Food practices associated with increased risk of bacterial food-borne disease of female students in self-catering residences at the Cape Peninsula University of Technology

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OPSOMMING

Kommer is oor die voedselpraktyke van studente in koshuise van die Kaapse Skiereilandse Universiteit van Tegnologie: Kaapstad-kampus, uitgespreek nadat daar tot die selfvoorsiening van voedsel oorgeskakel is. Gestruktureerde onderhoude is met 60 ewekansig geselekteerde swart vroulike studente in die selfspysenieringkoshuise gevoer. Die doel was om vas te stel of hul praktyke rakende die aankope, berging, bereiding en gaarmaak van voedsel, asook die hantering van voedsel wat na maaltye oorbly, met riglyne om bakteriële voedseloordraagbare siektes te voorkom, ooreenstem. Die resultate toon dat die studente sommige veilige voedselaankoperiglyne volg en dat hulle in baie gevalle bestanddele en voedsel wat na 'n maaltyd oorbly, veilig berg. In teenstelling is persoonlike higiëne, bv. die was van hande met seep en water, en algemene higiëne, bv. vermyding van kruiskontaminasie tussen rou en gereed-om-te-eet voedselitems, afgeskeep. Die studente het verder aangedui dat hulle voedselitems genoegsaam gaarmaak, maar voedsel wat vooraf berei word of na maaltye oorbly, is nie voldoende verhit nie. Minder as die helfte van dié studente was bewus van die oorsake van voedseloordraagbare siektes, hoë risiko voedselitems en kruiskontaminasie, terwyl nog minder studente aangedui het dat hulle die ooreenstemmende veilige voedselpraktyke in die verband, uitvoer. Studente wat bewus was van die verband tussen pluimvee en *Salmonella* of in staat was om kruiskontaminasie te defineer was nie meer geneig om voedselpraktyke, wat bakteriële voedseloordraagbare siektes sal voorkom, te rapporteer, as dié wat nie daarvan bewus was nie. Daar word aanbeveel dat 'n intervensie program spesifiek gemik op die verbetering van vroulike studente in selfspysenieringkoshuise se voedselpraktyke opgestel en geïmplementeer word om bakteriële voedseloordraagbare siektes te voorkom.

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INTRODUCTION

In the range of 6.5 million (Altekruse *et al*, 1999) to 76 million (Mead *et al*, 1999) food-borne disease cases are recorded annually in the United States of America (USA). The most common food-related illnesses result from bacterial food infections and intoxications (Jones, 1992:107; Brown, 2000:114, Crawford & Murano, 2002; Bennion & Scheule, 2004:67). Bacterial food-borne infections are caused by the proliferation of micro-organisms, such as *Salmonella* and *Campylobacter jejuni* in the intestine of the host, whereas bacterial food-borne intoxications result from toxins produced by bacteria such as *Staphylococcus aureus* and *Clostridium botulinium* (Jones, 1992:109; Pelczar *et al,* 1993:680).

Food-borne disease can only be prevented by the multifaceted efforts of all role players involved in the production, processing, regulation and preparation of food (Bennion & Scheule, 2004:57). Epidemiological data from Europe, the USA, the United Kingdom (UK), Australia and New Zealand indicate that a considerable proportion of food-borne disease cases are caused by food prepared in the home (Williamson *et al*, 1992; Worsfold & Griffith, 1997b; Miles *et al*, 1999; Meredith *et al*, 2001). By not adhering to bacterial food-borne disease prevention guidelines consumers can undo the efforts made by food producers to provide safe food (Simpson, 1993). Factors that contribute to outbreaks of bacterial food-borne disease in homes include, obtaining food from unsafe sources; contaminated raw food items; improper food storage; poor personal hygiene during food preparation; inadequate cleaning of kitchen equipment and utensils; inadequate cooking; inadequate cooling and reheating of food items and a prolonged time lapse between preparing and consuming food items (Bryan, 1988; Bean & Griffen, 1990; Pelczar *et al,* 1993:680; Knabel, 1995).

Other factors that appear to influence the prevalence of bacterial food-borne disease, resulting from food prepared in domestic kitchens, are age, how frequently the consumer prepares food, and whether the kitchen is shared. In studies conducted in the USA Klontz *et al* (1995) found that young adults did not adequately clean chopping boards, used for raw and ready-to-eat foods, as often as older adults, while Altekruse *et al* (1996) found that young adults and occasional food preparers, described as people who prepare the main meal only some of the time, were more

likely not to wash their hands or take precautions to prevent cross-contamination when preparing meals. The risk of bacterial food-borne disease also increases when food is prepared in communal kitchens, as in student accommodation, youth hostels and shared homes. This increase may be due to the number of individuals using the kitchens, the lack of feelings of responsibility and the differing standards of hygiene of the users of these kitchens (Sharp & Walker, 2003).

Since 2002 the majority of the student residences housing undergraduate students of the Cape Peninsula University of Technology (CPUT): Cape Town campus, have a self-catering food provision system. A catering company was previously contracted to supply meals to the students in the residences. The catering company staff prepared the meals, in centrally located kitchens, under supervision, and in accordance with food-borne disease prevention guidelines as set out by the catering company. Students in the residences were generally not involved in the purchasing, storage or preparation of food items for meals. The change in catering arrangements was necessitated by a lack of finances on the part of the students to pay for the full-board accommodation.

Although the majority of consumers in studies conducted in the USA and Australia reported an awareness of some food-borne bacterial pathogens, such as *Salmonella*, they lacked awareness of other pathogens, such as *Staphylococcus aureus, Listeria monocytogenes* and *Escherichia coli* (Williamson *et al*, 1992; Jay *et al*, 1999a). Williamson *et al* (1992) also found in their study conducted in the USA that consumers under 35 years of age knew less about the causes of bacterial food-borne disease than those over 35 years of age. Consumer awareness of the causes of bacterial food-borne disease had a positive effect on their self-reported adherence to food-borne disease prevention guidelines (Altekruse *et al,* 1996; Meer & Misner, 2000; Lin *et al,* 2004). In studies conducted by the Canadian Food Inspection Agency (1998), Griffith and Redmond (2001) and Clayton *et al* (2003) a large number of consumers (47% to 85%) reported following bacterial food-borne disease prevention guidelines, such as washing their hands after handling raw food items. However, in other studies, conducted in Australia, the USA and the UK there were significant gaps in the self-reported adherence by consumers to some of the bacterial food-borne disease prevention guidelines (Jay *et al*, 1999a; Knabel, 1995).

Only two published studies that investigated higher-education students' awareness of bacterial food-borne disease (Unklesbay *et al*, 1998) and the adherence to guidelines that would prevent food-borne disease (Unklesbay *et al*, 1998; Sharp & Walker, 2003) could be obtained. The student respondent groups resided in the USA and the UK respectively. Very little is known about the awareness of South African consumers regarding the causes of bacterial food-borne disease and their adherence to guidelines that would prevent the occurrence of food-borne disease. A South African study on young adults preparing food in communal kitchens was prompted as a result.

The objectives of this study were to determine whether female students living in the self-catering residences of the CPUT: Cape Town campus were: (i) aware of selected aspects of food-borne disease and (ii) reported adhering to guidelines that would prevent bacterial food-borne disease, when purchasing, storing, preparing, cooking and handling left-over food items intended for their own consumption. In addition the relationship between the awareness of food-borne disease and the self-reported adherence to guidelines that would prevent bacterial food-borne disease was investigated.

LITERATURE REVIEW

Food preparation practices associated with bacterial food-borne disease

Food preparation, whether in a domestic or communal kitchen, includes the purchase and transport of ingredients to the kitchen and the storage of ingredients in frozen, chilled or dry storage areas. It further includes preparation actions such as measuring, cleaning, and peeling, slicing, chopping, and mixing of ingredients in the creation of dishes. The final steps include the cooking and service of these dishes. Where food items are cooked in advance of consumption, or left over after consumption, actions such as the storage and, where applicable reheating before service are included (Griffith & Worsfold, 1994). According to Bryan (1988), Bean and Griffen (1990), Pelczar *et al* (1993:680) and Knabel (1995) each one of these actions can contribute to outbreaks of bacterial food-borne disease.

Purchasing Food items are purchased from supermarkets, fast-food outlets and street vendors (Opare-Obisaw, 1998; Azanza, 2001; Nel & Steyn, 2001). Studies in developing countries, such as South Africa and Ghana, show that street vendors do not always follow bacterial food-borne disease prevention guidelines. Despite this, the microbial levels of most of the street foods investigated in the studies conducted in Johannesburg, South Africa and Accra, Ghana, were within acceptable limits (Mosupye & Von Holy, 2000; Kubheka *et al*, 2001; Mensah *et al*, 2002). However, in a study conducted by the Department of Health in the Western Cape in 1995, food items obtained from street vendors in tourist areas carried high concentrations of *Escherichia Coli* and *Staphylococcus Aureus* (Sidley, 1995).

In addition to purchasing food items from reputable dealers, certain food items such meat, poultry, eggs, fish, dairy products and combination-type chilled foods, such as tuna salad, should be chosen and handled with extra care. These food items, high in protein and water, are at risk of bacterial contamination and, due to their composition, ideal to support bacterial growth (Brown, 2000:129). Van Nierop *et al* (2005) found that 60% of whole-chicken carcasses, sourced

from various retailers in Gauteng, were contaminated with *Campylobacter* spp. (32.3%), *Salmonella* spp. (19,2%) or *Listeria Monocytogenes* (19,2%). Moore *et al* (2002) found an even higher number of contaminated carcasses in a study conducted in Northern Ireland, where 94% of the fresh and 77% of the frozen chickens obtained were contaminated with *Campylobacter* spp. In addition Harrison *et al* (2001) found in a study conducted in South Wales, UK that 34% of whole-chicken packaging was contaminated with *Campylobacter* and 11% with *Salmonella.* Other high-risk raw food items include minced meat and shellfish. Although the carcass of a healthy animal usually has a low level of surface microbial contamination, the chopping or grinding of the meat allows for a high potential of bacterial contamination (Pelczar *et al,* 1993:846). Raw shellfish from polluted water may be contaminated with *Escherichia coli* (Roberts, 1990). In recent years, bacterial food-borne disease has also been associated with foods that do not fit into the high protein/high water risk category (Brown, 2000:129). Fresh fruit and vegetables may be contaminated with *Listeria monocytogenes, Clostridium botulinium* and *Bacillus cereus*, which are present in the soil in which they are grown (Roberts, 1990; Adams & Moss, 1995:176; Kubheka *et al*, 2001). Contamination with organisms, such as *Salmonella*, *Escherichia coli* 0157:h7, *Campylobacter jejeni* and *Vibrio cholerae,* can also occur owing to the use of contaminated wash-water used for partially prepared fresh vegetable products (Adams & Moss, 1995:186; Beuchat & Ryu, 1997).

Once purchased food items need to be transported to the kitchen for further preparation. High-risk food items, such as raw meat and poultry, are usually purchased in a chilled or frozen state. If these low temperatures are to be maintained, transport time should be as brief as possible and the items transported in an insulated cool bag. In this way the growth of pathogenic, spoilage bacteria can be limited (Griffith & Worsfold, 1994; Jay *et al*, 1999a).

Storage On reaching the kitchen, food items should be stored and handled correctly to decrease the growth of the micro-organisms already present and to minimise the risk of contamination (Griffith & Worsfold, 1994; Gorman *et al*, 2002). Results from studies conducted in the UK and Australia indicate that many consumers do not follow bacterial food-borne disease prevention guidelines, such as keeping high-risk food products at or below 4^{o}C, separating raw and ready-to-eat food products during storage, or applying the correct procedures when thawing frozen food items (Worsfold & Griffith, 1997b; Jay *et al*, 1999a). Most consumers are aware that a refrigerator extends the shelf life of food items and keeps food safe. However, in order to attain these beneficial effects and to prevent the growth of *Staphylococcus aureus, Clostridium perfringens, Listeria monocytogenes* and *Bacillus cereus*, a refrigerator must be operated correctly to maintain a temperature of below 5 ^{0}C (Jay *et al*, 1999a; Medeiros *et al*, 2001a; Brown, 2000:130; Rosset, 2001). Storing raw meat, poultry or fish on the top shelf in the refrigerator increases the risk of cross-contamination due to the potential dripping of raw juices onto other foods stored beneath. The risk is especially high if the foods stored below are ready-to-eat items that will not be heated to high enough temperatures to destroy pathogenic bacteria (Chicken safety tips, 2001; Bennion & Scheule, 2004:63). Frozen meat and poultry should be thawed by putting it in the refrigerator, placing it in a sealed package in cold water or in a microwave oven. Defrosting frozen food items at room temperature or in warm water is a hazardous practice as temperatures between 5^{0}C and 60^{0}C can lead to the growth of food-borne pathogens (Handling food in the home, 2000; The big thaw. Safe defrosting methods for consumers, 2003).

Preparation

Personal hygiene during preparation When hands are not washed correctly and at appropriate times, pathogens such as *Escherichia coli* O157: H7 can be transmitted to prepared or ready-to-eat food items (Collins 1997; Medeiros *et al*, 2001a), directly to the mouth, or to other household members (Jay *et al*, 1999b). Patrick *et al* (1997) and Hunter (2000) found that drying of hands after washing is critical as bacteria are frequently recovered from hands that have not been dried effectively. The residual moisture remaining on hands, if not dried, contributes to the number of micro-organisms transferred from hands to solid surfaces. The choice of cloth for the drying of hands is important. Using a kitchen cloth to dry hands may lead to recontamination as such a cloth is normally used for actions such as wiping surfaces. Using a drying cloth is also not recommended as it is possible that following hand-washing and even more so if the hands are merely rinsed, bacteria will be transferred from the hands to the cloth. In addition, the damp state of many kitchen and drying cloths creates conditions for the survival of bacteria over a significant time period. If subsequently used for drying dishes or wiping hands, re-contamination would occur (Meredith *et al*, 2001; Bennion & Scheule, 2004:62).

General hygiene during preparation Bacterial contamination in the kitchen often occurs during processing of raw foods (Enriquez *et al*, 1997). Raw meat and poultry products may be contaminated with *Salmonella typhimurium DT105, Campylobacter, Listeria monocytogenes* and *Escherichia coli* 0157:H7 (Ralston *et al*, 2000; Zhao *et al*, 2001; Borch & Arinder, 2003). During food preparation pathogenic organisms may be transferred to food items by the handler both directly or by cross-contamination through hands, surfaces, utensils and equipment that have been inadequately cleaned and disinfected between the preparation of different types of food (Roberts, 1990; Scott & Bloomfield, 1990). In studies conducted by De Wit *et al* (1978), Gorman *et al* (2002), Mattick *et al* (2003) and Haysom and Sharp (2004) pathogenic micro-organisms were spread from raw chickens to hand and contact surfaces in kitchens during the domestic preparation of meals.

Cooking and serving The consumption of high-risk food products, such as contaminated raw or undercooked protein foods, can contribute to outbreaks of bacterial food-borne disease (Bryan, 1988; Roberts, 1990; Jones, 1992:112; Doyle, 1993, Griffith & Worsfold, 1994; Adams & Moss, 1995:186). It is thus recommended that all high-risk food items be cooked to a temperature of at least 74^{o}C (Brown, 2000:129; Bennion & Scheule, 2004:64). Food items should be served as soon as possible after preparation. If food items are kept for extended periods, they must be kept either above 60 ^{0}C or below 5^{0}C (Brown, 2000:130). Food items prepared in advance of consumption should be rapidly cooled, within 90 minutes, and stored covered, below 5 ^{0}C for less than three days (Griffith & Worsfold, 1994).

Handling left-over food The handling of left-over foods is a further high-risk action in a domestic kitchen (Beumer and Kusumaningrum, 2003). Brinkman *et al* (1999:12) found that 7,3% of the left-over food samples collected from domestic kitchens showed high bacterial counts (>10^6 cfu/g). Bacteria found in these samples included *Enterobacteriaceae* and *Bacillus cereus.* The microbiological guideline for ready-to-eat foods, such as cooked and sliced chicken, as indicated by the Airline Catering: Code of Good Catering practice in Britain is <10^3 cfu/g (as cited by Worsfold & Griffith, 1995). Beumer and Kusumaningrum (2003) concluded that leftovers should be handled hygienically, kept in clean containers and cooled as quickly as possible. Leaving food to cool at room temperature before refrigeration allows for an uncontrolled time period where food is left in the temperature danger zone of 5 ^{o}C to 60^{o}C (Knabel, 1995; Brown, 2000:130). According to Brown (2000:130), improper cooling of prepared food items frequently contributes to outbreaks of food-borne disease. When reheating previously cooked foods, the same high temperatures should be reached as in the initial cooking as poor storage practices may have led to the proliferation of large numbers of bacteria in the cooked food (Worsfold, 1995).

Bacterial food-borne disease awareness related to food practices associated with decreased risk of bacterial food-borne disease

In studies conducted in the USA by Altekruse *et al* (1996), Meer and Misner (2000) and Lin *et al* (2004), it was established that the self-reported awareness of guidelines to prevent bacterial food-borne disease had a positive effect on the self-reported food practices associated with a decreased risk of food-borne disease. Altekruse *et al* (1996) found that respondents who were able to specify a food item associated with *Salmonella* spp. were more likely to report washing their hands and cutting boards after handling raw meat or poultry, than those respondents who were unaware of this association. Similarly, Lin *et al* (2004) found that the self-reported awareness of *Salmonella* was associated with safer before-meal preparation hand-washing practices and that the awareness of *Campylobacter* or *Escherichia coli* was associated with serving thoroughly cooked hamburgers.

However, in other studies where respondents reported their own home food preparation practices, awareness of the causes of microbial food-borne disease did not always correspond with practices associated with a decreased risk of food-borne disease. Williamson *et al* (1992) reported that 51% of the respondents correctly identified *Salmonella* as a term associated with poultry and eggs and indicated that they would use the correct procedure of immediately refrigerating a chicken after cooking. In contrast, 15% of the respondents did not know the term, but indicated using the correct storage procedure, and 23% of the respondents, although they correctly identified the term, did not indicate following proper storage procedures for cooked chicken.

Lack of awareness may thus contribute to food-handling practices that increase the risk of bacterial food-borne disease, but ignorance may not be the only cause why consumers may fail to apply principles already known to them (Worsfold & Griffith, 1997a). Williamson *et al* (1992) concluded that knowledge in itself did not guarantee that bacterial food-borne disease prevention practices would be implemented.

METHODOLOGY

Sample

During June 2003 the total number of students studying at the Cape Technikon (now the Cape Town campus of the CPUT) was 15 592, of whom 7 991 were female and 812 resided in the self-catering residences (Student statistics, 2003) (See Table 1). Stratified random sampling was used to obtain a sample of 60 female students from the self-catering residences. The kitchens in each residence were numbered and a list compiled of the students who used a particular kitchen. Simple random sampling, using a table of one-, two- and three-digit random numbers (Mason & Bramble, 1989:431), was then used to determine the specific participants from each name list of kitchen users. The use of kitchens is allocated by the residential management and is based on the location of a student's room. All kitchens are supplied with basic equipment such as a stove, microwave oven, toaster and kettle by the institution (Residence facilities, 2003), but differ in size, layout and additional equipment. To decrease the effect of the kitchen environment on food preparation practices, the sample was drawn so that most of the kitchens were represented in the study. As indicated in Table 1 the student representation in the sample equalled the student ratio to specific residences.

The study population was limited to female students living in the self-catering residences, with the exception of female students studying the National Diploma (ND): Consumer Science: Food and Nutrition, as they were either involved in the preliminary study, the pretesting of the questionnaire or participated as interviewers. Permission to undertake the study was granted by the Head of the Department of Residences and the wardens of the self-catering residences.

TABLE 1: DISTRIBUTION OF STUDENTS AND RESPONDENTS PER SELF-CATERING RESIDENCE

Cape Peninsula University of Technology: Cape Town campus self- catering residences	Female students per residence		Kitchens per residence	Respondents per residence	
	n	%	n	n	%
Catsville Residence	432	53,2	18	31	51,7
Elizabeth Women's Residence	236	29,1	11	18	30,0
DownTown Lodge	78	9,6	7	6	10,0
Waterside Residence	50	6,2	1	4	6,7
J&B House	16	2,0	5	1	1,7
Total	**812**	**100**	**42**	**60**	**100**

Questionnaire development and testing

Development During October 2002 a preliminary study was undertaken to collect information that could serve as a starting point in constructing a questionnaire covering the adherence to bacterial food-borne disease prevention guidelines by female students in self-catering residences. A structured questionnaire with closed-ended questions on the ingredients purchased, the preparation of meals, the availability of food preparation equipment/utensils and the kitchen-cleaning practices in the female self-catering residences was distributed to 30 ND: Consumer Science: Food and Nutrition students residing in the self-catering residences. Nineteen students returned the questionnaires. The results of the questionnaire indicated that more than half (58% to 84%) of the students purchased ingredients such as maize porridge, bread, milk, cheese, polony, rice, dried pasta, breakfast cereals, raw and frozen vegetables and raw chicken. These ingredients were used in the preparation of breakfast and supper for themselves. Students also indicated that they had the necessary equipment and utensils available for food preparation. However, kitchen-cleaning practices differed according to the specific residence and were not included in the final questionnaire and the study.

As there is no standard for measuring adherence to bacterial food-borne disease prevention guidelines in the home (Worsfold & Griffith, 1997a; Lewis, 1998), the data gathered from the preliminary study, together with the following sources, were used for the compilation of five bacterial food-borne disease prevention guidelines that were applicable to the objectives of this study. The sources are as follows:

- The South African regulations relating to food premises and the transport of food (South Africa. Department of Health, 1977).
- The food handling concepts identified by Medeiros *et al* (2001b) based on the food items mostly associated with pathogens causing food-borne illness and the unsafe food-handling behaviours most often practised by food handlers.
- The critical control points identified by Griffith and Worsfold (1994) in applying Hazard Analysis and Critical Control Point (HACCP) principles to domestic food preparation.

Each of the five guidelines was used as a starting point for formulating individual close-ended questions on the usual behaviour of the respondents with "usual" defined as "most of the time". Each of the questions had between two and four possible response categories. Response categories were supplied to the respondents as possible answers during the interviews. To overcome the problem of excluding a response category, a category labelled "other" was added. Responses interpreted by the interviewers as "unsure" were also indicated in the "other" options. The utilisation of mostly close-ended response categories, providing a number of options, made for greater uniformity of responses.

The guideline "follow safe purchasing practices" led to three questions. The first two pertained to the place where ingredients and ready-to-eat food items were usually purchased and the last the purchasing characteristics taken into consideration when purchasing food items. The guideline "store ingredients safely" led to questions on when, where, how and for how long ingredients were stored. The handling of frozen food items was also included under this guideline. The guideline "practise good personal and general hygiene during preparation" led to questions on the washing and drying of hands before and during food preparation as well as the cleaning of fresh produce, utensils and equipment during food preparation. The guideline "cook food items thoroughly" concentrated on the cooking of high-risk food items such as chicken and burger patties. The final guideline "handle leftovers safely" contained questions on the storage and reheating of left over food and the storage and reheating of food prepared in advance. A total of 38 questions were formulated to address adherence to the five selected bacterial food-borne disease prevention guidelines.

According to Jones (1992:112) and Pelczar *et al* (1993:687) *Salmonella* is one of the major causes of food-borne disease and its incidence is increasing. In studies conducted in the USA and Australia a larger number of consumers (80% to 96%) were aware of *Salmonella* compared to an awareness of other food-borne bacteria (3% to 74%) (Altekruse *et al,* 1996; Jay *et al*, 1999a). In addition, more than half of these consumers were also aware of the link between *Salmonella* and poultry. Based on these results and the questions used by Williamson *et al*, (1992), Altekruse

et al (1996) and Jay *et al*, (1999a) four additional questions were formulated to determine consumer awareness of food-borne disease and food-borne pathogens. These four open-ended questions focused on the causes of food-borne disease, specific bacteria associated with food-borne disease, the association between *Salmonella* and certain food items or preparation practices and the meaning of the term "cross-contamination. During the interview respondents were not supplied with answers to these factual questions. A "don't know" option was included as a potential response. Babbie (1990:128) and Bowling (2002:279) recommend the inclusion of such an option as it lowers the risk of obtaining incorrect information by forced choice.

In the section on biographical information interviewers noted gender and race. In addition respondents were asked their age, the course they were studying and whether they received information on bacterial food-borne disease prevention guidelines at school or as part of a subject they were studying at the CPUT. This section included a total of 5 close-ended questions with two to six response options.

Testing A pre-testing of the questionnaire was conducted to eliminate any misunderstandings and ambiguities caused by improper wording of questions and to detect possible flaws in the planned methodology (Babbie, 1990:221; Huysamen, 1994:197). It was noted whether participants found questions understandable and unambiguous and whether some questions were answered in an unexpected manner (Babbie, 1990:230). Nine ND: Consumer Science: Food and Nutrition students residing in self-catering residences took part in the pre-test. The procedure to be used during the interview was used, but the students were not supplied with the possible answers to the closed-ended questions. The students indicated that three of the questions on bacterial food-borne disease prevention practices were not entirely clear. Examples of food items were added to the wording of these questions. In two of the questions additional responses were added. None of these students were familiar with the term "food-borne disease". When the term was explained, the students indicated that they would use the word "food poisoning". The term "food poisoning", although not the correct terminology, was used in the questionnaire.

Interviewers

Ten ND: Consumer Science: Food and Nutrition students, of the same gender, race and background as the respondents, were trained as interviewers. This similarity enabled the interviewers to be familiar with the cultural influences and food habits of the respondents. In addition, the interviewers all lived in the residences, making them familiar with the daily routine of residence occupants. Furthermore, these students had knowledge of food items and preparation practices as it formed part of their course content. The interviewers participated in a one-day training session. Interviewers were trained as a group to ensure that they all received the same information. Role-playing was used as the main training technique.

Validity and reliability

The questionnaire was compiled based on the results of the preliminary study as well as food safety guidelines selected from recognised sources. Face and content validity was subjectively judged during the construction of the initial questionnaire. The researchers, four staff members in the Faculty of Applied Sciences: CPUT and a statistician reviewed the items in the questionnaire for wording, clarity and relevance.

The questionnaire was tested on a convenient sample of female students from self-catering residences. The nine students making up the sample were all studying the ND: Consumer Science: Food and Nutrition programme, which would make them more knowledgeable about the content of the questionnaire, compared to the general population, as the prevention of food-borne disease and food preparation formed part of their course content. This could have influenced their understanding of the questions. However, they were able to provide valuable feedback on the questionnaire due to their basic knowledge of food preparation as well as their familiarity with the food preparation practices in the self-catering residences.

Social desirability bias is associated with an interview situation (Bowling, 2002:153). Social desirability bias may influence the respondents making them feel the need to create a good impression. However, the use of fellow students as interviewers compared with interviewers formally qualified in food science and/or nutrition may have a lesser effect on the expectations felt by the respondents towards the interviewers on following food practices that are in line with bacterial food-borne disease prevention guidelines.

The reliability of the questionnaire as such was determined on a limited basis. The structured response format of the questionnaire, made possible by the preliminary study, the pre-testing of the study and the training of the interviewers, as well as the fact that the interviewers were knowledgeable in the fields of the research study, support the inter-interviewer reliability testing done that did yield identical results.

Data collection

The interviews took place during the first three weeks of May 2003 at the residences. By May, even first year students should have settled in as they would have been living in the residence for approximately three months and should have developed a routine regarding their food practices. The first semester examinations commence at the beginning of June and food practices might change during this time. It was assumed that the small sample would, to a certain extent, cover the characteristics of the population. However, owing to the small sample, the results obtained cannot be generalised and only certain tendencies could be determined.

Data analysis

All 60 completed questionnaires were screened by the researcher to clarify vague or inconsistent response

information and to identify and collate the "other" responses provided. Questions on the awareness of food-borne disease were scored as either "correct" or "incorrect". "Not sure" or "don't know" awareness responses were scored as incorrect. The SPSS (Statistical Package for Social Sciences) for Windows was used for the statistical analysis of the data. Frequency results were obtained for the response categories of the questions that addressed the adherence to the food-borne disease guidelines and biographical information. The chi-squared test was applied to determine whether the aspects related to food safety awareness were associated with the related self-reported food safety behaviour. The level of significance used was p = 0,05 or 0,001.

RESULTS AND DISCUSSION

Sample and biographic description of the respondents

Sixty black female students aged between 18 and 24 years voluntarily participated in the study. The 60 students represented 7,4% of the female self-catering residence population. Slightly more than half of the respondents (53,3%;n=32) indicated that they were registered for the first year, 28,3% (n=17) for the second year and 18,3% (n=11) for the third year of study at the CPUT: Cape Town campus. More than a third of these respondents (38,3%; n=23) indicated that they were studying a course that fell under the Faculty of Management, 23,3% (n=14) were studying in the Faculty of Applied Sciences, 18,3% (n=11) in the Faculty of Business Informatics, 11,7% (n=7) in the Faculty of the Built Environment and Design and 8,3% (n=5) in the Faculty of Engineering. None indicated that they were studying a course that fell under the Faculty of Education. The campuses of the Faculty of Education are situated in Wellington and Mowbray and the residences situated in these areas had meal-provision facilities at the time that the study was conducted. Less than a third of the respondents (28,3%;n=17) indicated that they received information on bacterial food-borne disease, either at school or as part of a subject such as microbiology, environmental studies or food science in the course that they were studying.

Food preparation practices associated with bacterial food-borne disease

Purchasing All the respondents (n=60) reported that they purchased ingredients for food preparation at supermarkets, while 11,7% (n=7) reported purchasing ingredients and 6,7% (n=4) reported purchasing ready-to-eat food items from street vendors. Van Eeden and Gericke (1996) indicated similar purchasing practices. In their study conducted in Pretoria, the majority (73,2%) of the urban black female students indicated regularly shopping at a supermarket, while only 6,3% indicated purchasing food items from street vendors. In contrast, in a study conducted by Opare-Obisaw (1998) at the University of Ghana, 86% of the respondents regularly purchased cooked meals and snacks from street vendors.

Purchasing characteristics that would decrease the risk of bacterial food-borne disease, were mentioned by half of the respondents, as 50% (n=30) reported checking for freshness of produce when purchasing food and 48,3% (n=29) reported using the sell-by date. A small number (11,7%; n=7) indicated checking the packaging of food items. However, the majority (73,3%; n=44) reported that they looked at price when purchasing food items. A possible reason for this may be the available funds of students. Other characteristics reported by the respondents included brand (53,3%; n=32) and taste (16,7%; n=10).

Storage As indicated in Table 2, the majority of the respondents reported packing ingredients away immediately on arrival at the residence after shopping, and all the respondents reported storing perishable food items in the refrigerator. Similar results were obtained in a survey conducted among Sainsbury customers in the UK where the majority (84%) of the shoppers questioned said that they quickly unpacked and stored bought food items on returning home. They also indicated an awareness of the need to store perishable food items in the refrigerator (Spriegel, 1991).

However, less in line with recommendations was the fact that only approximately half of the respondents (see Table 2) reported that they usually had sufficient space in the refrigerator for storing food. An overloaded refrigerator impairs air circulation that keeps food cold and it can also result in poor stock rotation (Eley, 1992). *O*nly a small number of the respondents reported using the expiry date as a guideline for determining the storage time of perishable food items (see Table 2). Expiry dates are better indications of the safety of perishable food items compared with a specific storage period. Food products may no longer be fresh on purchasing if sufficient control regarding the discarding of stock past its sell-by date is not implemented in the retail store. Keeping food items such as milk, processed meats and cheese until they show signs of decay does not constitute a safe practice as processes such as pasteurisation may kill spoilage bacteria and not affect heat-resistant bacterial spores. If these food items are handled incorrectly, e.g. left at room temperature for extended periods of time, spores may proliferate. Food items may thus appear safe as no spoilage is visible, but if consumed may cause bacterial food-borne disease (Jones, 1992:108).

As indicated in Table 2, approximately one-third of the respondents reported usually storing raw meat or chicken in the refrigerator, with a third of these respondents reported storing it on the bottom shelf. An even lower number reported storing these food items in a container with a lid. Similar results on the specific storage site of raw meat, fish and poultry in the refrigerator were indicated in studies conducted by Spriegel (1991) in the UK, Jay *et al* (1999a) in Australia and Li-Cohen and Bruhn (2002) in the USA.

The majority of the respondents reported safe handling of frozen food items as they indicated that they

TABLE 2: STORAGE PRACTICES OF RESPONDENTS (N=60)

Storage practice	Respondents	
	N	%
Pack purchased ingredients away immediately	53	88,3
Store perishables in refrigerator	60	100,0
Space in refrigerator		
Usually sufficient	34	56,7
Sometimes sufficient	8	13,3
Insufficient	18	30
Storage time of perishable food items		
Keep for a limited time	44	73,3
Keep until the expiry date	5	8,3
Keep until signs of decay	8	13,3
Consume on day of purchase	3	5,0
Storing raw meat/chicken (n* =59)		
In refrigerator	5	8,5
In refrigerator and/or freezer	13	22,0
Only in freezer	41	69,5
Storing raw meat/chicken in refrigerator*=18)		
On bottom shelf	6	33,3
Top/middle shelf or no particular place	12	66,7
Storing raw meat/chicken in refrigerator in container with lid (n*=18)		
Usually	4	22,2
Not in container with lid	14	77,8
Cooking of frozen food items (n*=54)		
Usually defrost food items	38	70,3
Sometimes defrost food items	11	20.3
Cook food items from frozen	5	9,2
Method of defrosting (n*=49)		
Microwave oven	37	75,5
Refrigerator	3	6,1
Kitchen counter	6	12,2
Warm water	3	6,1

n* = number of respondents in group/sub-group applying practice

usually defrosted frozen meat or chicken before cooking, using either a microwave oven or the refrigerator (see Table 2). A larger percentage of the respondents used a correct method for defrosting compared with other studies. Meer and Misner (2000) reported that only 53% of the respondents indicated using a correct method for defrosting raw animal food products in a study conducted in the USA. Twenty-one per cent of their respondents indicated placing food products on a counter to defrost, while 41% indicated that they used the refrigerator, and 12% indicated that they used a microwave oven. The high percentage of respondents who reported using a microwave oven in this study could be contributed to the fact that all the kitchenettes in the self-catering residences were equipped with microwave ovens.

Preparation

Personal hygiene during preparation As indicated in Table 3 the majority of the respondents reported that they usually washed their hands before starting food preparation and after handling raw meat or chicken. A smaller number reported that they sometimes washed their hands before starting food preparation and after handling raw meat or chicken. In studies conducted by Altekruse *et al* (1996), Yang *et al* (1998) and Shiferaw *et al* (2000), 87% to 92% of the respondents also indicated that they always or usually washed their hands before handling food, and 62% to 100% that they also always or usually washed their hands after handling raw meat or poultry.

Although a large percentage of respondents reported that they usually washed their hands, the number that indicated that they followed the correct procedure of using soap and water for lathering and rinsing (Bennion & Scheule, 2004:62) was low (see Table 3). Less than one-third of these respondents indicated using soap and water for washing their hands before starting food preparation and an even lower number reported using soap and water after handling raw poultry or meat. More than half of the respondents who reported washing their hands indicated rinsing as the manner in which they washed their hands prior to food preparation and after handling raw meat or poultry. According to the USA Department of Agriculture (USDA), consumers may think that they have washed their hands, but in reality they have only rinsed them (Hunter, 2000). More in line with bacterial food-borne

TABLE 3: PERSONAL AND GENERAL HYGIENE PRACTICES OF RESPONDENTS (N=60)

Personal and general hygiene practices	**Respondents**	
Personal hygiene	**N**	**%**
Before starting food preparation		
Wash hands		
Usually	45	75,0
Sometimes	15	25,0
Manner of washing hands		
Using soap and water	18	30,0
Rinsing with water only	42	70,0
Manner of drying hands		
Using paper or hand towel	1	1,7
Using kitchen or drying cloth	54	90,0
Not dried	5	8,3
After handling raw meat or poultry		
Wash hands		
Usually	45	75,0
Sometimes	8	13,3
Do not wash	7	11,7
Manner of washing hands (n*=53)		
Using soap and water	11	20,8
Rinsing with water only	42	79,2
Manner of drying hands (n*=53)		
Using paper or hand towel	0	0,0
Using kitchen or drying cloth	50	94,3
Not dried	3	5,7
General hygiene		
Washing fresh produce		
Usually	43	71,7
Sometimes	13	21,7
Not washing	4	6,7
Using same knife for raw and ready-to-eat food items		
Usually	33	55,0
Sometimes	4	6,7
Not using	23	38,3
Treatment of knife in between use of raw and ready-to-eat food items (n*=37)		
Washing with soap and water	5	13,6
Rinsing with water	30	81,0
Wiping	2	5,4
Using the same plate/chopping board for raw and ready-to-eat food items		
Usually	21	35,0
Sometimes	5	8,3
Not using	34	56,7
Treatment of plate/chopping board in between use of raw and ready-to-eat food items (n*=26)		
Washing with soap and water	13	50,0
Rinsing with water	12	46,2
Wiping	1	3,8
Using same cloth for wiping raw food items and/or surfaces and to clean or dry dishes		
Usually	29	48,3
Sometimes	6	10,0
Not using	25	41,7

n* = number of respondents in group/sub-group applying the practice

disease prevention guidelines are the results cited by Redmond and Griffith (2003) from surveys conducted in the UK by the Department of Health and Social Sciences and Northern Ireland Health and Social Services Board in 1998, the Food and Drink Federation in 1996 and the Food Safety Authority of Ireland in 1998. In these surveys, 87% to 92% of the respondents indicated that they always or usually washed their hands with soap and water before handling food.

Hands should be dried after washing using a clean, unused hand towel or paper towel (Bennion & Scheule, 2004:62). However, only one of the respondents reported using either a paper towel or hand towel for drying her hands after washing, before the commencement of food preparation (see Table 3). The rest of the respondents all reported following the incorrect behaviour; that is either using a kitchen or drying cloth to dry their hands or not drying their hands.

General hygiene during preparation The Food Safety and Inspection Service (Does washing food promote safety?, 1999) recommends that fresh produce should be washed under cold running tap water before preparation or consumption to reduce or remove micro-organisms. As seen in Table 3 the majority of the respondents reported that they usually washed fruit and vegetables before eating. In a national USA mail survey conducted by Li-Cohen and Bruhn (2002) most of the respondents also indicated washing fresh produce, while only 6,7% indicated that they seldom or never washed fresh produce.

Cross-contamination can be avoided if utensils or equipment is washed with soap and water in between using it for raw and ready-to-eat food items. As seen in Table 3 more than half of the respondents reported usually using the same knife for slicing raw and ready-to-eat food items. However, only a small number of these respondents reported washing the knife with soap and water in between uses. While less than half of the respondents reported usually using the same plate/chopping board for raw and ready-to-eat food items, half of them reported washing it with soap and water in between use. Less than half of the respondents also reported using the same cloth for wiping raw food items and/or surfaces and to clean or dry dishes.

These results indicate a great degree of cross-contamination as only a small percentage of the respondents reported that they would clean the knife in between using it for raw and ready-to-eat food items. More encouraging results were reported by Jay *et al* (1999a), Li-Cohen and Bruhn (2002) and Klontz *et al* (1995). In the study conducted by Jay *et al* (1999a), 76% of the respondents indicated that they would use the same utensil for cutting raw meat and ready-to-eat food items, but 46% indicated that they would wash the utensil with detergent and hot water in between uses. Li-Cohen and Bruhn (2002) found that 97% of the respondents indicated that they always washed their cutting surfaces after contact with meat, poultry or fish, and 86% indicated that they always cleaned the cutting surface after cutting fruit and vegetables. Klontz *et al* (1995) reported that 25% of the respondents in a telephone survey conducted in the USA said that they would use the same cutting board again without cleaning it with soap or bleach after cutting raw meat or chicken. Jay *et al* (1999a) reported that only 18% of the respondents in an Australian study indicated that they would use the same cloth for drying dishes and for drying hands.

Cooking Foods such as poultry, eggs, minced beef and seafood should be cooked to specified temperatures to kill micro-organisms associated with bacterial food-borne disease (Bennion & Scheule, 2004:63). The majority of the respondents reported that they cooked or liked high-risk food items to be cooked thoroughly, as 86,7% (n=52) cooked chicken, or liked it to be cooked, to the well-done stage and 76,7% (n=46) cooked burger patties, or liked it to be cooked, to the well-done stage. Ninety-five per cent (n=57) reported not consuming raw fish and 85% (n=51) reported not consuming dishes containing raw eggs. Similarly, Shiferaw *et al* (2000) and Yang *et al* (1998) found in multi-state surveys in the USA that only a small percentage of respondents (1,5% to 8%) reported eating raw shellfish. In contrast Altekruse *et al* (1999) and Klontz *et al* (1995) found that 50% to 53% of the respondents, in studies conducted in the USA, indicated that they ate undercooked eggs and Shiferaw *et al* (2000) and Yang *et al* (1998) respectively found that 30% and 19,7% of their respondents respectively indicated that they preferred "pink" burger patties. In the study of Yang *et al* (1998) the number of respondents, in the age group 18 to 29 years, who ate "pink" meat patties increased to 21,8%.

Handling left-over food As indicated in Table 4 approximately half of the respondents indicated usually or sometimes cooking food in advance of consumption. The majority of them reported storing the food prepared in advance in the refrigerator, but also reported leaving the food to reach room temperature, after cooking it, before placing it in the refrigerator. Similarly Jay *et al* (1999a) reported that 85% of the respondents in their telephone survey admitted that they allowed cooked food to cool to room temperature before refrigerating it.

Regarding the storage and reheating of left-over food, the majority of the respondents reported storing it in the refrigerator, in a container with a lid, for three days or less. The majority of respondents also reported that they would not reheat left-over food more than once. However, none of the respondents reported heating left-over food items or food prepared in advance to safe temperatures. Jay *et al* (1999a) reported that 69% of the respondents thought it was very important not to reheat food more than once. Reheating food items more than once is not necessarily a dangerous microbiological practice. However, if it is linked to leaving food at room temperature before refrigeration, it may mean that many consumers allow their left-over food items to be at unsafe temperatures for time periods that are cumulatively dangerous.

TABLE 4: COOKING FOOD IN ADVANCE AND LEFT-OVER FOOD HANDLING PRACTICES OF RESPONDENTS (N=60)

Cooking food in advance and handling left-over food	Respondents	
Cooking food in advance of consumption		
Usually	24	40,0
Sometimes	8	13,3
Not cooking in advance	28	46,7
Storing food cooked in advance (n*=32)		
In refrigerator	26	81,3
In cupboard or on kitchen counter or stove	6	18,8
Leaving food to reach room temperature before refrigerating (n*=26)		
Usually	21	80,8
Sometimes	4	15,4
No	1	3,8
Handling left-over food		
Storing left-over food		
In refrigerator	49	81,7
In cupboard or on kitchen counter or stove	11	18,3
Storing left-over food in the refrigerator (n*=49)		
In container with lid	48	97,9
Not in container with lid	1	2,1
Storage time of left-over food in refrigerator (n*=49):		
3 days or less	44	89,7
4 days or more	5	10,3
Reheating food prepared in advance and left-over food		
Stage of reheating		
Until boiling hot	0	0,0
Until hot	31	51,7
Until warm	29	48,3
Reheating it more than once		
Usually	10	16,7
Sometimes	2	3,3
No	48	80,0

n* = number of respondents in the group/sub-group applying the practice

Food-borne disease awareness related to food practices associated with decreased risk of bacterial food-borne disease

Awareness of the causes of food-borne disease

Awareness of the causes of food-borne disease was low as less than half of the respondents mentioned any of the causes associated with food-borne disease. The cause that was mentioned by most of the respondents was food items that were stored for too long. However, only 8 respondents (13,3%) indicated that they would store perishable food items until its showed signs of decay. Less than half of the respondents indicated bacteria as an organism that is linked to food-borne disease. Table 5 indicates the causes of food-borne disease as indicated by the respondents.

A far higher awareness of the causes of microbial food-borne disease was found in a telephone survey conducted by Jay *et al* (1999a). In the Australian survey, 88% of the respondents contributed food-borne disease to the incorrect storage of food items, 80% to bacteria, 79% to consumption of food items past their use-by date and 74% to incorrect cooking. Similar to this study, a small percentage of the respondents (2,1%) also indicated that they did not know the causes of food-borne disease.

Awareness of specific bacteria associated with food-borne disease was also limited, as a large percentage of respondents could not name any bacteria associated with bacterial food-borne disease. The majority of respondents that indicated the name of a bacterium mentioned *Salmonella.* Table 6 indicates the number and percentage of respondents that mentioned each type of bacteria.

Results from other studies indicated a higher level of

TABLE 5: NUMBER AND PERCENTAGE OF RESPONDENTS (N = 60) WHO INDICATED EACH OF THE CAUSES OF FOOD-BORNE DISEASE

Causes of microbial food-borne disease	Respondents	
Causes relating to food practices	**n**	**%**
Purchasing		
Contaminated food items	23	38,3
Storage		
Food stored for too long	28	46,7
Preparation		
Personal hygiene		
Hands not washed	17	28,3
Poor hygiene practices	20	33,3
General hygiene		
Dirty equipment and utensils	22	36,7
Cross-contamination between raw and cooked food	13	21,7
Contact with animals and flies	11	18,3
Cooking		
Food items not cooked to well done	9	15,0
Food items held at warm temperatures for too long	20	33,3
Food not cooled quickly after cooking	1	1,7
Handling left-over food		
Leftovers not reheated to boiling point	7	11,7
Organisms causing microbial food-borne disease		
Bacteria	27	45,0
Viruses	13	21,7
Other micro-organisms, e.g., mould	13	21,7
Don't know	3	5,0

consumer awareness regarding food-borne disease causing bacteria. In the study conducted by Jay *et al* (1999a), 96% of the respondents indicated that they had heard of S*almonella*. Similarly, in a study conducted by Woodburn and Raab (1997) in the USA, 99% of the respondents recognised *Salmonella* as a problem in food. And 88% could name appropriate foods at high risk of *Salmonella* contamination. Poor results were also obtained with regard to the question on the association between *Salmonella* food-borne disease and specific food items or food preparation practices. Only 15 respondents (25,0%) indicated an association between *Salmonella* and poultry and only 3 respondents (5,0%) indicated that contamination might occur when raw poultry came into contact with ready-to-eat food items. None of the respondents indicated that inadequate cooking could be associated with *Salmonella* food-borne disease. Results from other studies again show a greater awareness of bacterial food-borne disease. Williamson *et al* (1992) reported that 74% of the respondents in a mail survey associated *Salmonella* with raw poultry and eggs.

Only 26 respondents (43,3%) could indicate the meaning of the term "cross-contamination" 20 (33,3%) of whom indicated that they understood it to be when raw and ready-to-eat foods were in contact with each other, while four (6,6%) referred to the preparation of food on a contaminated surface and two (3,3%) mentioned using the same knife for raw and ready-to-eat foods.

Food practices associated with decreased risk of bacterial food-borne disease The 18 respondents (30%) who were aware of the association between *Salmonella* and poultry (n=15) and that raw poultry may cause contamination (n=3) were not more likely to report following the corresponding *Salmonella* food-borne disease prevention guidelines than those who were not aware of the association. Only 2 of the 13 respondents who reported washing a plate/chopping board with soap and water in between using it for raw and ready-to-eat food items and only 2 of the 11 respondents who reported washing hands with soap and water after handling raw poultry indicated the association between *Salmonella* and poultry. In addition, only 1 of the 5 respondents who reported washing a knife with soap and water in between using it for raw and ready-to-eat food items indicated the association mentioned above.

Respondents who were able to describe cross-contamination (n=26; 43,3%) were also not more likely to report using the corresponding cross-contamination prevention practices. Only 6 of the 13 respondents who reported washing a plate/chopping board with soap and water in between using it for raw and ready-to-eat food items and only 5 of the 11 respondents

TABLE 6: NUMBER AND PERCENTAGE OF RESPONDENTS (N = 60) WHO INDICATED SPECIFIC BACTERIA ASSOCIATED WITH FOOD-BORNE DISEASE

Bacteria	Respondents	
	n	%
Salmonella	25	41.7
Staphylococcus aureus	7	11.7
Clostridium botulinium	6	10.0
Bacillus cereus	5	8.3
Clostridium perfringens	4	6.7
Escherichia coli	4	6.7
Shingella	3	5.0
Camplyobacter Jejuni	1	1.7
Don't know	27	45.0

who reported washing hands with soap and water after handling raw poultry described cross-contamination as contact between contaminated food or equipment and ready-to-eat food items. In addition 4 of the 6 respondents who reported storing meat or chicken on the bottom shelf of the refrigerator and only 1 of the 5 respondents who reported washing a knife with soap and water in between using it for raw and ready-to-eat food items explained cross-contamination satisfactorily. None of these associations were significant.

The finding that an awareness of bacterial food-borne disease does not necessarily lead to safe food practices is supported by studies conducted by McIntosh *et al* (1994), Altekruse *et al* (1996) and Woodburn and Raab (1997). The disparity between awareness and practices may be due to a lack of food preparation experience. Altekruse *et al* (1996) based this assumption on the fact that although the knowledge of specific groups of consumers, such as young adults and occasional food preparers, was similar to that of the overall sample, they had lower rates of self-reported adherence to bacterial food-borne disease prevention practices. In this study 17 respondents (28,3%) indicated that they had been exposed to information on bacterial food-borne disease, either at school or as part of a subject at the CPUT. However, they may not practically apply the theoretical principles of bacterial food-borne disease prevention in their own food preparation practices.

In contrast, although only 18 respondents (30%) were aware of the association between poultry and *Salmonella,* 52 respondents (86,7%) reported cooking chicken or liking it to be cooked to the well-done stage. However, this may be due to personal taste rather than an awareness of the risk associated with the consumption of undercooked poultry.

CONCLUSION AND RECOMMENDATIONS

As only a small sample was used the results could not be generalised to the population of self-catering residential students as a whole. However, the results obtained do provide a description of the current food safety practices and dietary intake of the sample studied. This study indicated that although female students in self-catering residences adhered to some bacterial food-borne disease prevention guidelines, personal and general hygiene practices were neglected. However, a return to the previous system of catered residential meals, where the purchasing and storage of food items and the preparation of meals are done according to guidelines set by the contracted catering company, is not financially viable. At present institutions of higher education are more accessible to students from previously disadvantaged backgrounds with the resultant increase in the number of students with limited financial resources.

Several studies have concluded that education regarding the prevention of food-borne disease is required if standards are to improve (Barrett *et al*, 1996; Ropkins & Beck, 2000; Medeiros *et al*, 2001b; Gorman *et al*, 2002; Li-Cohen & Bruhn, 2002). In this study, students indicated low levels of awareness regarding the causes of food-borne disease, high-risk food items and cross-contamination. Although a higher awareness of food-borne disease issues does not necessarily lead to food practices more in line with bacterial food-borne disease prevention guidelines, the results from studies conducted by Altekruse *et al* (1996), Meer and Misner (2000) and Lin *et al* (2004) indicate that a raised awareness of these issues can be a potentially useful approach to promote safer food practices.

Based on these determined behaviour tendencies it is recommended that an intervention programme aimed at improving adherence to bacterial food-borne disease prevention guidelines by female students living in self-catering residences be designed and implemented. The time spent attending tertiary institutions has been identified as one of the most influential times in students' lives, providing the perfect opportunity to instil lifelong habits (Klemmer, 2002). According to Huang *et al* (2003), colleges and universities can be ideal settings for interventions because students are still forming lifestyle patterns. Although all consumers would benefit from interventions aimed at improving adherence to bacterial food-borne disease prevention guidelines, results of studies conducted by Williamson *et al* (1992) and Woodburn and Raab (1997) indicate that these programmes should be directed towards consumers younger than 35 years of age.

This study was a once-off survey of the food practices of female students living in self-catering residences at the CPUT:Cape Town campus. Male students residing in self-catering residences were not included in this study. It is assumed that they will exhibit similar behaviour to the female students, but this assumption has not been empirically tested. A large number of students also do not live in residences, but in flats or rooms, where they are responsible for their own food provision. The facilities available to them differ from

those provided in the residences, which may in turn affect their food practices. It is thus recommended that the food practices of male students in self-catering residences and those of students living in flats or rooms also be investigated and that based on the results of these studies, the intervention be extended to include female and male students in self-catering residences and all students who are responsible for their own food provision.

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