Original Research Article

ASSESSMENT OF HYGIENE PRACTICES AND OF HEALTH STATUS OF STREET- FOOD VENDORS IN YAOUNDÉ, CAMEROON

ABSTRACT

Background: Since 1993, the government has adopted new working hours: the 8am to 4pm working day (with short lunch break). However, this new regulation was not accompanied by effective measures (formal eating houses or canteens) to ensure provision of services that could satisfy food needs of workers. Consequently, there has been a development and concentration of informal food vendors around public administrations and schools. While street foods are an important source of ready-to-eat nutritious, low-cost meals for the urban poor, the health risk posed by such foods may outweigh their benefits **Objective**: This study aims at assessing personal hygiene and health status of vendors involved in informal sale of food in Yaoundé. **Method:** In this cross-sectional epidemiological design, 837 food vendors were investigated through medical examinations (stools analysis for ova and cysts of parasites) and questionnaires. They were selected within the three main places in the city where people congregate (e.g. schools, marketplaces, and ministries/office centres). **Results:** Personal hygiene of the great majority of street-food vendors in Yaoundé (87, 1%) is of poor quality, i.e. inadequate. And this is reflected on their health status because among the 837 food vendors enrolled in the study, 379 were found infected with one or more faecal-orally transmissible parasites (i.e. a 45.28 percent prevalence rate). **Conclusion:** There is a need to improve personal hygiene of food vendors in Cameroon in order to reduce food-related diseases prevalence. This can be done through adequate enlightenment programmes, good sensitization, and food handling policies.

Keywords: food vendors, food consumption, informal sector, personal hygiene, oro-fecal transmitted diseases, parasites, health risk, Yaoundé.

1. INTRODUCTION

Urbanization in Africa has been phenomenal and puzzling; with a rapid shift from 15% in 1950 to about 41% urban proportion currently [1].According to UNFPA [2], it is estimated that by 2030, the continent may attain 54% urban proportion. This phenomenal urban growth has been qualified variously as “galloping” and “wild“ [3] to express not only the uncontrolled nature, but also the socio-economic changes and sanitary consequences often associated with it along with the implications they may have on human health and well-being [4]. Among those socio-economic changes, stands the upsurge of the "street food industry". In fact, the street food sector is a source of nutrition, place of consumption and an important provider of income for many urban-dwelling individuals and families in developing countries.

It is widely recognized as an inevitable phenomenon tied to urban growth. In big cities, almost everyone (students, civil servants, traders, workers etc.) eats on street foods due course distance workplaces houses, but also because of poverty because at lower cost, one can easily feed into the street. Street food accounts for a part of the daily diet and so contributes towards meeting nutritional requirements, although the contribution varies and is rarely quantified. Street foods are sold in almost every country in the world [5, 6].The FAO Alimentarius Commission defines “street foods” as ready-to-eat foods prepared and/or sold by vendors and hawkers especially in the streets and other public places [7]. Street foods show great variation in terms of ingredients, processing, methods of marketing and consumption. They often reflect traditional local cultures and exist in an endless variety, encompassing meals, drinks and snacks. There is much diversity in the raw materials as well as in the method of preparation of street foods. In addition, there are differences in the places where street foods are prepared and can be broadly grouped into four: food prepared in small-scale food factories or traditional workshops; food prepared in the home; food prepared in markets; and food prepared on the street. While street foods are an important source of ready-to-eat nutritious, low-cost meals for the urban poor, the health risks posed by such foods may outweigh their benefits. In fact, certain street-vended foods pose significant risk to consumers due to microbiological contamination. Every year, millions of people become ill and thousands die as a result of eating unsafe food [8]. The risk depends primarily on the type of food, the method of preparation and the manner in which it is held before consumption [9]. In addition to microbial hazards, several studies show that street foods can become contaminated with high levels of toxic chemicals including pesticide residues, heavy metals, mycotoxins and unapproved food additives [10,11]. Food can become contaminated at any point before its consumption, including during preparation. There is general acceptance on contamination and infection arising from practices of food preparation/storage/sale and consumer morbidity and even mortality. Explanations on health conditions of street vendors are still less debated, whereas there are many sicknesses which can be caused by inadequate/poor personal hygiene such as bacterial (gastroenteritis, diarrhea), viral (hepatitis A, colds and flu), and parasitic diseases (giardiasis, scabies infection, pediculosis, hookworm infection, roundworm infection (strongyloides). Since there is a lack of awareness that poor personal hygiene practices can help the transmission of disease-causing germs [12], this work is intended to assess personal hygiene of street-food vendors in Yaoundé as well as their health status. It focuses on disease-causing organisms transmitted directly by the faecal-oral route.

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2. MATERIAL AND METHODS

2.1 DEFINITION OF CONCEPTS

Personal hygiene: First attested in English in 17th century, the word hygiene comes from the French word *hygiène*, meaning "(art) of health" or "good for the health"[13]. Thus, hygiene is an old concept related to medicine, as well as to personal and professional care practices related to most aspects of living. In medicine and in everyday life settings, hygiene practices are employed as preventative measures to reduce the incidence and spread of diseases. In line with this, the terms hygiene and cleanliness are often used interchangeably, which can cause confusion. In general, hygiene mostly means practices that prevent spread

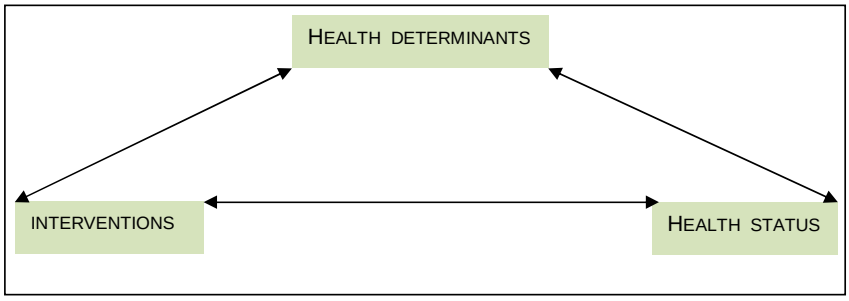
of disease-causing organisms [14]. Since cleaning processes such as hand washing and teeth brushing remove infectious microbes as well as dirt, they are often the means to achieve hygiene. Other uses of the term appear in phrases including: body hygiene, sleep hygiene, mental hygiene, dental hygiene, and occupational hygiene, used in connection with public health. Hygiene is also the name of a branch of science that deals with the promotion and preservation of health, also called hygienic [15]. However, within the framework of this study, we are primary interested in personal hygiene, which involves practices performed by an individual to care for one's bodily health and well being through cleanliness. Motivations for personal hygiene practice include reduction of personal illness, healing from personal illness, optimal health and sense of well being, social acceptance and prevention of spread of illness to others [16].

Health status: Health status is not a term that is commonly used or instantly understood. Most people, even those who are familiar with health care, consider it a medical jargon. The major reason that this term has eluded simple definition is the lack of an agreed-upon definition of health. An operational definition of health is essential before the health status of an individual or a population can be assessed. According to the WHO [17], health is "*the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*" and the "*extent to which an individual or group is able to realize aspirations and satisfy needs, and to change or cope with the environment. Health is a resource for everyday life, not the objective of living; it is a positive concept, emphasizing social and personal resources as well as physical capabilities*." Although this definition has been subject to controversy as lacking operational value and because of the problem created by use of the word "complete," it remains the most enduring [18]. From an operational point of view, health is the level of functional or metabolic efficiency of a living organism. In humans, it is the general condition of a person's mind and body, usually meaning to be free from illness, injury or pain.Thus, since main determinants of health include the social and economic environment, the physical environment, and the person's individual characteristics and behaviors [19], health status is the level of health, poor or good of the individual, group, or population. That level of health can be subjectively assessed by the individual or by more objective measures through indicators such as morbidity, mortality, disability.

So explained, how health status is measured in this study? Before we present how we measure health status, let's conceptualize what is being measured. Health status needs to be examined in more detail in order to emphasize the complexity of health. Graph 1 below is a simple model of health status showing that health is the result of *health determinants* and of diverse interventions. Health status is defined through these two factors individually and as a result of the interaction between them. *Health determinants* laid down at the Ottawa conference in 1986 can be labeled proximal (direct) or distal (indirect) [20]. According to Lerer et al. (1998) [21], distal determinants mainly made up of "*the macro-economic, educational, environmental, demographic and health factors, are considered to be the driving forces of health status and are often, but not invariably, mediated through proximal determinants*". Besides, "*proximal determinants whose some can be prevented (through health education/promotion) and regulated (through fiscal and legislative measures), are regarded as direct causes of changes in health status*". Viewed as such, relation between

determinants and health status is largely indirect and is modified only by factors like gender, education and socio-economic disparity.

Graph 1: The relationship between health status, determinants and interventions



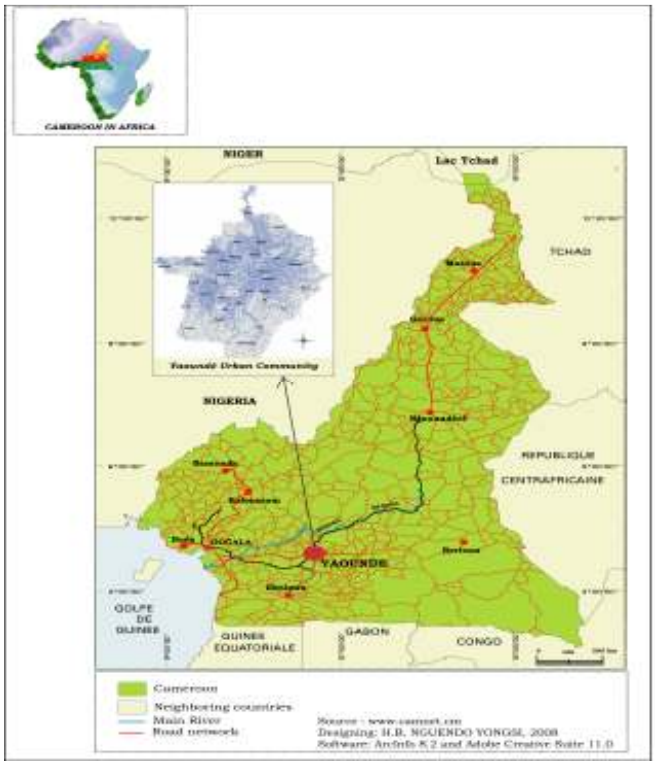
Thus, health is a multi-dimensional concept that is usually measured in terms of: (i) absence of physical pain, physical disability, or a condition that is likely to cause death, (ii) emotional well-being, and (iii) satisfactory social functioning. Some have advocated including the quality of an individual's physical environment in the definition of health, but this dimension is not at present included in the most widely used measures of health. However, there is no single "standard" measurement of health status for individuals or population groups. Individual health status may be measured by an observer, usually a physician who performs an examination and rates the individual along any of several dimensions, including presence or absence of life-threatening illness, risk factors for premature death, severity of disease, and overall health. Individual health status may also be assessed by asking the person to report his/her health perceptions in the domains of interest, such as physical functioning, emotional well-being, pain or discomfort, and overall perception of health. Although it is theoretically attractive to argue that the measurement of health should consist of the combination of both an objective component plus the individual's subjective impressions, no such measure has been developed. It is suggested that in the absence of comprehensive or absolute measures of the health of a population, average lifespan, prevalence of preventable diseases or deaths, and availability of health services serve as indicators of health status [22]. That is why most studies measure health status by using a variety of indices including morbidity, mortality, and available health resources. These health indicators are quantifiable characteristics of a population which researchers use as supporting evidence for describing the health status of a population. Thus, in the frame of this work, we have resorted to morbidity indicator through the prevalence of fecal orally transmissible parasites.

2.2 STUDY AREA

The study was conducted in Yaoundé, the capital city of Cameroon, situated in Central Africa between latitudes 3° 47’ and 3° 56’ North an d 11° 10’ and 11° 45’East (Fig. 1).

Yaoundé displays the classical Equatorial climate (regular and abundant rainfall of more than 1,600 mm per annum, and a fairly high average annual temperature of 23℃). Like many sub-Saharan African cities, Yaoundé is currently experiencing very rapid urbanization. With an estimated annual growth rate of 4.5 per cent since 1980, its population has grown from 812,000 inhabitants in 1987 to 1,500,000 inhabitants in 2000, and to about 2,100,000 inhabitants in 2007. Thus, like many metropolises, Yaoundé is in the grip of sudden and unprecedented urban growth (with a growth rate of 3.9% and a current urban population estimated at 3,000,000 inhabitants) with an increase in the size of the city's labour force. Consequently, the demand for non-traditional services has increased and there has been a surge in service-oriented activities that are not part of the formal economic system. As the population pressure in the inner city grows, many people settle in suburbs and distant areas, and daily commuting has become a way of life. Dwellers like civil servants who are subject to the 8am to 4pm in a day (with short lunch break) have been forced to change their schedules, tastes and attitudes towards food consumption, by resorting to street-vended foods. Though foods sold on the streets are relatively cheap and readily available, lack of access to potable water supply and garbage disposal, and unsanitary environmental conditions further exacerbate the public health risk associated with street-food in such an urban setting.

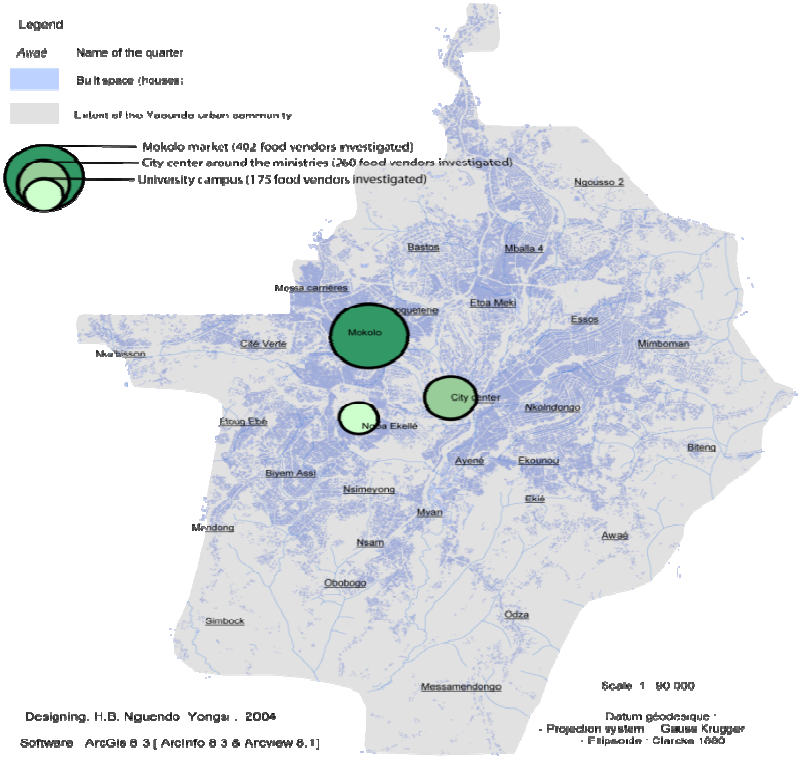
Figure 1: Map of Cameroon showing the location of the urban community of Yaoundé



2.3 SOURCES OF DATA AND METHODS OF COLLECTION

Data used in this work come from a cross-sectional study carried out on the town in 2013 by the working group (Population-Pauvreté-Santé) of Institute of Population and Research Studies (IFORD). Although the whole city constituted the basis sampling because of the proliferation of street food vending (even in gaps between buildings and in urban open spaces), a double strata sample was carried out. First, 3 main representative sectors were chosen out of the 11 where dwellers congregate daily: the City-center with its public offices and ministries, the Mokolo market which is the biggest one in Yaoundé, and the Ngoa Ekelle university campus with its faculties and higher schools. Secondly, 837 food vendors were randomly selected from these 3 sectors on the basis that they sell food items that are consumed directly or food items that require cooking before consumption (Fig. 2). The survey was designed and supervised by us but was carried out by nurses and professional investigators from the Yaoundé Population Institute (IFORD). After four days of theoretical and practical training, those nurses and investigators visited targeted food vendors to collect data through standardized questionnaires. Collected information were related to age, educational qualification, knowledge, attitude and practices as regards parasite infestation), and to medical investigation (stools screening for identification of faecal orally transmissible parasites). As far as ethical considerations are concerned, the study was first introduced to the National Ethics Committee who approved it. Then the study was presented and explained to food vendors whose consent was obtained through a signed document for those who were willing to participate. Consented food vendors were given well labeled universal tubes in which they placed a little lump of freshly passed stool. Stool samples were later collected and transported to the parasitological unit of the *Medical Laboratory Center* located in the city center) within the accepted requirements, for direct smear method and formol ether concentration methods as described by WHO, and for confirmation and identification of parasite species. Computer programmes used were Epi info (recording raw data, verifying and validating the data collected), SPSS 10.0 (statistical analysis and tabulation).

Figure 2: Sampling sites



3. RESULTS

3.1 SOCIO-ECONOMIC CHARACTERISTICS OF STREET-FOOD VENDORS IN YAOUNDÉ

Street-food vending is an activity in which city dwellers from different ages and from both genders are involved (Table 1).

Table 1: Distribution of investigated food vendors in Yaoundé according to age and sex

Age group (years)	Food Vendors				
	Males		Females		
	Size	%	Size	%	Total
[10 – 19]	57	16.38	49	10.03	106 (12.66)
[20 – 29]	106	30.46	151	30.88	257 (30.71)
[30 – 39]	130	37.36	195	39.87	325 (38.84)
[40 – 49]	47	13.50	75	15.34	122 (14.57)
[50 – 59[	8	02.30	19	03.88	27 (03.22)

Total	348	100	489	100	837 (100%)

Source: Field investigations, 2013

Revenues earned by vendors vary according to vending areas. Vendors who sold full meals in congested areas (markets) earned more than those who sold snacks in less frequented places (university campus) (Table 2).

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Table 2: Total revenues earned daily by food vendors in Yaoundé (in FCFA)

	Areas of sale			
Revenue range	Mokolo market	Around the ministries	University campus	Total
≤ 5 000	22 (17.88%)	43 (34.96%)	58 (47.15%)	123 (14.69%)
[5 000 - 10 000]	29 (17.57%)	71 (43.03%)	65 (39.40%)	165 (19.71%)
[10 000 -15 000]	86 (41.54%)	69 (33.33%)	52 (25.13%)	207 (24.73%)
[15 000 - 20 000]	112 (44.26%)	87 (34.39%)	54 (21.35%)	253 (30.22%)
≥ 20 000	58 (65.16%)	22 (24.72%)	9 (10.12%)	89 (10.63%)

Source: Field investigations, 2013

3.2 ASSESSMENT OF PERSONAL HYGIENE OF STREET-FOOD VENDORS IN YAOUNDÉ

For some street-vendors in Yaoundé, good hygiene is so much a part of their daily routines that they think largely about it as they bathe, brush their teeth, and wash their hands when preparing or eating food and handling unsanitary items. For the others on the contrary, proper personal hygiene is of little attention. Table 3 shows practices of investigated food vendors with regard to their personal hygiene.

Table 3: Personal hygiene practices of street-food vendors in Yaoundé

	frequency	percentage
1. Body washing daily?		
- No	309	38,10
- Yes	502	61,90
2. Hand washing regularly?		
- No	683	81,61
- Yes	154	18,39
3. Teeth brushing daily and regularly?		
- No	196	23,91
- Yes	624	76,09
4. Clean clothing wearing daily?		
- No	529	64,27
- Yes	294	35,73
5. Nails cutting or trimming?		
- No	612	77,87
- Yes	174	22,13
6. Hair cutting or shampooing?		
- No	658	78,62
- Yes	179	21,38
7. Covering nose when coughing?		
- No	741	93,37

- Yes	70	06,63
8. Wearing high/lace-up shoes?		
- No	718	85,79
- Yes	119	14,21
9. handling food in clean area?		
- No	385	46,00
- Yes	452	54,00

Source: Field investigations, 2013.

The table above does not indicate who can be considered as foods vendors with inadequate personal hygiene or not. It just provides us with items that should help building an index of personal hygiene quality. To build such an index, we must resort to a statistical approach called "score". It consists of classifying variables' modalities from "slightly poor personal hygiene" to "Very poor personal hygiene" [Table 4]. Foods vendors with adequate personal hygiene are those responding to our nine criteria that is who bath daily in the morning, regularly brush their teeth, wash their hands with soap all the times, cut their nails and hair, wear clean clothes and high shoes, and who cover their noses and mouths with a tissue or the hand when coughing or sneezing, handle food in clean area. Unfortunately, we didn't find food vendors who fulfill all those criteria. Besides, we found foods vendors with slightly adequate personal hygiene i.e.; who respond to at least seven of our pre-defined criteria of adequacy. Foods vendors with poor personal hygiene are those responding to at least four of the criteria. And foods vendors with inadequate or very poor personal hygiene are those not responding to up to seven of the pre-defined criteria of adequacy which respond to more than six of the criteria. They represent 23.54% of our sample.

Table 4: Building's process of the personal hygiene quality level

Table 4a: Hygiene quality (by sum of valid elements ,increasing order)

Valid	frequency	percentage
1	25	02.98
2	83	09.92
3	136	16.25
4	148	17.68
5	130	15.53
6	118	14.10
7	109	13.02
8	88	10.52
9	00	00.00
Total	837	100,00

Constitutive variables (nine): 1.teeth brushing, 2.nails cutting/trimming, 3.hand washing, 4.bathing, 5.wearing clean clothing, 6.wearing clean shoes, 7.covering nose when coughing, 8.hair cutting, 9.food handling in clean area.

Average score : 2,07 ; Median score : 2,00

4b : Personal hygiene according to level of quality or adequacy

Level of quality	Distribution of the numbers	percentage
Slightly poor	108	12.90
Poor	532	63.56
Very poor	197	23.54
Coverage of the variable	*100.0 (837)*	*100.00*

Source: Field investigations, 2013

3.3 ASSESSMENT OF HEALTH STATUS OF STREET-FOOD VENDORS IN YAOUNDÉ

Among the 837 food vendors involved in our study and who were subjected to medical investigation, 379 were found infected with one or more faecal-orally transmissible parasites (i.e. a 45.28 percent prevalence rate). Men have appeared to be more vulnerable than women (Fig. 3) and independently of the gender, vendors less than 19 years were the most infected (Fig. 4).

Figure 3. Distribution of Faecal orally transmissible parasites among street-food vendors in Yaoundé, according to gender

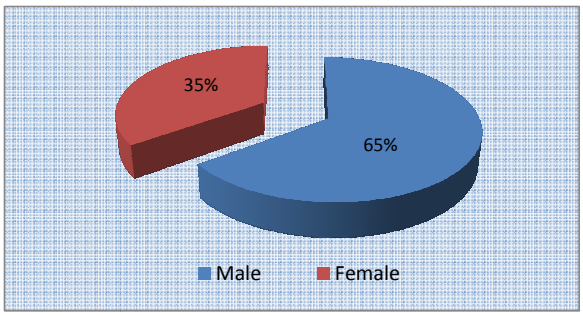
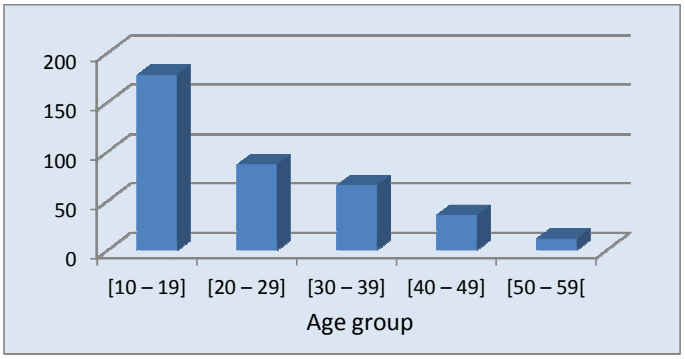


Figure 4. Distribution of Faecal orally transmissible parasites among street-foods vendors in Yaoundé, according to age



Faecal orally transmissible parasites found were the *Entamoeba*, and then followed the *Giardiasis*, *Ankylostoma duodenalis*, *Ascaris lumbricoides* and the others (Table 5).

Table 5 : Parasite species found among street-food vendors in Yaoundé

Species	Frequency	Percentage
Entamoeba histolytica	67	17.68
Entamoeba coli	61	16.10
Giardia lamblia	54	14.25
Giardia duodenalis	46	12.13
Ankylostoma duodenalis	49	12.93
Ascaris lumbricoides	43	11.34
Trichuris trichiura	42	11.08
Enterobius vermicularis	17	04.49
Coverage of the variable	*100,0 (379)*	

Source: Microbiologic examinations operated at Laboratoire du Centre, Yaoundé, 2013

Comment [A1]: Is this the number of times recorded or the quantity recorded? Because it sums up to 379 instread of 837

Comment [D2]: ***Answer: remember that, out of our 837 investigated, only 379 were found positive/infected.***

We also investigated infection with multiple parasite species as a modulator of disease severity by examining the association of concomitant infection of parasites in our sample study. And cases of polyparasitism were recorded in 248 vendors, i.e. 65,43%. There was more incidence of double infection compared to single or triple. Adults appeared to record more of single and double infection while teenagers recorded more double and triple infection (Table 6).

Table 6 : Cases of polyparasitism among street-food vendors in Yaoundé, according to age group

Infection	Teenagers [10 – 19 years]	Young adults [20 – 39 years]	Adults [40 years and more]
Single	48 (21.54%)	59 (30.31%)	24 (41.17%)
Double	91 (50.77%)	75 (48.48%)	21 (52.94%)
Triple and more	39 (27.69%)	19 (21.21%)	3 (05.89%)
Total	178 (100%)	153 (100%)	48 (100%)

Level of significance: p <0.05
Source: Medical investigations, 2013

Our results show that streets food vendors with poor and inadequate (very poor) personal hygiene are more prone to faecal orally transmissible parasites (35,09% and 46,70%) than those with slightly poor quality of personal hygiene (18, 20%) (Table 7).

Table 7: Distribution of parasites species according to quality level of street-food vendors personal hygiene in Yaoundé

	Quality level of personal hygiene		
Parasite species	Slightly poor	Poor	Very poor
Entamoeba histolytica (n=67)	11 (15.94%)	23 (17.29%)	33 (18.65%)
Entamoeba coli (n=61)	13 (18.85%)	19 (14.28%)	29 (16.38%)
Giardia lamblia (n=54)	9 (13.05%)	20 (15.03%)	25 (14.12%)
Giardia duodenalis *(n=46)*	12 (17.39%)	19 (14.28%)	15 (08.47%)
Ankylostoma duodenalis (n=49)	7 (10.14%)	14 (10.52%)	28 (15.81%)
Ascaris lumbricoides (n=43)	7 (10.15%)	18 (13.55%)	18 (10.18%)
Trichuris trichiura (n=42)	8 (11.59%)	14 (10.52%)	20 (11.30%)
Enterobius vermicularis (n=17)	2 (02.89%)	6 (04.53%)	9 (05.09%)
Total	69 (100.00%)	133 (100.00%)	177 (100.00%)

Level of significance: p < 0.005
Source: Field and medical investigations, 2013

Not surprisingly, results obtained show that high exposure to faecal orally transmissible parasites are informal settlements, particularly the peri-urban and Sub-central spontaneous quarters areas known as to be poorly equipped with socio-economic infrastructure (Table 8).

Table 8 : Spatial variation of personal hygiene quality of street-food vendors in Yaoundé according to type of their residence/quarter

Type of residence (quater):	Level of quality of personal hygiene						
	Slightly poor		Poor		Very poor		
	frequency	%	frequency	%	frequency	%	Total
Wealthy residential quarters	00	00	00	00	00	00	00
Housing estates	13	12.04	27	05.07	03	01.52	43 (05.13)
Communal plots	17	15.74	59	11.10	14	07.11	90 (10.75)

central spontaneous quarters	25	23.14	83	15.60	46	23.35	154 (18.41)
Sub-central spontaneous quarters	32	29.63	138	25.94	75	38.07	245 (29.27)
Peri urban quarters	15	13.89	130	24.44	40	20.31	185 (22.10)
Semi rural quarters	6	05.56	95	17.85	19	09.64	120 (14.34)
Total	108	100	532	100	197	100	837 (100%)

Level of significance: $p < 0.002$
Source: Field and medical investigations, 2013

4. DISCUSSION

The street food sector is very important in Cameroonian cities for socio-cultural and economic reasons. It has grown in the last twenty years for a variety of social and economic reasons: deteriorating living conditions in rural areas, rapid urbanization, structural adjustment and economic recession [22]. However, the activity accounts for 20 to 30 percent of household expenditure, and is also a major provider of employment. The street food sector has therefore received special attention worldwide, when its socio-cultural and sanitary relevance was finally recognized. During the outbreak of cholera in most developing countries, street food was seen as a possible avenue for the spread of the disease. This idea triggered priority sanitary actions to reinforce street food control programmes among which evaluation of vendors personal hygiene. Yet, what is considered proper personal hygiene can be cultural-specific and may change over time. In some cultures removal of body hair is considered proper hygiene. In others, do not kiss or shake hands to reduce transmission of bacteria by contact is hygienic. Other personal hygienic practices would include covering one's mouth when coughing, disposal of soiled tissues appropriately, making sure toilets are clean, and making sure food handling areas are clean, besides other practices [23]. Which means that personal hygiene practices should be assessed according to specific criteria like those used in Bangkok [24], Calcutta [25], in Lima [26], and in Johannesburg [27]. However, health issues related to street foods are related to disease transmission route. In fact, the human body provides places for disease-causing germs and parasites to grow and multiply. These places include the skin and in and around the openings to the body. Parasites are very common around the world and infections are transmitted in crowded places. Intestinal parasites are spread when fecal matter gets into the mouth. This can happen through ingested contaminated food or water. Hookworms like Ancylostoma are generally contracted by walking barefoot on soil contaminated by feces from infected persons or by wading in contaminated water. In short, poor sanitation and unsafe water increase the risk of catching parasites. It is less likely that germs and parasites will get inside the body if people have good personal hygiene habits. Using the guide to good personal hygiene drafted by the Australian government [28], personal hygiene was measured in this study through the following practices: washing the body, washing hands regularly and especially before handling food, cleaning the teeth at least once a day, wearing clean clothing, covering the nose and mouth with a tissue or the hand when coughing or sneezing, making sure food handling areas are clean, cutting or trimming finger nails, keeping hair short or removing hair, wearing lace-up/high shoes. We did not include items like availability of toilet facilities, access to water system closets, use of tap water, waste disposal considered by Costa-Cruz and Cardoso [29] and Muinde and Kuria [30] because

they are pertained to environmental hygiene or to community health [31, 32]. Unsafe food has been a human health problem and many food safety problems encountered today are not new. Some unpublished reports even attribute the death of Buddha to foodborne illness and a number of religious dietary rules reflect food hygiene concerns. Although governments throughout the world are doing their best to improve safety of food supply, occurrence of foodborne disease remains a significant health issue in both developed and developing countries. While the foodborne disease burden is often most well-documented in developed countries, the implications for developing countries are extremely serious in terms of both human suffering and increased demand on health care systems. The long term consequences are malnutrition and increased vulnerability to a wide range of diseases. This is particularly true for faecal orally transmissible diseases. The prevalence of faecal-orally transmissible parasite recorded in this study (45.28 %) is indicative of a high level of faecal contamination of food since these parasites are acquired via accidental consumption of parasite eggs and cysts [33]. This prevalence signals high possibility of transmission of these parasites through infected food vendors to their customers especially in cases where such food vendors are unhygienic in food handling. The facts that those food handlers are asymptomatic make them cysts and/or egg passers and are unaware that they are possible transmitters of parasitic infections/diseases. Yet, they are and are accounted to the WHO evidence that, every year, millions of people become ill and thousands die as a result of eating unsafe food. These foods have come to be contaminated at any point before its consumption, mostly during preparation and delivering by vendors whose personal hygiene has been assessed insufficient or poor.

A large proportion of street-food vendors in Yaoundé has attained the secondary education i.e. have acquired basic education on hygienic practices, but like it has been reported by Ghosh et al. [op cit] in India, they lack adequate means and an enabling environment to safely serve the clients. The three types of quarters/suburbs with higher percentages of infected food vendors were central spontaneous quarters, sub-central spontaneous quarters and peri urban quarters with poor living conditions (overcrowded rooms, lack of adequate sanitation, low or limited connection to the drinking water network).This may be due to the lack of adequate supply of water which could encourage food vendors to bath at least in the morning before going out for vending, if we agree with Kubota et al [34] that bathing in the morning is important from a hygiene point of view as it removes the bacteria that form by the process of sweating and that which settle down from external sources, and therefore appears as a preventative measure to reduce the incidence and spread of disease. In those suburbs, majority of the food vendors use pit latrine and other related structures and/or dung hills for defecation. These structures may however, facilitate contact with stools from which they can either acquire infection or carry eggs and cysts of parasites with which contamination of their wares may be inevitable thereby leading to widespread contamination of food and drinks. In addition, lack of public toilet in their points of sale may be one of the factors of epidemiology since food hawkers make use of dung hill for defaecetion while hawking their wares. The exposure of food items by stationery food vendors facilitated contact of insect with such food items, thereby increasing possible contamination of foods with eggs and cyst of parasites since insects have been identified as carriers' of eggs and cysts of parasites [35]. Furthermore, those overpopulated quarters contain the major slums in the city. And due to high cost of living and high rental cost, most vendors live in shacks

houses that are situated in marshy areas with increased probability of acquiring faecal-oral infections [36]. From our field observations, one of the most critical problems in street food vendors in Yaoundé is their indecent physical appearance: uncut hairs and nails, sandals or dirty plastic shoes, clothes soaked with sweat. This is a sign of their low standard of living which prevent them from taking care of their bodies. Anyway and according to FAO and Akindes [37, 38], the ultimate objective of the street vendors is not to take care of their body, but to earn their living.

This study shows the high incidence of protozoan parasites (nearly 60%) among food vendors and a high prevalence of *Entamoeba histolytica* and *Entamoeba coli*. Poverty may be responsible for this prevalence and/or re-infection with these parasites since the use of soap in cleaning of hands for example, is considered an additional cost even by the adult's vendors that are aware of the need for hygienic practices in food handling. From our results, we've noted that none of the food vendors met the WHO requirement for effective hand wash which include washing of hands in soapy water before preparing or handling foods. The lower incidence of multiple infections among adult food vendors implies that the routine inspection and supposed periodic deworming have a reducing effect on infection especially with helminthes [39]. Children and teenagers are known to be more vulnerable to parasitic infection than adults because of their level of exposure to parasite eggs and cysts, their level of hygiene and immunity to infection [40, 41]. This may account for higher prevalence of infection recorded among teenagers' food vendors. Infection with helminthes recorded indicate high level of environmental contamination with helminth eggs, coupled with the fact that faecal-oral mode of transmission is the easiest and commonest mode of transmission of parasites in tropical areas [42] In such a situation, the use of anti-helminthes drugs is less effective if factors promoting transmission have not been removed.

5. CONCLUSION

Street foods are ready-to-eat foods prepared and/or sold by vendors and hawkers especially in the streets and other public places. The street food sector plays an important role in providing accessible, low-cost meals for urban populations, particularly those in many developing countries. In Cameroon, they often reflect traditional local cultures and exist in an endless variety encompassing meals, drinks and snacks. The street food sector also plays an important role in providing employment opportunities for millions of men and women with limited education or skills, especially as the initial investment is low. In Yaoundé as well as in Douala (the main Cameroonian metropolis), it has even become an important component of food distribution system, particularly for midday meals. However, certain street-food vendors can pose significant risk to consumers due to microbiological contamination. In fact, vendors are often poorly educated and untrained in food safety. Yet, they work under unsanitary conditions with little or no infrastructure support, but their personal hygiene is generally inadequate. Research has shown that their health status is also bad, since some of them are suffering from faecal-oral transmitted parasites or infections. This study reveals then the need to improve personal hygiene of food vendors in Cameroon in order to reduce the prevalence of faecal-orally transmissible parasites. Based on this, there is the need for adequate enlightenment programmes for street food handlers. There is also the need to enact necessary food handling policies, and appropriate implementation of such policies

should be ensured. While some countries have conducted training programmes to educate street vendors on food safety, the development of training materials has to be tailored to meet their needs and situations. Recently the Five Keys of Safer Food have been successfully utilized in an evidence-based training programme for the vendors to improve their food handling practices [43]. In 2009 WHO published a Train the trainer course on the Five Keys to Safer Food which builds upon the safe food handling behaviours developed for the Five Keys to Safer Food Poster [44]. To our knowledge, this study through its cross sectional design and direct investigation is the first to examine the extent to which faecal-orally transmissible parasites may be mediators in the relationship between personal hygiene and health outcomes in Cameroon. However, there are two main limitations to this study. First, the cross sectional design does not allow us to infer that any associations was causal. Second, we only modeled the relationships between quality personal hygiene and faecal-orally transmissible parasites --- an intermediate health outcome. While we were underpowered to address more distal outcomes, faecal-orally transmissible parasites are closely linked to unsafe drinking water, contaminated foods. If our results were to be replicated with other populations in different settings and across health conditions and outcomes, use of a multi-level design with all known pathogens of faecal-orally transmissible pathogens would be recommended.

COMPETING INTERESTS

The author has declared that no competing interests exist.

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