including a low education level, single status, students

Table 1. Summary of the studies (Continued)

Author and year	Study aim	Sample and setting	Variable	Findings
12. Langiano et al., 2012 ²⁸ (Continued)				living far from their families and blue collar workers. They found that those group lack of correct adherence to food hygiene, food preparation and storage. It was a higher risk in families with children, older persons and pregnant women.
13. Xayaseng et al., 2013 ²⁹	To understand of how best to achieve food consumption behavior change in this context	72 adults aged 16-59 years randomly selected from four villages in Saravane District, Laos	knowledge, attitudes, perceptions, consumption of raw and insufficiently cook fish	People preparing and consuming a sticky raw fish dish that was served with Lao alcohol ("lao lao" made of rice) and consumed papaya salad with raw fermented fish sauce. Forty-one participants were aware of liver flukes and some of those heard about symptoms of liver flukes. About 60% of participants stated that fish prepared with weaver ant extract was equivalent to well-cooked food and not harmful to health. Some participants believed that by adding ingredients such as spices, salt, monosodium glutamate, alcohol, or warm water, the fish would become a well-prepared. Some participants believed that these foods provide physical energy and strength necessary for hard work. The majority of participants (75%) feels safe consuming raw fish dish because it is a long-standing tradition. Men consumed raw fish dish more than women. Young children aged less than 14 years were not allowed to consume raw fish.



Results

Description of the data

This integrative review is composed of eleven quantitative¹⁻¹¹, one qualitative¹³ and one mixed method study¹². The literatures include studies conducted in seven countries: Slovenia^{1,3}, USA^{2,4,8}, Turkey^{5,6,10,11}, Ireland⁷, Australia⁹, Italy¹² and Lao¹³. Most studies are related to all process: purchase material, transfer, storage, preparing, cooking and serving for home kitchen. The sample size were large^{3,4,5,6,7,10,11} including both male and female adolescents, adults, and older adults.

Factors related to food safety in home kitchens

Knowledge

Knowledge is the most important issue related to food safety. People do not understand about defrosting practices, poor cooling of cooked food, re-heating of cooked food, Also people are lack of knowledge in concerning cross-contamination and respect to hand hygiene, lack of knowledge concerning cross-contamination, a lack of knowledge with respect to hand hygiene^{24,12,18} lack of knowledge regarding refrigeration temperatures¹⁹. About 46-97% of US consumers and 50-93% of UK do not know the ideal refrigeration temperature^{24,30}. Consumers lack knowledge concerning adequate refrigeration temperatures or do not check the temperatures

of their refrigerators^{26,17} and do not use a thermometer to safe cooking animal. Consumers are concerned about ingredient list but they do not understand²¹. The knowledge scale about foodborne disease and cross-contamination prevention self-report behavior scale tends to be significant predictors of actual food preparation behaviors²⁴.

Gender

Women are more aware and responsible for food safety than men by checking the expiration date and ingredient more often^{19,25,21} washing their hands all the time before preparing food more frequently and more likely to have a built-in refrigerator thermometer²⁰, but less knowledge about the correct temperature at refrigerator²¹. Women perceive risk and perceive control¹⁸ while men consume more street vender food than women²¹.

Age

Younger people check the expiration date more often than older ones¹⁹. In contrast, two studies show that 24 years old people pay more attention to ingredient list and expiration date than younger ones^{27,21}. Anderson and colleagues (2011)²⁰ found that older adults aged 60 years or over are more likely to follow recommended food safety practices than young adults. Food safety attitude and practices in adolescent are positively correlated with

education level of their mother. Young people are not aware of cross-contamination from sharing their plates and cups with others²². They have less knowledge about sources of food-borne pathogens²⁴. Although young people perceive risk of illness more than older people, they are less responsible for their own food safety²⁵.

Education level

People with lower educational level have more willingness to buy food from bazaars than their counterparts²¹. Men aged 18-35 years, from the lowest social class and primary level education, are most likely to have negative attitude toward healthy food eating behavior²³. University graduates are more aware of the cholesterol in meat than those with lower education. Students in high schools or universities are more likely to use soap than the primary or secondary levels. There are significant differences between the consumers' education level and the propensity to wash a chopping board between the preparation of raw meat and vegetables²⁶.

Perceived risk and Perceived control

Langiano and colleagues (2012)²⁸ found that consumers do not know about the effect of foodborne pathogens on food. Perception of risks have positive correlation with food safety practice²⁰. Perceived risk and Perceived control

are significant factors predicting both hand washing and food thermometer use^{25,18}.

Attitudes

For some traditions, people believe that raw food provides physical energy and strength necessary for hard work so they feel safe to consume raw food since it has been passing on from generation to generation²⁹.

Discussion

The findings of the review show that most people need to be informed about food-related risk, food label, food storage in appropriate temperature, food preparation, personal hygiene and adequate cooking. Accordingly, previous studies suggest that five keys of food safety education are personal hygiene, adequate cooking, avoiding cross-contamination, keeping food at safe temperatures, and avoiding food from unsafe sources^{31,32}. Young adults are not aware of cross-contamination due to minimal knowledge about sources of food-borne pathogens²⁴, and feel less responsible for their own food safety than older ones²⁵ in that they may have no experience on cooking³³. However, they are concerned about expiration for packaged food and food practices in these young people are influenced by their parents. Men aged 18-35 years, from the lowest social class and primary level of education, were at risk for food borne



illness because they do not aware of harmful food²³. Eating behavior of younger people is influenced by social media and peer group. Target populations of education program are both younger men and women who have low level of education^{24,25}. However, the older adults are at risk population for foodborne illness because their immune systems decrease with normal aging process, chronic disease, nutritional status, dementia, and decreased physical activity³⁴. Thus, we should be concerned about promoting food safety in older adults. Perceived risk and control are protective factors for food practice^{25,18}. In some cultures, consuming raw foods are barrier to food safety practice due to belief²⁹. In fact, raw food is an issue that healthcare providers should take into consideration.

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