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Assessment of Pupils' Knowledge and Practices Towards Prevention and Control of Tungiasis Infestation in Ugenya Sub County, Kenya

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Abstract

Background: Tungiasis is a parasitic tropical disease caused by female *Tunga penetrans* which has remained an important public health problem and it affects resource-poor communities causing different health disabilities hence the need for behavior change. Main objective of the study was to determine factors influencing prevention and control of tungiasis infestation among school age children in Ugenya Sub County, Kenya.

Methods: A descriptive cross sectional design and utilizing quantitative data collection method. Simple random sampling technique was applied to select the participants. Quantitative data was collected through a pretested structured questionnaire. The data was keyed-into excel and analyzed using SPSS version 23.

Results: Study findings indicate that majority of the pupils infested with tungiasis were in classes 5 – 6 at 191 (49%). Male participants were 200 (51%), while 185(49%) were female. Gender of pupils (χ^2=4.383^a, df=1, P<0.005) and household head occupation (χ^2=44.729, df = 28, P<0.005) had a statistical significance with tungiasis infestation. Further significance was noted between participants who had ever heard of jiggers (χ^2=6.361, df=1, P<0.005), Knowledge on important causes of jiggers (χ^2=36.482, df = 9, P<0.005), mode of disease transmission (χ^2=17.215, df = 5, P<0.005), signs and symptoms (χ^2=4.088, df = 1, P<0.005), seriousness of jiggers in the area (χ^2=13.175, df = 1, P<0.005) as well as pupil's wearing of shoes (χ^2=3.934, df = 1, P<0.005) and tungiasis infestation.

Conclusions: Study concludes that tungiasis is still a big problem in rural settings and knowledge on tungiasis infestation does not translate to prevention and control in the areas. More emphasis should be given to improving practices touching on personal hygiene and health education to increase awareness both at school and in the households.

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Background

Tungiasis is caused by the "jigger" flea *Tunga penetrans*. The sanitation related disease has been described to cause severe morbidity among patients in endemic areas [1]. According to Black and Fawcett (2008c), more than 1.2 billion people worldwide gained access to improved sanitation between 1990 and 2004 [2]. However, even with this progress, some 41 percent of the world's population- an estimated 2.6 billion people, including 980 million children lack access to proper sanitation. Lack of adequate sanitation, poor hygiene and safe portable water are serious global health problems and contribute to deaths of 1.5 million children under the age of five years annually due to sanitation related diseases. In the past few years, the public health importance of tungiasis in resource-poor populations has been highlighted from different countries, including Brazil, Argentina, Haiti, Nigeria and Tanzania [3]. School age children in developing countries bear the greatest health burden from neglected tropical infections including tungiasis, accounting for an estimated 20% of the disability-adjusted life years lost due to infectious diseases in children less than 14 years old [4].

About 2.6 million Kenyans are infested with jiggers out of which 1.5 million are school going children who are physically and mentally disabled and unable to walk [5]. The impact of the disease is felt heavily among poverty stricken rural-agricultural communities and is believed to inhibit progress and development. Serious infestations of jiggers may lead to severe inflammation leading to loss of toenails, auto amputation of digits, and death may also occur [6, 7]. It lowers the quality of life of its victims. The risk of secondary infection, such as tetanus, is also high [8]. The jigger menace deprives the pupils' concentration in class, affects extra curriculum participation often leaving children lethargic and slow in action. Adults who are attacked by the jiggers are entirely dependent as they cannot actively take part in day to day activities. In Ugenya Sub County it is believed that jigger infestation is a curse and once infected, the individual is discriminated.

Tungiasis has a focalized distribution with the disease occurring predominantly in impoverished populations. According to pilot investigations, tungiasis is highly prevalent in parts of Coast, Nyanza, Rift Valley, Western and Central regions of Kenya. However, sustainable control measures against tungiasis can only be developed if the epidemiological situation is well understood. Children are the hardest hit with a recent study estimating a point prevalence of 57% among children aged 5-12years in Murang'a South district, Kenya [9]. Unhygienic conditions have been identified as the major causes of tungiasis in Kenya [10]. Though such information is already available, more work on epidemiology especially in vulnerable age groups such as children and the aged in other endemic regions need to be pursued. Control measures for tungiasis can only be developed if epidemiological situation is well understood. To fill this gap and validate anecdotal observations, a cross-sectional study was carried in Ugenya Sub County, which provided evidence-based information and form basis for further studies and effective sustainable control measures among school age children and the community as a whole in Kenya.

Study Site

The study was conducted in Ugenya Sub County in Nyanza region of Kenya. It is one of six constituencies of Siaya County. Population of 108,934 [11]. It has 4 wards namely; West Ugenya, East Ugenya, Ukwala and North Ugenya. The rural setup covers an area of 310.20 Sq. Km [11]. Statistics from ministry of health Siaya county show that over 200,000 people in the county are infested with jiggers [10].

Study Design, Study Population and Sample size and Sampling procedure

The study employed a descriptive cross- sectional design adapting both qualitative and quantitative data approaches. Studies by Ugbomoiko *et al,.* 2007; Muehlen *et al.*, 2003 [8, 13], have indicated that School children aged 6 to 14 years are mostly affected.

Sample Size Determination

Since the prevalence of tungiasis in Siaya County is not known. 50% prevalence will be used to determine the sample size. Minimum sample size will be determined using the following formula;

$$n = \frac{Z^2_{1-\alpha/2} P(1-P)}{d^2}$$ (Fisher *et al.*, 1998 Ψ)[14]

Where;

N = The minimum sample size

δ = The degree of precision (5%)

α = The level of significance (5%)

Z = The standard normal deviate that corresponds to 95% confidence interval

P = Estimated prevalence of Tungiasis (50%)

Therefore, N $=(1.96)^2 \times 0.50(1\text{-}0.50)/(0.05)^2 = 384.16$ Therefore 385 participants will be the minimum sample size.

The study adopted Multi-Stage sampling.

Participant Selection Criteria

Inclusion Criteria

Pupils in the selected schools who assented to participate.

Exclusion Criteria

Pupils in the selected schools who did not assent to participate.

Data Collection

Before the onset of the study, information meetings were held with County officials in the line ministries, School committees and the Communities gatekeepers so as to sensitize on disease prevention and control, and for ownership of the process before the study commenced. Community Health Workers (CHWs) were involved from the onset of diagnosis and a pre examination on how to identify classification of jiggers was done for them and the field officers. A pretested semi structured questionnaire was conducted among 385 participants and administered in English, or the local language to the participants.

Questionnaire Survey

For the school based survey; interviewer administered semi-structured questionnaires were developed and used as one of the data collection tools to elicit information on the demographic data that is age, gender and class levels, behavioral that is, personal hygiene such as bathing and wearing shoes. Before administration, approximately 10% of the 385 questionnaires (38 questionnaires) were pretested by administering them to schools from an area neighboring the survey site. Revisions after pretesting were done before implementation.

Quantitative Data Management and Analysis

Data was entered into the computer using Excel and Access. Statistical analysis was done after data validation. Data was then exported into the Statistical Package for Social Scientists (SPSS) version 23 and was analysed. Summary/descriptive statistics was used to describe the data and generate summary tables for each level-factor. Chi square tests used to test associations between variables where applicable. Results were presented in frequency distribution tables and charts. Differences between the parameters of estimate was deemed statistically significant at $p < 0.005$.

Results

Demographics

The 385 respondents class distribution had 5 – 6 classes were the majority at 191(49%) while those in class 7 – 8 were 189 (48%) and respondents who were in class 3 – 4 (3%) was the least category. The clients who had ever been infested with jiggers were at 333 (85.4%). The 385 respondent's gender distribution had 200 (51%) male and 185(49%) female. There was significant association between sex and tungiasis infestation at (χ^2=4.383[a], df=1, p=0.036). The age distribution of 10 - 15 category were the majority at 303 (78.3%) with 15 – 18 category at 81 (21.0%). The family size distribution of 4 -7 category had the highest respondents at 60.2%, 9 – 11 category at 121(31.3%. The household head occupation distribution the majority were farmers at 177 (47.7%) and businessmen were 44 (11.9%).Chi – Square test indicated relationship between the household head occupation and tungiasis infestation at (χ^2=44.729[a], df=28, p=0.023). Christians were the majority of respondent's parents at 383 (99.2%).

Knowledge Levels among Pupils

The 385 respondent's gender distribution had 200 (51%) male and 185 (49%) female. There was significant association between There was significant association between gender and ever infested with jiggers at (Pearson value=4.383[a], df=1, p=0.036).The

clients who had ever hear of jiggers and knew breeding place a majority indicated dusty soils at 231 (62.1%), under body skin at 71 (19.1%) and the least indicated on trees at 2 (0.5%). The respondents who heard ever had of jiggers a majority indicated family at 143 (36.9%), from friends and peers at 70 (18.0%), teachers at 68 (17.5%) and the least were respondents who had from media, health worker, family friends religious leader, teachers and campaigns at 2 (0.5%). The most important cause of jiggers according to the majority of the respondents was soil at 156 (39.9%), pigs 133 (34.0%) and the least was poverty at 4 (1.0%). There is dependency between the stated important causes of jiggers and who had ever been infested with jiggers at (Pearson value=36.482[a], df=9, p<0.0001). Soil was indicated by respondents as the main media for disease transmission at 113 (29.5%), Contact with infected person 109 (28.5%), through domestic animals at 74 (19.3%) and the least was Contact with infected water at 5 (1.3%). Disease transmission had a relationship with respondents who had ever been infested with jiggers at (Pearson value=17.215[a], df=5, p=0.004). Itchiness was the major Signs and symptoms of disease that was indicated at 381 (99.0%) with a significant chi-square association at (Pearson value=4.088[a], df=1, p=0.043). Jigger prevention method that was rated highest was washing regularly at 140 (40%), followed by wearing shoes 130 (37%) those who felt that a combination of washing regularly and wearing shoes is also a prevention strategy were 50 (14%). Jigger infestation season that had the highest proportion was dry season at 359 (92%) while those who do not know were 8 (2%). The respondents who felt that jigger was a serious problem in the area were 265 (69%) and the chi – square test indicated association between the jiggers being a serious problem and respondents who had ever been infested with jiggers at (Pearson value=13.175[a], df=1, p<0.0001).

Pupils practices towards Tungiasis Occurrence

313 (80%) of the respondents indicated that they normally wear shoes to school and 261 (83.4%) among those who wore shoes to school had ever been infested with jiggers. There was a statistically significant association between wearing shoes to school and tungiasis infestation at (χ^2=3.934[a], df=1, P =0.047). The respondent who wore shoes to school on daily basis were 201 (56%) and those who occasionally wore were 79 (22%). 176(49%) indicated that they wear closed shoes and open shoes at 125(35%), The respondent who wash themselves on daily basis at 359 (92%), occasionally were 23 (6%).187(48%) were the respondents who often washed uniforms biweekly and 102 (26%) washed weekly and only 63 (16%) washed on daily basis. Majority of the respondents indicated that they sleep in the main house at 165 (43%) and in stand-alone kitchen were 141 (36%).

Discussion

Summary of the key findings of the study indicate a positive relationship between; gender of pupils, occupation of household head, participants who had ever heard of jiggers, signs and symptoms, Seriousness of jiggers in the area, disease transmission and causes of jiggers, pupils practices like wearing of shoes significantly predict tungiasis infestation.

Study findings indicate a significant association between gender of pupils and them being infested with tungiasis. These data differences were attributed to exposure and environmental factors, rather than difference in susceptibility, thus, we speculate that gender differences are, similar to age, related to different exposure and disease-related behavior. These findings have been consistent across studies and seem to differ from community to community. Research in Cameroon and Trinidad found statistically significant differences between the sexes with which males carried higher disease burden compared to females [15,7], this could be due to the fact that males are less sensitive to their health compared to females. Higher prevalence was high noted in male children of between classes 5 – 6. This was attributed to the fact that children are allowed to go to school barefooted and play around in the community without shoes as they interact with contaminated ground hence compromised personal hygiene and environmental sanitation. This is in agreement with a study which was conducted in Western Nigeria where majority of those affected by tungiasis were children aged 5 to 14 years old and the elderly [8]. Other socio-economic and behavioural factors found in this study included occupation of household head which significantly affected tungiasis

Table 1. Socio-Demographic Characteristics

Socio-Demographic Characteristics		Tungiasis Infestation		Total	χ^2	df	P-value
		No n %)	Yes n (%)				
Respondents class	03-Apr	3(30.0)	7(70.0)	10	4.177	2	0.124
	05-Jun	22(11.5)	169(88.5)	191			
	07-Aug	32(16.9)	157(83.1)	189			
Sex	Male	22(10.9)	179(89.1)	201	4.383	1	0.036
	Female	35(18.4)	155(81.6)	190			
Age	05-Sep	0(0.0)	2(100.0)	2	1.036	3	0.793
	Oct-15	47(15.4)	259(84.6)	306			
	15 - 18	10(12.2)	72(87.8)	82			
	19 and Above	0(0.0)	1(100.0)	1			
Family size	01-Mar	4(17.4)	19(82.6)	23	2.55	3	0.466
	04-Jul	36(15.5)	197 (84.5)	233			
	09-Nov	15(12.4)	106(87.6)	121			
	12 and Above	3(30.0)	7(70.0)	10			
Household head occupation	Business	10(20.5)	40(79.5)	50	44.729	28	0.023
	Farmer	22(12.4)	155(87.6)	177			
	Formal Employment	5(5.3)	50(94.7)	55			
	Not working	2(20.0)	8(80.0)	10			
	Informal employment	9(15.4)	70(84.6)	79			
Religion of the parent	Christian	58(15.1)	325(84.9)	383	0.535	1	0.465
	Muslim						

Table 2. Pupils' Knowledge on tungiasis occurrence

Knowledge on disease occurrence		Ever infested with jiggers		Total	χ^2	df	p-value
		No n (%)	Yes n (%)				
Ever heard of jig-gers	No	2(66.7)	1(33.3)	3	6.361.	1	0.012
	Yes	56(14.5)	329(85.5)	385			
Jiggers breeding place	Trees	0(0.0)	2(100.0)	2	10.827	5	0.055
	Water	3(60.0)	2(40.0)	5			
	Dusty soils	41(13.4)	233(86.6)	274			
	Under body skin	11(15.5)	60(84.5)	71			
	Other	5(25.0)	15(75.0)	20			
Mode of finding information about the disease	Media	5(36.4)	8(63.6)	13	19.222	12	0.083
	Health workers	1(4.5)	28(95.5)	29			
	Family	18(9.1)	142(90.9	160			
	Friends and peers	13(15.7)	68(84.3)	81			
	Religious leaders	0(0.0)	5(100.0)	5			
	Teachers	14(20.6)	54(79.4)	68			
	Community baraza	1(10.0)	9(90.0)	10			
	Campaigns	1(20.0)	4(80.0)	5			
	Others	3(17.6)	14(82.4)	17			
Most important cause of jiggers	Soil	15(7.7)	183(92.3)	198	36.482	9	<0.0001
	Chicken	0(0.0)	2(100.0)	2			
	Dogs	6(20.0)	24(80.0)	30			
	Pigs	25(18.8%)	108(81.2)	133			
	Other	12(34.8%)	16(65.2)	28			
Disease transmission	Contact with infected water	0(0.0)	5(100.0)	5	17.215[a]	5	0.004
	From soil	15(6.2)	149(93.8)	161			
	Through domestic animals	20(27.0)	54(73.0)	74			
	Contact with infected person	14(12.8)	9(87.2)	109			
	Other	5(16.1)	26(83.9)	31			
Seriousness of jiggers in the area	No	28(23.1)	93(76.9)	121	13.175	1	<0.0001
	Yes	25(9.4)	240(90.6)	265			

Prevention of jiggers	Wearing shoes	24(18.5%)	106(81.5%)	130	7.802[a]	5	0.167
	Washing regularly	13(9.3%)	127(90.7%)	140			
	Wearing school uniform	2(33.3%)	4(66.7%)	6			
	Using the toilet	1(12.5%)	7(87.5%)	8			
	Others	2(10.5%)	17(89.5%)	19			
	Wearing shoes and washing regularly	10(20.0%)	40(80.0%)	50			
High season of jiggers infestation	Wet	4(19.0%)	17(81.0%)	21	2.317[a]	3	0.509
	Dry	52(14.5%)	307(85.5%)	359			
	Don't know	1(12.5%)	7(87.5%)	8			
	Wet, dry	1(50.0%)	1(50.0%)	2			

Table 3. Individual/Pupils practices towards disease occurrence

Pupils practices towards disease occurrence	**Ever infested with jiggers**			**Total**	**X^2**	**df**	**p-value**
	No n (%)		**Yes n (%)**				
Wearing of shoes to school	No	6(7.7)	72(92.3)	78	3.934	1	0.047
	Yes	52(16.6)	261(83.4)	313			
		58(14.8)	333(85.2)	391			
Frequency of wearing shoes to school	Daily basis	31(15.4)	170(84.6)	201	3.092	3	0.378
	Occasionally	12(15.2)	67(84.8)	79			
	Rarely	10(18.5)	44(81.5)	54			
	Other	1(3.8)	25(96.2)	26			
Type of shoes worn to school	Open shoes	19(15.2)	106(84.8)	125	4.027	3	0.259
	Closed shoes	29(16.5)	147(83.5)	176			
	Sandals	6(15.0)	34(85.0)	40			
	Other	0(0.0)	21(100.0)	21			
Frequency of washing self	Daily basis	54(15.0)	305(85.0)	359	1.699	3	0.637
	Occasionally	4(17.4)	19(82.6)	23			
	Rarely	0(0.0)	4(100.0)	4			
	Other	0(0.0)	5(100.0)	5			
Frequency of washing uniforms	Daily basis	16(25.4)	47(74.6)	63	6.587	3	0.086
	Weekly	12(11.8)	90(88.2)	102			
	Bi weekly	25(13.4)	162(86.6)	187			
	Other	5(14.3)	30(85.7)	35			
Part of house pupils sleep	Main house	30(18.2)	135(81.8)	165	3.519	3	0.318
	Stand-alone Kitchen	17(12.1)	124(87.9)	141			
	Extension	11(14.7)	64(85.3)	75			
	Other	0(0.0)	7(100.0)	7			

occurrence. For example, families with better access to water and using soap are prone to better hygiene standards. In addition, tungiasis can be regarded as a poverty-associated disease [16,17] and improving sanitation have been discussed as factors in reduction of tungiasis incidence[18].

Current study findings reported a significance dependency between participants who had ever heard of jiggers and tungiasis infestation. This finding emphasizes the importance of education and raising awareness in the prevention and control of tungiasis [19]. This finding implies that the level of knowledge on prevention and control and predisposing factors for tungiasis infestation was relatively low. This could explain inability by the locals to take informed prevention and control measures. However, these study findings contradict with a study conducted by Kimani *et al.,* (2012) where the reported level of knowledge on tungiasis prevention was relatively high but there was no related evidence for sand flea prevention and control in the area [19]. Another important finding is that majority of the participants' associated poor hygiene to tungiasis. This is consistent with previous literature that reported poor hygiene and dusty soil as the breeding place as the most important cause of tungiasis infestation [19]. It is therefore important that the hygiene status in homesteads is improved to reduce tungiasis [20]. Dirty feet and clothes provide a conducive environment for *T. penetrans* to survive and hide. Several studies have highlighted personal hygiene as an important factor in control and prevention of tungiasis [10, 21, 22].

The findings indicated a positive significance with regard to knowledge, specifically on signs and symptoms and tungiasis infestation. The knowledge on early signs and symptoms should act as a trigger mechanism for the household members to take appropriate action to prevent and control infestation. Further findings revealed that Itching is the commonest symptoms. Studies by Muehlen (2005) posted that the first evidence of infestation by the sand flea is a tiny black dot on the skin at the point of penetration and then a small inflammatory papule with a central black dot forms within the next few weeks [23]. Though the respondents reported mixed attitude toward tungiasis infestation, the problem is often brushed off as a thing of the past, or as a minor problem that can be relegated for more pressing issues.

Positive level of significance was also noted on the seriousness of jiggers as a disease in the study area. These findings are in tandem with a study by Winter *et al.,* 2009 that revealed that tungiasis is associated with poverty and occurs in resource poor countries in the Caribbean, South America and Africa [24]. Public health experts warn that heavy jiggers infestations goes beyond mere discomfort and can leads to loss of toe/ finger nails, amputation of the digits and could even cause death [23] which only exacerbate the problem further. Study findings indicates that family members play a major role in knowledge transfer while health agents, nurses, and physicians only marginally contribute to knowledge on this parasitic skin disease. Consequently, addressing comprehensive and sustainable solutions to these neglected health problems cannot be the sole responsibility of the health sector but it also requires community participation and multi-sectoral approaches to the health determinants [25]. Some of the reported reasons for tungiasis persistence in this study may contribute to continued tungiasis infestation in the area bearing in mind that highest levels of infestation occurs during the dry seasons.

Findings revealed a positive influence on disease transmission and causes of jiggers with disease occurrence. Soil was noted as the main cause of tungiasis. A study by Heukelbach *et al.,* (2004) posted that knowledge on disease cause, transmission, and treatment practices was very similar in both rural and urban settings. The few exceptions can be explained by behavioural or environmental particularities present in one setting, but absent in the other [26]. Current study indicated washing of self as one way of prevention and control. Similarly, a high degree of knowledge on the infectious agent of a disease was noted in Brazil by Winter *et al.*, (2009), where 90% knew the flea as the etiological agent of tungiasis [24]. A similarly high degree of knowledge on the infectious agent of a disease has been noted in populations suffering from malaria, schistosomiasis and filariasis, parasitic diseases with prevalences in endemic areas similar to tungiasis [27, 28, 29].

Study findings reported level of significance between pupil's wearing of shoes and tungiasis

infestation. Pupils behaviour and practices towards a certain disease normally affects occurrence. These findings are in tandem with a study on tungiasis conducted in Brazil, which revealed that there was remarkable reduction in tungiasis when people started using shoes as opposed to sandals [24]. This is also in agreement with the study by Kimani *et al.,* (2012) where they found out that people associated tungiasis with poor hygiene and sanitation (79.3%), poverty (43.5%) [19]. Although the use of shoes can provide some measure of protection, it is unrealistic as a solution as neither eradication nor elimination of the parasite will occur. However, social efforts to improve hygiene, welfare and standard of living do provide additional protection against the jigger flea as tungiasis is mostly a disease of the poor. Economical, behavioural and cultural constraints may prohibit the intensive use of closed footwear in endemic communities including Eastern Africa.

Conclusions and Recommendation

Study concludes that tungiasis is still a big problem in rural settings and Knowledge on tungiasis infestation does not translate to prevention and control in the areas. More emphasis should be given to improving practices touching on personal hygiene and health education to increase awareness both at school and in the households.

Study Limitations

Since it was a Cross-Sectional study, it was therefore difficult to infer causality.

List of abbreviations

CLTS: Community Led Total Sanitation

ESACIPAC: Eastern and Southern Africa Centre of International Parasite Control

KEMRI: Kenya Medical Research Institute

MDG: Millennium Development Goals

PHAST Participatory Hygiene and Sanitation Transformation

SERU: Scientific Ethical Review Committee

SHNP: School health and nutrition programmes

SPSS: Statistical Package for Social Sciences

STLS: School total led sanitation

UN: United Nations

WASH: Water Sanitation and Hygiene

Declarations

Ethics Approval and Consent to Participate

This study was approved by the KEMRI Ethical Review Committee (SSC/ERC protocol No. (KEMRI/ SERU/ESACIPAC/P003/353). The study used questionnaires uniquely coded with results of each questionnaire being kept in strict confidence. Participating in the study was voluntary and one could withdraw at any point. The purpose of the study and its objectives were explained to local authorities, opinion leaders, head teachers, and community members. Informed consent and assent was obtained from the participating respondents in writing. Parental consent was obtained for participants under 16. Subjects were assured about confidentiality of information obtained from them and personal identifiers were removed from the data set before analysis.

Consent for publish

Not applicable

Availability of data and materials

That all data used in the manuscript is available for sharing; including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes, without breaching participant confidentiality.

Competing Interests

The authors declare that they have no competing interests.

Authors' contributions

JM- conceived of the study, participated in its design coordination, and helped to draft the manuscript.

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