Assessment of Unhealthy Diets and Unsafe Foods and its Risks to Human Consumers: Public Health Approaches to prevent Chronic Diseases and Food Poisoning among University of Gezira Students, Sudan (2010 -2013).

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Abstract

This study was conducted in the University of Gezira, Sudan; among 4800 students from the first year in the different colleges in ten campuses distributed in the Gezira State Sudan, to know, investigate, and assess the health risks resulting from the consumption of unhealthy and unsafe foods and public health approaches to prevent chronic diseases and food poisoning among students. Fifty duplicate swab samples of equipment preparation surfaces, cooking surfaces and hand swabs of the food handlers were collected. All samples were analyzed in the laboratory of Microbiology, Faculty of Public and Environmental Health, University of Khartoum to evaluate the levels of contamination by using the approved isolation and identification methods. Interpretations of the API Staph numerical profile of all samples were performed in Pasteur Institute, Casablanca, Morocco. Results showed that 87.5% of the total students have no physical activities and 28.96% of the total students have family history of diabetes. The present study showed there is a significant relation between Body Mass Index of students and their physical activity ($P < 0.005$). All samples of cooking equipments and hand swabs of the food handlers were contaminated with six bacterial species: *Staphylococci* species, *Bacillus* species, *Kocuria varians/rose*, *Proteus species*, *Enterobacter* species and *Tatumella* species. *Staphylococci* were the predominant bacteria species (79%) of the total isolated Gram – positive cocci, but Gram- negative rods constituted 6% of the total isolated species. This indicating the improper hygiene practices, improper hand washing, lack of surfaces and food preparation equipment, cleanliness and disinfection. About 43.3% of the total food handlers know the proper way to wash their hands during working hours and only 3.3% of them know the proper way of cleaning food preparation surfaces.

Keywords: Non-communicable diseases, University of Gezira, Sudan, Food-borne illness.

1. Introduction

Food is a source of nutrients, central to health, prosperity and social well-being of individuals and societies. If not handled hygienically, it could be a medium for disease transmission. Consumer awareness of food safety and nutrition is a major issue in relation to healthy lifestyles and disease prevention. Almost half of the total deaths related to chronic disease are attributable to cardiovascular diseases. Obesity and diabetes are also on rise. It has been projected that by 2020, chronic diseases will account for almost three fourths of all death worldwide. The number of people with diabetes in the developing countries will increase from 84 million in 1995 to 228 million in 2025.chronic diseases are the most serious public health burden that the world faces today. Moreover the burden of chronic diseases is rapidly increasing around the word [1]. In the second half of the twentieth century, adult chronic diseases become the main public health problem. Non-communicable conditions were responsible for between 83 and 89% of deaths in the very-low-mortality countries of the European and Western Pacific region and America. Cardiovascular disease, cancer, chronic obstructive lung disease and diabetes have now become a major and growing public health problem-worldwide, accounting for 50% of the global mortality burden [2]. Mental illnesses and chronic diseases are closely related. Chronic diseases can exacerbate symptoms of depression, and depressive disorders can themselves lead to chronic diseases [3]. Non-communicable diseases have become a major health problem not just in developed countries but also in developing countries. Already 79% of the deaths attributed to the non-communicable diseases occur in developing countries [4]. Contaminated food contributes to 1.5 billion cases of diarrhea in children each year, resulting in more than three million premature deaths, according to the World Health Organization [5]. Those deaths and illnesses are shared by both developed and developing nations. Many countries have not yet established adequate surveillance or reporting mechanisms to identify and track food-borne illness. Therefore, data on food-borne diseases are extremely scarce and improvements are needed to better identify the causes of food-borne diseases. In the absence of strong consumer protection bodies, consumer groups and informed citizens aware of food safety and their right to safe food, it remains a significant challenge for many countries to respond in the most appropriate way to the needs of their people for safe and healthy food. Food-borne diseases are of major concern worldwide. To date, around 250 different food-borne diseases have been described, and bacteria are the causative agents of two thirds of food-borne disease outbreaks **[6]**.

2. Materials and methods

2.1. Study site

This cross-sectional study was conducted in the University of Gezira, Gezira State, Sudan, to determine and to assess the knowledge, attitude, and practices of students and food handlers regarding assessment of mishandling of foods and public health approaches to prevent associated risks among University of Gezira students. Methods of data collection were represented by questionnaires, direct observation, field survey, focused food safety and chronic diseases prevention discussions, health education lectures and bacteriological analysis. A random sampling was used. The University of Gezira includes ten campuses; namely, Alneshashiba, Alrazy, Hantoub, Fadasy, Almanagel, Alhosh, Alhasahesa, Alkamleen, Alhedibah, and Alhelaliah. The study was carried in the University of Gezira, Sudan. The Gezira State lies between longitudes (22°.32 east and 20°.34 east) and latitude (32.°13 north and 30°.15 north) in area of 35340 square

kilometers. The capital is Wad Medani. The population is about 3475221. There are seven provinces in the Gezira State, namely the Managil, El Hassheisa, El Kamlin, El Butana, Rufaa, ElGezira and Um ElGura province. The State includes thirty four localities, distributed upon the provinces. The University of Gezira was established in 1975 at Wad Medani City in central Sudan. The University is close to one of the biggest agricultural projects in Africa. The mission of the institution was to create a regional university for training of personnel to service the large Gezira. The Gezira State is one of the most distinctive and affluent areas of the country and considered to be the cornerstone of the country's economy. Initially, there were a handful of schools, but today the university has expanded to fourteen schools and four institutes [7].

2.2. Isolation and identification

All samples were analyzed by using conventional bacteriological techniques to isolate and identify (Staphylococci and Enterobacteriaceae) [8-10]. Eossine-methilene-blue (EMB) medium was used to isolate Enterobacteriaceae species from the hands of food handlers and the cooking equipments and food preparation surfaces. Nutrient agar, was prepared according to manufacturer instructions, and then used for isolation. Standard bacteriological methods were used for identification of different bacteria [8,9]. Several single colonies from each plate were randomly isolated based on their colonial and microscopic morphology, catalse production and their ability to ferment mannitol salt agar [2]. Gram positive cocci isolates that showed positive catalse were tested using API systems strips as recommended by manufacturer API [10]. Gram's negative rod-shaped isolates were identified as Enterobacteriaceae by biochemical reactions which include motility, oxidase test, glucose fermentation, catalase production, indole test, methyl red test, urease test, vogesproskauer test, H2S production and growth on Eosin-methylene-blue agar (EMB) and kliglers-Iron-Agar (KIA) [8, 9]. Identification System for Staphylococcus, According to Manufacturer's Recommendations API Test [10].

Table 1. API Staph medium 6 ml at pH 7.

Yeast extract Bactopeptone	0.5 g
Bovine/porcine origin	10 g
NaCl	5 g
Trace elements	10 ml
Demineralized water	1000 ml

The identification of a bacterial strain is a key element in the effective management and control of bacterial infections. Commercial kits are now available to ease the testing and to decrease the completion time required to get the identification information on time. The API Staph strip consists of 20 micro-tubes containing dehydrated substrates. These Micro-tubes are inoculated with a bacterial suspension, prepared in API Staph medium that reconstitutes the tests. During incubation, metabolism produces color changes that are either spontaneous or revealed by the addition of reagents. The reactions are read according to the reading table and the identification is obtained by referring to the analytical Profile Index or using the identification software. The content of the kit is 25 API Staph strips, 25 incubation boxes, 25 ampoules of

API Staph medium, 25 result sheets and one package insert. The composition of the API staph strip is given in the Table 1.

3. Results and Discussions

Table 2 show the students family history of diabetes. Studying the Television watching and internet browsing are given in Fig 1.

Table 2: Students family history of diabetes.

Gender	Males			Females			Grand Total	Total	%
	No.	Total	%	No.	Total	%			
Father	14	145	9.66	38	335	11.34	52	480	10.83
Mother	1	145	0.69	16	335	4.77	17	480	3.54
Brother	0	145	0	2	335	0.60	2	480	0.42
Sister	1	145	0.69	1	335	0.30	2	480	0.42
Others	12	145	8.28	54	335	16.12	66	480	13.75
Total	28	145	19.32	111	335	33.13	139	480	28.96

The findings showed that the family history of diabetes of the total students who participated in the study represented 28.96%, 33.13 of the total females and 19.32% of the total males had family history of diabetes (Table 2). In the same line diabetes is an iceberg. Although increase in both the prevalence and incidence of type2 diabetes have occurred globally, then have been especially dramatic in societies in economic transition, in industrialized countries and in developing countries. Currently the number of cases of diabetes worldwide is estimated to be around 150 million. This number is predicted to double by 2025[11].
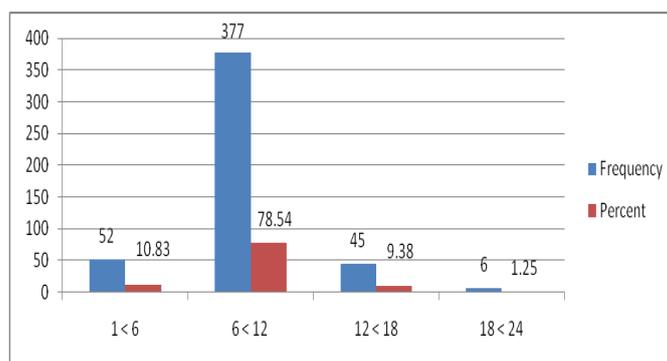

Fig 1: Studying the Television watching, and internet browsing

As shown in this study 78.54% of the total students were sitting between 6 to12 hours per day Figure 1. The result of long sitting hours per day may lead to high prevalence of obesity, overweight and related diseases. Sitting time, TV time, and time sitting in automobiles increase premature mortality risk. Even when adults meet physical activity guidelines, sitting for prolonged periods can compromise metabolic health [12]. The results concerning student's physical activities showed the percent of 87.5% of the total students have no physical activities. The amount of physical activity has been greatly reduced at home and in colleges as well

as by increasing use of mechanized transport. Several studies have reported the importance of regular physical activities and a psychological well-being. Depression scores were also found to be higher among those with a sedentary life style than among those exercising moderately [13]. Physical activity confers significant protection from chronic diseases such as cardiovascular diseases and non-insulin-dependent diabetes mellitus and because it appears to reduce the risk of osteoporosis and some cancers, there is substantial interest in beginning the prevention of these adult diseases during the first two decades of life through regular physical activity [14]. Table 3 represent the habit of eating foods with high content of fibers.

Table 3: Habit of eating foods with high content of fibers

Students habit of eating foods with high content of fibers.	Gender		Total	%
	Male	Female		
Yes	50	167	217	45.21
	34.48%	49.85%		
No	95	168	263	54.79
	65.52%	50.15%		
Total	145	335	480	100

The findings of this study showed that student habits of eating foods with high content of fibers according to their gender represented 50.15% of the total females and 65.52% of the total males participating in the study do not eat foods with high content of fibers (Table 3). Female students reported positive health habits, in terms of eating foods with high content of fibers. Individuals with high intakes of dietary fiber appear to be at significantly lower risk for developing coronary heart disease, stroke, hypertension, diabetes, obesity, and certain gastrointestinal diseases. Increasing fiber intake lowers blood pressure and serum cholesterol levels. Increased intake of soluble fiber improves glycemia and insulin sensitivity in non-diabetic and diabetic individuals. Students Knowledge about Sleeping Habits are given in Table 4.

Table 4: Students Knowledge about Sleeping Habits.

Sleeping Habits	Frequency	Percent	Valid Percent	Cumulative Percent
Improper sleeping habits	343	71.5	71.5	71.5
Proper sleeping habits	52	10.8	10.8	82.3
Don't know	85	17.7	17.7	100.0
Total	480	100.0	100.0	

About 89.2% of the total students do not know a proper sleeping habits (Table 4). A number of causal pathways linking short sleep duration with obesity have been suggested based on experimental studies of sleep deprivation. Lately attention has been paid to sleeping habits and length of sleep. Inverse associations between sleep length and overweight have been found in several studies and reviews, both in adults and children. This supported by Westerlund et al. [15] ; they mentioned that inadequate sleep was measured as

short sleeping hours during study nights and weekend nights, difficulties in waking up in the morning and tiredness during the day. Short sleeping hours result in several hormonal changes, which increase perceived hunger and appetite. This could affect food intake, and consequently lead to overweight because sleep restriction decreases circulating levels of the appetite-suppressing hormone leptin, and increases levels of the appetite-stimulating hormone ghrelin. Figure 2 show the isolated bacterial species from food surfaces and hands of food handlers.
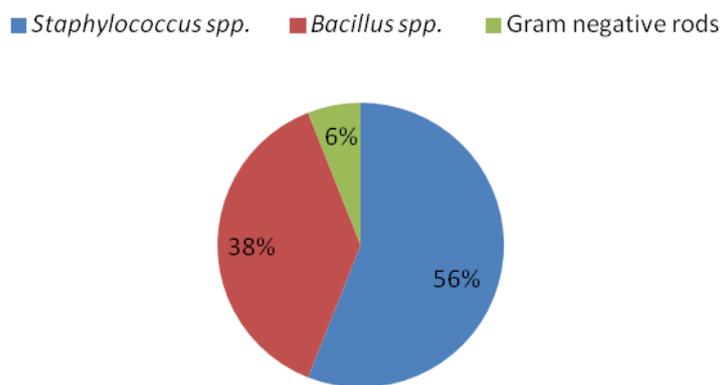

Fig 2: Isolated Bacterial Species from Food Surfaces and Hands of Food Handlers.
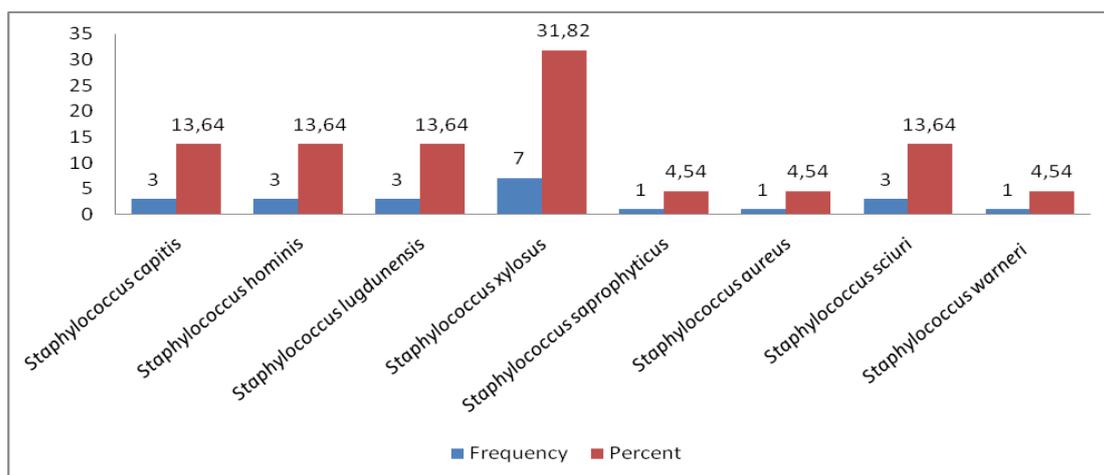
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Fig 3: Frequency of Identified *Staphylococci* species by API Staph Method.

In this study *Staphylococcus* specious constituted 56% of the total isolated species, while *Bacillus* specious constituted 38% of the total isolated bacteria, but Gram- negative rods constituted 6% of the total isolated species. The occurrence of *Bacillus* species, enteric bacteria species and *Staphylococci* species particularly *Staphylococci* species on the food handler hands and cooking equipment surfaces is a clear indicator of the inefficiency of hand washing and improper hygiene operations (Fig 2). The majority of outbreaks are caused by the direct contamination of cooked foodstuff by hands soiled with secretions from the nose, mouth and skin lesions. Such levels of toxin are harmless but storage at ambient temperatures for few hours should allow significant levels of toxin to be produced **[16].** The frequency of identified *Staphylococci* species by API Staph method is given in the Fig 3

Staphylococcus aureus constituted 4.54% of the total identified *Staphylococci* species (Fig 3). *Staphylococcus aureus* can be used to indicate handling of heat-processed foods by human beings, as well as to provide evidence of risk of food-borne diseases. If any of these agents are suspected in an outbreak, surface swabbing can sometimes be helpful in tracing the primary source of contamination. Swabbing surfaces of equipment (tables, cutting boards, grinder, and slicing machine) that contacted the suspect food and testing the swabs for pathogens of concern can sometimes establish link in the transmission of contamination [17]. Food-borne diseases are of major concern worldwide. To date, around 250 different food-borne diseases have been described, and bacteria are the causative agents of two thirds of food-borne disease outbreaks. Among the predominant bacteria involved in these diseases, *Staphylococcus aureus* is a leading cause of gastroenteritis resulting from the consumption of contaminated food. Staphylococcal food poisoning is due to the absorption of staphylococcal enterotoxins preformed in the food [6]. The occurrence of *Staphylococcus aureus* on the food handler hands and cooking equipment surfaces highlights the possible contamination of prepared foods by human handling [16]. Practices of food handlers about washing their hands are given by Table 5.

Table 5: Practices of Food Handlers about Washing their Hands.

Hand washing	Frequency	Percent	Valid Percent	Cumulative Percent
After using the toilet	15	50.0	50.0	50.0
After the preparation of food	1	3.3	3.3	53.3
After the disposal of waste	1	3.3	3.3	56.7
All of the previous mentioned points	13	43.3	43.3	100.0
Total	30	100.0	100.0	

50% of the total food handlers in the study know that they must wash their hands after using the toilet only (Table 5). In spite of improving knowledge and understanding of epidemiology of food-borne diseases and illnesses, efforts to reduce their impact on health and the economy have proved inadequate, and their incidence continues to rise. Because most outbreaks result from faulty food handling practices, it is generally believed that hygiene training of food handlers could contribute significantly to prevention and control. Food handlers play an important role in ensuring food safety throughout the chain of production, processing, storage and preparation. Planning health education intervention programs for food handlers in order to have improvement in knowledge, attitude and practice towards food-borne diseases and food safety. Furthermore, it will in turn reduce national morbidity and mortality of food-borne diseases [18]. The knowledge of the food handlers participating in the study about the proper way to wash their hands during working hours is presented in Table 6. 6.7% (2 food handlers) of the total 30 food handlers participating in the study do not know the proper way to wash their hands. Unsafe food handling practices in food service establishments are a major contributor to the transmission of food-borne illness. Efforts to change food service workers' behaviors are more likely to be effective if they pay greater attention to the ecological context, address multiple influences on worker behavior, and view workers as partners in preventing food-borne illness in food service establishments. Because most outbreaks result from faulty food handling practices, it is generally believed that hygiene training of food handlers could contribute significantly to

prevention and control. Table 7 represente the practices of food handlers about the proper way of cleaning preparation surfaces.

Table 6: Knowledge of Food Handlers about the Proper Way to Wash their Hands During Working Hours.

Proper way to wash hands	Frequency	Percent	Valid Percent	Cumulative Percent
Washing hands with warm water.	5	16.7	16.7	16.7
Washing hands with soap and water and dry them by using a piece of cloth.	10	33.3	33.3	50.0
Washing hands with soap and water and dry them with a tissue paper.	13	43.3	43.3	93.3
Do not know	2	6.7	6.7	100.0
Total	30	100.0	100.0	

Table 7: Practices of food handlers about the proper way of cleaning preparation surfaces.

Cleaning action	Frequency	Percent	Valid percent	Cumulative percent
Do not need for daily cleaning	5	16.7	16.7	16.7
Cleaned with a damp cloth with water	8	26.7	26.7	43.3
Washed with soap and water	14	46.7	46.7	90.0
Washed with soap and water and disinfected with a solution of salt or vinegar or chlorine if any	1	3.3	3.3	93.3
Do not know	2	6.7	6.7	100
Total	30	100	100	

As shown in Table 7 the knowledge of the food handlers about the proper way to clean food preparation surfaces during working hours, is very poor. 16.7% of the total food handlers think that food preparation surfaces do not need for daily cleaning. 6.7% of the food handlers do not know about the correct way to clean food preparation surfaces during working hours. The law and the good hygiene practices, require every person working in food handling areas to maintain high standards of cleanliness [16]. Understanding of epidemiology of food-borne diseases and illnesses needed many efforts to reduce their impact on health and the economy because their incidence continues to rise. Most outbreaks result from improper food handling practices; it is generally believed that hygiene training of food handlers could contribute significantly to prevention and control [19]. The most important route of infections caused by *Enterobacteria* is contaminated food. Individuals handling the banknotes and coins shed some of their body flora on them; leading to the spread of the microorganisms among the handlers. In this study *Proteus* species constituted 25% of the total isolated Gram negative bacteria species, *Enterobacter* species constituted 25%, but *Tatumella* species constituted 50% of the total isolated Gram negative bacteria species. The occurrence of *Tatumella* on the food handler hands and cooking equipment surfaces high lights the possible contamination of prepared foods by human handling [20]. *Tatumella* is a relatively unknown new member of the *Enterobacteriaceae* family which was previously thought to belong to an unclassified bacterial.

4. Conclusion

- Most college students do not follow the dietary and physical activity guidelines.
- The food handlers examined in this study, have insufficient knowledge, attitude, and practices of the proper hygiene practices.
- The results of bacteriological laboratory analysis of this study showed that routine environmental samples are needed to determine the initial contamination. The purpose of collecting environmental samples is to trace the sources of, and evaluate the extent of contamination that may have led to, the outbreak. Samples may be taken from work surfaces, food contact surfaces of equipment, containers, and other surfaces such as refrigerators, door handles, etc. Environmental samples may also include hand swabs from food workers.
- All samples were collected from cooking equipment surfaces, food preparation surfaces, money drawer handles, chiller and freezer handles, and hands of food handlers in this study were contaminated with six bacterial species: *Staphylococcus* species, *Bacillus* species, *Kocuriavarians/rose, Proteus* species, *Enterobacter* species, and particularly the new genera *Tatumella* species. This indicates the improper hygiene practices, improper hand washing, lack of surfaces and food preparation equipment, cleanliness and disinfection.

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