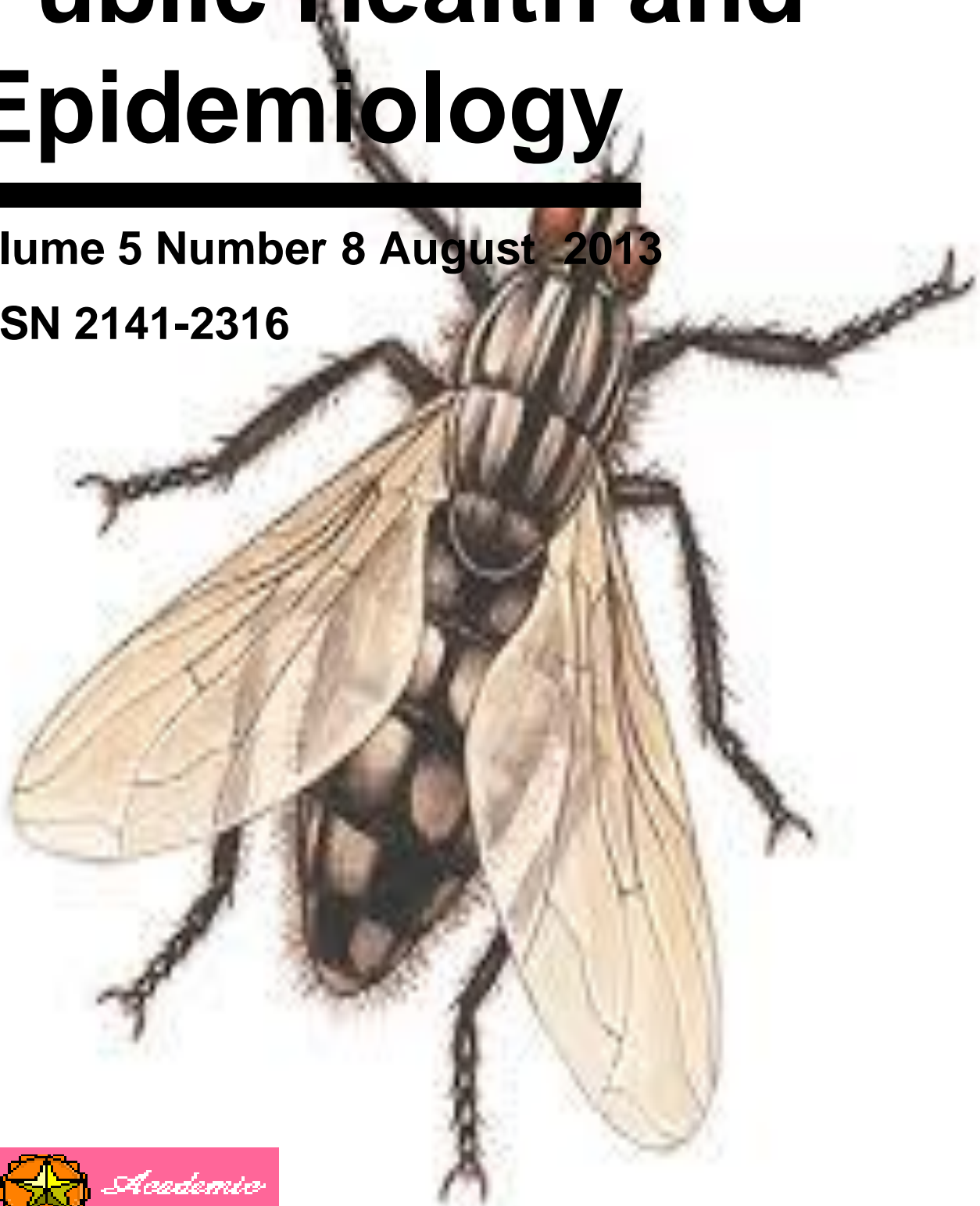


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Full Length Research Paper

Parasitic load on *Musca domestica* (Diptera: Muscidae) from different synanthropic environments in Umuahia metropolis

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Houseflies (*Musca domestica*) have been incriminated as transmitters of pathogenic organisms from humans or animals to humans. They transmit viruses, bacteria, protozoa and helminthes. This study was aimed at ascertaining the different parasites retrieved in houseflies from different sampling sites during the wet and dry season in Umuahia metropolis of Abia State, Nigeria. During the study, 500 houseflies were collected in the two seasons of the year in the study area (250 for each season). Six different parasites were isolated from both the exoskeleton and the gut of the houseflies captured in the different synanthropic sites. The pit latrines had the highest parasite prevalence (57.60%), while the eateries had the lowest prevalence (30.92%). *Entamoeba histolytica* was the parasite with the highest prevalence (25%), while *Haemonolypes nana* had the lowest prevalence (11.36%). The result was attributed to inadequate personal and environmental hygiene. Therefore, proper health education and community participation is advocated to get rid of this health scourge.

Key words: Houseflies, transmitters, protozoa, helminthes, health education.

INTRODUCTION

Houseflies (*Musca domestica*) are the most common of all domestic flies, accounting for about 90% of all flies in human habitation all over the world (Nmorsi et al., 2006). There are about 170 genera and 4200 species in the family Muscidae, some of which are medically important including the housefly, *M. domestica* (Service, 2004). Insects are classified as vectors when they transmit pathogenic organisms from humans (or animals) to humans. Insects, particularly refuse and promiscuous-landing synanthropic flies, that is, houseflies (*M. domestica*) are known to be transport hosts of a variety of pathogens of public health importance (Akinboade et al.,

1984; Umeche and Mandah, 1989; Tatteng et al., 2005). Refuse houseflies have been incriminated in transmission of helminth eggs, that is, *Ascaris lumbricoides*, *Trichuris trichiura*, *Enterobius vermicularis*, *Toxocara canis* and *Strongyloides stercoralis*, protozoan cysts and trophozoites such as *Entamoeba histolytica*, *Giardia* species, *Trichomonas* species, *Taenia* species, *Hymenolepsis* species, *Dipylidium* species, *Diphyllobothrium* species and bacteria such as *Shigella* species, *Escherichia coli*. *Eimeria tenella*, the coccidian parasite of poultry can be mechanically transmitted by house flies (Graczyk et al., 1999; Mullen and Durden

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Table 1. Parasite load on houseflies captured during the dry season in the study area.

Sampling site	Parasites isolated						Total
	<i>Entamoeba histolytica</i> [No. (%)]	<i>Giardia lamblia</i>	<i>Ascaris lumbricooides</i>	<i>Trichuris trichiuria</i>	<i>Haemenolypes nana</i>	<i>Enterobius vermicularis</i>	
Abattoir	2 (4.17)	1 (2.08)	2 (4.17)	1 (2.08)	0 (0.00)	1 (2.08)	7 (14.60)
Dustbin	3 (6.25)	2 (4.17)	2 (4.17)	1 (2.08)	1 (2.08)	1 (2.08)	1 (20.83)
Latrines	4 (8.33)	3 (6.25)	2 (4.17)	3 (6.25)	3 (6.25)	3 (6.25)	18 (27.60)
Eateries	1 (2.08)	1 (2.08)	1 (2.08)	1 (2.08)	1 (2.08)	0 (0.00)	5 (18.42)
Fish/Tomato shops	2 (4.17)	1 (2.08)	1 (2.08)	2 (4.17)	1 (2.08)	1 (2.08)	8 (18.67)
Total	12 (25.00)	8 (16.66)	8 (16.66)	8 (16.66)	6 (12.50)	6 (12.50)	48 (100.0)

Of these sites, the highest parasite abundance was recorded in the pit latrines 12 (30.00%), out of a total of 50 (100%) parasites isolated, while the least occurred in the eateries centre as well 5 (12.50%) out of the same total of 50 (100%).

2002). House flies move around mostly during the day and like warm places showing a preference for direct sunshine. Their filthy habits is seen in the way they defecate while they feed, thereby distributing germs (Olsen, 1998). Houseflies as mechanical vectors pick up the infection agent on the outside of its body and transmit it in a passive manner. Flies can carry human pathogens on the sponging mouth part, on body and leg hairs (that is, setae) or on the sticky pads of the feet (that is, tarsi) (Graczyk et al., 1991). Protozoan parasites can pass through the fly gastrointestinal tract without alteration of their infectivity and can be subsequently deposited on visited surface in fecal spots (Graczyk et al., 1999). Houseflies are recognized as carriers of communicable diseases. They collect pathogens on their body parts when females lay eggs on decomposing organic matter such as the droppings of domesticated birds, cows and pig's feces, rubbish dumps, corpses and foods (Chin et al., 2008). Diseases carried by houseflies include typhoid, cholera and dysentery. Other diseases carried by houseflies include salmonella, anthrax, and tuberculosis. They have also been known to transmit the eggs of parasitic worms. Synanthropic flies abound in the tropics especially in areas with substandard environmental sanitary conditions. Here, they constitute serious public nuisance through their dirty breeding environments, feeding mechanisms and indiscriminate travel, thus making them efficient vectors of human enteric protozoan parasites (Graczyk et al., 2005).

In other parts of the globe, information on the occurrence of veterinary and medically important parasitic agents, non-biting flies such as *M. domestica* exists (Graczyk et al., 2001; Cladel et al., 2002; Szostakowska et al., 2004).

However, despite the abundance of house flies in our immediate locality, there is little or no information on their role as mechanical transmitters of parasitic diseases in Umuahia metropolis. This paper apart from giving more

information on this subject in Nigeria (Dipeolu, 1982; Akinboade et al., 1984; Umeche and Mandah, 1989; Okonkwo and Onwuliri, 2000), reports on the parasitic load on house flies gotten from different sites in Umuahia metropolis, the capital town of Abia State, Nigeria.

MATERIALS AND METHODS

This investigation was carried out between November 2009 and October 2010 in Umuahia, Abia State, Nigeria, that is located on latitude 5.5°N and longitude 7.5°E. November to March is the dry season with relatively low rainfall while April to October marks the rainy season in the study area. The monthly temperature ranges from 22 to 37°C. The average relative humidity is between 80 and 85%.

Five hundred house flies were captured in two seasons, the wet and dry seasons (250 for each season) using the sweep net method over the surfaces where flies visited from the residential areas, dustbins, abattoir sites and eateries centre.

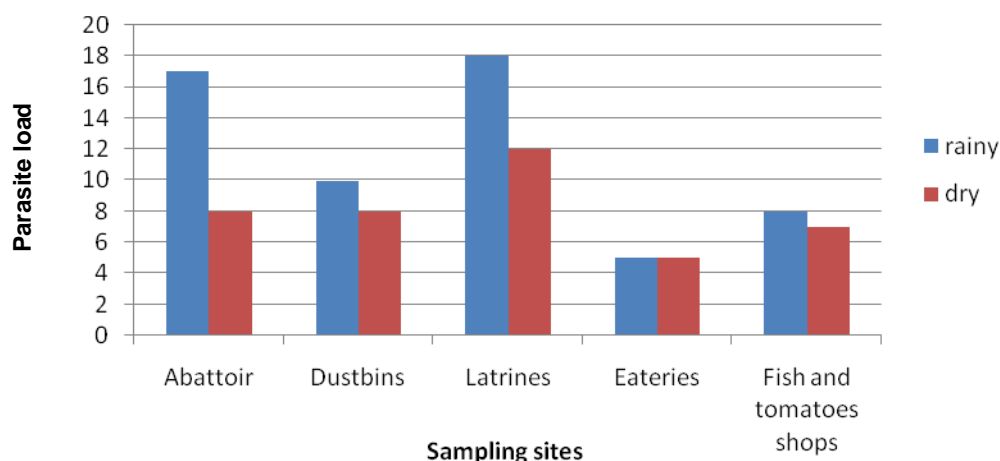
The house flies were placed into labeled plastic container and transported to the laboratory of Zoology Department, Michael Okpara University of Agriculture, Umudike for further procession. About 5 ml of formal saline was added into each universal bottle containing the house flies and shaken vigorously to dislodge the parasites from the exoskeleton (body) especially hair of the house flies. The fluid was transferred into a conical tube and centrifuged at 3000 rpm for 300 s. The sediment was examined microscopically for parasites under x400 magnification. The parasites were also quantified (Nmorsi et al., 2006). The houseflies were later dissected and the gut examined for parasites. Identification of the parasites was done with reference to a Color Atlas of Parasitology authored by John T. Sullivan, University of San Francisco (2009). The data were subjected to statistical analysis using Microsoft Excel.

RESULTS

The parasitic load on house flies captured from different environments namely pit latrines, dustbins, abattoir, fish/tomatoes stores and eateries sites in Tables 1 and 2. Table 1 shows the parasitic load on houseflies captured

Table 2. Distribution of parasites retrieved from the gut of houseflies collected from different sampling sites during the rainy season.

Sampling site	Parasites isolated						Total
	<i>Entamoeba histolytica</i> [No. (%)]	<i>Giardia lamblia</i>	<i>Ascaris lumbricoides</i>	<i>Trichuris trichiuria</i>	<i>Haemenolypes nana</i>	<i>Enterobius vermicularis</i>	
Abattoir	3 (7.50)	1 (2.50)	2 (5.00)	1 (2.50)	0 (0.00)	1 (2.50)	8 (20.00)
Dustbin	2 (5.00)	1 (2.50)	1 (2.50)	2 (5.00)	1 (2.50)	1 (2.50)	8 (20.00)
Latrines	2 (5.00)	3 (7.50)	1 (2.50)	2 (5.00)	2 (5.00)	2 (5.00)	12 (30.00)
Eateries	1 (2.50)	1 (2.50)	1 (2.50)	1 (2.50)	0 (0.00)	1 (2.50)	5 (12.50)
Fish/Tomato shops	2 (5.00)	2 (5.00)	1 (2.50)	1 (2.50)	1 (2.50)	0 (0.00)	7 (17.50)
Total	10 (25.00)	8 (20.00)	6 (15.00)	7 (17.50)	4 (10.00)	5 (12.50)	10 (100.00)

**Figure 1.** Prevalence rate of parasites recovered from the house flies.

during the rainy season in the study year. Of these sites, the highest parasite abundance was recorded in those caught in the pit latrines 18 (27.60%), out of 96 (100%) parasites isolated, while the least occurred in the eateries centre 5 (18.42%), out of the same total of 96 (100%).

DISCUSSION

The present study shows that these parasites are present in Umuahia, South Eastern Nigeria and are transmitted by houseflies. This also demonstrates the fact that houseflies are mechanical transmitters of important and predominant tropical diseases such as gastroenteritis and other human helminthiasis which abound in our locality despite the growing level of personal hygiene. This study is in agreement with the findings reported by Adeyeba and Okpala (2000) in Ibadan, Nigeria, where the presence of some pathogens like *E. histolytica*, *A. lumbricoides* and *T. trichiura* were isolated in *M. domestica*.

High endemicity of human gastroenteritis has been

attributed to poor personal and environmental hygiene, inadequate supply of clean potable water and indiscriminate defaecation. The parasites retrieved from both the external body and guts of houseflies as encountered in this study, has been attributed to the aforementioned factors.

The very high parasite load encountered among houseflies captured in the pit latrines in both seasons of the study year, showed that parasitic organisms thrive more in environments contaminated with feces and are subsequently transmitted in the locality under study. This is in agreement with a similar finding by Nmorsi et al. (2006) who made similar assertion in a study in Ekpoma, Nigeria. Of the parasites encountered within the body and gut of the houseflies, *E. histolytica* had the highest prevalence of 25% with *Giardia lamblia* trailing behind with 18.20% from both seasons in the year (Tables 1 and 2). This is in agreement with the findings of Pai et al. (2003) who reported the presence of *E. histolytica* in *M. domestica* in China. *Haemenolypes nana* had the lowest prevalence rate in both seasons (11.36%) (Figure 1). This is in agreement with the

findings of Akogun and Badaki (1998) in Adamawa who attributed it to low survival of the parasite in tropical environments. The parasitic organisms recovered from the houseflies during the two seasons under study did not vary much, though it was slightly higher during the rainy season (19.20%) than in the dry season (16.00%). This could be due to the fact that houseflies multiply and develop in their dirty environments more during rainy season than during the dry season. Also, manure decay faster during the rainy season which happens to be a suitable environment for the multiplication of houseflies.

With respect to eateries site, parasites isolated from houseflies captured in these areas were limited owing to the fact that such areas were always closed and the food kept in ovens and show cases which discouraged access to the houseflies.

Some of the parasites reported causes morbidity and often mortality arising from the infection in man. House flies have been reported to be a major epidemiologic factor responsible for the spread of acute gastroenteritis and trachoma amongst infants and young children in predominantly developing countries (Mache et al., 1989; Okonkwo and Onwuliri, 2000; Graczyk et al., 2001). It has been reported that *A. lumbricoides* and *T. trichiura* are causative agents of human helminthiasis and these pathogens were isolated on the exoskeleton and guts of *M. domestica* in the study area. It is quite imperative to note that the rate of people getting infected in the study area will be quite high if not properly handled.

Conclusion

This study underscores the need to institute a functional control measures such as community health education and proper environmental sanitation where everyone will be made to actively participate. Basic social amenities such as potable water, proper means of waste disposal and treatment of wastes in the environment should be intensified. Finally, the practice of personal hygiene is strongly advocated.

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Full Length Research Paper

Anthropometric parameters of malnutrition in children 5-15 years old in Khartoum State, Sudan

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A cross sectional descriptive study was conducted using a structured questionnaire and anthropometric measurements to assess chronic malnutrition (stunting) and acute malnutrition (wasting) for 570 children at 60 to 180 months age, including 294 girls and 276 boys at Dar EL Salam, Khartoum State, Sudan. The prevalence of malnutrition was calculated using World Health Organization (WHO) Anthro Plus; it was shown that severe and moderate chronic malnutrition in both male and female was 4.6 and 15.25%, respectively. The prevalence of chronic malnutrition (stunting) in male was 6.2 and 17.43% for severe and moderate stunting and in females was 3.03 and 12.85% for severe and moderate stunting, respectively. The prevalence of acute malnutrition in both males and females according to the BMI-for-age body mass index (BMI) was 6.99 and 19.19% for severe and moderate acute malnutrition. The prevalence of acute malnutrition (wasting) in males was 6.66 and 19.66% for severe and moderate acute malnutrition and in female was 6.95 and 18.93% for severe and moderate acute malnutrition.

Key words: Cross-sectional study, chronic malnutrition, acute malnutrition, World Health Organization (WHO) Anthro Plus.

INTRODUCTION

World Health Organization (WHO, 2000) defines malnutrition as the cellular imbalance between supply of nutrients and energy and body's demand to ensure growth, maintenance and specific function (WHO, 2000). Clinically, malnutrition is characterized by inadequate or excess intake of protein, energy and micronutrients. In the world, annually, over three million deaths occur from protein energy malnutrition (PEM) in the children under five (Stephan et al., 2000). Currently, 195 million under-five children are affected by malnutrition; 90% of them live in sub-Saharan Africa and South Asia (Black et al., 2008). At least 20 million children suffer from severe acute malnutrition and another 175 million are

undernourished (Black et al., 2008). Severe malnutrition has high mortality rate among admitted children in hospital in Saharan Africa (Maitland et al., 2006). The mortality rates and causes of death are an indicator of social progress and inequalities within and between societies (Razum and Breckenkamp, 2007).

Wasting indicates current or acute malnutrition resulting from failure to gain weight or actual weight loss (Bruce, 2001). Stunting is an indicator of past growth failure, which is a sign of poor nutritional history. Stunting results from long-term nutritional deprivation, inadequate childcare and poor environmental and socio-cultural conditions, poor educational achievement and reduced

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capital and social progress (Black et al., 2008). Child parental education, maternal nutritional knowledge, age, gender and father's occupation may be considered as important risk factors for stunting among school children aged 6 to 12 years (Smith et al., 2003; Khuwaja et al., 2005; Olwedo et al., 2008; Alredaisy and Ibrahim, 2011).

The prevalence of overweight in urban primary-school children in Babol comparing body mass index (BMI) values to the BMI index for age and sex was 5 to 8 and 12.3%, respectively (Hajian et al., 2011). Abdelmageed (2007) indicated that malnutrition situation in different schools in Khartoum State, Sudan for children between 7 to 12 years is considering a serious issue, about 44% of boys and 46% of girls were malnourished; 24% of boys and 17% of girls were at risk of being malnourished, only 19% of boys and girls were normal. On the other hand, Ngwenya and Nnyepi (2011) indicated that among Sudanese children aged 10 to 18 years in Khartoum, more than 9% of the children were obese and 10.8% were overweight.

In Sudan, factors that influencing nutritional status of children less than 10 years in rural western Kordofan included mothers' level of education and environmental degradation as well as those factors which are working at the country level, such as absence of social development programs, insufficient productive capital investment in agriculture and industry, inappropriate development policies (Alredaisy and Ibrahim, 2011). The nutrition status in Sudan is poorly characterized by high level of underweight and chronic malnutrition, well persistently elevated level of acute malnutrition. Therefore, the available data about nutritional status of children under 5 years in Sudan reflects the worse and miserable situation, especially in the marginalized rural areas (Abdalla et al., 2009), but the situation is extending to urban area of Sudan. Therefore, the aim of this study was to measure the prevalence of malnutrition (wasting, stunting and underweight) severe and moderate for each type, and to identify the socio-economic characteristic of households.

METHODOLOGY

Study location

This study was conducted in Ombada locality namely Dar El Salam, Khartoum state, Sudan. The state has an area of 22,122 km² and an estimated population of approximately 7,152,102. The state included seven localities, Khartoum, Khartoum Bahri, Omdurman, Jabal Awliya, Sharq Alnil, Ombada and Karari locality. Dar El Salam was established in 1983 to 1987, during famine periods and natural disasters such as desertification (Eltype, 2003). Dar El Salam area was expanded to 52 blocks with total population of 582,661 due to civil war in Western, Eastern and Southern Sudan. The population in the study area was heterogeneous in terms of ethnic and tribal composition. The area has twenty one nongovernmental organizations (NGOs) working in health service, and primary health care units, in addition to eight governmental health centers and eight clinics. intellectual capacity, and is a strong predictor

of human.

Study design

The cross-sectional descriptive study was designed to collect information of nutrition status for the children from 15th March to 15 April, 2012. Approximately 5% of samples were collected to represent the community of Dar El Salam. Sample size was calculated based on the total population of Dar El Salam (582,661) using the following formula:

$$N = Z^2.PQ / D^2$$

Where: N: is the required sample size, Z: is the value of the standard normal variable corresponding to 95% level of significance, P: estimated prevalence of malnutrition in the area ($p = 0.1$) and ($Q = 1-p$), D: marginal of error at 5% (standard value of 0.05)

Therefore, a total of 505 household with 570 children at age groups 60 to 180 months participated in the present study. Questionnaire was designed to collect primary data from households using cluster sampling approach. Secondary data was collected from Federal Ministry of Health report, consultation of experts working in Federal Ministry of Health (FMOH) and Non Governmental Organizations (NGOs), publications of united nation (UN) statistical report, World Food Programme (WFP), World health organization annual reports, Food and Agriculture Organization (FAO) reports and scientific articles from search engine such as pub med.

Anthropometric measurements

Body weight was estimated using mechanical dial weighing scale with capacity of 130 kg to the nearest 0.5 kg. All children were weighed with light cloth without shoes. Height was measured using non elastic measuring tape to the nearest 0.1 cm and age was estimated from birth certificate.

Nutrition indicators

In conformity with the national guidelines for nutrition surveys, acute malnutrition (wasting) was the main nutrition indicator used to monitor the effect of the nutritional status of the children. Weight and height (a measure of acute malnutrition (wasting)), height for age (a measure of chronic malnutrition) and weight for age (an indicator of both chronic and acute malnutrition) were used in the present study.

Data analysis

Data was analyzed using Statistical Package of Social Sciences (SPSS) version 15 to estimate the frequencies of descriptive variables (Gender, level of education, income and age), cross tabulation was used to find the relationship between variables and Chi-square was used to determine the level of significance. P value less than 0.05 were accepted as statistically significant. WHO Anthro software v 1.04 was used to estimate the prevalence of malnutrition among the 570 children at age 60 to 180 months. The National Centre for Health Statistics/World Health Organization (NCHS/WHO) guidelines and cut off points were also used to determine the degree of stunting and wasting. WHO Anthro software version v1.04, expressed as z-scores for each of the anthropometric indices of malnutrition against both the new WHO child growth standards and the older National Center for Health

Table 1. Distribution of age and gender among the children.

Age (months)	Boys (%)	Girls (%)	Total (%)	Boy: girl ratio
60-71	4 (57.14)	3 (42.8)	7 (1.22)	1.33
72-83	43 (44.79)	53 (55.20)	96 (16.84)	0.81
84-95	41 (59.42)	28 (40.57)	69 (12.10)	1.46
96-107	46 (50.54)	45 (49.45)	91 (15.96)	1.02
108-119	32 (55.17)	26 (44.82)	58 (10.17)	1.23
120-131	23 (40.35)	34 (59.64)	57 (10)	0.67
132-143	21 (36.84)	36 (63.15)	57 (10)	0.58
144-155	30 (49.18)	31 (50.81)	61 (10.70)	0.96
156-167	21 (46.66)	24 (53.33)	45 (7.89)	0.87
168-180	13 (44.82)	16 (55.17)	29 (5.08)	0.81
Total	274 (48.50)	296 (51.50)	570 (100)	9.77

Table 2. Prevalence of chronic malnutrition (stunting) in males and females.

Age (years)	No.	Severe % (< -3 SD)	Moderate% (< -2SD)	Mean±SD
5-7	172	3.1	60.3	-1.15±4.0
8-10	206	13.8	36.8	- 2.0±4.16
11-15	192	28.5	55.4	-3.71±5.27
Total	570	4.6	15.25	-0.79±1.34

Table 3. Prevalence of chronic malnutrition (stunting) in male.

Age (years)	No.	Severe% (< -3 SD)	Moderate % (< -2SD)	Mean±SD
5-7	88	4.4	24.7	-2.73±3.74
8-10	101	18	10.6	- 2.11±4.23
11-15	85	39.3	17.1	-5.0±4.69
Total	274	6.2	17.43	-0.98±1.26

Statistic NCHS/WHO reference put in high considerations.

Ethical approval

The Study was approved by Medical and Health Studies Board committee of the University of Khartoum and Ministry of Health Research unit of Khartoum State

RESULTS

Approximately 48.50% of boys and 51.50% of girls of age 60 to 180 months participated in the present study (Table 1). About 82.3% of fathers in Dar El Salam were laborers and 0.2% of fathers were jobless, while 9.1% of mothers in Dar El Salam were labourers and 85.7% were jobless (housewives). The prevalence of chronic malnutrition (stunting) was calculated using WHO Anthro Plus, it is shown that severe and moderate chronic malnutrition in both male and female based on (< -3 SD and < -2 SD reference height-for age z-scores) for the children was

4.6 and 15.25%, respectively, with the means and standard deviation (mean ± SD = -0.79 ± 1.34) (Table 2). The prevalence of chronic malnutrition (stunting) in male groups based on (< -3 SD and < -2 SD reference height-for age z-scores) at age groups 60 to 180 months, using WHO Anthro Plus was 6.2 and 17.43% for severe and moderate stunting, with the means and standard deviation (mean ± SD = -0.60 ± 1.26) (Table 3).

The prevalence of chronic malnutrition (stunting) in female groups based on (< -3 SD and < -2 SD reference height-for age z-scores) at age groups (60 to 180) months, using WHO Anthro Plus, was 3.03 and 12.85% for severe and moderate stunting, respectively, with the means and standard deviation (mean ± SD = -0.608 ± 1.37) (Table 4). Acute malnutrition based on (< -3 SD and < -2 SD reference BMI-for-age z-scores) was 6.99 and 19.19% for severe and moderate acute malnutrition for age groups 60 to 180 months (Table 5). The prevalence of acute malnutrition (wasting) in males based on (< -3 SD and < -2 SD reference BMI-for-age z-scores) was 6.66 and 19.66% for severe and moderate acute

Table 4. Prevalence of chronic malnutrition (stunting) in female.

Age (years)	No.	Severe% (< -3 SD)	Moderate% (< -2SD)	Mean±SD
5-7	84	1.9	40.8	-0.47±1.46
8-10	105	8.1	40.3	0.65±1.31
11-15	107	20.3	47.4	1.80 ±4.11
Total	296	3.03	12.85	0.60 ±1.37

Table 5. Prevalence of acute malnutrition (wasting) in males and females.

Age (years)	No.	% < -3SD	% < 2 SD	% < +1 SD	% < +2 SD	% < +3 SD	Mean±SD
5-7	172	23.4	55.6	58.6	14.4	5.8	-1.22±5.07
8-10	206	15.5	43.5	38.8	5.1	1.1	-2.17±4.17
11-15	192	31	93	18.3	76.7	2.2	-3.85±5.37
Total	570	6.99	19.19	11.75	2.67	0.91	-7.24±1.46

Table 6. Prevalence of acute malnutrition (wasting) in male.

Age (years)	No.	% < -3 SD	% < 2 SD	% < +1 SD	% < +2SD	% < +3 SD	Mean± SD
5-7	88	29.6	49.3	56.7	24.3	9.6	0.67±5.1
8-10	101	5.3	35.2	40.5	10.8	2.2	-1.82 ±4.17
11-15	85	31.7	112.1	8.2	0	0	-4.79±4.9
Total	274	6.66	19.66	10.54	3.51	1.18	-0.73±1.41

Table 7. Prevalence of acute malnutrition (Wasting) in female.

Age (years)	No.	% < -3 SD	% < 2 SD	% < +1 SD	% < +2SD	% < +3 SD	Mean±SD
5-7	84	16.2	64.3	62.7	3.8	1.9	-1.83±5.1
8-10	105	23.9	47.5	35.1	0	0	-2.46±4.11
11-15	107	69.5	77.5	26.9	13.7	4	-3.13±5.63
Total	296	6.95	18.93	12.47	1.75	0.59	-0.64±1.39

malnutrition in male for age groups 60 to 180 months (Table 6). The prevalence of acute malnutrition (wasting) in female groups based on (< -3 SD and < -2 SD reference BMI-for-age z-scores) according to age group 60 to 180 months was 6.32 and 17.05% for severe and moderate acute malnutrition in study population (Table 7).

DISCUSSION

About 82.3% of fathers in Dar El Salam were labourers and 0.2% were jobless, while 9.1% of mothers were labourers and 85.7% were jobless (housewives). In agreement with Majlesi et al. (2001) the better parental jobs have positive effect on nutritional status of children. In the present study, the prevalence of malnutrition was calculated using WHO Anthro Plus. The results shows

that severe and moderate chronic malnutrition (stunting) in both male and female was 4.6 and 15.25%, respectively. The prevalence of chronic malnutrition was higher in males compared to females. The prevalence of acute malnutrition (wasting) in both males and females was 6.99 and 19.19% for severe and moderate acute malnutrition. The prevalence of acute malnutrition (wasting) was higher in males compared to females.

Goon et al. (2011) found that high prevalence of both chronic and acute malnutrition was observed in 9 to 12 years old children attending public primary schools in Makurdi, which are unexpected from an urban region. However, the fact is that most of the children attending primary school in this region are from relatively low socio-economic background (Goon et al., 2011). Therefore, the low socio-economic background of these children suggests that factors such as education, occupation and economic status of parents may also account for the high

prevalence of under nutrition among our study (Goon et al., 2011). Three studies reported the prevalence of stunting 14 to 17% and wasting (25 to 32%) among school-aged children in Pakistan using the World Health Organization/National Centre of Health Statistics (WHO/NCHS) reference (Khuwaja et al., 2005).

Recent study showed that in Pakistani primary schools, 8% of children were stunted and 10% children were thin (Mushtag et al., 2011). Stunting and thinness were not significantly associated with gender (Mushtag et al., 2011). In contrast, there were 17.0% severely stunted girls as compared to 14.8% boys (Dutta et al., 2009). Wamani et al. (2007) indicated that gender differences were more marked in low socio-economic groups with boys being more undernourished, consistent with previous literature (Wamani et al., 2007). Prevalence of stunting significantly increased with age among both boys and girls ($P < 0.001$) while thinness showed significant increasing trend with age among boys only ($P = 0.034$) (Mushtag et al., 2011) while Dutta et al. (2009) noted that age do not show a significant relationship with stunting or wasting.

Significantly higher prevalence of stunting and thinness were found among the rural and the urban poor, the least educated, the residents of low-income neighborhoods and those having crowded houses (Mushtag et al., 2011; Dutta et al., 2009). One of the explanations could be that the boys are rarely at home, they tend to be active, running around in the neighborhood as compared to the female children who probably eat whatever small feeds that their mothers got since they are always with them at home (Onis et al., 1993). Furthermore, in Sub-Saharan Africa Wamani et al. (2007) reported that low social economic status of the parents predisposes the boy child to stunting. Indeed in the internal displaced people (IDP) camps settings, the parents/caretakers have very poor social economic status; owing to several years of deprivation, homelessness, loss of their wealth, lack of farming and employment opportunities (Onis et al., 1993). In Burkina Faso Dabone et al. (2011) reported that the prevalence of stunting was 8.8%, and that of thinness was 13.7%. Overweight was low 2.3% and affected significantly more children in private schools ($p = 0.009$) and younger children 7 to 9 years ($p < 0.05$). Thinness and stunting were significantly higher in peri-urban compared to urban schools ($p < 0.05$ and $p = 0.004$, respectively) (Dabone et al., 2011).

Conclusion

Study of nutritional status among children at age 5 to 15 years revealed with a high prevalence of malnutrition among the children. More research was needed to determine the nutritional status of children and made proper intervention to improve nutrition status. Enhancement of the social and economic progress of the

people is needed for example, by increasing household income and employment opportunities for better jobs.

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Full Length Research Paper

Dengue fever in a border state between Sudan and Republic of South Sudan: Epidemiological perspectives

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Dengue fever is a vector-borne disease; it is transmitted to humans by infected *Aedes mosquitoes*. In this study, we estimated the prevalence of IgG antibodies in a border oil rich state between Sudan and the new republic of South Sudan, estimated the prevalence of dengue IgG antibodies in Lagawa locality populations age 15 to 60 years in 2012 and described the most affected groups within the locality. This is a cross sectional community-based study with multi-stage cluster sampling technique conducted in 2012. Overall dengue IgG prevalence was found to be 27.7% with 95% confidence interval (CI) (24 to 31%) in Lagawa locality. Dengue looks to be having a burden in South Kordofan state on the top of its current complicated political and geographical contexts. Community awareness regarding dengue fever in the state has to be raised in addition to implementing vector control programs, insuring community participation and sustainability.

Key words: Vector borne disease, communicable diseases, surveillance, South Kordofan.

INTRODUCTION

Dengue is a vector-borne virus which is transmitted to humans by infected *Aedes mosquitoes*. It is a disease of tropical and sub-tropical areas (Guzman and Isturiz, 2010). Dengue disease severity varies from asymptomatic infections to undifferentiated fever and small proportion of cases present as a severe form known as dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS) (Halstead, 1990; Wichmann et al., 2011). Dengue burden have been rising in the recent years and has become a public health problem of global

importance. The World Health Organization (WHO) estimates that two-fifths of the world's population is at risk of dengue infection (Murrell et al., 2011).

Regionally, it is known that dengue virus has circulated in the African continent since the early 20th century (Guzman and Isturiz, 2010). Sudan is known to have dengue virus circulating. Dengue is a considerable contributor of febrile illness causes in Sudan health care facilities (Woodruff et al., 1988).

Dengue serotype 3 was found in outbreak in children in

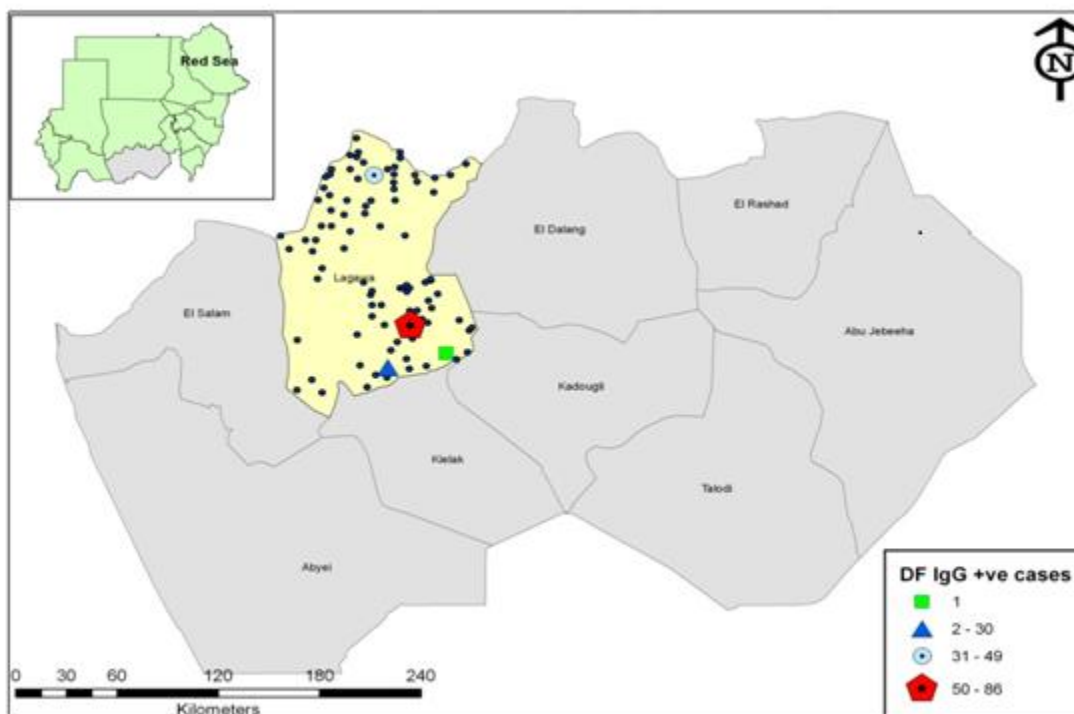


Figure 1. Dengue IgG prevalence per sampled location, Sudan, 2012.

Port Sudan in 2005 (Abdallah et al, 2012). Suspicion of dengue in all cases with fever in Port Sudan was an important finding and conclusion of the study (Ali Khider and Mubarak, 2006). Moreover, presence of DEN-1, DEN-2 and DEN-3 was confirmed in the port city of Jeddah just across the Red Sea with connections with Port Sudan (Fakeeh and Zaki, 2001). Lately, in 2011 an outbreak of non-specific symptoms was detected through the National surveillance system in Lagawa locality within South Kordofan state.

Apart from yellow fever, no proper epidemiological studies had been conducted to estimate the prevalence of Viral Hemorrhagic Fevers (VHFs) in border States between Sudan and South Sudan. Dengue fever in eastern Sudan was studied in a better way and many control achievements were documented. DF prevalence rate in Red Sea and Kassala States was found to be 9 and 6%, respectively (Sayed Shareef, Public Health Institute, Sudan unpublished observations). On the other hand all previous entomological studies in Sudan documented the presence of diverse groups of arthropods which are the primary vectors for viral hemorrhagic fevers including dengue.

Ethical approval was obtained from the ethical review committee in Aga Khan University in November, 2011. Permission from the Sudan Federal Ministry of Health

(FMOH) was issued in July, 2011. Signed, informed consent was obtained from all participants.

MATERIALS AND METHODS

Study area and study population

Study area of the investigation was the state of Southern Kordofan which is a border state in current demarcations between Sudan and republic of South Sudan (Figure 1). Population 15 to 60 years old of South Kordofan state was considered to be the targeted population, 15 to 60 years old population of Lagawa locality was the source population. Both sexes and anyone who gave the consent for interview and blood sampling were included. Visitors to the area for less than 14 days and immunocompromized patients (for example, patients with HIV, transplants, malignancies) were excluded. Side by side, subjects with chronic kidney disease or those who were taking immunosuppressant therapies for any medical reason were also excluded. Subjects who might have altered immunological response to infections as well as pregnant or women in the puerperal period due to altered immune responses to Dengue virus were also not included.

Sampling techniques

A multi-stage cluster sampling technique (Bennett et al., 1991) was used. Clusters (Popular Administrative Units (PAU)) were selected using a probability proportionate to size technique (PPS).

Households and participants were randomly selected.

Sample size

Altogether, 615 participants were interviewed in the period from April 15th to April 25th, 2012. The estimated prevalence of DF in Sudan eastern states was 9.4%. A design effect of 1.5 and a rate of 2% for missed data are taken into account to calculate the sample size which was maximized with an error as $\pm 3\%$.

Tools and quality assurance

All required epidemiological data was collected through standard structured questionnaire that underwent validation and editing after small piloting study. 4 to 5 mls venous blood samples were collected from the participants using sterile syringes and vacutainers with ideal identification labeling and maintained in cold chain. Blood samples were analyzed using Panbio Enzyme-linked immunosorbent assay (ELISA) kits for (DFIgG indirect). Positive and -negative control serum specimens were used, and the ELISA kits tested (Panbio) before analyzing the serum samples. The ELISA PanBio indirect DF IgG test has high sensitivity (99.72%) and specificity (99.62%) according to the manufacturer (Hang and Nguyet, 2009). Summary statistics were computed using SPSS-19 and STATA-12 software.

RESULTS

Basic characteristics

Among the study participants, females were 51%. Age of participants was found to be normally distributed with mean of 37 years and standard deviation of 12.6 years, knowing that the study population was between 15 to 60 years old. 41% of the participants were residing in urban settlements including Lagawa town, 15.5% of the participants reported to have travelled to the republic of South Sudan previously while 13.2% reported travelling history to Red Sea State, the endemic area of dengue fever in Sudan. More than 35% of the participants were farmers, while more than 36% were unemployed since all students were gathered under this category. Medical review history showed that 38.2% of participants had complained of fever during the last three months before the interview while only 7.8% were found to experience fever with a hemorrhagic manifestation during their life course. A very considerable proportion (77.8%) of study participants were found to be vaccinated against yellow fever (YF), almost all of them got the vaccination during 2005 YF outbreak in South Kordofan. Main characteristics of the participant are presented in Table 1.

Regarding the important entomological indicators, the study noticed that 90.7% of participants were storing water at home and only 67% of them were properly covering the water containers at the time of interview. Despite that, the presence of indoor mosquito breeding

was only confirmed in 9% of visited households. Also, the study has documented the habit of mosquito net usage in a proportion of 90.8% among interviewed participants. Majority of participants sleep under the nets at night while only 2% of them use the nets at both day and night. 24.8% of visited households were found to have windows screens, 14.7% of them were perfectly intact during the survey visit. Regarding insecticide indoor spraying, only 9.2% of the participants were performing regular indoor spraying at visited households. 79.3% of visited households were found to keep domestic animals within their homes, 31.3% were keeping goats and 40% were keeping more than one animal type including goats, sheep and cows at the time of visit.

Dengue IgG prevalence

The overall prevalence of dengue IgG in Lagawa locality is found to be 27.7% (95% CI: 24.1 to 31.3%). Participants of the age group (35 to 39 years) were found to have the highest DF IgG prevalence rate 35.3%, while the age group (≥ 45 years) found to have the lowest prevalence rate (23%). Females had shown a higher prevalence rate than males (30%). Government employees have shown the highest prevalence among other occupations, with prevalence rate approaching 40%. Residents of Lagawa (urban settings) sector have shown prevalence rate approaching 50%. Dengue IgG prevalence per specific characteristic are shown in Table 2.

DISCUSSION

This was the first study estimating the burden of dengue fever infection among apparently healthy people in the boarder state between Sudan and the new republic of South Sudan. Based on that purpose, this study attempted to measure the study outcome by quantification of the prevalence of DF IgG among the study population. DF IgG is generally considered as an indicator for cumulative infection (Nishiura, 2006; Vanwambeke et al., 2006). The overall prevalence of dengue IgG in Lagawa is 27.7% (95% CI: 24.1 to 31.3%). While this is the first study to estimate the prevalence rate of DF IgG in South Kordofan, earlier studies conducted in the eastern part of Sudan found the prevalence of DF IgG ranging between 6 to 9.4%, and in some neighboring countries as high as 14 to 31.33% (Fakeeh and Zaki, 2001; Coldren et al., 2005). Females in the study area were having higher prevalence of DF serological outcome compared to male's population, this finding is suggesting the high exposure to the infected mosquito and this supports the claim that the main

Table 1. Distribution of basic characteristics among the study population.

Characteristic	(N=600)	
	N	%
Age		
Less than 35 years	141	23.5
35-39 years	139	23.2
40-44 years	167	27.8
45 years and more	153	25.5
M±SD	37±12.6 years	
Sex		
Males	294	49
Females	306	51
Occupation		
Farmer	212	35.3
Animal keeper	45	7.5
Shop keeper	51	8.5
Government employee	73	12.2
None employed	219	36.5
Education level		
Illiterate	214	35.7
Traditional religious education (Khalwah)	102	17
Basic education	192	32
Secondary education	77	12.8
University or higher	15	2.5
Duration of continues residence in South Kordofan (M±SD)	33.6±15 years	
Residence cluster (locality)		
Lagawa	250	41
Alsunut	161	27
Jangaru	120	20
Shingil	69	12
History of:		
Fever during the last 3 months	229	38.2
Fever with bleeding	47	7.8
Yellow Fever vaccination	467	77.8
Travel to Red Sea State	79	13.2
Travel to South Sudan	93	15.5
Indoor water storage	544	90.7
Indoor breeding of mosquito	54	9
Use of mosquito nets	545	90.8
Timing for mosquito nets		
At night	522	87
At day time	11	1.8
Both day and night	12	2
Use of mosquito repellent	45	7.5

Table 1. Contd'.

Intact screens	88	14.7
Regular indoor insecticidal spraying	55	9.2
Keeping domestic animals at home	476	79.3
Type of animals		
Sheep	81	13.5
Goats	291	48.5
Cows	104	17.3

Table 2. Dengue IgG prevalence by characteristics among the study population.

Characteristic	DF IgG prevalence per strata	
	n/N	%
Positive dengue fever IgG serology	166/600	27.7
Less than 35 years	34/141	24.1
35-39 years	49/139	35.3
40-44 years	48/167	28.7
45 years and more	35/153	22.9
Sex		
Males	73/294	24.8
Females	93/306	30.4
Occupation		
Farmer	54/212	25.5
Animal keeper	12/45	26.7
Shop keeper	13/51	25.5
Government employee	29/73	39.7
None employed	58/219	26.5
Education level		
Illiterate	55/214	25.7
Traditional religious education (Khalwah)	10/102	9.8
Basic education	54/192	28.1
Secondary education	42/77	54.5
University or higher	5/15	33.3
Residence cluster (locality)		
Lagawa urban settings	80/161	49.7
Lagawa rural settings	86/250	34.4

source of DF infection is the household itself, since the key breeding sites for dengue vector are found at home (Kohn, 1990; Chen et al., 2006).

In such rural settings and very conservative community, it is quite normal to observe all females expending the

major portion of their time at home. Elder participants in this study were found to have a lower prevalence of DF IgG antibody than younger population; this finding is very interesting since the current scientific knowledge regarding DF and other vector born diseases are

believed to be prevalent more as age advances, since it depends on the exposure which is increasing with the age assuming IgG antibody will still be detected (Ferguson et al., 1999). On the other hand, some investigators found that younger adult (particularly 30 to 35 years) populations tend to be more reactive to the majority of serological tests (Teixeira et al., 2002) which supports our results, this could be also justified by the fact of decrease immunological response and serological reactivity for many viruses in elder population (Schoub et al., 1992; Ergunay et al., 2011).

This study documented that participants who live in popular administrative units within Lagawa town are more affected than those who live outside Lagawa town. This finding is also very coherent and consistent with the current knowledge regarding DF etiology since the responsible mosquito vector is classified as an urbanized mosquito that predominantly grow and expand with the population urbanization dynamics. Many DF ecological studies found increasing and re-emerging of the disease with the rapid urbanization process (Gubler, 1998). Distribution of DF IgG prevalence among the participant's occupations ranked the government employees on the top of the list with prevalence rate approaching 40%, this might be true due to specific exposure at the place of work particularly at rainy seasons since many potential breeding sites might not carefully look at. An other explanation; this result might be distorted by confounding effect of some other factors associated specifically with governmental employees such as age, residence, travelling history etc. (Vanwambeke et al., 2006). Secondary school educated participants have the highest prevalence rate (> 50%). This also might be attributed to the above mentioned justifications for occupations.

As a conclusion, Dengue looks to be having a burden in South Kordofan state on the top of its current complicated political and geographical contexts. The community awareness regarding dengue fever has to be raised in addition to implementation of vector control programs insuring community participation.

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Full Length Research Paper

Long lasting insecticidal nets use, efficacy and physical integrity in a vector resistance area after a nationwide campaign in southern Benin, West Africa

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Although effective malaria control measures such as long lasting insecticidal nets (LLINs) have been promoted, relatively little is known about their coverage dimension. However, usage varies among households, and such variation may seriously limit the potential impact of nets. Moreover, the efficacy of these measures against *Anopheles gambiae* in some departments is unknown. The objective of this study was to investigate LLINs coverage and use, and their efficacy against *A. gambiae* in Ouémé department after a mass free distribution. A post survey campaign was undertaken in January, 2012 to assess the effect of campaign six months after LLINs (Olyset net) free distribution in southern Benin. A questionnaire has been provided to heads of 1,600 households randomly selected from four districts. Despite LLINs use reaching more than 80%, coverage was low at 50.9%. A considerable damage rate (14%) of Olyset nets after only 6 months of use was observed. Bioassays revealed inefficacy of olyset toward the local population of *A. gambiae* after only 6 months of use. Free distribution of LLINs rapidly improved their coverage in communities. The rapid wear observed associated with low efficacy raises the problem of the choice of impregnated materials in a context of high vector resistance to insecticides.

Key words: Long lasting insecticidal nets (LLINs), olyset, efficacy, *Anopheles gambiae*, vector control.

INTRODUCTION

Malaria is a severe public health issue, causing roughly 216 million cases of disease and 655,000 deaths per year (World Health Organization (WHO), 2011). Most victims are children under five living in sub-Saharan Africa (WHO, 2011). Malaria is transmitted by *Anopheles* mosquitoes, and because there is currently no vaccine available, vector control is one of the most important means of malaria prevention. Long lasting insecticidal nets (LLINs) are effective tools for malaria prevention and can significantly reduce severe disease and mortality due

to malaria, especially among children under five in endemic areas (Lengeler, 2004).

In the recent decade, many countries across sub-Saharan Africa are rapidly increasing insecticide-treated nets (ITNs) coverage through several strategies including, social marketing (Noor et al., 2007; Grabwosky et al., 2007), free distribution to target groups (Beer et al., 2010; Grabwosky et al., 2010), and more recently, free universal population-based distribution campaigns target the entire population at risk (Beer et al., 2010;

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Teklehaimanot et al., 2007). If the results are below what is expected, this is due to several factors. In addition to the extension of resistance to pyrethroids in malaria vectors which represents a serious obstacle to the implementation and use of LLINs in Africa (Corbel et al., 2007; Yadouleton et al., 2010), significant problems remain, endangering the sustainability goals and achievements. Indeed, in recent years, the National Malaria Control Program (NMCP) in African countries has invested heavily in the acquisition and distribution of LLINs for malaria control. However, monitoring the use of these materials is often overlooked.

The use of insecticide-treated nets (ITNs) is a major component of malaria prevention. A meta-analysis by the Cochrane group of 22 studies that used random sampling revealed that sleeping under an ITN can decrease the morbidity and the mortality due to malaria in children under five, respectively by 50 and 17% (Lengeler, 2004). In communities with ITNs coverage over 60%, a group effect occurs and people who do not use the ITNs receive similar protection in comparison with those who use them (Hawley et al., 2003; Russell et al., 2010). Mass ITN distribution campaigns target all persons at risk for malaria, particularly in high transmission settings, and have the advantage of rapidly achieved high community-level coverage which benefits everyone in the community and not just those who own and sleep under nets (Teklehaimanot et al., 2007). This strategy also has the potential to achieve equity in mosquito net ownership and use as shown by a number of studies in different settings (Noor et al., 2007; Beer et al., 2010); however, the level of achievement depends largely on specific context settings and the effectiveness of the distribution strategy. It is therefore important to assess equity in mosquito net ownership and use after each mass distribution in a new setting.

Benin is currently engaging in free mass distributions of LLINs, a type of net that is factory-treated with insecticide and designed to maintain efficacy against mosquito vectors for at least 3 years. In Ouémé department, after indoor residual spray (IRS) withdrawal in 2011, the NMCP with the support of United States Agency for International Development (USAID), distributed LLINs in July 2011 to the inhabitants of the areas of this department previously under IRS intervention in order to limit the recovery of transmission. But the free distribution of LLINs to people is just not for solving social problems created by the cessation of IRS. The big challenge is their use by the communities. That is why the first goal of this study was to determine the utilization rate of nets distributed. The nets distributed are Olyset, impregnated with permethrin. However, mosquitoes have developed a strong resistance against this product. It is for this reason that, after six months of use, we found it important to determine the effectiveness of Olyset on local populations of *Anopheles gambiae*. So, we propose to identify transactions about these nets and their physical

integrity, namely the degree of wear. In addition, the resistance of malaria vectors to pyrethroids represents a potential liability for the success of vector control programs in Benin. As the *kdr* mutation that confers vector resistance to pyrethroids is involved in this resistance, it is therefore important to know the impact of this mutation on the efficacy of Olyset currently in use in Benin as part of vector control.

METHODOLOGY

Study area

The study area is located in Ouémé Department and includes four districts: Adjohoun, Dangbo, Misséréte and Sèmè (Figure 1), an area of approximately 1000 km². The total population is 310,400. There are approximately 65,000 households with 62,890 children aged 0 to 5 years, spread in 174 villages (INSAE, 2004). In 2010, the cumulative incidence of malaria was estimated at 11.2 and 12.6%, respectively in the Departments of Plateau and Ouémé (MS, 2011). Each district includes two different settings: the plateau area, characterized by the presence of temporary mosquito breeding sites and the valley area, characterized by the presence of permanent mosquito breeding sites associated with numerous pools and swamps. The entire region is characterized by a sub-equatorial climate, with two dry seasons (August to September and December to March), and two rainy seasons (April to July and October to November). The average annual rainfall is 1,500 mm with a relative humidity of 70 ± 5% and an average monthly temperature ranging from 23 to 32°C.

Sampling

Selection of study sites

A sampling plan level was used by associating each district with a uniform ponderation, followed by a simple random sample of households. Using probability proportional size (PPS) sampling methodology, two boroughs per district were first selected. PPS was then used to select two villages per borough. Thus, the boroughs of Adjohoun and Démè, Dangbo and Kessounou, Katagon and Misséréte, Agblangandan and Djrègbé were selected, respectively in the districts of Adjohoun, Dangbo, Misséréte and Sèmè. The purpose of each of the 2 ponderations is to meet the requirement of representativeness of our sample.

Sample size

In view of our objectives and the aim to have a good estimation of the parameters measured by the survey, we decided to visit 96 households per village with a margin of 5% to compensate for contingencies such as non-response due to errors and other registration. Thus, 100 households were visited per village, 400 households per district and a total of 1,600 households for all the study area.

LLIN coverage, use and the degree of wear

Households were interviewed about LLINs ownership and their use as means to prevent malaria. To evaluate the coverage of Olyset distributed by the NMCP in July, 2011, in each district, we

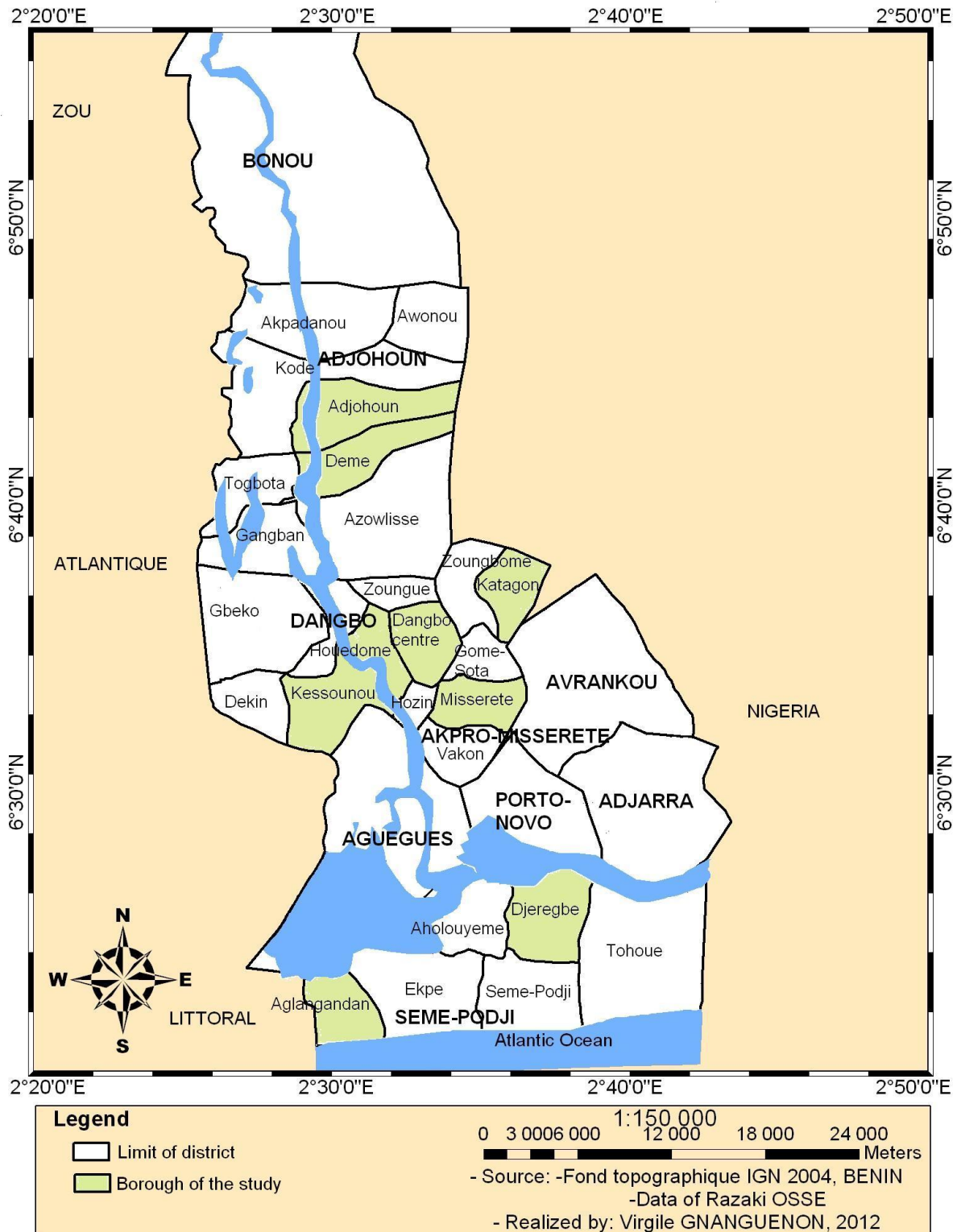


Figure 1. Map of study area - Ouémé department, Benin.

determined the number of people who declared having received Olyset NMCP 2011 and the number of people who do not receive. According to the principle of one net for two people, the coverage

rate was calculated as the ratio of the number of Olyset NMCP 2011 available in households by the number of Olyset that should be present. The evaluation of utilization rate of the Olyset

distributed by NMCP in 2011 required knowledge of the number of Olyset actually in use in households. People who use them are those who reported having slept under ITNs the previous night of the survey. To calculate this rate, the number of respondents reported sleeping under NMCP Olyset 2011 the previous night was divided over the total number of respondents who reported having received it. A rate of usage over 80% was considered satisfactory. In a household, any net hung or not folded meant it has been used the previous night of the survey, and is supposed to be a net in use. The physical aspect of each net was evaluated. The number and size of the holes in the nets were recorded and classified. The holes and tears observed were classified as (I) small holes size (hole that would allow a thumb to pass through), (II) middle holes size (more than a hole as in (I) but not large enough to allow a hand to pass through), (III) large holes size (hole larger than the fist).

Survey

The survey was conducted 6 months after the campaign in Ouémé department in January, 2012 during the dry season. It is a cross-sectional study based on quantitative and qualitative questionnaire. The quantitative questionnaire had targeted to 1,600 individuals, in particular adult male and female heads of households (family unit). The respondents' consent was sought and gained by explaining the aims of the study. The questionnaire was administered to them by trained interviewers. The questionnaire focused on the knowledge, attitudes and practices of respondents on the quality of the implementation of LLINs and their use. Individuals who could not read or write or understand French language were interviewed in the local language of the Ouémé region. Direct observations on the field allowed us to record the types of nets used by communities in the four districts, their setting, their use and their state after six months of use in order to assess the physical durability of these nets. The information gained was recorded on a form. Surveyors identified, counted and examined each type of nets that were found during the investigation. The purpose of the sociological survey is to assess the state of the nets in terms of both efficiency and utilization, and to assess the sustainability of the nets sampled.

Mosquitoes

The susceptible strain "Kisumu" of *A. gambiae* originated from Kenya and bred in the insectary of the Entomological Research Centre of Cotonou (CREC) was used for the bioassays. A local population of *A. gambiae* collected as larvae and raised to adulthood in the insectary was also used.

WHO cone bioassay

Twenty nets (10 Olyset distributed in July, 2011 and 10 Permanets which are in use for 1 to 2 years: 2009 to 2010) from the study area were randomly selected and submitted to the efficacy test (cone test) to verify the presence of insecticide residues on the fibers. Four other nets (2 new untreated nets, 1 unused Olyset, 1 unused permanent) were also tested and used as negative and positive controls. Olyset nets were treated with 2% permethrin while permanent nets contained 55 mg active ingredient of deltamethrin per m². Cone tests were performed according to the WHO protocol (WHO, 2005). Cones were placed on different sides of LLINs test: 5 to 10 young females aged 2 to 5 days of *A. gambiae* Kisumu and wild *A. gambiae* were introduced into each cone. Mosquitoes were in contact with the different sides for 3 min, then were removed using an aspirator. Once transferred in sterile cups, they were provided with sugar solution (sugar solution to 10%) and

maintained at 27 ± 2°C with a relative humidity of 80 ± 10% for 24 h to assess delayed mortality. After 24 h, the mortality rates were determined for each strain of mosquitoes. Abbott (1975) was not used in this study for the correction of mortality rates in the cone test because the mortality rates in all controls was always less than 5%. Survivors and dead specimens from field bioassays were kept in different Eppendorf tubes and passed polymerase chain reaction (PCR) to find the different mechanisms involved in the resistance to insecticides.

Knock down resistance (*kdr*) diagnostic

DNA was extracted from *A. gambiae* Kisumu and wild *A. gambiae* mosquitoes (survivors and dead from the cone tests) and was used to genotype samples for the *kdr* "Leu-phe" allele, using the PCR-based method of Martinez-Torres et al. (1998).

Data processing and analysis

Data obtained from the survey were checked and recorded using Epi Info version 6 and Microsoft Office Excel 2007 for Windows. Simple descriptive statistics such as frequency and percentage of variables were computed and cross-tables were performed using R software version 2.11.1. A chi-square test for the comparison of proportions was performed to compare the proportions of each variable related to each region. Summary procedure base packages of this software were used to perform the frequency distribution of *kdr* mutations. Then the Fisher's exact test was used to compare allele frequencies of *kdr* mutations in the dead and the survivors. The same test was used to compare mortality rates observed for the different genotypes. The level of significance was 0.05.

Ethical clearance

This paper used data from the Ouémé post mosquito net free distribution campaign survey conducted on the behalf the National Malaria Control Program. Because this was part of the programmatic activity, ethical clearance was exempted. Informed consent was obtained from each participant.

RESULT

Nature of nets recorded

During our survey in the four districts, various kinds of nets were found. The majority of LLIN recorded were Olyset distributed in July, 2011 by the NMCP (59.3%: 998 Olyset from a total of 1682 registered) (Table 1) and 2% of other Olyset. LLINs like PermaNet (20.9%) and some unidentified but treated nets (17.8%) were also found. In the district of Sèmè, the distribution rate of Olyset NMCP reported is low: 15.6% against 29.6% in Adjohoun, 26.1% in Dangbo and 28.5% in Missérété district (Table 1).

Household LLIN coverage and use

Table 1 shows the coverage rate of Olyset distributed in July, 2011 in the four districts. In total, 1,996 Olyset

Table 1. Frequency of types of mosquito nets, coverage rate and use rate of Olyset NMCP mosquito nets in some districts from Ouémé department, Benin, in January, 2012.

Districts	Boroughs	Olyset NMCP (I)	Other Olyset	Permanet	Other nets	Total	People visited	Coverage rate of Olyset NMCP			Use rate of Olyset NMCP		
								Olyset NMCP which should be distributed (I × 2)	Coverage rate (%) (95% CI)	Coverage rate (%)/district	Olyset NMCP used	Use rate (%) (95% CI)	Use rate (%)/district
Adjohoun	Adjohoun	198	1	32	25	256	568	396	69.7 [66, 73]	70.1	184	92.9 [89, 96]	84.1
	Deme	98	7	42	26	173	276	196	71.0 [65, 76]		65	66.3 [57, 75]	
Dangbo	Dangbo Centre	96	5	59	16	176	499	192	38.5 [34, 42]	47.9	84	87.5 [81, 94]	87.4
	Kessounou	165	3	31	35	234	590	330	55.9 [52, 60]		144	87.3 [82, 92]	
Misserete	Katagon	88	0	38	21	147	405	176	43.5 [39, 48]	60.9	70	79.6 [71, 87]	69.8
	Misséréte	197	0	25	20	242	531	394	74.2 [70, 77]		129	65.5 [58, 72]	
Seme	Djregbe	59	17	25	120	221	497	118	23.7 [20, 27]	29.6	55	93.2 [87, 99]	89.7
	Agblangandan	97	0	99	37	233	558	194	34.8 [31, 38]		85	87.6 [81, 94]	
Total		998 (59.3%)	33 (2%)	351 (20.9%)	300 (17.8%)	1682	3924	1996	50.9 [49, 52]	-	816	81.8 [79, 84]	-

CI: Confidence interval.

should be distributed to 3,924 people (children and adults). Thus, 50.9% of this population has received the new Olyset meaning 1 Olyset for 1.9 person. In Adjohoun and Misséréte districts, the rate was higher, respectively, 70.1% (1 Olyset for 1.4 person) and 60.9% (1 Olyset for 1.6 person). However, the coverage rate was low in Dangbo district (47.9%: 1 Olyset for 2.1 persons) and very low in Sèmè (29.6%: 1 Olyset for 3.4 persons). But in these two latter districts, if we took into account the other nets available before the distribution campaign in July, 2011, the coverage would be improved: 1 Olyset for 1.2 person in Sèmè (86.1%) and 1 Olyset for 1.3 person in Dangbo (75.3%). Among 998 Olyset distributed, 816 were regularly used. The usage rate was 81.8% (Table 1). This rate was high in all localities visited except Misséréte where it was less than 80% (Table 1).

Households LLIN position and location

In Adjohoun, Dangbo and Sèmè districts, more than 82% of Olyset NMCP received by the populations were in use. But at Misséréte, the percentage of Olyset in use was lower (below 70%) (Table 2); 92.4% of the Olysets NMCP not in use were stored. Overall, in all 4 districts, 81.7% of Permanets and other types of Olyset were in use.

Wear on Olyset after 6 months of use

After six months of use, 14% of Olyset NMCP were found with tears and holes (Table 3). The frequency of mosquito holes varied from one district to another: 4.9% in Misséréte, 10.8% in

Adjohoun, 18.6% in Sèmè and 24.5% in Dangbo (Table 3). Of the 139 Olyset found with holes, 557 holes were recorded, averaging 4 holes per Olyset. The holes of size I, II and III represent, respectively 27.1, 41.3 and 31.6% of all the holes. In Adjohoun and Misséréte districts, holes size II were the most recorded, respectively 55.2 and 75.5% (Figure 2). In both districts, there was a significant difference between the frequency of these holes and the holes of size I and III ($p < 0.05$).

In Sèmè, the frequency of holes size III (47.2%) on the Olyset NMCP was significantly higher than the holes size II (33.3%) and size I (19.5%) ($p < 0.05$). But in Dangbo, frequencies of holes size I (37.5%) and size III (34.4%) were almost the same ($p > 0.05$) and were significantly higher compared to the frequency holes size II ($p < 0.05$) (Figure 2).

Table 2. Position and place of mosquito nets in households at some districts in the department of Ouémé, Benin, in January, 2012.

Types of nets	Localities	Position of LLINs		Place of LLINs		
		suspended		unsuspended		
		N	% (CI 95%)	Suitcase	On rope	Total
Olyset NMCP	Adjohoun	245	82.8 [78, 87]	47	4	51
	Dangbo	225	86.5 [82, 90]	32	3	35
	Missérété	194	68.1 [62, 74]	86	5	91
	Sèmè	137	87.8 [82, 93]	16	3	19
Other Olyset	Adjohoun	8	100 [63, 100]	0	0	0
	Dangbo	8	100 [63, 100]	0	0	0
	Missérété	0	0	0	0	0
	Sèmè	14	82.4 [57, 96]	3	0	3
Permanet	Adjohoun	59	79.7 [69, 88]	13	2	15
	Dangbo	81	90 [82, 95]	9	0	9
	Missérété	50	79.4 [67, 89]	12	1	13
	Sèmè	107	86.3 [79, 92]	17	0	17
Other nets	Adjohoun	47	92.2 [81, 98]	2	2	4
	Dangbo	48	94.1 [84, 99]	3	0	3
	Missérété	25	61.0 [45, 76]	16	0	16
	Sèmè	125	79.6 [73, 86]	30	2	32
Total		1373	81.7 [80, 84]	286 (92.9%)	22 (07.1%)	308

N: number; CI: Confidence interval.

Effectiveness of Olyset after 6 months of use

More than 400 specimens of *A. gambiae* Kisumu (susceptible reference strain) were exposed to Olyset after 6 months of use. Most Olyset tested were effective. However, one of them (1/10) gave a mortality rate less than 80%, the threshold of bio-efficacy of ITNs on susceptible mosquito strains (Figure 3). However, for the other types of nets that were in use for more than 6 months, especially mosquito nets of type Permanet 2.0, the mortality rates of *A. gambiae* Kisumu were below 65.1% (Figure 3). With the resistant population (local *A. gambiae*), there was a remarkable decline in the effectiveness of two types of nets (Olyset NMCP and Permanet). The mortality rate recorded was between 0 and 36.4% for Olyset after 6 months of use (Figure 3), and between 0 and 11.8%, with Permanets in use for 2 years (Figure 3).

Kdr genotyping

The allele frequency of the *kdr* mutation in 154 individuals (26 dead and 128 alive) from the tested population was 90.3%. Moreover, the allele frequency of the *kdr* mutation in *A. gambiae* Kisumu was 0%. The *kdr* frequencies in dead and alive mosquitoes were, respectively 94 and 89.5%. No significant difference in allele frequency of this

mutation was observed between dead mosquitoes and those alive ($p = 0.5$) (Table 4). As the *kdr* mutation is partially recessive, we compared the mortality rates observed in individuals with genotype RS with those observed in individuals with genotype RR. The mortality rate of mosquitoes RS genotype was 10%, and 17.7% for RR genotype. These rates were not significantly different ($p = 0.5$) (Table 5).

DISCUSSION

The large-scale introduction of LLINs has become a priority for malaria prevention. Access to universal coverage of LLINs and proper use of these nets are a challenge for an effective control against malaria in sub-Saharan Africa. Many African countries are already investing in the free distribution of mosquito nets. Actually, the overall coverage is below the WHO target to reach at least 80% of people at risk or suffering from malaria (WHO, 2008). According to a study by the UNDP (United Nations, 2009), the success in achieving the objective of the sixth MDGs (Objective of the Millennium Development Goals) and other global targets for malaria depends on public awareness about the value of human health, the use of treated mosquito nets and the provision of effective access to nets.

Table 3. Frequency of damaged mosquito nets in districts from the Ouémé department, Benin, in January 2012.

Localities and types of nets	Total nets	No. of damaged nets	Frequency of damaged nets (%) (95% CI)
Adjohoun			
Olyset NMCP	296	32	10.8 [7, 14]
Other Olyset	8	5	62.5 [29, 96]
Permanet	74	18	24.3 [15, 34]
Other nets	51	21	41.2 [28, 55]
Dangbo			
Olyset NMCP	261	64	24.5 [19, 30]
Other Olyset	8	4	50 [15, 85]
Permanet	90	31	34.4 [25, 44]
Other nets	51	18	35.3 [22, 48]
Misserete			
Olyset NMCP	285	14	4.9 [2, 7]
Other Olyset	0	0	-
Permanet	63	17	27 [16, 38]
Other nets	41	6	14.6 [4, 25]
Seme			
Olyset NMCP	156	29	18.6 [12, 25]
Other Olyset	17	5	29.4 [8, 51]
Permanet	124	59	47.6 [39, 56]
Other nets	157	62	39.5 [32, 47]

N: number CI: Confidence interval.

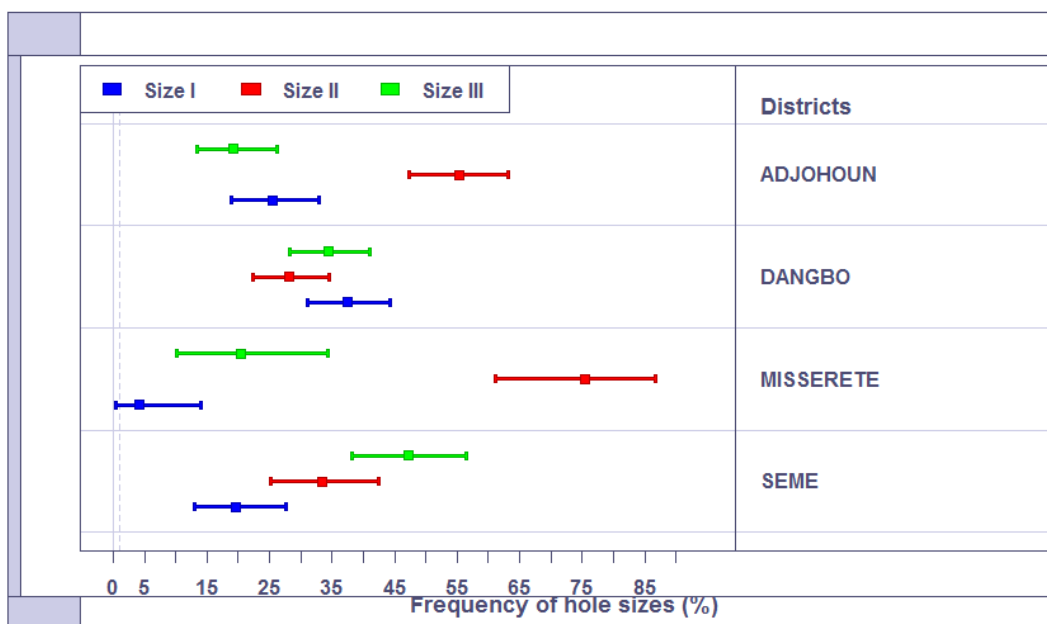


Figure 2. Frequency of hole types on the Olysets NMCP mosquito nets in some districts at the department of Ouémé, Benin, in January, 2012.

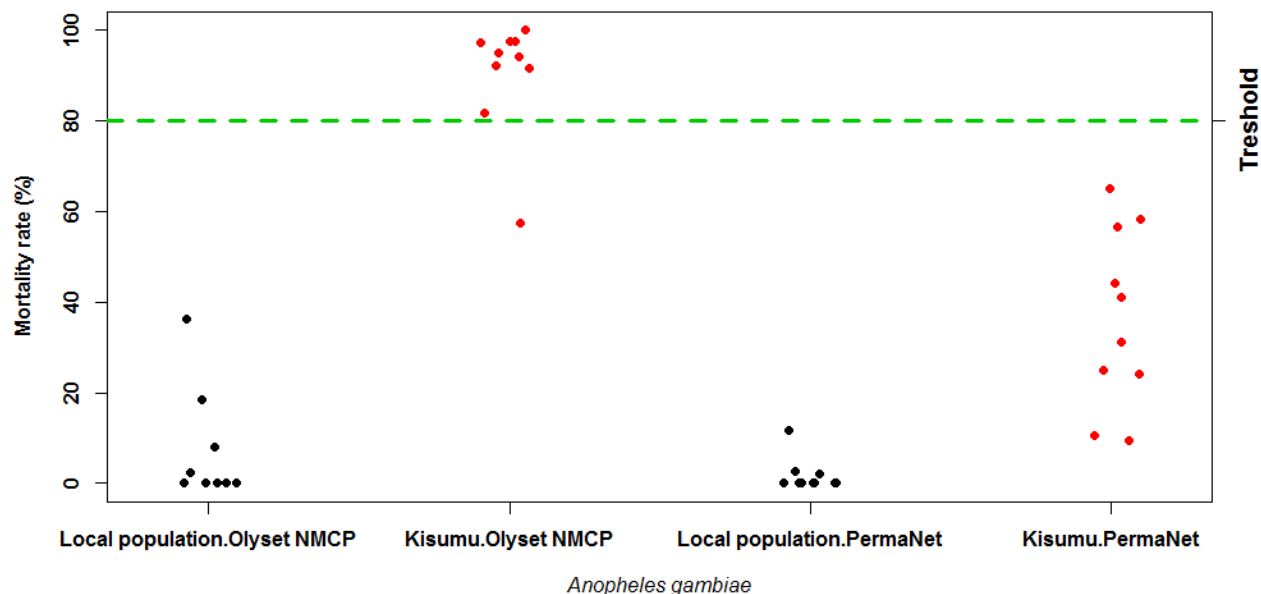


Figure 3. Mortality rate of *Anopheles gambiae* Kisumu (susceptible strain) and local population (resistant strain) observed 24 hours after a 3 min- exposure to Olyset NMCP and PermaNet nets withdrawn from the study areas.

Table 4. Allele frequencies of the *kdr* mutation observed in *A. gambiae* after exposure to Olyset mosquito nets in the department of Ouémé, Benin, in January 2012.

Status of mosquitoes	<i>Kdr</i> mutation					p
	Total	RR	RS	SS	Frequency (%)	
Kisumu (susceptible strain)	25	0	0	25	0	
Survivors	129	102	27	0	89.5	0.5
Dead	25	22	3	0	94.0	
Total	154	124	30	0	90.1	

Table 5. Mortality rate of *A. gambiae* exposed to Olyset mosquito nets according to genotypes for the *kdr* mutation in the department of Ouémé, Benin, in January, 2012.

Genotype	N tested	N dead	Mortality rate (%)	p
RR	124	22	17.7	0.5
RS	30	3	10.0	

This survey showed that the Olyset LLIN average coverage in the department of Ouémé in 2011 is generally good with a rate of 50.9% (one Olyset for 1.9 person), which corresponds to the expectations of the NMCP. But, the Olyset coverage rate was especially low in Dangbo (1 Olyset for 2.1 persons) and very low in Sèmè (1 Olyset for 3.4 persons). In 2001, before the national campaign distribution of LLINs in southern

Benin, only 4.3% of homes owned an ITN and 2.4% of children under 5 were sleeping under insecticide treated nets (Kinde-Gazard et al., 2004). The significant increase in coverage after the distribution of LLINs campaigns is quite logical and has been previously recognized (Skarbinski et al., 2007; Thwing et al., 2008; Matovu et al., 2009). However, the coverage rate obtained is lower than those observed in households in Kenya (68%),

Niger (70%) and Mali (81%) after the national campaign distribution (Cervinkas et al., 2008; Thwing et al., 2008; Hightower et al., 2010).

The use of Olyset in turn is better in the whole population (81.8%) except Missérété, where the Olyset use is lower than 80% (74%). This high use of LLINs observed among populations of the four districts during the dry season can be explained by the presence of permanent breeding spots and swamps in those areas, causing a permanent nuisance of Culicidae. These rates are higher than those recorded by Ahorlu et al. (1997) and Toe et al. (2009) in previous studies in West Africa during the same period (dry season). Indeed, these studies that were conducted in Ghana and Burkina Faso showed that people were less motivated to use the nets during the dry season with high temperatures at night.

The physical barrier provided by LLINs is very important. It is the first factor of personal protection against mosquito bites and we must ensure that they retain this physical integrity. Adjohoun, Dangbo and Sèmè showed that more than 10% of Olyset were torn after only 6 months of use, so there is an accelerated degradation of nets fiber. The degradation was increased in areas where lake water is permanently available (Adjohoun, Dangbo and Sèmè). The proximity with water and high anopheline densities are some of the reasons of the extensive use of nets and their regular washing. LLINs fibers were thereby weakened and this reduces their durability, besides insecticide concentration. Indeed, when children urinate or oil stains nets, these nets were systematically washed. On the other hand, in some communities, another factor contributing to accelerate the degradation of LLINs are the types of beds (the racks) and the use of burning lamps. The degradation is less pronounced in Missérété. Indeed, in this locality, nets sustained less pressure due to the lower use rate in comparison with the other districts.

In a sociological study conducted in 2005 in the framework of Pal + program, residents of Kétonou, a district of high nuisance of mosquitoes like Dangbo and Sèmè located along lake Nokoué, said that in their area, people “eat and sleep” in nets. If this statement is true, it shows the frequent contact that might exist between man and mosquito net in some environments. The results of the sociological survey at that time showed more than 95% of the population regularly used their nets. Additional nets were also available for visitors.

The percentage of holed LLINs and the size of their holes vary from one district to another. The presence of large holes constitutes a big problem because according to Hill et al. (2006), once LLINs are holed, they lose their protection. But to reinforce the effectiveness of holed LLINs and to increase their lifetime, we suggest to provide repair kits to communities to repair nets with large holes. Preliminary works showed that ITNs were effective even if they were holed. Nowadays, due to the high level of resistance of mosquitoes to insecticides,

these data must be updated.

In our study area, the acceptability of LLINs is good. The majority of LLINs distributed by the NMCP were found hung in households. The LLINs which were not found hung were stored or given to other family members. A similar situation was also observed in Niger (Thwing et al., 2008). The results obtained in this study show a low efficacy of Olyset against wild population of *A. gambiae*. As a matter of fact, the mortality rates observed after exposure specimens of wild *A. gambiae* to Olyset were very low, confirming the resistance of these mosquitoes to pyrethroids previously reported by several authors (Akogbéto and Yacoubou, 1999; Etang et al., 2003; Corbel et al., 2007; Yadouléon et al., 2010). These low mortality rates are due to the fact that pyrethroids affect sodium channel and vectors carrying the *kdr* mutation. This target is changed and the insecticide is no longer the channel's specific receptor and therefore cannot act. However, the dead mosquitoes were nevertheless recorded among the individuals carrying the *kdr* mutation, indicating that this is probably not the only part of the *kdr* mutation that determines the resistance of vectors (Padonou et al., 2012). It was shown that other mechanisms, including enzymatic mechanisms were involved in this resistance (Djouaka et al., 2008; Yewhalaw et al., 2011).

In population genetics, a phenotype is expressed by the combination of genotypes, environment and gene interactions. These gene interactions are important as they affect the fitness of individuals. The fact of being the bearer of the resistance allele is not the only parameter for the survival of the individual in an environment under insecticide treatment. Furthermore, it is important to note that a gene mutation also causes it to be advantageous genetic burden for the population considered. The resistance of malaria vectors to pyrethroids is a potential threat to the success of vector control using this tool. The mechanisms involved in this resistance appear to be complex and finer investigations on this subject are desirable. As part of these investigations, it is imperative to also take into account gene interactions, genetic burden is relatively difficult to quantify. If this decrease in efficacy was related to the resistance, it also is possible that the demand of LLINs in the tropics cause a decrease of rigor of the production control of these LLINs before leaving industries. In addition, some sampled nets stay long in health facilities in inadequate conditions before being used. During this long period, it is possible that the active ingredient in the insecticide content lost some of its effectiveness.

Permanets inefficacy, one to two years after their use, may be due not only to their usage time but also to some wash soaps used by recipients. In fact, the majority of Permanets removed (9/10) were washed with detergents (Kogui and Klin) since their acquisition. However, previous studies showed that some washing soaps have a negative impact on the effectiveness of insecticide-

treated nets (Azondékon and Vigninou, unpublished).

The results of this study relativize the idea of the concept of "long-lasting" of nets under field conditions. Indeed, a perforation rate (14%) of Olyset after only 6 months of use was not low. One wonders if it is the material used in the manufacture of the net that is in question, or the early perforations are due to a lack of care and maintenance in households. Nets were distributed free of charge to people regularly and could be considered as a vulgar tool and lose their value. The rapid wear associated with low efficacy raises the problem of the choice of materials impregnated in a context of high vector resistance to insecticides. Each year, we propose a new formulation of insecticide solution to control resistant mosquitoes or a new type of ITN with longer duration of action. But on the field, new tools behave as much the same way as the previous tools.

Conclusion

Overall, access to universal coverage based on one Olyset for two people during the distribution of LLINs in July, 2011 was reached in the department of Ouémé. Taking into account other nets rather than Olyset, this access is exceeded. However, in Sèmè and Dangbo districts, Olyset NMCP coverage is below the level expected. It is interesting that the NMCP reviewed its strategy of distributing nets to bring all districts towards universal coverage. The results show a decrease in efficacy of Olyset towards the local mosquito populations after only 6 months of use. The concept of LLINs as defined by the designers fails to take into account current status of mosquito resistance to insecticides and the various pressures that may undergo the routine use of nets in communities. Today, LLINs are freely given to the public in many countries. This gratuity certainly improves their possession but does not guarantee effective home use. It is the awareness and involving of the social human potential that can yield results beyond our expectations and induce the perpetuation of the use of mosquito nets at the community level.

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Full Length Research Paper

Improving food safety in Asia through increased capacity in ecohealth

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Interest has increased considerably in the last five years in transdisciplinary approaches to addressing the precipitating factors of emerging infectious and zoonotic diseases. During this time, several One Health and ecohealth initiatives have begun in Asia. This paper reports on recommendations coming out of one such initiative (the Building Ecohealth Capacity in Asia project) and outlines a strategy for promoting an ecohealth approach in research and in practice relevant to prioritized concerns relating to reducing zoonotic disease in Asia. The three main aspects of the strategy that are presented and discussed include: (1) Promote transdisciplinary approaches to understanding the complexity of zoonotic disease that compromise food safety; (2) increase teaching and application of ecohealth in medical sciences and other subjects relevant to food safety; and (3) bring ecohealth and One Health approaches into health policy discussions, particularly where these discussions influence policy formulation. Main constraints to applying such a strategy include limited awareness and knowledge of ecohealth and One Health, lack of willingness to engage in a transdisciplinary setting, restricted capacity to change academic curricula, rigid institutional frameworks for problem solving, and availability of funding. Suggestions for reducing these constraints are addressed.

Key words: Ecohealth, one health, food safety, zoonoses, medical education, Asia.

INTRODUCTION

Considerable interest has been generated in the last decade in transdisciplinary approaches (crossing of disciplines to generate a holistic approach) to address the precipitating factors of emerging infectious and zoonotic diseases (Charron, 2012; Hall et al., 2011). This has been punctuated by a rapid growth of interest in One

Health and related philosophies, formation of several One Health and ecohealth (Ecohealth is the participatory transdisciplinary approach to understanding and promoting health, including social-ecological interactions, in the context of complexity of the interactions of animals, humans, and the environment) initiatives in Asia,

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development of related networks, launching of workshops, and creation of centres of excellence. Most, if not all of these networks and collaborations recognize that a joint approach to preventing and responding to zoonotic disease requires improved communication, sharing of knowledge and resources, agreement to work together, and building capacity in skills and institutional response to hazards and outbreaks.

Many of the hazards addressed by these One Health and ecohealth initiatives are linked to food safety issues. For example, microbial contamination of livestock products, socio-economic factors related to marketplace structure and producer involvement in participatory surveillance programs. This paper offers suggestions for the role of ecohealth in improving food safety in Asia, based on discussions and other activities that have taken place within the framework of one of the new ecohealth initiatives in the region, the Building Ecohealth Capacity in Asia (BECA) project. The BECA project, funded by the International Development Research Centre (IDRC) and AusAID, aims to build capacity for ecohealth research and application through partnering with six Asian countries (Cambodia, PR China, Indonesia, Lao PDR, Thailand, and Vietnam). International trade in food products, both imports and exports, will be an increasingly important element of Asian economies over the next decade (Hertel et al., 2007); building capacity in ecohealth will support this growth while contributing to national and regional ability to develop and comply with food safety standards of local, regional, and international stakeholders, improving food safety for Asian consumers.

MATERIALS AND METHODS

Workshops and discussions

One of the main sources of motivation for the recommendations in this paper is observation by the author during a series of workshops held by the BECA project from 2010 to 2012 as part of training in ecohealth. The ongoing workshops are designed to increase knowledge in ecohealth and to generate interest in applying ecohealth to local problems. Presentations from regional participants emphasize application of principals to solving problems that may engage participants in their respective agencies and countries. Three workshops have been conducted (Fundamentals of Ecohealth, Research Issues in Ecohealth, and Ecohealth Influencing Policy) and the general stream of discussion during these workshops added to some of the basis of this paper. More than 100 participants have attended the workshops, and several participants have attended more than once. Discussions during workshops have been stimulated by task oriented problem solving and break-out sessions, usually directed at applying some component of an ecohealth approach to a particular health problem. It is worth noting at this point the five pillars of ecohealth: (i) transdisciplinarity; (ii) gender and socioeconomic equity; (iii) engaging in a participatory process; (iv) recognition of complexity; and (v) sustainability (Lebel, 2003).

Questionnaire and follow-up

Questionnaires handed out to workshop participants were also used to gather data regarding views on the general usefulness of the ecohealth approach, expected application, consideration of working with other health and related disciplines other than one's own, and demographic data. At each of the first two workshops, 35 questionnaires were returned anonymously. Participants were free to provide open comments. Follow-up with key participants was also conducted on an email or personal communication basis to solicit opinions regarding the potential applications of an ecohealth approach. These data and observations were valuable to developing some of the recommendations in this paper. As well, an evaluation of the impact of the training and information received by Vietnamese participants was conducted. The results of that evaluation were also used for this paper.

RESULTS

From questionnaire results gathered at the BECA Researchable Issues workshop, the three most important researchable ecohealth issues identified are: (i) prevention and control of emerging infectious diseases; (ii) zoonotic disease including food borne disease; and (iii) better understanding of the epidemiology of infectious diseases. All of these researchable issues have clear relevance to controlling food borne disease and to improving food safety in Asia. Nevertheless, if research and application in ecohealth in Asia is to be effective in improving food safety, a number of additional issues need to be addressed.

Institutions, complexity, and transdisciplinarity

A factor that complicates the application of an ecohealth approach to food safety management is the level of interaction that should occur within and between institutions. This will not be news to anyone who has worked with public health issues. It is not uncommon that a single major public health concern, food safety for example, is the charge of numerous agencies, ministries, academic institutions, and industry representations. Considering food safety, there are easily at least two ministries involved in each of the Asian countries in this study, and usually more (Table 1). The Government of Vietnam cites more than seven major ministries/directorates involved in food safety for example (ASEAN, 2006) while the Government of China reports ten (Government of PR China, 2011). Within each, there are again several agencies responsible for various tasks and duties related to food safety. This was the basis for a common observation and main complaint of participants; communication and knowledge sharing within and across institutions is difficult, sometimes seemingly impossible. Major reasons for this include: (i) lack of knowledge of

Table 1. Government agencies in six Asian countries with significant roles in food safety legislation and inspection.

Country	Agency	Ministry or Directorate
Cambodia	Department of Public Health, Department of Animal Health and Protection	Ministry of Health, Ministry of Agriculture, Forestry, and Fisheries
PR China	Institute of Food Safety Control and Inspection, State Food and Drug Administration of China Veterinary Bureau, Bureau for Agricultural Food Quality and Safety	Ministry of Health, State Council of PR China, Ministry of Agriculture, Ministry of Agriculture
Indonesia	National Agency of Drug And Food Control, Directorate of Veterinary Public Health, Directorate of Animal Health	Ministry of Health, Ministry of Agriculture, Ministry of Agriculture
Lao PDR*	Food and Drug Department, Department of Livestock and Fisheries, Lab of X	Ministry of Health, Ministry of Agriculture & Forestry
Thailand	Food and Drug Administration, National Bureau of Agriculture Commodities and Food Standards, Department of Livestock Development	Ministry of Public Health, Ministry of Agriculture and Cooperatives, Ministry of Agriculture and Cooperatives
Vietnam	Food Administration, Department of Animal Health	Ministry of Health, Ministry of Agriculture and Rural Development

*Not a WTO member, thus not signatory to the WTO SPS agreement, but developing a framework (April 27, 2011).

institutional structure; (ii) weak access to other agencies; (iii) the chain of authority hampers communication; and (iv) cultural barriers (for example, low respect for other disciplines) constrain willingness to communicate.

Part of the difficulty is unwillingness to admit a lack of knowledge, revealed during problem solving when one requests the assistance of an alternate discipline. But of course it is quite unreasonable to expect, for example, that a veterinarian would be expert in all matters related to toxicology, just as a physician cannot be expected to understand all the socio-economic reasons behind willingness to change behaviour. Food safety issues are no less complex than other ecohealth problems and require transdisciplinary approaches. This leads to the first recommendation of this paper in developing an ecohealth approach to food safety: food safety experts need to promote and accept transdisciplinary approaches to understanding the complexity of zoonotic diseases that compromise food safety. There are good examples where this is already happening to a degree, but there is still much work ahead to forge transdisciplinary working relationships.

Increased training and knowledge in ecohealth

A second major point (an expression of interest rather than a concern) was for increased knowledge and training in ecohealth and related topics. For each of the BECA workshops, there were up to four times the number of formal requests to participate than could be accommodated. Other ecohealth initiatives are experiencing a similar high level of interest in training in ecohealth. This is also the case with the many One

Health initiatives; at the recent 1st International One Health Conference, Melbourne, February 2011, there were more than 600 delegates, many of whom were attending a One Health or ecohealth related meeting for the first time. From a Southeast Asian perspective, One Health University Network in Southeast Asia has been initiated by USAID in May, 2011 and committed by 16 faculties of public health, medicine and veterinary medicine in four countries Indonesia, Malaysia, Thailand and Vietnam.

When the BECA project leaders consulted participants who represented academic or related Asian institutions involved in training health professionals, they learned that none were teaching a formal course in which understanding of ecohealth or One Health was part of the curriculum. Differences of opinion may exist on how this should be addressed, but if ecohealth is to be applied to food safety, there must be training beyond the introductory level. This would include extended field exercises, graduate education, training of field practitioners, research activities, and engagement with industry, government, and communities in solving real life problems. The response from participants as well as persons outside the project has been enthusiastic in terms of developing course and programme options for ecohealth courses (academic, industry training, research institutions, etc.) but of course the reality of bringing this to fruition is dependent on funding, leadership approval, and teaching capacity. One of the proposals that came out from different regional discussions was to gradually integrate ecohealth or One Health concepts and practices in the existing teaching modules that could be more easily accommodated, such as environmental health, epidemiology, nutrition, and food safety. This is the basis

for the second recommendation of this report: for ecohealth to contribute to improvements in food safety in Asia there needs to be increased teaching and application of ecohealth in medical sciences and other subjects relevant to food safety.

Incorporating ecohealth in the policy process

A third area of high need and concern relative to food safety in Asia is that of policy. From discussions with numerous stakeholders including BECA workshop participants, agency and ministry representatives, persons working in food industries, and academics, several general observations can be drawn. There is a false impression among many stakeholders that the process of policy formulation rests solely in the domain of government. When asked who is responsible for policy, most stakeholders will indicate some branch or agent of government, from local to national and regional levels. In fact, all stakeholders have a role to play in the policy process, from identification and agenda setting, to formulation and adoption, and implementation and evaluation. This is particularly true of engaging in dialogue with those who are executors or legislators of policy; they may not be government representatives, but they probably do hold some authority in governance (from community to provincial to national levels).

Comments from participants, questionnaire respondents, and results of semi-structured interviews indicate that even for those stakeholders who have better understanding of the policy process, there is a feeling that community members are somehow too far removed from the policy process to have opportunities for engagement. For an ecohealth approach to food safety to be of value, it is essential that stakeholders recognize the importance of engaging with the policy process, at all stages, at all opportunities, and with wide representation from community members (that is, usually the persons who ultimately are affected by policy).

The third recommendation of this paper is to bring ecohealth and One Health approaches into health policy discussions, particularly where these discussions have influence on the policy formulation stage of the process. Food safety policy formulation should be based on sound science-based decision making, but for this to have relevance input from members of the non-scientist community is equally important, particularly as it relates to preferences and choices.

DISCUSSION

The complexity of the issues surrounding food safety in Asia demands systems of prevention and control that

embrace a wide number of disciplines, are founded and applied by those with sound competence (knowledge, attitudes, skills, and awareness), and incorporate ecohealth in the policy process to support their effectiveness. These are broad-sweeping recommendations. They will require examination of the requirements and resources needed for change as well as the distribution of benefits, from the level of village communities up to international trading partners.

Of these proposed changes, the third may be the most neglected. The latter is important because of the strong influence preferences and choices (including willingness to examine and change their rankings) have on behaviour change. This is just as true for behaviour affecting food safety as it is for any other health issue in which policy can have an influence. For these recommendations to be considered regarding the role of ecohealth in improving food safety programmes in Asia, we must consider the constraints. It is not difficult to understand the value of transdisciplinarity, for example, but genuine engagement requires institutional investment and cultural change that may be constrained by rigid organizational communication policies, agency ideology, or simply mistaken perceptions of the value of the opinions of others.

With respect to applying these recommendations for the role of ecohealth in improving food safety in Asia, probably the most important constraint is limited acceptance for application of ecohealth to the many opportunities that exist. Following BECA workshop attendance, some participants have noted that while their community, supervisor, or institution may support ecohealth in concept, supervisors or directors are constrained from making this decision by the complicated and time consuming process of approval required from high levels of authority. Where it has been successful in application, transdisciplinarity has either benefitted from a starting point of previously existing good relations and communications between individuals across disciplines or agencies (for example, the Government of Vietnam-UN Joint Programme to Fight HPAI), or it has been the product of a long and carefully cultured relationship for the benefit of all stakeholders, such as the collaborative work in food safety between Thai ministries, industry, and producers (for a recent example of this collaboration see Bangkok Post, 2011).

To encourage transdisciplinarity, it may be helpful to start simply. For example, sharing knowledge with colleagues in other disciplines through programme briefs, including leaders or supervisors in post-training information sessions, or inviting ecohealth practitioners outside one's area of expertise to meetings to share experiences or approaches to food safety. The importance of including producers and industry in such activities should be emphasized. Discussions with

academic leaders indicate that main constraints to incorporating ecohealth education into a health science curriculum are usually based on funding or availability of knowledgeable instructors. Interest in ecohealth instruction is high and administrators seem willing to consider such changes, but unless the identified constraints are addressed this is unlikely to change soon. For this reason, workshops and related training programs may be of high value until regular programmes are established.

To increase engagement in the policy process, there must be existence and awareness of opportunity. For example, preparation and promotion of gatherings to discuss food safety related topics (for example, village discussions, town hall meetings) that will influence policy decisions complete with a plan for dissemination of meeting conclusions. Finally, ecohealth and One Health are now on the interest lists of donors and implementing agencies. It is timely to pressure donors to fund collaboration, transdisciplinary approaches to food safety, training in ecohealth, and dialogue with individuals and institutions influential in policy formulation.

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Full Length Research Paper

The effect of metformin on the lipid profile of women with polycystic ovary syndrome: A randomized controlled trial

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Polycystic ovary syndrome (PCOS) is one of the most common endocrinopathies affecting 4 to 7% of women in the reproductive age. The purpose of this study was to investigate the effects of metformin on the lipid profile of women with PCOS. This randomized controlled study was conducted in public and private obstetrics clinics in Sanandaj city, Northwest Iran. One hundred women with polycystic ovarian syndrome diagnosed by the Rotterdam criteria were enrolled in the study. Patients with premature ovarian failure, hyperprolactinemia, diabetes mellitus, thyroid disease, adrenal hyperplasia, and androgen-secreting tumors, were excluded. The patients were randomly divided into case (n=50) and control (n=50) groups. Metformin was prescribed for the case group for 6 months. The patients in the control group received tablet of pepper mint. Fasting insulin, cholesterol, triglycerides, low- and high-density lipoproteins (LDL and HDL) levels were checked 3 and 6 months after for all the participants. Data were analyzed using *t* and analysis of variance (ANOVA) tests. No statistically significant difference between the two groups was found before and after intervention regarding the serum cholesterol, and triglycerid levels.

Key words: Lipid profile, metformin, polycystic ovary syndrome.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is one of the most common endocrinopathies affecting 4 to 7% of women in the reproductive age. PCOS manifests in variety of clinical presentations including hirsutism, irregular menstruation, anovulation, insulin resistance, obesity and infertility. Moreover, hyperandrogenemia, increased luteinizing hormone (LH), decreased follicle stimulating hormone (FSH) and sex hormone binding globulin (SHBG), and hyperinsulinemia are also observed in most cases (Knochenhauer et al., 1998; Asuncion et al., 2000; Banaszewska et al., 2006). Anovulation is a rife health issue with various clinical manifestations such as amenorrhea, irregular menstruation, and hirsutism

(Knochenhauer et al., 1998).

An elevated level of insulin due to insulin resistance is observed in 50 to 70% of patients with PCOS, which will lead to increased androgen levels. *In vitro* studies have proven the stimulatory effect of insulin on the production of androgen, estrogen, and progesterone (Knochenhauer et al., 1998). Increased insulin levels followed by hyperandrogenemia will lead to hypertension, glucose intolerance and dyslipidemia (Asuncion et al., 2000). Hyperandrogenemia and insulin resistance play the most important role in the pathology of lipid disorder (Onalan et al., 2005). Dyslipidemia is probably the most common metabolic disorder in patients with PCOS (Banaszewska

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et al., 2006).

Metformin is an oral biguanide that inhibits hepatic gluconeogenesis and stimulates peripheral glucose uptake, reduces the production of fatty acids, and increases their oxidation. Metformin also enhances the sensitivity of skeletal muscles, reduces appetite, improves metabolic abnormalities leading to low androgen levels and improves and regulates ovarian function and menstrual cycles (Onalan et al., 2005). Various studies confirm the positive effect of metformin on most metabolic functions such as better blood glucose control, lipid profile improvement, and decrease in cystic inflammation (Yu Ng et al., 2001; Onalan et al., 2005; Banaszewska et al., 2006). Also, various clinical trials have examined the effects of metformin in women suffering from PCOS, in most of which the daily dose of metformin was 1500 to 2000 mg. These studies have indicated that treatment with metformin increases insulin sensitivity and reduce weight and body mass index (BMI), blood pressure, and cholesterol levels (Knochenhauer et al., 1998; Onalan et al., 2005).

The most common gastrointestinal side effects of metformin includes nausea and vomiting, bloating, diarrhea, loss of appetite, and metallic taste. However, these side effects will reduce or perish when the drug is taken with food (Moggetti et al., 2000). There is still controversy regarding the effects of metformin. Some studies have shown decreased cholesterol, low-density lipoprotein (LDL) and triglycerides levels following metformin consumption (Knochenhauer et al., 1998; Onalan et al., 2005), while other researchers reported no significant change in the lipid profile (Asuncion et al., 2000). Several other findings have also shown that metformin reduces triglycerides, but has no effect on cholesterol (Knochenhauer et al., 1998).

The aim of the present study was to investigate the effect of metformin on the lipid profile of women with PCOS.

MATERIALS AND METHODS

This randomized controlled trial was performed on women with PCOS who referred to public or private obstetric clinics in Sanandaj, Northwest Iran. The protocol of the study was approved by the Ethics Committee of Kurdistan University of Medical Sciences. The patients were informed about the aim and objectives of the study and written informed consent was obtained from them. Demographic data including age, educational level, weight, height, waist circumference, and blood pressure were also recorded.

PCOS was diagnosed according to Rotterdam diagnostic criteria (Marc and Speroff, 2011). Therefore, women with at least two of the following signs: chronic anovulation, hirsutism, or characteristics of a polycystic ovary in abdominal ultrasonography were enrolled.

To exclude patients with premature ovarian failure (POF), hyperprolactinemia, diabetes mellitus, thyroid disease, adrenal hyperplasia, and androgen-secreting tumors, laboratory tests such as thyroid stimulating hormone (TSH), T4, LH, FSH, and 17-OH progesterone and prolactin test were requested. Based on the test results, five patients were excluded from the study. Moreover, laboratory tests such as fasting insulin, cholesterol, triglycerides,

low-density lipoprotein (LDL), and high-density lipoprotein (HDL) were also requested for all participants.

The calculated human was 50 for each group (95% confidence interval and $\alpha=5\%$). The case (study group) group received one tablet (500 mg) metformin (Sobhan company, Iran) per day at baseline, which was gradually increased to three tablets per day over the succeeding two weeks and continued for 6 months. For the control group during the same time tablet of pepper mint (Aysuda Company, Iran) was prescribed.

The study groups were advised to avoid consuming oral contraceptive pill (OCP), steroids, and any medication that could affect lipid metabolism during the period of study. They were also advised to continue their routine daily activities and nutrition but to avoid smoking and drinking alcohol. The fasting blood sugar (FBS), triglycerides, cholesterol, LDL, and HDL tests were requested for the participants 3 and 6 months after the start of the study. Data were analyzed using Statistical Package for Social Sciences (SPSS) software, version 16. Analysis of variance (ANOVA) and *t* tests were used. The significance level was set at $p<0/05$ (Figure 1).

RESULTS

Of the total 100 patients with PCOS who referred to the obstetric (OB) clinics in Sanandaj city during the mentioned period, 19 patients were excluded, because of not meeting the inclusion criteria (11), declined to participate (6) and other reasons (2). Forty-one were assigned to the case group and the remaining 40 patients were assigned to the control group. In the case group, 9 patients refused to continue taking the medication, because of side effects such as bloating and vomiting. In the control group, 14 patients were excluded, because of the unwillingness to collaborate, distance or pregnancy.

The mean age of the participants in the case and control groups was 21.6 ± 3.2 and 21.4 ± 3.8 years, respectively. The mean BMI and waist circumference were 27.3 ± 9.9 kg/m² and 77.2 ± 11.7 cm and 23.8 ± 5.5 kg/m² and 77.5 ± 10.9 cm in the case and control group, respectively. The *t* test showed no statistically significant difference between the two groups in this regard ($p=0.065$ and 0.5 , respectively) (Table 1). No significant difference was found between the two groups with respect to thyroid hormones, prolactin, 17-hydroxyprogesterone, LH, and FSH levels ($p<0.05$).

Before intervention, FBS levels were 84.7 and 79.9 mg/dl in the case and control groups, respectively. FBS levels were normal after 3 and 6 months in both groups, and metformin had not significantly reduced blood sugar (Table 2).

No significant difference was observed between pre- and post-treatment evaluation of cholesterol level in both groups. Regarding the triglyceride level, although 20% reduction was found in triglyceride levels after metformin consumption, no statistically significant difference was found between the groups (Table 2).

HDL levels were almost similar in both groups before and after intervention. Moreover, although the HDL level in the case group decreased after 6 months, no statistically significant difference between the two groups

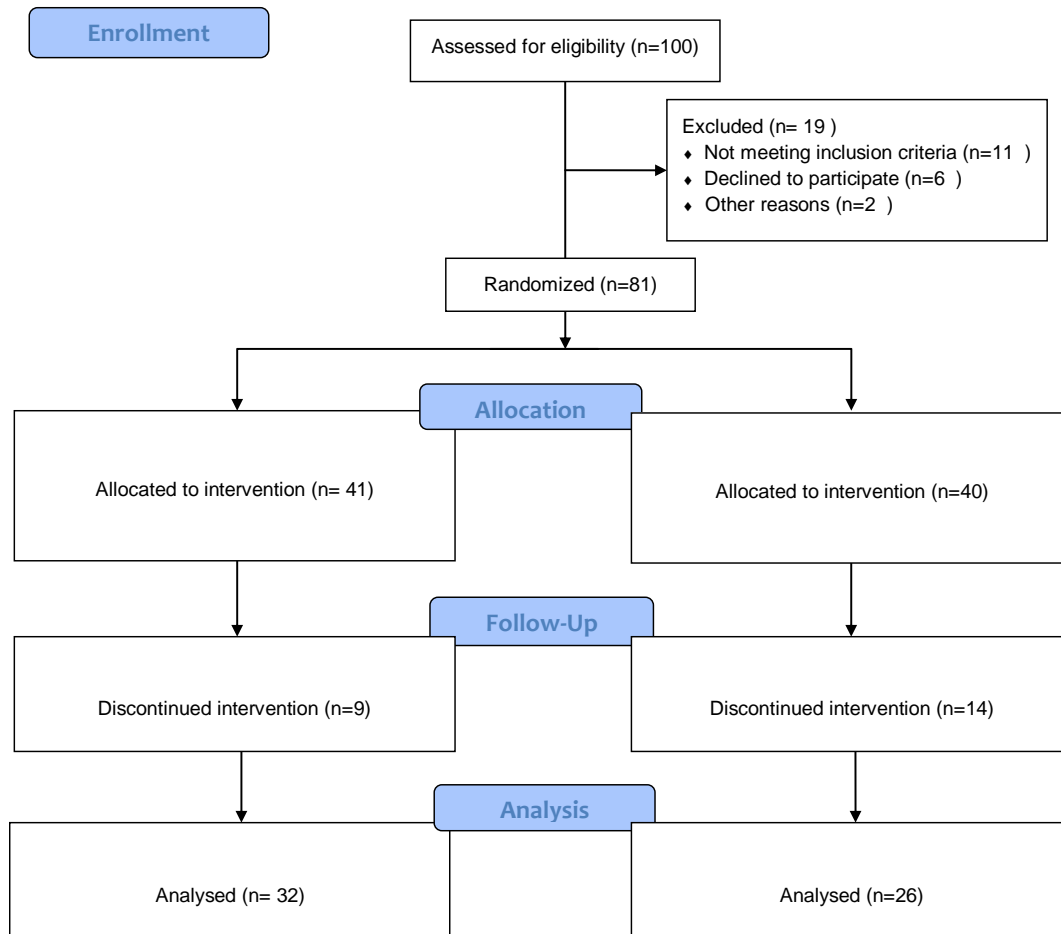


Figure 1. Flow chart of the study.

Table 1. Comparison of some variables between the case and control groups.

Variable	Group	df	Mean±SD	t- test	p value
Age	Case	79	21.6±3.2	0.25	0.8
	Control		21.4±3.8		
BMI	Case	79	27.3±9.9	1.9	0.065
	Control		23.8±5.5		
Waist circumference	Case	79	77.2±11.7	0.66	0.5
	Control		77.5±10.9		

LDL levels increased after six months in both groups. However, no statistically significant difference was found (Table 2). observed between the two groups before and after intervention ($p < 0.05$).

DISCUSSION

It was found that taking metformin compared with peppermint had no effect on the lipid profile of the

participants during our 6-month intervention. Cholesterol, LDL, HDL and triglyceride levels did change, but differences were not statistically significant. These results are consistent with some other studies (Luque-Ramirez et al., 2004; Kazerooni et al., 2010). Luque-Ramirez et al. (2004) in Brazil found that metformin had no effect on metabolic function and lipid profile. Also, Kazerooni et al. (2010) performed a study in Shiraz and found no significant change in blood sugar, insulin, cholesterol,

Table 2. Comparison of fasting blood sugar, cholesterol, triglycerides, and HDL levels between the case and control groups.

Variable		Group	df	Mean±SD	t- test	p value
Fasting blood sugar	Before intervention	Case	78	84.7±8.2	2.1	0.038
		Control		79.9±12.1		
	After 3 months	Case	54	73.9±12.7	-0.26	0.79
		Control		74.8±10.9		
	After 6 months	Case	54	72.5±8.1	-1.44	0.15
		Control		76.1±10.3		
Cholesterol	Before intervention	Case	78	157.1±27.1	-3.2	0.002
		Control		175.7±24.6		
	After 3 months	Case	54	153.7±30.8	-0.85	0.4
		Control		160.5±29.2		
	After 6 months	Case	54	155.6±27.2	-1.6	0.11
		Control		167.4±26.6		
Triglycerides	Before intervention	Case	78	117.3±49.8	0.67	0.5
		Control		110.6±35.8		
	After 3 months	Case	54	78.3±32.2	-1.5	0.14
		Control		91.9±37.1		
	After 6 months	Case	54	86.5±28.5	-1.2	0.22
		Control		97.6±38.8		
HDL	Before intervention	Case	78	43.8±4.5	-0.1	0.95
		Control		43.9±10.2		
	After 3 months	Case	54	41.2±6.3	-1.4	0.16
		Control		43.7±6.9		
	After 6 months	Case	54	40.1±5.1	-2.6	0.01
		Control		43.9±5.8		

HDL and triglycerides levels after one year treatment with metformin.

Several other studies have shown the effect of metformin on insulin reduction, sensitivity increase and lipid metabolism improvement (Banaszewska et al., 2006; Moghetti et al., 2000; Morin-Papunen et al., 2000; Onalan et al., 2005; Zheng et al., 2002).

In the aforementioned studies, metformin increased HDL and decreased LDL and triglycerides levels. In a study conducted by Banaszewska et al. (2006) in Poland, metformin consumption lowered triglyceride levels and increased HDL levels after 6 months in the group with high insulin levels. Onalan et al. (2005) performed a study on six different groups of women with PCOS and

different BMI and insulin levels in Turkey, and reported a decrease in triglycerides levels and increase in HDL levels, especially in slim women with high insulin levels who received metformin (Onalan et al., 2005).

The existing inconsistencies between this study and a number of other studies could be because of the difference in selecting women with PCOS. In earlier studies, patients were selected based on the 1990 definition of the National Institute of Health, and diagnostic criteria were based on clinical and para-clinical hyperandrogenism and oligo-ovulation. However, patient selection is currently based on the Rotterdam criteria. These criteria include both patients who suffer from oligo-ovulation presented with polycystic ovaries, without being

hirsute as well as hirsute women with regular menstruation affected by sonographically confirmed polycystic ovaries. Therefore, this variety in definitions leads to the inclusion of patients with no metabolic disorders or minor abnormalities. In this study, patients were selected based on the Rotterdam criteria. Therefore, women with metabolic disorders were excluded.

Metformin decreases hepatic glucose production and increases peripheral sensitivity to insulin. Studies have shown that obese patients and patients with hyperinsulinemia respond better to metformin. In Banaszewska et al. (2006) study, women suffering from hyperinsulinaemia were selected according to the NIH criteria. Consequently, metformin increased their HDL and decreased their LDL and triglyceride levels. Whereas in a similar study conducted by the same group in 2011 in which the Rotterdam criteria was used, metformin had no effect on the participants with normal fasting insulin levels (Banaszewska et al., 2011).

Aleyasin et al. (2011) also conducted a study on patients suffering from PCOS with different BMIs who received an increasing dose of daily metformin up to 3000 mg. They observed that metformin was effective only on patients with BMIs greater than 35 to 40 kg/m² and elevated fasting insulin levels. Therefore, the fact that metformin had no effect in our study can be because of normal BMI and fasting insulin levels in our participants.

The limited number of participants, unfeasibility of categorizing them based on different weight and different age ranges were the limitations in this study. Thus, broader studies with greater humans, different BMIs, and different age ranges are recommended.

In conclusion, treatment with metformin in women with PCOS does not change cholesterol, HDL, LDL and triglycerides levels during a 6-month period. Therefore, further studies are needed to evaluate the lipid profile in women with different BMIs and also the effects of metformin with different doses.

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Abbreviations:

PCOS, Polycystic ovary syndrome; **LDL**, low density lipoprotein; **HDL**, high density lipoprotein; **ANOVA**, analysis of variance;

LH, luteinizing hormone; **FSH**, follicle stimulating hormone; **SHBG**, sex hormone binding globulin; **BMI**, body mass index; **TSH**, thyroid stimulating hormone; **POF**, premature ovarian failure; **OCP**, oral contraceptive pill; **FBS**, fasting blood sugar; **OB**, obstetric; **NIH**, National Institute of Health.

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Full Length Research Paper

The effect of maternal body mass index on the delivery route in nulliparous women

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Body mass index (BMI) is widely used to categorize the degree of obesity and to guide recommendations for weight gain during pregnancy. To examine the relationship between the maternal body mass index of nulliparous women and the route of delivery in a sample of Iranian Kurdish women, a cross sectional descriptive study was conducted, at Beasat Hospital in Sanandaj, the capital of Kurdistan province, West of Iran. The study sample consisted of 980 nulliparous women with spontaneous labor. Results showed that there is a significant association between cesarean section and higher maternal BMI. The cesarean section rate rose from 30% in women with normal BMI to 56% in the women with BMI \geq 35. Overweight women should be given information about risk of cesarean section before conception and be encouraged to reduce their weight.

Key words: Body mass index, cesarean section, nulliparity.

INTRODUCTION

Body mass index (BMI) is used to measure obesity, and it is defined as the ratio of body weight in kilograms divided by the square height in meters (World Health Organization, 2000). BMI is widely used to categorize the degree of obesity and to guide recommendations for weight gain during pregnancy (Bell et al., 2011).

Obesity is an epidemic not only in developed countries but also in the developing world. Furthermore, obesity is becoming an increasingly common problem, both in general population and in women of the reproductive age (Catalano, 2007). There is a growing body of evidence suggesting that obese pregnant women are at greater risk of a number of maternal and fetal complications of pregnancy, including pre-eclampsia, cesarean section, intrauterine death (Cedergren, 2004; Dempsey et al., 2005), induction of labor, and anesthetic complications (Robinson et al., 2005). Heslehurst et al. (2007) conducted a systematic review to ascertain the impact of BMI on pregnancy outcomes. The results indicate that labor complications in heavier women may lead to

cesarean births.

Despite the abundance of research investigating pregnancy outcomes in obese women, no study has been done regarding this issue in Kurdish women. Therefore, this study aimed to examine the relationship between the maternal BMI of nulliparous women and the route of delivery in Sanandaj, Northwest Iran.

MATERIALS AND METHODS

This cross sectional study was conducted at Beasat Hospital in Sanandaj. 980 nulliparous women with a spontaneous labor were enrolled. Written informed consent was obtained from the participants.

Term primigravida women with a singleton fetus and cephalic presentation who were willing to participate were included. The exclusion criteria were pre- and post-term labor, fetal distress, and disproportion of the pelvis and head.

Maternal height and first-trimester weight, as written in the patients' medical records, were used to calculate BMI. It was calculated for each patient by using the formula kg/m^2 .

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Table 1. Maternal, fetal, and labor characteristics of the study population, with crude CD rate.

Variable	No.	%	Crude CD rate (%)
First-trimester BMI (kg/m²)			
<25	556	56.7	30.9
25-<30	317	23.3	36.0
30-<35	88	9.0	40.9
>35	19	1.9	56.9
Mean ±SD	24.7±4.06		
Maternal age			
<20	151	15.4	23.8
20-24	400	40.8	27.3
25-29	303	30.9	41.6
30-34	99	10.1	46.5
>35	27	2.8	59.3
Mean±SD	24.4±4.7		
Oxytocin			
No	477	48.7	36.9
Yes	503	51.3	31.2
Origin			
Rural	348	35.5	27.3
Urban	632	64.5	37.7

CD: Cesarean delivery.

The women were grouped into four categories with respect to their BMI: normal (<25), overweight (25-<30), obese (30-<35) and morbidly obese (≥35) (World Health Organization, 2000). Data regarding the patients' demographic and labor characteristics including maternal age, educational level, place of residence (urban versus rural), oxytocin induction of labor (yes/no), and mode of delivery (vaginal versus caesarean section) were obtained (Table 1).

Data were analyzed by Statistical Package for Social Sciences (SPSS) software, version 18. A P value<0.05 was considered as statistically significant. Descriptive analysis and multivariable regression was used to calculate odd ratios (OR) with 95% confidence intervals (CI).

RESULTS

The study sample consisted of 980 singleton pregnancies in nulliparous women. The mean age of the women was 24.4±4.7 years (range: 16 to 40 years). 632 (64.5%) women lived in urban area. 873 (80%) had a BMI<30. 88 (9%) women were obese, with a BMI between 30 and 35, and 19 (1.9%) women were morbidly obese with a BMI≥35.

Overall, 583 (59.5%) women had vaginal deliveries and 397 (40.5%) had unplanned cesarean births. A significant association between cesarean section and higher maternal BMI was found. The cesarean section rate rose

from 30% in women with a normal BMI to 56% in women with a BMI≥35 (Table 1). In the logistic regression model, the OR for all cases of cesarean delivery increased significantly from 1.0 to 3.1 (95% CI: 1.21 to 7.78) within the same two groups of women.

For 51.3% of the deliveries, oxytocin was used to induce labor. The cesarean section rate was 31.2% in the women with oxytocin induction; while in women whose labor was not induced with oxytocin, the cesarean section rate was 36.9% (p<0.05).

The rate of cesarean section also increased from 41.6% in women of 25 to 29 years of age to 59.3% in women >35 years of age (Table 1). In the logistic regression model, the OR for all cases of cesarean delivery increased significantly from 2.3 to 4.6 (95% CI: 1.98 to 10.9) within the same two groups of women.

It was found that an increase in BMI increased the risk of cesarean section for suspected fetal distress (SFD). The OR for fetal distress rate increased from 1.0 in women with a normal BMI to 3.18 in women with a BMI≥35. In the logistic regression model, the OR for SFD cesarean delivery increased but not significantly from 1.0 to 3.18 (95% CI: 1.0 to 10.0) within the same two groups (Table 2).

Furthermore, with respect to failure to progress in labor (FTP), the OR increased from 1.0 in women with a BMI

Table 2. Risk for cesarean delivery in total, due to suspected fetal distress or failure to progress in spontaneous labor, at term with a single cephalic presentation

Variable	CD due to FTP (n=980)		CD due to SFD (n=980)		CD in total (n=980)	
	95% CI	OR	95% CI	OR	95% CI	OR
First – trimester BMI (kg/m²)						
25	1.0	-	1.0	-	1.0	-
25-30	1.28	0.82-2	1.92	1.23-9	1.2	0.94-1.68
30-35	0.84	0.37-1.91	2.86	1.55-5.28	1.54	0.98-2.45
35	2.6	0.83-8.07	3.18	1.0-10.0	3.1	1.21-7.78**
Maternal age (years)						
20	1.0	-	1.0	-	1.0	-
20-25	1.02	0.55-1.86	1.6	0.65-4	1.2	0.78-1.86
25-30	0.83	0.43-1.59	5.4	2.52-12.76	2.3	1.47-3.53**
30-35	1.2	0.53-2.58	5.4	2.05-14.07	2.8	1.61-4.78**
35	0.68	0.15-3.12	4.2	1.1-16.0	4.6	1.98-10.9**
Origin						
Rural	1.0	-	1.0	-	1.0	-
Urban	0.98	0.64-1.50	3.28	1.92-5.6	1.6	1.2-2.14**
Oxytocin						
No	1.0	-	1.0	-	1.0	-
Yes	27.9	10.1-76.5	0.39	0.26-0.60	0.77	0.59-1.02

Odds ratios and 95% confidence intervals are mutually adjusted all variables in the model. BMI, Body mass index; CD, cesarean delivery; CI, confidence interval; FTP, failure to progress; OR, odds ratio; SD, standard deviation; SDF, suspected fetal distress.

normal to 2.6 in women with a BMI \geq 35. In the logistic regression model, the OR for FTP cesarean delivery increased even not significantly from 1.0 to 2.6 (95% CI: 0.83 to 8.07) within the same two groups (Table 2).

DISCUSSION

Obesity is an epidemic not only in developed countries but also in the developing world. Our findings suggest that an increased BMI is associated with an increased risk of perinatal complications, including cesarean section. These findings are consistent with other studies (Bergholt et al., 2007; Graves et al., 2006; Mantakas and Farrell, 2010; Kominiarek et al., 2010; Vahratian et al., 2004). Ehrenberg et al. (2004) showed that obesity exerts significant influence on the route of delivery.

In this investigation, the study was restricted the population to nulliparous woman at term to ensure a homogenous group as possible. The risk of cesarean section increased from 30.9% in women with BMI $<$ 25 to 56.9% in women with BMI \geq 35. This is consistent with a prior study including 6509 nulliparous women that showed that the cesarean section rate rose from 18.2% in women with a normal BMI (20 to 25) to 40.6% in the morbidly obese women (BMI $>$ 40) (Mantakas and Farrell, 2010).

The exact causes of the increased cesarean section rates amongst obese women could not be identified from the obtained data, and it was not possible to confirm exactly why obese women were experiencing more cesarean section. The increased cesarean section rate could be attributable to a variety of factors, including delay in the first stage of labor, unsuccessful induction of labor, fetal macrosomia, fetal distress, and the obstetrician's decision.

Vahratin et al. (2004) studied the impact of BMI on the outcome of pregnancy. They found that labor progression in overweight and obese women is slower than women with a normal weight. In our study, an increase in BMI significantly increased the risk of cesarean delivery in total cases but not for suspected fetal distress and failure to progress cases when analyzing them separately. According to Cnattingius et al. (1998), the presence of excess intra-abdominal adipose tissue itself could mechanically obstruct the progression of labor, contributing to a failure to progress. In addition, if progression of labor is mechanically obstructed, this could over time compromise fetoplacental circulation and cause fetal distress.

Zhang et al. (2007) found that the myometrium in obese women contracted with less force and frequency and had less Ca²⁺ flux that of women with a normal

weight. They concluded that obesity may impair the ability of the uterus to contract in labor. The exact mechanism of dysfunctional labor in obese women is not completely understood. Elevated cholesterol level has been shown to decrease uterine contractility, and obese women are more likely to have elevated cholesterol levels than women with a normal weight (Wray, 2007). This elevation in cholesterol may result in the higher incidence of dysfunctional labor in obese women and subsequent cesarean section.

In this study, the increased risk of cesarean section in obese women could also be a consequence of difficulty and lack of facilities for accurate monitoring of the progress of labor and fetal condition in our center. Without accurate monitoring of progression in labor, the risk of cesarean section may have increased. Moreover, the outcomes may have been influenced by differences in the decision-making processes leading to detected progress of labor and the monitoring of obese woman among different obstetricians.

Another contributing factor to the increased cesarean section rate was maternal age. Maternal age of more than 30 years was found to increase the chance of a cesarean delivery. Bergholt et al. (2007) also found an association between maternal age and cesarean delivery. According to Toro et al. (2002), the physiological mechanism resulting in efficient uterine action in nulliparous women could be affected by maternal age. This could be the result of increased incidence of anatomical age-related alteration in uterine contractility.

The most important finding of this study was the cesarean rate (41%) in 980 births in our center which is different from WHO standards and recommendations (2008). This finding confirms the importance of understanding the causes or contributing factors and presenting approaches for avoiding or reducing cesarean section. Studies show that obese and overweight women were more likely to be induced and required a cesarean section compared with women with a normal BMI (Athukorala et al., 2010; Demont-Heinrich et al., 2009; Kominiarek et al., 2010; Mantakas and Farrell, 2010; Park et al., 2011).

In contrast to another study, the findings of the present study showed that the rate of cesarean section was lower in the women whose labor was induced. This may be related to the obstetrician's decision for cesarean section before using oxytocin for induction.

One of the limitations of the study was the insufficient number of morbidly obese women (n=19) to analyze the effects of morbid obesity separately. Moreover, there is failure to collect reliable data on the indication for cesarean section. It would be valuable to explore how the indications for cesarean section in obese women compare with those of women with a normal weight.

In the present study, the authors found a correlation between the delivery route and increased BMI which could be important from a clinical point of view

concerning the management of vaginal deliveries among overweight, obese, and morbidly obese women. Therefore, overweight women should be given information about risk of cesarean section before conception and be encouraged to reduce their weight.

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Full Length Research Paper

Tobacco smoking and awareness of smoking-cessation products in a university community

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Cigarette smoking is one of the most significant preventable causes of death and illness in the world. The present study investigated tobacco smoking among patrons of joints in Amassoma, the host community of Niger Delta University. Participants' awareness of various smoking-cessation products was also explored. Participants in the cross-sectional survey were 261 patrons of "Joints" or pubs in Amassoma, who completed and returned the research questionnaire with usable data. Informed consent was implied by participants' voluntary completion and return of the research instrument. In terms of gender, 194 (74.3%) of the participants were males while 67 (25.7%) were females. Participants' mean age was 25.7 ± 4.8 . Age at smoking debut was 15.7 ± 7.6 years while age at regular smoking was 17.1 ± 8.3 . 136 (72%) of respondents had made attempts to quit smoking in the past, 152 (80.4%) found it difficult or impossible to quit smoking while 173 (91.5%) felt in need of help to quit smoking. Findings indicated further that 91.5% of respondents who smoked also use other psychoactive substances. Level of awareness of smoking cessation products was very low among participants. There is need to sensitise stakeholders (smokers, researchers, and policy makers, governmental and non-governmental organizations) to the inherent dangers in cigarette smoking, and also to the availability of various effective smoking cessation products and techniques. These could go a long way in reducing the high mortality and morbidity associated with continued smoking.

Key words: Tobacco smoking, smoking-cessation products, awareness, university community.

INTRODUCTION

Cigarette smoking is one of the most significant preventable causes of death and illness in the world. It accounts for some 400,000 deaths per year in the USA, approximately 100,000 in the UK and about 5 million worldwide (Herman and Sofuoglu, 2010; West, 2010; West and Shiffman, 2007). Smoking is a well known risk factor for the development of cardiovascular diseases,

chronic obstructive pulmonary disease, many forms of cancer, as well as major disabling conditions, such as dementia, blindness (macular degeneration), deafness, peripheral vascular disease (leading to amputations), stroke, premature death, etc. and therefore represents a major public health concern. It has been estimated that smoking may shorten life expectancy by 7 to 10 years.

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A quarter of smokers who fail to stop die an average of 20 years earlier than comparable non-smokers (West, 2010; West and Shiffman, 2007).

Currently, there is a dearth of empirical data on tobacco-attributable morbidity and mortality in Nigeria. However, the scanty epidemiological statistics on smoking are inconsistent and conflicting, but nevertheless alarming. For instance, while Salawu et al. (2009) reported a prevalence rate (current smokers) of 33.9% in Northeast Nigeria, and Obot (1990) reported a prevalence rate of 22.6% in a sample of 1,271 Nigerians, other researchers have found relatively lower prevalence rates. Odey et al. (2012) reported a prevalence rate of 6.4% among adolescents in Calabar, Southeastern Nigeria. Fawibe and Shittu (2011) reported a prevalence rate of 5.7% in Ilorin, North central Nigeria. In a national survey, smoking prevalence rates ranging 4.7% in Ibadan (Southwestern Nigeria) to 16.7% in Kano (Northeast Nigeria) among respondents aged between 13 to 15 years was reported (Ekanem, 2008).

There seems to be a point of convergence that age of smoking debut for majority of current smokers was below the age of 18 years (Abikoye and Fusigboye, 2010; Action Health Incorporated (AHI), 2009; Adeyeye, 2011; Fawibe and Shittu, 2011; Salawu et al., 2009). More alarming was the finding that one in four of students who ever smoked cigarette smoked their first cigarette before age 10 years (AHI, 2009). These findings indicate that young persons are now getting initiated into cigarette smoking at relatively younger ages than in the past. Intervention programmes should, therefore, take cognizance of these current trends.

Many smokers may be aware of the risks and motivated to stop smoking, but have severe difficulties to quit. In UK and US, 40% of smokers report having made a quit attempt in the past year (West, 2010). Furthermore, 50% of quit attempts involve no pre-planning and 75% of quit attempts fail in the first week (West, 2010). Smokers experience powerful feelings of urge or need to smoke which overwhelm and undermine their resolving not to. This is because nicotine acts as both a positive and negative reinforcement. Positive reinforcement in the sense that nicotine acts on the reward pathways in the brain, generating urges to smoke in the presence of smoking cues. Nicotine serves as negative reinforcement in the sense that it causes chronic changes to the brain, resulting in a need to smoke to alleviate 'nicotine hunger' and aversive withdrawal symptoms (West, 2010). Many attempts to stop smoking are made unaided, with a success rate of around 2 to 4% (West, 2010). Aided quit attempts have been shown to be more effective (West, 2010; Ussher et al., 2013).

Many pharmacological products, in addition to behavioural or psychological services, are available to help smokers abstain from cigarette (Fiore et al., 2008;

Herman and Sofuoglu, 2010). Quitting smoking is associated with immediate health benefits irrespective of age or presence of smoking-related diseases (Fiore et al., 2008; Herman and Sofuoglu, 2010). Effective smoking cessation products include nicotine-replacement therapy (NRT) and medications. Common NRTs include smokeless cigarettes (SC), nicotine chewing gum (NCG), nicotine lozenges (NL), nicotine patches, nicotine inhalators (NI), nicotine nasal sprays (NNS), and nicotine sublingual tablets (NST). All forms of NRT have been shown to reduce craving and withdrawal symptoms. Smoking cessation medications include bupropion, varenicline, nortriptyline, and clonidine.

Given the large number of smokers in Nigeria (Abikoye and Fusigboye, 2010; AHI, 2009; Fakoya, 2008; Fawibe, 2011; Salawu et al., 2009) and the fact that prognosis for unaided smoking cessation is very poor (West, 2010; West and Shiffman, 2009), stakeholders have expressed serious concern on the dearth of sound information and baseline data on tobacco smoking patterns and attributes, making formulation and implementation of a national policy on tobacco difficult. It is needful, therefore, to address the issues of scanty epidemiological studies on tobacco smoking in Nigeria. Additionally, to date, no single study has been conducted in Nigeria to examine the awareness or use of smoking cessation products. The expediency of the present study in attempting to gauge the awareness levels of smoking-cessation products by Nigerians can, thus, not be overemphasized. A World Health Organization (WHO) review suggests that while some of these smoking cessation techniques are available in Nigeria, several issues such as affordability, regulatory issues, fear of side effects, fear of addiction to the drug, among other factors, make the approach to be less popular than expected (WHO, 2011).

The present study, therefore, investigated tobacco smoking among an at-risk population (joint patrons) and gauged the extent to which participants were aware of smoking-cessation products, with a view to not only adding to scientific knowledge but also sensitizing the various stakeholders to the availability of effective techniques and services to aid smokers who are motivated to quit smoking.

MATERIALS AND METHODS

Setting and participants

The study was carried out in Amassoma, the host community of Niger Delta University. Amassoma is a densely-populated, sub-urban community in Southern Ijaw Local Government area of Bayelsa state, Nigeria. Due to the shortage of accommodation space on the university campus, majority of the students reside in the Amassoma community, which is directly opposite the university. Like similar university host communities in Nigeria, Amassoma is proliferated with "joints" (local language for pubs or relaxation

Table 1. Participants' demographic characteristics.

Variable	n (%)	Mean (SD)
Sex		
Males	194 (74.3)	-
Females	67 (25.7)	-
Age	261 (100)	25.7 (4.8)
Total no of years of formal education	261 (100)	13.8 (3.5)
Smoking Status		
Smokers	189 (72.4)	-
Non-smokers	72 (27.6)	-
Number of sticks smoked/day	189 (100)	9.7 (5.4)
Age at smoking debut	189 (100)	15.7 (7.6)
Age at regular smoking	189 (100)	17.1 (8.3)

Table 2. Participants' smoking history and quit attempts.

Question	Response	n	%	χ^2	p																																													
Have you ever made any quit attempts?	Yes	136	72	36.4	<0.001																																													
	No	53	28			Apart from cigarette, do you also take other substance (s)?	Yes	173	91.5	130.4	<0.001	No	16	8.5	None	16	8.5	Apart from cigarette, what other substance (s) do you take?	Alcohol	131	69.3	130.4	<0.001	Marijuana	14	7.4	Cocaine	12	6.3	Others	3	1.6	Alcohol plus others	13	6.9	Do you find it difficult or impossible to control your smoking?	Yes	152	80.4	69.9	<0.001	No	37	19.6	Do you think you need help to stop smoking?	Yes	173	91.5	130.4	<0.001
Apart from cigarette, do you also take other substance (s)?	Yes	173	91.5	130.4	<0.001																																													
	No	16	8.5																																															
	None	16	8.5																																															
Apart from cigarette, what other substance (s) do you take?	Alcohol	131	69.3	130.4	<0.001																																													
	Marijuana	14	7.4																																															
	Cocaine	12	6.3																																															
	Others	3	1.6																																															
	Alcohol plus others	13	6.9																																															
Do you find it difficult or impossible to control your smoking?	Yes	152	80.4	69.9	<0.001																																													
	No	37	19.6																																															
Do you think you need help to stop smoking?	Yes	173	91.5	130.4	<0.001																																													
	No	16	8.5																																															

centers) which both staff and students of the university as well as indigenes patronize (Abikoye and Fusigboye, 2010). Purposive sampling technique was used to select participants from twenty of these joints over a six-month period. In terms of gender, 194 (74.3%) of the participants were males while 67 (25.7%) were females. Participants' average number of years of formal education was 13.8 ± 3.5 . Other demographic characteristics of the participants are presented in Table 1.

Instrument and procedure

Data were collected using a three-sectioned structured questionnaire. Demographic information of participants were

assessed by requesting participants to indicate their age (actual age as at last birthday), sex (male or female), total number of years of formal education, religious affiliation and marital status (single/married/divorced/separated/widowed). Participants' smoking history and other smoking-related data were collected. Sample items from the section (Table 2) included "How many sticks of cigarette (on the average) do you smoke per day?", "How many sticks of cigarette per day would you prefer to smoke?", "How old were you when you first smoked a cigarette?", "How old were you when you started smoking regularly?", "Apart from cigarette, what other substance(s) do you smoke?", etc. The third section of the questionnaire tapped participants' awareness level of smoking-cessation products. Participants were asked to indicate their level of awareness of each of 11 smoking-cessation products, along a five-

Table 3. Respondents' awareness of smoking cessation products.

Smoking cessation product	Not aware of product		Aware but never used product		Aware but product not available		Aware but product not affordable		Aware and used product	
	n	%	n	%	n	%	n	%	n	%
Nicotine gum	180	69.0	66	25.3	10	3.8	0	0.0	1	0.4
Nicotine patch	213	81.6	31	11.9	9	3.4	8	3.1	0.0	0.0
Nicotine lozenges	198	75.9	15	5.7	19	7.3	29	11.1	0.0	0.0
Nic nasal spray	192	73.6	21	8.0	20	7.7	7	2.7	21	8.0
Nicotine inhaler	228	87.4	19	7.3	13	5.0	1	0.4	0.0	0.0
Nic sublingual tabs	208	79.7	25	9.6	14	5.4	14	5.4	0.0	0.0
Smokeless cigarette	195	74.7	40	15.5	18	6.9	8	3.1	0.0	0.0
Bupriopion	211	80.8	18	6.9	4	1.5	14	5.4	14	5.4
Varenicline	218	83.5	16	6.1	6	2.3	7	2.7	14	5.4
Notriptyline	198	75.9	17	6.5	30	11.5	9	3.4	7	2.7
Clonidine	196	75.1	15	5.7	36	13.8	14	5.4	0.0	0.0

point scale, ranging from "I am not aware of the product", "I am aware of the product but have never used it", "I am aware of the product, wanted to use it but the product is not available", "I am aware of the product, wanted to use it but the product is not affordable", to "I am aware of the product and have used the product".

Twenty popular pubs or "joints" were used for the study. Although no specific statistics could be obtained regarding the exact number of patrons per joint, estimates given by operators of the joints indicated that each of them had more than fifty patrons. Twenty questionnaires were, thus, administered at each of the twenty selected joints. Questionnaires were administered to sober patrons in the joints (pubs) in Amassoma by attendants of the joints. Consenting patrons were given the option of completing and returning the questionnaire immediately or taking it home and return later. No financial incentive was given to participants, and informed consent was inferred by voluntary acceptance, completion and return of the research questionnaire. At the end of six months, 261 questionnaires were returned with usable data, out of 400 administered, representing a 65.3% return rate. Data was analysed using the 18th version of statistical package for the social sciences (SPSS).

RESULTS

Results indicated that out of the 261 participants, 189 (72.4%) were current smokers while 72 (27.6%) never smoked cigarette. Average number of cigarette sticks smoked per day was 9.2 ± 5.4 . Mean age at smoking debut was approximately 16 years while age at regular smoking was 17 years. Of the 189 participants who smoked cigarette, 173 (91.5%) also used other psychoactive substances. The breakdown shows that 131 (69.3%) of those who smoked also used alcohol, 14 (7.4%) used marijuana, 12 (6.3%) used cocaine, 13 (6.9%) used a combination of alcohol and other

substances while 3 (1.6%) used "other" unnamed substances.

With regards to previous quit attempts, 136 (72%) of participants who smoked had made attempts at quitting smoking. Of the participants who smoked, 152 (80.4%) found it difficult to quit tobacco smoking while 173 (91.5%) admitted that they would require help to quit smoking.

The researchers were of the opinion that awareness of smoking cessation products would be beneficial to both smokers and non-smokers because the latter can use their awareness to advise smokers willing to quit on the availability and efficacy of these products. Therefore, data (Table 3) was analysed for all participants. Results indicated that participants' levels of awareness of smoking-cessation products were generally very low. As shown in Table 3, 180 (69%) of participants were totally not aware of nicotine gum, 213 (81%) were not aware of nicotine patch, 198 (76%) were not aware of nicotine lozenges, 192 (74%) were not aware of nicotine nasal spray, 228 (87%) were not aware of nicotine inhaler, 208 (80%) were not aware of nicotine sublingual tablets and 195 (75%) were not aware of smokeless cigarettes.

Similar lack of awareness was also observed for smoking-cessation medications as 81, 84, 76, and 75% of the participants were not aware of bupriopion, varenicline, notriptyline, and clonidine, respectively. Even the few participants who reported being aware of some of these products also reported that the products were either not available or affordable. The only exceptions were nicotine nasal spray, varenicline and notriptyline in which 8, 5.4, and 2.7%, respectively were aware of and had used the products. Participants' awareness of these smoking-cessation products are further depicted in Figure 1

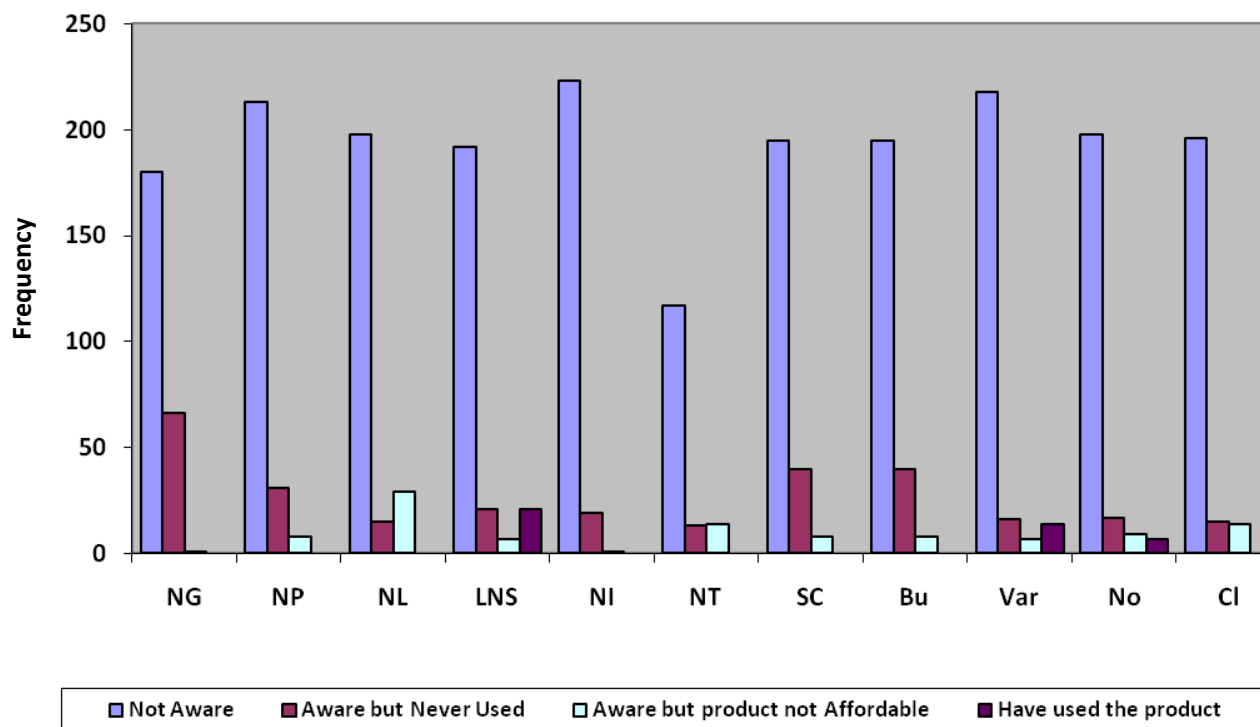


Figure 1. Participants' awareness of selected smoking-cessation products. NG = Nicotine gum; NP = Nicotine patch; NL = Nicotine lozenges; LNS = Nicotine nasal spray; NI = Nicotine inhaler; NT = Nicotine sublingual tablets; SC = Smokeless cigarette; Bu = Bupropion; Var = Varenicline; No = Nortriptyline; CI = Clonidine.

DISCUSSION

The present study has thrown more light on smoking among patrons of pubs or "joints" in a sub-urban university community: history, previous quit attempts and awareness of smoking-cessation products. Findings indicated that majority of the participants smoked cigarettes. A large number of the participants also took other substances in addition to tobacco, indicating that tobacco smoking is associated with other substance use. The reason for the high incidence of smoking and other substance use could be the proximity of the pubs or joints to the university campuses, and the fact that the pubs are primarily alcohol consumption outlets. Another reason could be the influence of the inhabitants of the host community on the students.

The finding that the average age of smoking debut was less than sixteen years is consistent with recent findings in Nigeria (for example, Abikoye and Fusigboye, 2010; Salawu et al., 2009; Fawibe and Shittu, 2011; AHI, 2009), and this has serious implications for interventions aimed at encouraging smoking cessation in Nigeria. The finding also implies that university students among the participants had probably acquired the smoking habits

from peers, mass media and other influences before entering the university (since the minimum age of entry into the university in Nigeria is sixteen years), and such influences should be the focus of preventive intervention among young people.

The average number of cigarette smoke per day was found to be 9.2. This finding appears to corroborate previous empirical evidence showing that although smoking is highly prevalent among diverse Nigerian populations (Adeyeye, 2011; Abikoye and Fusigboye, 2010; Ekanem, 2008; Obot, 1990; Odey et al., 2012), the average Nigerian smoker is a light smoker. This, however, does not imply that the situation is a positive one, considering the fact that even second-hand smoking is deleterious to health. A very worrisome finding in the present study to the effect that 91% of respondents who smoked were also users of other psychoactive substances portends serious health and socio-economic implications for the users but for the society at large. Given the plethora of health consequences associated with multiple substance use, and its attendant ripple effects on families and other social networks, there is need for more concerted effort by stakeholders to reduce smoking and mitigate its effects. This need to intervene

becomes particularly germane considering the finding that about 80% of respondents in the present study admitted to having difficulty quitting smoking, 72% had made unsuccessful attempts to quit smoking, while 91% realised that they would require help to stop smoking.

Not surprisingly, a vast majority of participants were ignorant of the various NRTs and medications that could aid smoking-cessation. This is an issue that stakeholders should address through awareness creation and advocacy. Since unaided attempts at quitting smoking have been shown to have very low success rate (West, 2010), it is expedient that people who are motivated to quit be helped in achieving this through every legitimate means possible, especially through empirically-tested and clinically-validated products such as the NRTs, varenicline, bupropion, nortriptyline, and clonidine. The use of these pharmacological smoking-cessation products, however, should be used with psychologically-oriented strategies. As noted by West (2010), highest abstinence rates are achieved when psychological approaches are combined with either the use of one of the NRTs and one of the medications.

It is recommended, therefore, that more awareness about pharmacological smoking-cessation products should be created among smokers, clinicians, policy makers, and other stakeholders with a view to sensitising them to the availability and efficacy of the products in helping smokers who are motivated to stop smoking. Since findings have consistently shown that incidents of substance use and abuse are highly prevalent among patrons of joints/pubs (and in most cases, multiple substance use), it is recommended that joint patrons should be targeted for psychological intervention or substance abuse intervention. While people other than students participated in the present study, majority of participants were university students. It is therefore, needful to recommend that pubs/joints should not be situated very close to university or college campuses in order to minimise proximity and accessibility. Finally, joint/pub patrons, as an at-risk population, have received a disproportionately scanty research attention, especially in Nigeria where pubs/joints business is a thriving venture. It is recommended, therefore, that researchers and other stakeholders should devote adequate attention to this vulnerable population.

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**10th International Meeting on Microbial Epidemiological Markers (IMMEM-10), Paris,
France, 2 Oct 2013**

A banner for the 10th International Meeting on Microbial Epidemiological Markers (IMMEM-10). The banner has a green background with a white search bar on the left containing the text "Search" and "Ok My file". To the right of the search bar, the text "October 2-5, 2013" is displayed in a small font, followed by "IMMEM 10" in a large, bold, white font. Below this, the full name of the event is written in white: "10th International Meeting on Microbial Epidemiological Markers (IMMEM-10)". On the right side of the banner, there is a logo for Institut Pasteur, which consists of a stylized white plant-like symbol above the text "Institut Pasteur". Below the Institut Pasteur logo is the IMMEM-10 logo, which features a colorful, multi-layered circular design above a blue, stylized human figure with arms raised, and the text "IMMEM-10" in red at the bottom.

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