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기생성 질병의 방역과 빈곤 정도와의 관계: 케냐 Njoro 지역의 사례연구

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Relationship between Control of Parasitic Infections and Poverty Levels: A Case Study of Njoro District, Kenya

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ABSTRACT

A cross sectional study was conducted in selected rural areas of Njoro, Kenya, to determine the socio economic variables, poverty levels and disease control practices among the residents in 336 homesteads. The objective was to establish the relationship between parasitic diseases control practices, lifestyles and the poverty levels among the residents in the rural areas. In addition, a retrospective study involving recording of the frequency of parasitic and bacterial diseases diagnosed and treated in

four randomly selected health centers, in the study area, from 2004 to 2009 was carried out. The results showed that the rural residents tend to have large families (68%), low education level (67%), high responsibility burden (67%) and a large number were living below poverty line (81%). The low economic status of residents coupled with certain lifestyles and practices pre-disposed the residents to infectious diseases. It was observed that'not boiling drinking water'had a higher probability of occurring among the lower economic cadre of residents than in medium economic cadre [Odds ratio (OR) = 2.36, 95% Confidence Interval (CI) of 1.38 - 4.03]. Occurrences probability of 'not using a mosquito net'(OR = 1.44) and'not using a toilet paper always' (OR = 2.60) were higher in residents of low economic cadre. Retrospective survey showed that the malaria had a higher frequency (42.75%), followed by typhoid (24.14%), Entamoeba histolytica (20.83%), Giardia lamblia (20.32%), intestinal worms (4.57%), Escherechia coli (3.35%) and Trichomonas hominis (1.63%). It was concluded that a combination of large family size, low education levels, high responsibility burdens, and low economic status contributed significantly to the occurrence of infectious health conditions in rural residents.

Key Words: Parasitic Infection, Poverty, Economic Status, Responsibility Burden, Odds Ratio, Kenya

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INTRODUCTION

Most developing countries show certain common features including limited central organization of services, low level of economic development, limited educational facilities and inadequate control of disease agents (Lucas & Gilles, 1973). In 1991, the theme for the 44th World Health Assembly was, 'Health for all in the face of rapid urbanization'(WHO, 1994). With such a theme, a main concern would be whether the rural population has been catered for all along with the scarce funding in developing countries.

The official figures released in August 2010, estimated the population of Kenya to be 38.6 million and a GDP per capita income of 938 US dollars in the year 2010 (IMF, 2010). According to Gichinga (2007), the economy survey of 2007 indicated that half of Kenya's population lived below poverty line and rural areas accounted for the highest incidence of extreme poverty with an estimated 82% of the population subsisting on less than one US dollar per day. The same report indicated that there existed a relationship between the individual socio-economic status and the way the responded to infectious disease and vectors (Gichinga, 2007). To address to this problem, the Kenya government has come up with strategies including the Poverty Reduction Strategy Papers (PRSP), unfortunately such programs have not been well funded to succeed (Akumu, 2004).

Most parasitic infections are transmitted by ingesting the parasites in food, water or from hands that have been contaminated with materials that contain the infective form of the parasite or through vectors (Cheesebrough, 2000). Such diseases can be controlled by observing personal hygiene, provision and proper use of latrines, and taking treated or boiled water. Regular de-worming of people and pets, eating sufficiently cooked beef, mutton, pork and fish are strategies that can reduce infections. Anopheles *gambiae* complex, *An. funestus* and *An. Arabiensis* are competent vectors of the malaria parasite, *Plasmodium* in Africa (Walker, 2002). Malaria is a major public health threat to more than 600 million Africans and its control is recognized as critical in the Millennium Development Goals (MDG) achievement (Grover *et al.*, 2006). Malaria and poverty are intimately connected and are amplified by factors such as the tropical location, colonial history and geographical isolation (Gallup & Sachs, 2001; Weller, 1958) of Africa. The occurrence of malaria is not a consequence of poverty but geographically specific yet the occurrence of malaria tends to amplify poverty (Gallup & Sachs, 2001). According to Albonico *et al.* (2008), there is ample evidence that regular treatment of helminth infections produces immediate and long term benefits. Regular use of treated mosquito nets can significantly reduce cases of mosquito transmitted diseases like malaria (Rozendaal, 1997). Malaria epidemics in Africa have been on an increase during the last 10 years as a result of the interactions among the human, the mosquito vector, the malaria parasite, environmental factors and anthropogenic determinants (Kiszewski & Teklehaimanot, 2004). Malaria is known to lower the gross domestic

per capita of a country in various ways (Ruger *et al.*, 2001). Estimates suggest that malaria costs the African countries about 12 billion dollars annually and retards development (Gallup & Sachs, 2001). An average African family spends up to 25% of their income on malaria control and prevention (WHO, 2000). The control of parasitic infections depends on understanding of the conditions that increase the risk of exposure (Tshikuku *et al.*, 1995). Such control strategies can be expensive for people whose economic status is low and in addition, they can increase the average spending per given period of time hence promoting poverty. The current research was designed to investigate whether there was a relationship among the peoples'lifestyle practices, their poverty levels and the frequency of selected parasitic infections.

MATERIALS AND METHODS

Study Area

The study was carried out in Njoro, a rural area to the southwest of Nakuru town in the Rift Valley Province, Kenya. The residents of Njoro are subsistence farmers, small traders and civil servants. Data was collected from Kikapu, Piave and Belbur rural villages of Njoro.

Ethical Issues

Permission to carry out the study was sought and granted from the School of Health Science, Department of Pathology, at Kenyatta University and the Department of Research at Daystar University. Written permit to retrieve data from the records in the health centers was provided by the District medical officers. Other relevant government offices were consulted and their approval was granted. The residents in the study area were briefed on the research and their cooperation was sort.

Study Design

Cross-sectional study: The study which involved an observational approach, use of a questionnaire and an interview guide was carried out to determine the frequency of several variables which included socio-economic status, application of disease control practices or lifestyles. The data sheets were used to record the observed aspects from each homestead plus the responses captured during the interviews.

The target population: The target group comprised of the people in each homestead visited. The homesteads were randomly selected. One or two respondents were interviewed and preference was given to the owners of the homestead or people who lived there.

The retrospective study: In order to assess the occurrence of diseases, the health records in selected health centers, from 2004 to 2009, were retrieved in order to establish the frequency of parasitic diseases. The local health centers chosen for this study were Njoro Presbyterian Church of East Africa (PCEA) health center; Njoro County Council health center; Piave dispensary; and Pwani health center. Both Njoro PCEA and Njoro County have fairly equipped laboratory

facilities.

The records retrieved included those for malaria cases, typhoid, intestinal worms, amoebiasis, giardiasis, tuberculosis, gastroenteritis and dysentery. The frequency of these diseases was the retrogressively compared to the socio-economic, socio-demographic and lifestyle variables in the study area. A pre-designed data sheet was used to record the diseases treated, their frequency and the total number of patients in each health center.

Data Collected

Socio-demographic and social-economic variables: These included, the age, sex, marital status, family size, education level, occupation, and indicators of economic status of the respondents. The data was collected through direct observation in the field as the researchers interacted with the respondents.

Disease control practices or lifestyles variables: These included aspects of lifestyle or daily practices that may have enhanced or transmission of parasitic diseases. Such aspects were those associated with drinking boiled water, use of treated or non-treated mosquito nets, washing hands, among others. Observable indicators of unhygienic practices were recorded in every homestead visited.

Morbidity variables: They included the types and frequencies (%) of parasitic and bacterial infections in selected health centers in the study area from 2004 to 2009 as indicated by the diagnosis and laboratory records available and obtained from the chosen health centers.

Data Analysis

Percentages for socio-demographic and socio-economic variables were computed and compared. Odd ratios (OR), chi square tests, and confidence limits were used to determine the probabilities of occurrence for lifestyle variables among different economic categories of the residents by using a SPSS program (Ver. 16 for Windows; SPSS Inc., Chicago, IL, USA).

RESULTS

Socio demographic variables

The women respondents were 208 (62%) while men were 128 (38%). Their age depicted a normal distribution and 253 (75%) of the respondents were married. Majority of the respondents had 4 to 6 children comprising a proportion of 126/336 (38%) of respondents. Most of the respondents' highest education level was primary education level (61%). Only 2.7% of the respondents had college or university level education and only 0.9% were going on with their high level or professional studies. Also, 98% of the respondents were unemployed and they obtained their income from small scale farming or small scale trade that was based on farming activities or produce. The responsibility burden in terms of educating children indicated that only 20% had all their children working, 4% had no children to educate and an enormous 67% were still educating their children or their grand children (Table 1).

Table 1. The family size, educational level, occupation and responsibility burden of the respondents (n = 336)

Variable	Nature of variable	Frequency	Percent (%)
No. of children in the family	None	10	2.9
	1-3	66	19.6
	4-6	126	37.5
	7-9	101	30.1
	10 and above	33	9.8
Children in school	None	105	31.3
	1-2	98	29.2
	3-4	82	24.4
	5-6	40	11.9
	7-8	10	3.0
	>9	1	0.3
Education level	None	56	16.7
	Primary	205	61.0
	Secondary	66	19.6
	College	7	2.1
	University	2	0.6
Studying	Currently on study	3	0.9
	Not on study	333	99.1
Occupation	Unemployed	328	97.6
	Employed	8	2.4
	Small scale farmer	323	96.1
	Large scale farmer	1	0.3
	Not farmer	12	3.6
	Small scale trade	21	6.3
	Large scale trade	0	0.0
Responsibility	Children not working & others in school	117	34.8
	All children working	68	20.2
	All children in school	66	19.6
	Children in school & others are infants	29	8.6
	Children working, others not & not in sch.	21	6.3
	No children to take care of	10	4.0
	Children not working & others in school	12	3.6
	Children are infants & toddlers	7	2.1
	Children not working & none in sch.	6	1.8

Lifestyles and practices that predisposed the respondents to parasitic infections

Drinking water and its source

Out of 336 respondents, those who normally boil drinking water were 126 (37.5%) while those who do not boil drinking water were 206 (61%), and those that were not always boiling drinking

water were 5 (1.5%). The sources of the water varied from collected rainwater (44.6%), domestic and public dams (22.6%), plus rivers (7.7%) to centralized community watering points (82.4%). It was noted that 57 (17%) of the respondents used water chemicals popularly referred to as 'alums' meant to bring about sedimentation in the water.

Washing hands

Out of 336 respondents, 266 (79.2%) wash their hands in a basin after using the pit latrines, and only 16 respondents (4.8%) wash their hands in running tap water. In addition, 54 respondents (16.1%) do not always wash their hands after using the pit latrine. It was also noted that 45 (13.4%) of the respondents do not use a soap to wash their hands after using the pit latrine while 274 interviewees (81.5%) use a soap to wash hands after using a latrine.

Nature of pit latrines and toiletries

Through direct observation of the nature of the pit latrines used in each homestead, 113 (33.6%) were either dirty and/or not roofed. It was noted that 63.7% of the homesteads visited had clean and appropriate pit latrines. However, 2.7% of the homesteads visited lacked latrines and the occupants of such homesteads used their neighbors' pit latrines or the bushes near. Thirty-one percent of the interviewees always use other inappropriate materials as equivalents of toilet papers.

De-worming children and domestic animals

About a third (36.3%) of the 336 interviewees de-wormed their children frequently, however one out of every eight respondents (13.1%) did not while 27.7% of the respondents rarely de-wormed their children (Table 2). It was noted that 68 respondents (20.2%) rarely de-wormed their livestock while 19 respondents (5.7%) did not de-worm them at all. It was further noted that in 152 (45.2%) homesteads, livestock roamed freely in the compound near the residences since the animals were fenced near the houses (Table 2). Out of 336 respondents, 191 (56.9%), did not or rarely de-wormed their dogs which may host some zoonotic worms. It was further observed that in 108 out of 164 homesteads where dogs were reared, the dogs were not restricted and therefore they interacted freely with the livestock and human beings in the compound (Table 2).

Table 2. The lifestyle practices among the respondents (n = 336)

Variable	Aspect verified	Frequency	Percent(%)
De worm children	De-worm children frequently	122	36.3
	De-worm children rarely	93	27.7
	Do not de-worm children	44	13.1
	Not applicable (do not have children)	77	22.9
De worm Animals	Frequently de-worm livestock	173	51.5
	Rarely de-worm livestock	68	20.2
	Do not de-worm my livestock	19	5.7
	Not applicable (no livestock)	76	22.6
	De-worm dogs and cats frequently	43	12.8
	De-worm dogs and cats rarely	55	16.4
	Do not de-worm dogs and cats	136	40.5
	Not applicable (no dogs and cats)	101	30.0
Location of domestic animals	Fenced away from the house	79	23.5
	Fenced near the house	168	50.0
	Animals roam in the compound	152	45.2
	Animals do not roam	94	28.0
	No animals (livestock)	90	26.8
	Dogs restricted	56	16.7
	Dogs not restricted	108	32.1
	No dogs	172	51.2

Control of disease transmitting vectors

The efforts to control disease vectors in the study area were relatively low (Table 3). Only 106 out of 336 respondents (31.6%) used mosquito nets although 81/336 homesteads (24.1%) had domestic dams near their houses which served as source of water for domestic use and livestock. They also communicated the fact that most of their nets were old and torn. Some homesteads had long grasses (29/336; 8.6%), others had containers, plastics and papers scattered in the compound (105/336; 31.3%) and others had bushy flower plants and bushy fences near their houses (93/336; 27.7%) all suitable habitats of malaria transmitting mosquitoes. Among the respondents rearing livestock, only 52.1% sprayed their livestock frequently as recommended while the remaining 48% did not spray regularly.

Economic status

Houses, average spending, vehicles and electronic gadgets

About 93.5% of the respondents lived in their own houses of which 80.9% were semi permanent houses made up of iron sheets, timber walls or mud walls and earth floor (soil) and in addition 81.0% had an average spending of ≤ 2200 Kenya shillings per month (27.5 US dollars).

Table 3. The nature of the homestead and vector control practices among the respondents(n = 336)

Variable	Aspect verified	Frequency	Percent(%)
Home compound	Long grass present	29	8.6
	Short grass present	132	39.3
	Bare (no grasses)	175	52.1
	Dirty (containers and plastics)	105	31.3
	Clean compound	231	68.8
	Flower plants near the house	93	27.7
	No flower plants near the house	243	72.3
	Domestic dam near	81	24.1
	No domestic dam near	255	75.9
Control of disease vectors	Use mosquito nets	106	31.6
	Do not use mosquito net	218	64.9
	Sprays domestic animals every week	175	52.1
	Do not spray animals per week	42	12.5
	Rarely sprays my animals	29	8.6
	Not applicable (no animals)	90	26.8

It was further established that about 69% of the respondents utilized less than Kenya shillings 500 (about 6 US dollars) for health related expenses at the last time they visited a health center. A large portion of this money was obtained from small scale farming activities or from well wishers and relatives. Only 5 (1.5%) and 1 (0.3%) respondents owned cars and tractors respectively. The respondents owned a radio (44.6%) or both a TV and a radio (47.6%).

Land and livestock

It was established that 238 (71%) respondents owned land ranging between a 'plot' (an eighth of an acre) and 20 acres, with the majority owning 1 to 3 acres (25%) or 5 to 8 acres (24%) and 98 out of 336 (29%) of the respondents were squatters with no land of their own. Thirty eight percent and 41% of the respondents owned 1 or 2 cows and 1 to 4 goats or sheep, respectively. Thirty seven percent of the respondents had no livestock. Rearing of chicken was common with 39% of the respondents having 1 to 4 adult chickens and 46% of the respondents having more than 5 adult chickens. More than 96% of the interviewees were not rearing donkeys.

Classification of the respondents based on economic status

Out of a total of 336 respondents, 268 respondents (79.8%) were grouped under low economic status, 67 respondents (19.9%) were categorized under medium economic status and only 1 respondent (0.3%) qualified to be under the high economic status according to the scale used (Table 4). It was noted that some aspects of lifestyles were significantly frequent among the low economic categories of the respondents than in the medium and high economic

categories. The aspect of 'not boiling drinking water' had a higher probability of occurring in the low economic group than in medium economic category, with an OR of 2.36, and 95% confidence interval (CI) of 1.38 - 4.03 (Table 5). Similarly, other aspects of 'not always using a toilet paper' and 'not using a mosquito net' were significantly common among residents in the low economic cadre, with ORs of 2.60 (95% CI of 1.35 - 5.00) and 1.44 (95% CI of 0.84 - 2.48), respectively (Table 5).

Table 4. The scales used to categorize the respondents into their economic status (n = 336)

Category	Variables	Frequency	Percent(%)
Low status	Semi permanent houses[1] Radio only No car or tractor 0 to 2 cows 0 to 4 goats and/or sheep 0 to 5 adult chickens 0 or 1 donkey 0 or 1 acre Spends≤12 dollars per person /month[2]	268	79.8
Medium status	Good moderately permanent house[3] Has both radio and TV No car or tractor 2 to 5 cows 5 to 10 goats and/or sheep 6 to 15 adult chickens 2 donkeys 2 to 5 acres of land Spends 12-61 dollars per person /month	67	19.9
High status	Very good permanent house[4] Radio and TV Car or tractor More than 5 cows More than 10 goats and sheep More than 15 adult chickens 3 or more donkeys More than 5 acres of land Spends > 61 per person / month	1	0.3

1) Semi permanent houses: Mud or timber walled, soil floor, grass thatched or iron sheet roofed.
2) 1 US dollar = 80 Kenya shillings.
3) Good moderately permanent house: Timber or plastered walled/Iron sheet roofed, cemented floor house.
4) Very good permanent house: Stone walled/Iron sheets or bricks roofed and cemented floor.
Note: A respondent must have scored 78% (7/9 variables) to qualify into any of the three categories and the variables including type of the house, car or a tractor ownership, size and ownership of the land and average income per month, were compulsory among the 7 variables considered to compute the 78%.

Table 5. The comparison of some aspects of lifestyles among low, medium and high economic categories of the respondents

Group	Total no.	Do not boil drinking water (%)	Do not use a soap after using pit latrine(%)	Do not always use a toilet paper (%)	Do not use a mosquito net (%)
Low	268	176(66)	36(13)	97(36)	179(67)
Mid	67	30(45)	9(13)	12(18)	39(58)
High	1	0(0)	0(0)	0(0)	0(0)
OR [1]		2.36	1	2.60	1.44
X^2		9.88	0.00	8.16	1.74
CI [2]		1.38-4.03	0.00	1.35-5.00	0.84-2.48

1) OR (Odds ratio) in the table compares the low and the medium economic categories only for each of the lifestyle aspect indicated.
2) CI means 95% confidence interval.

Frequency of infectious diseases treated in the selected local health centers

Frequency based on laboratory records

Malaria and Typhoid: Out of an average of 1834 blood tests per year carried out at the Njoro PCEA health center between 2004 and 2009, malaria had frequency of 42.8% with infection among children being up to 37.7%. In the same health center, over the same duration of time, typhoid had a prevalence of 24.1% of which 6.9% were children and 93.1% were adults (Table 6). In comparison, out of an average of 493 blood tests per year carried out at Njoro County Council health Center, for patients from the study area, for the years 2004 to 2009, malaria had a frequency of 14.6% while typhoid had 23.0% (Table 6). The frequency of typhoid tended to be constant in the two health centers.

Intestinal parasites: Out of a total of 804 stool tests carried out between 2004 and 2009 at Njoro PCEA health center, 20.8% were positive for *Entamoeba histolytica*, 20.3% for *Giardia lamblia*, 4.6% for intestinal worms, 1.6% for *Trichomonas hominis* and 3.4% for *Escherechia coli* (Table 6). Out of 2464 stool tests from the study area carried out between 2004 and 2009 at Njoro County Council Health Center, 1.3% was positive for *E. histolytica* and 0.8% for intestinal worms; 0.0% for *G. lamblia*, *E. coli* and *T. hominis* and (Table 6). Stool samples that were positive for both *E. histolytica* and *G. lamblia* (concurrent infections) were totally absent in the two health centers studied.

Table 6. The comparison of the frequency of various medical conditions based on the laboratory tests at two health centers in the study area

	Average frequency (%) from 2004 to 2009						
	Blood Test[1]		Stool Tests[1]				
Health center	Mal	Typh	Ameb	Giard	Wor	*E.coil*	T.hom
Njoro PCEA	42.8	24.1	20.8	20.3	4.6	3.4	1.6
Njoro County	14.6	23.0	1.3	0.0	0.8	0.0	0.0
Mean frequency	28.7	23.6	11.1	10.2	2.7	1.7	0.8

1) Mal: malaria; Typh: typhoid; Ameb: amoebiasis; Giard: giardiasis; Wor: intestinal worms; *E. coli: Escherechia coli; T. hom: Trichomonus hominis*

Frequency based on the doctor's diagnosis

From the diagnosis records obtained from the health centers, the frequently diagnosed medical condition was malaria in all the health centers in the study area. This included Njoro PCEA Health center (35.63%), Njoro County Council Health Center (28.72%), Pwani Health Center (18.23%) and Piave Health Center (30.82%). Other parasitic infections had a frequency of <5 % of the total patients. The sequence of the infections' average frequency in a descending order was malaria (28.35%); gastroenteritis (2.86%); typhoid (1.70%); dysentery (1.27%); amoebiasis (1.08%); intestinal worms (0.73%); giardiasis (0.24%), and tuberculosis or TB (0.10%) as indicated in the Table 7.

Table 7. The frequency of various medical conditions based on the doctor's diagnosis at the four health centers in the study area from 2004 to 2009

		Diagnosis and frequency(%)[1]							
Health Center	Total patients s/area	Mal	Typh	G/E	Amoe	Wor	Giar	Dys	TB
Njoro PCEA	457	35.63	4.67	4.08	2.82	0.91	0.91	0.66	0.04
Njoro County	3010	28.72	2.05	2.59	1.50	0.47	0.03	0.68	0.22
Piave	5294	30.82	0.06	4.80	0.00	0.45	0.00	0.00	0.15
Pwani	5685	18.23	0.00	0.00	0.00	1.07	0.00	3.72	0.00
Mean frequency	(%)	28.35	1.70	2.86	1.08	0.73	0.24	1.27	0.10

1) Mal: malaria; Typh: typhoid; G/E: gastric enteritis; Ameb: amoebiasis; Wor: intestinal worms; Giar: giardiasis; Dys: dysentery; TB: tuberculosis.

These results showed a cross relationship between the individuals' socio economic status, the methods used to prevent infectious diseases and lifestyle in the study area.

DISCUSSION

The World Bank estimates that a slowdown in economic growth may push 53 million people into poverty (Sauti, 2009). Accomplishment of the Millennium Development Goals (MGDs) which include the eradication of the extreme poverty and hunger, provision of universal primary education and reduction of child mortality is under serious threat in Kenya (Sauti, 2009). In line with the millennium development goals, the Kenyan government targeted reducing the percentage of Kenyans living in absolute poverty to 26% by 2010 and 10% by 2015 (Gichinga, 2007). According to the current research, 80.95% of those interviewed in rural Njoro were spending less than 2200 Kenya shillings (27.5 US dollars) per month, translating to about 73 Kenya shillings (0.9 US dollars) per day. This matches well with the economy survey of 2007 in Kenya, which indicated that an estimated 82% of the population spent less than US 1 dollar per day (Gichinga, 2007). This implies that Kenya is unlikely to meet its target of reducing poverty to 26% by 2010. High poverty levels could have prevailed due to food insecurity and hunger that emanated from severe draught experienced in 2008 and part of 2009 (IMF, 2010).

Despite majority of the respondents in the current study, owning substantial pieces of land (71%) and living in their own houses (94%), their monthly spending was less than 26.8 dollars per month implying that their farms were not contributing significantly to their wealth. The fact, that the majority of the houses were semi permanent (81%) and about 29% of the respondents were squatters, was a clear indication of low revenue. In terms of health, about 69% of the respondents utilized less than 6.25 US dollars for health related expenses when they visited a health centers. This implied that many individuals were not willing to spend a lot of money for health matters probably as the health needs have to compete with other needs over the little money available.

The finding of this work was in agreement with works by other researchers. Illness imposes high and regressive cost burdens on the patients and their families in Africa (Russell, 2004) which may push patients without enough money to self medicate. The self-treatment through purchase of drugs has been a major point of interest since it was reported that every patient seeks treatment from the health centers in Africa while another 4-5 sick people are self-medicating at home (Agyepong & Kengeya-Kayondo, 2004). As the malaria pathogen developed resistance towards drugs such as chloroquine and sulfadoxin-pyrimethamine (SP), there is a shift towards the use of combination drugs. The Artemisinin based Combination Therapy (ACT), in use currently in Kenya, delays the development of resistance towards the available antimalarial drugs (Yeung *et al.*, 2004). The ACT treatment is however costly at 1.2 dollar per an

adult treatment compared to the 0.1-0.2 dollars per adult treatment for chloroquine and SP (Breman *et al.*, 2004). A study in four African countries found that it costs 9.83 dollars (1987) to treat a single case of malaria, 19% of which was direct cost of treatment and control while 81% was indirect cost (Shepard *et al.*, 1991). Between 1.6 to 3.4 billion dollars per year, it will be required to give malaria treatment based on ACT (Snow *et al.*, 2003). Studies to assess the economic burden of malaria by use of cross-country regression analysis found the disease to have significant effects in long-term economic growth and development of African countries (Gallup & Sachs, 2001). There are also indirect costs including loss of household productive labor time for patients and care givers (Russell, 2004). It also implies that the respondents may have been seeking for treatment in low cost health centers or just stay at home without seeking for medical attention.

Economic status of the respondents was noted to have a significant influence on the lifestyle of the people and hence the methods used to protect themselves from infectious diseases. This was established when the probability of a specific lifestyle occurring in a low economic group was compared with that of a medium economic group. For instance, those who did not boil drinking water had an OR of 2.36, 95% CI of 1.38 - 4.03, implying that they were 2.36 more likely than those who boiled water to have had a low economic status and higher infection rate. Similarly, the aspects of 'not always using a toilet paper' and 'not using a mosquito net' were significantly common among residents in the low economic cadre, with ORs of 2.60 (95% CI of 1.35 - 5.00) and 1.44 (95% CI of 0.84 - 2.48), respectively (Table 5) suggesting more infection with diseases like malaria among this group. This could be true because these lifestyles need finances to be accomplished, for example, to boil water always, means a continued supply of fuel, and to have a mosquito net or even a steady supply of tissue papers means having money to buy them. It therefore follows that an economically advantaged person may boil water always, buy a mosquito net whenever needed, and always use a toilet paper and hence avoid infections. This was exactly the case for the high economic group in this research. Deviating from this, however, it was the aspect of 'using a soap to wash the hands after visiting the pit latrine'. It was noted that the OR was 1 and 95% CI of zero (Table 5). An OR of 1 indicated that there was no association between the using of soap after visiting the latrine and the economic status of the individuals and similarly a CI including zero indicated that the means were the same. Equal means was also indicated by the identical percentages of those using a soap in the low economic status and those using a soap under a medium economic status in Table 5. This observation suggests that there could be other factors not necessarily based on economic status such as education levels, influencing and dictating the washing of hands with soap after using a pit latrine. Washing hands with soap and water especially at the critical time after using the toilet and before handling food helps reduce the incidence of diarrhea disease by more

than 40%, yet this simple behavior is not practiced regularly in many African communities in the rural areas (Ghanaian Chronicle, 2010).

According to Radford (http://rehydrate.org/dd/dd27.htm) more than a half of the people in the world carry parasites around inside as an 'intestinal zoo' of parasites. Majority of them are transmitted to human by swallowing the egg or the cyst forms of the parasite in contaminated food, water or through contamination of the hands by infected feaces or fecal contaminated soils (Albonico *et al.*, 2008). The prevalence of intestinal parasite infection is influenced by factors like poor sanitation and hygiene, age of the individual, the particular characteristic of the parasites, the climate and the presence of animals known to be involved in the transmission of parasites (http://rehydrate.org/dd/dd27.htm). When analyzing the infectious diseases in tropical rural areas, Petit (1994) established that the number of patients with gastroenteritis tended to remain constant or decrease, in the hospitals under study. This was probably due to increased use of antibiotics, public health campaigns and vacations. The current research has established that both gastroenteritis and dysentery cases in the four health centers where data was obtained, had a frequency of less than 5% of the total patients (Table 6). This observation was in agreement with observations made by Heyworth *et al.* (2002) in South Australia where gastroenteritis accounts for 4.2% of the hospital admissions. The current research shows that the frequency was much lower at Njoro PCEA and Njoro County health centers where laboratory tests were frequently carried out. In contrast, the frequency of dysentery and gastroenteritis at Pwani and Piave health centers where laboratory tests were missing was higher, respectively (Table 7). This was probably because treatment at Piave and Pwani health centers was based more on signs and symptoms (physical examination) while at Njoro PCEA and Njoro County health centers, treatment was based on signs, symptoms and laboratory tests in order to verify cases that were not obvious. According to Petit (1994), lack of proper diagnostic facilities in hospitals may lead to over treatment which is expensive and may not help the patient, and it can also cause extensive drug resistance. Lack of amoebiasis, giardiasis and dysentery at Piave health center (Table 7) suggested that the patients may have been diagnosed as gastro enteritis. Similarly, at Pwani health center, lack of amoebiasis, giardiasis, and gastric enteritis suggested that they may have been diagnosed as diarrheal cases or dysentery whose cause was not specific.

However, despite these probable differences in diagnosis in the health centers, the ranking of the infectious conditions that could have emanated from unhygienic practices tended to be gastroenteritis, typhoid, dysentery, amoebiasis, worm infections, giardiasis, and tuberculosis, in a descending order (Table 7). The frequency of these infectious conditions in the local health centers seemed not so high when compared to malaria. This is probably because infections like dysentery, amoebiasis, giardiasis and gastric enteritis tend to have similar signs, symptoms and treatment hence raising a chance of wrong

diagnosis. According to Kapoor (http://www.bhj.org/journa/special_issue_tb/REV_4.HTM), many patients who are treated for amoebiasis are actually suffering from giardiasis.

Lack of money for the laboratory tests to confirm the infection may force the patients to avoid going for testing. This was observed in the current research where 80.95% (272/336 respondents) of those interviewed in rural Njoro were spending less than 26.8 dollars per month, translating to about 0.9 US dollar per day. The average costs for various laboratory tests in Kenya shillings for the Njoro PCEA and Njoro County council health centers were 0.69 US dollars for a malaria test, 1.06 US dollars for a typhoid test and 0.69 US dollars for a stool test pushing the tests beyond the reach of majority who live below a dollar per day. Significant numbers of respondents de-wormed themselves at home through self medication, for instance, the current study showed that 64% of the respondents de-wormed their children and most of them bought the drugs from the drug stores. The current public health campaigns especially in the rural areas of Kenya may be proving effective.

However, the current research shows that the unhygienic practices that could have led to the infections in question, may have included: not boiling drinking water; using water likely to be contaminated including rivers, public and domestic dams; and communal water collecting points. These were very common and probably contributed to inadequate and inappropriate washing of hands after visiting the latrines, dirty latrines with flies built near the houses and lack of appropriate toiletries hence increasing the chance of fecal contamination.

The stool tests indicated that amoebiasis and giardiasis were the most common intestinal protozoa treated at Njoro PCEA and Njoro County health centers, followed by worm infections, *T. hominis* and *E. coli*, respectively (Table 7). This observation agrees with that made by Kean *et al.* (1979) where the prevalence of E. histolytica was significantly higher than that of G. lamblia among homosexuals in New York City. This is a further confirmation that probably the unhygienic practices among people living in Njoro area could be exposing them to higher chances of getting infected bearing in mind that both are transmitted though water contaminated with cysts. Utilizing river water for domestic purposes, obtaining water from the communal water collecting points and using both domestic and public dams as sources of water may have raised the chances of drinking or using contaminated water.

The laboratory records for stool tests at Njoro PCEA health center indicated that increases in amoebiasis corresponded to decreases in giardia and vice versa. From a study carried in animals, giardia cysts are shed intermittently (http://www.merckvetmanual.com/mvm/htm/bc/21300.htm), and similarly according to Tomkins(1986) and (http://rehydrate.org/dd/dd27. htm), a negative stool test of giardiasis does not exclude the existence of giardia infection since the parasites may be passed only intermittently. Probably, this intermittent shedding of cysts explains the upsurge of the

cases in the health centers at certain times of the year. Could such a phenomena be occurring for *E. histolytica* too? Alternatively, it could be a question of unreliable diagnosis since according to Kapoor (http://www.bhj.org/journa/special_issue_tb/REV_4.HTM), the stool examination for giardia cysts is often negative and difficult in private practice and probably this would explain why the positive giardiasis cases were lower than that of *E. histolytica*. Kapoor recommends serological tests for giardia serum antibodies (IgM) as a more reliable procedure.

In the sub-Saharan Africa region, where malaria control is inadequate, the disease is closely linked to the seasonal rainfall patterns and influenced by climatic regimes and the effectiveness of the control strategies of both the vector and the parasite. This is the essence of the recently published Global Malaria Strategy (GMS) strategic plan on Roll-back-malaria 2005-2015 stated that six of the eight MDG can only be reached with effective control of malaria in Africa (GMS, 2008). The greatest burden of malaria in Africa is borne by the population in the regions where the malaria pathogen is perennially present in the community.

CONCLUSION

This combination of illiteracy, large family size, unemployment and a relatively increased responsibility burden must be enhancing poverty in rural areas of Kenya. Individuals who are economically disadvantaged in the rural areas tend to adopt a lifestyle that may predispose them to infectious diseases which then tend to have higher prevalence in the local health centers.

This study showed that the socio economic status, the lifestyle and education levels clearly determined the choice an individual made to avoid coming in to contact with infectious material. The choice to boil drinking water, wash hands under running water after visiting the toilet and sleep under a mosquito net were determined by how informed and availability of money among the respondents.

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국문 요약

본 연구는 Kenya, Njoro에 있는 시골지역 336개의 농가 거주민을 대상으로 사회적 변수, 빈곤수준, 질병방역을 알아보기 위해 실시되었다. 연구의 목적은 시골지역 거주민들의 기생성 질병방역, 생활습관과 빈곤 수준들의 관계를 규명하기 위함이다. 본 연구를 위해 2004년부터 2009년까지 해당지역에서 무작위로 4곳을 선정하여 보건소에서 진단과 치료가 수행된 기생충, 박테리아 감염 질병의 빈도수 자료를 바탕으로 조사하였다. 연구결과, 시골 거주민들의 대다수가 대가족(68%), 낮은 교육수준(67%), 높은 채무(67%)가 빈곤선 이하에서 생활하고 있는 것으로 나타났다. 낮은 경제적 지위는 특정 생활습관, 전염성 질병에 취약한 거주민의 삶과 관련이 있다. 저소득 계층군은 중소득 계층군보다 살균되지 않은 음료를 마실 가능성이 더 높은 것으로 나타났다. 저소득 계층군은 '모기장을 사용하지 않는다', '항상 화장지로 용무 처리를 하지 않는다'에서 발생확률이 더 높았다. 가장 높은 출현빈도는 말라리아(42.75%), 장티푸스(24.14%), 이질(20.83%), 장편모충(20.32%), 회충(4.57%), 대장균(3.35%), 장세모편모충(1.63%) 순으로 나타났다. 결론적으로, 대가족 제도, 낮은 교육 수준, 높은 채무와 낮은 경제 수준이 농촌지역의 거주민들에게 전염성 질병발생에 유의적인 영향을 준 것으로 나타났다.