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Exposure to secondhand smoke from cigarettes: A cross-sectional study of primary school adolescents in Awendo Sub-County, Migori-Kenya

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Abstract: (11Bold) *Tobacco use is responsible for 6 million deaths globally per year, of which 600,000 deaths are due to secondhand smoke (SHS) exposure mainly among children [1]. The aim of the study was to examine Second hand smoke exposure among primary school children, their awareness of its harmfulness and determinants of exposure to second hand smoke (SHS) exposure among non-smokers.*
A cross-sectional survey was conducted between February-March 2016 among 579 primary school students 14—17 year old from Awendo, Migori County, Kenya. The sample consisted of 291 students from government and 288 from private schools . Data was collected by a self-administered questionnaire adapted from the global youth tobacco survey questionnaire. The main outcome was exposure to secondhand tobacco smoke in the home and school and other variables included family setting, type of primary school attended and knowledge of SHS health risks. The response rate was 96.5%. More than 49% of respondents had been exposed to involuntary smoking at school and 44% at home in the previous seven days. The highest odds of exposure were associated with sibling smoking (OR = 5.06; 95% CI = 3.29-7.77), followed by parental smoking (OR = 3.69; 95% CI = 2.54-5.54), teacher smoking (OR = 3.67; 95% CI =2.43-5.55), and living with neither parent (OR = 2.48; 95% CI = 0.91-6.80). Odds were reduced among adolescents with knowledge about harms related to SHS exposure, however, few students (27.4%) understood these harms. Efforts are needed to decrease primary school children's exposure to SHS. These should include health campaigns in the media and schools to increase awareness about the dangers of SHS exposure.

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I. Introduction

Cigarette smoke contains over 4000 chemicals, including irritants and almost 70 carcinogens [1.] Involuntary smoking, also known as passive smoking, second-hand smoke (SHS) exposure or environmental tobacco smoke exposure, refers to the mixture of smoke coming from the burning tip of a cigarette and the smoke exhaled by the person smoking the cigarette. The concentration of toxins and carcinogens in the smoke from the burning tip of the cigarette is often much higher than in the smoke exhaled [2]. Active and passive smoking constitute a significant cause of morbidity globally and together are one of the main modifiable risk factors of preventable mortality [2, 3, 4, 5]. It is estimated that tobacco kills more than 7 million people each year [6] and that by 2030, the number of tobacco-attributable deaths will increase to 8 million each year, with 80 percent of those deaths in low- and middle income countries [7].Based on existing evidence, there is no safe level of involuntary smoking. [1,8,9] Children are a vulnerable population and have little choice about SHS exposure, which has been reported to precipitate asthmatic attacks, [10] respiratory infections, [11, 12]ear infections, [13] sudden infant death syndrome [14] and neurodevelopmental outcomes, such as behavioral problems or decreased cognitive and psychomotor functions,[8] In addition, considering their physical development, as well as longer exposure time, children and adolescents are at a greater future health risk from SHS exposure than adults. [9]Furthermore, SHS exposure is associated with an increased likelihood of initiation and continuation of cigarette smoking. [8,9]An analysis of 356,414 adolescents in Global Youth Tobacco Surveys conducted in 168 countries who had never smoked indicated that 30% were exposed to SHS at home, 44% outside home, and 23% both at, and outside, home. [15] One study in an Ethiopian school reported that classroom discussion of the dangers of smoking were significantly and negatively associated with SHS exposure [16] however, generally In the developing world there are inadequate initiatives, strategies, policies and legislation to reduce SHS exposure. Sub-Saharan Africa is at stage one of the tobacco epidemic continuum, in which the prevalence of smoking is higher among men than women.[17] In Kenya, studies monitoring the progress of legislation indicated that the country lacked coordinated efforts for tobacco control, enforcement was weak and monitoring of the existing tobacco

legislation was poor. [18] In 2013, a national survey of 1,326 Kenyan Primary and secondary school students aged 13-15-years old showed that SHS exposure was high, with 24.8%SHS exposure at home, and about 45% reporting SHS exposure in enclosed public spaces.[19] In Kenya, there is an increase in the number of people converting from being non-smokers to either daily or light smokers. [20] This increases the risk of second hand smoke exposure as only 49% of smokers in Kenya reported that they do not allow any smoking inside their home. [21]Effective implementation of SHS exposure control measures requires a better understanding ofthe factors associated with the involuntary smoking among the adolescents. It can be expectedthat these determinants may be country-specific and can depend on the level of exposure on the one hand, and on the existence and awareness of tobacco control policies on the other. Despite the fact that tobacco control activities and enforcement of the legislation are relatively well developed, these are mostly carried out among adults in metropolitan areas.[6] Remote rural regions and disadvantaged populations, which are more difficult to reach, are less frequently covered by these activities. [22] Even though Kenya has implemented legal limitations on smoking and a complete ban on smoking in public areas and selected workplaces, not as much effort has been put into encouraging the adoption of smoke-free rules in private settings. The aim of the study was to examine second hand smoke exposure, awareness of its negative

Healtheffects and the factors associated with SHS exposure at home and at school among non-smoking adolescents from a rural area in Migori, Kenya

II. Material And Methods

This 2-stage cluster-sample design was carried out among governmentand private day school students class 7–8 aged 14-17years old) at primary schools in Awendo in Kenya. Kenya primary school education begins in class one with a minimum age of 7 years and ends in class 8, with a minimum age of 14 years. A total of 544 students both male and female were recruited for this study.

Study Design: Cross sectional Survey

Study Location: This was a school based study done in both government and private primary schools at Awendo, Mogori-Kenya.

Study Duration: February to March 2016.

Sample size: 579 students.

Sample size calculation: The sample size was estimated on the basis of a single proportion design. The target population from which the sample was randomly selected was approximated to be 8,000. A confidence interval of 10% and confidencelevel of 95% was assumed. The actual sample size obtained for this study was 544adolescents consisting of 269 students from governmentschools and 275 from private schools. The study planned to include 300 students for each group with 5% drop out rate.

Subjects & selection method: In stage 1, schools were stratified into governmentand private schools, and 7 samples were drawn. Schools were selected for participation in the survey with a probability proportional to the number of students enrolled. The second sampling stage consisted of probability sampling of class 7 and 8 from each school that participated in the survey.

Inclusion criteria:

1. Class 7 or 8 Primary school students in Awendo Sub-County Migori
2. Either sex
3. Aged ≥ 14 years,
4. Those who do not Smokers cigarettes

Exclusion criteria:

1. Primary school students not in class 7or 8
2. Primary school students not within Awendo Sub-County
3. Students who smoked cigarettes
4. Students who abuse drugs

Procedure methodology

Ethical clearance was obtained from the relevant institutional review board.Permission to carry out the study in schools was obtained from the school administrations.After written informed consent was obtained, a self-administered questionnaire adapted from the global youth tobacco survey questionnaire was used to collect the data of the recruited students retrospectively. All students who chose to participate completed an anonymous, self-administered survey that included questions on: personal smoking status; SHS exposure at home and school, SHS exposure from parents, siblings and teachers; living status; and awareness of the health risks of SHS exposure. Data were weighted to account for nonresponses at both student and school levels and to ensure statistical representation of the government and private primary school students in Awendo according to

their class and sex. This study analyzed responses on SHS exposure, which was defined as being in a room during the previous 7 days with someone who was smoking cigarettes.

Statistical analysis

Data was analyzed using R software version 3.0.2 to determine what factors contributed to SHS exposure at home and at school. Socio demographic characteristics were analyzed using SPSS version 17. Multinomial logistic regression was used to estimate association between relevant predictor variables at school and at home with exposure to secondhand tobacco smoke. Odds ratios associated with each outcome were reported. The level $P < 0.05$ was considered as the cutoff value or significance.

III. Result

The overall response rate in this study was 96.5% (579/600), 96% (288/300) in public schools and 97% (291/300) in private schools, with no significant difference between schools. Adolescents who were smokers and questionnaires with missing data were excluded from analysis. A total of 544 (269 from governmentand 275 from private schools) students were included in the study analyses. The prevalence of SHS exposure was 49.3%, 44.1%, and 24.5% at school, at home, and both at home and school, respectively.

Table 1 shows there were significant differences between exposed and non-exposed adolescents in all socio-demographic characteristics except type of school. The highest SHS exposure was among adolescents who were more than 17 years old (63.6%), male (61.2%), in public schools (61.1%) and who lived with neither of the parents (69.1%). Only few (27.4%) adolescents had Knowledge about harmful effects of SHS exposure.

Table no 1: ShowsSocio-demographic characteristics of survey respondents by SHS exposure.

	SHS Exposure		
Variable	**Exposed N (%)**	**Not exposed N (%)**	**p value**
Exposure			
At school	268 (49.3)	276 (50.7)	
At home	240 (44.1)	304 (55.9)	
Both at home and school	133 (24.5)	411 (75.5)	
Overall Prevalence	375 (68.9%)	169 (31.1%)	
Age (years)			
<14	73 (46.1)	86 (53.9)	0.02*
14-17	152 (52.5)	137 (47.5)	
>17	61 (63.6)	35 (36.4)	
Sex			
Female	129 (50.8)	125 (49.2)	0.01*
Male	177 (61.2)	113 (38.8)	
Type of school			
Private	153 (54.5)	128 (45.5)	0.05
Public	161 (61.1)	102 (38.9)	
Family structure			
One or both parents	263 (53.9)	225 (46.1)	0.02*
Neither	39 (69.1)	17 (30.9)	
Knowledge about harmful effects of SHS exposure	92 (16.9%)	57 (10.5%)	

∗Significant difference.

Overall SHS exposure among the adolescents

As shown in Table 2, the highest odds of overall (both at home and school) SHS exposure were associated with sibling smoking (OR = 5.06; 95% CI = 3.29-7.77), followed by parental (OR = 3.69; 95% CI = 2.54-5.54) and teachersmoking (OR = 3.67; 95% CI =2.43-5.55). Adolescents attending government(as opposed to private) schools were also at increased risk of SHS exposure.

Table no2: Socio-demographic and smoking-related variables by overall SHS exposure.

	Overall SHS Exposure			
Factor	**Exposed**	**Not exposed**	**Adjusted OR***	**95% CI**
	N=133	**N=411**		
Age (years)				
<14	15	64	Reference	
14-17	69	212	1.3	0.74-2.59
>17	49	135	1.5	0.81-2.97
Sex				
Female	63	202	Reference	
Male	70	209	1.10	0.73-1.56
Type of school				
Private	56	229	Reference	

Public	77	182	1.7	1.17-2.56
Family structure				
One or both parents	126	402	Reference	
Neither	7	9	2.48	0.91-6.80
Parent smoking				
No	60	309	Reference	
Yes	73	102	3.69	2.54-5.54
Sibling Smoking				
No	67	344	Reference	
Yes	56	67	5.06	3.29-7.77
Teacher smoking				
No	44	265	Reference	
Yes	89	146	3.67	2.43-5.55
Knowledge about harmful effects of SHS exposure				
No	99	295	Reference	
Yes	34	116	0.87	0.56-1.36

Table no3: Shows Socio-demographic and smoking-related variables by SHS exposure at home.

Exposure to SHS at home was significantly associated with parental and sibling smoking with an adjusted OR of 6.46 (95% CI = 4.24-9.84) and 2.76 (95% CI = 1.95– 3.92), respectively (Table 3). Adolescents who were older (>17 years), attended public school and had siblings who smoked (OR = 4.17; 95% CI = 2.9–5.99) had an increased odds of SHS exposure at home.

Table no3: Shows Socio-demographic and smoking-related variables by SHS exposure at home.

	SHS Exposure at Home			
Factor	**Exposed**	**Not exposed**	**Adjusted OR***	**95% CI**
	N=240	**N=304**		
Age (years)				
<14	29	48	Reference	
14-17	127	155	1.36	0.81-2.27
>17	84	101	1.38	0.80-2.37
Sex				
Female	118	147	Reference	
Male	122	157	0.97	0.69-1.36
Type of school				
Private	124	169	Reference	
Public	116	135	1.17	0.83-1.64
Family structure				
One or both parents	229	297	Reference	
Neither	11	7	2.04	0.78-5.33
Parent smoking				
No	123	265	Reference	
Yes	117	39	6.46	4.24-9.84
Sibling Smoking				
No	96	197	Reference	
Yes	144	107	2.76	1.95-3.92
Knowledge about harmful effects of SHS exposure				
No	178	217	Reference	
Yes	62	87	0.87	0.59-1.27

Table no4 Shows Socio-demographic and smoking-relatedvariables by SHS exposure at School.The main factors were associated with increased odds of SHS exposure at school. Adolescents who lived with smoking siblings had 4-fold increased odds of SHS exposure (OR = 4.17; 95% CI = 2.9–5.99). Other factors found to increase the odds of exposure significantly were parental smoking, age >17 years, living with neither parent, being in government primary school, and male sex. The risk of exposure, however, was significantly reduced among adolescents having knowledge about the harmful effects of SHS exposure, with an adjusted risk of 0.69 (95% CI = 0.47–1.01) as shown in Table 4 below.

Table no4: Shows Socio-demographic and smoking-relatedvariables by SHS exposure at School.

	SHS Exposure at School			
Factor	**Exposed**	**Not exposed**	**Adjusted OR***	**95% CI**
	N=268	**N=276**		
Age (years)				
<14	30	50	Reference	
14-17	132	149	1.48	0.87-2.26

>17	106	77	2.29	1.34-3.94
Sex				
Female	113	152	Reference	
Male	155	124	1.68	1.20-2.36
Type of school				
Private	130	166	Reference	
Public	138	110	1.60	1.14-2.25
Family structure				
One or both parents	258	271	Reference	
Neither	10	5	2.10	0.71-6.23
Parent smoking				
No	182	229	Reference	
Yes	86	47	2.30	1.54-3.45
Sibling Smoking				
No	106	202	Reference	
Yes	162	74	4.17	2.90-5.99
Knowledge about harmful effects of SHS exposure				
No	204	190	Reference	
Yes	64	86	0.69	0.47-1.01

IV. Discussion

The current study demonstrates that about 69% of the participants were exposed to SHS, and about 64 % of them were males. What is more, the risk of SHS exposure was higher among those who had smoking siblings, parents or teachers. It was further observed that Knowledge about harmful effects of SHS exposure reduced the risk of exposure by 13-31%. However despite such awareness, many of the students were still exposed to involuntary smoking in their environment.

The prevalence of SHS exposure to adolescents in Awendo, Kenya, was 44.1% at home and 49.3% at school, with the SHS exposure in both places being 24.5%. A similar high prevalence of adolescent SHS exposure was also reported in a study conducted among adolescents who had never smoked in 168 countries which indicated that 30% of them were exposed to involuntary smoking at home, 44% outside of it, and 23% in both places.[15] A previous survey across Kenya has reported that more than a quarter (27.4%) of all school children were exposed to SHS at home.[19] The higher prevalence of exposure at home and at school compared to GYTS may be attributed to the difference in the sample population where GYTS survey was conducted among secondary school students. This difference could also be due to high prevalence of tobacco use in the current study area and lack of tobacco control activities.[18,22] In this study, the majority of those in the exposed group were males (61.2%), compared with 50.8% of females. This finding differs with those of a study in Ethiopia[16] where females were more exposed to SHS compared to Males. The findings were however similar to the GYTS Kenyan.[23] This can be explained by the fact that in Kenya there are more males smokers than females.[17] This can also be explained by the cultural and traditional background of the country, at which males tend to group together and females tend to group together.

The present study revealed that the highest risk of exposure at home and at school was associated with parental smoking, sibling smoking, and living with neither parent. A 6-fold increase in risk was observed with parental smoking for SHS exposure at home. Similarly, adolescents having either of their parents smoking were 3.3 times more likely to be exposed to SHS than their counterpart adolescents (AOR=3.34, 95% CI 2.37-5.03). Similarly female students were more likely to be exposed to SHS at home than their male counterpart. These results are similar to those of Orton et al, [24] where children whose mothers or both parents smoked were more likely to be exposed to SHS. Similarly students who lived with smoking siblings were at increased risk of SHS exposure in Athens and Thessaloniki, Greece. [25] Students who lived with a smoker were significantly more likely to be exposed to SHS than those who did not. Similarly, children are commonly exposed to SHS when their parents are smokers.[26]

Having a sibling who smoked also had a 4-fold increased risk for SHS exposure at school. This could be attributed to increased tolerance of SHS developed at home. The odds of adolescent exposure to SHS and specifically at school were significantly increased among late adolescents (>17 years). This is similar to the results of Raute et al [27] which indicated that the odds of adolescent exposure to SHS and specifically outside household were significantly increased among late adolescents (>15 years). Public primary school students were at a higher risk of exposure to SHS both at home and at school. Teachers smoking inside the school campus were significant determinants of students' exposure to passive smoking among adolescents in Greece. [25] This finding may be attributed to the higher student population and less stringent rules prohibiting smoking in government primary school compounds.

In this study, the risk of SHS exposure at school was decreased among adolescents having knowledge about the harmful effects of SHS exposure compared with those having no knowledge. However this decrease was insignificant. The present study revealed a 13% reduction in the risk of exposure to SHS at home and a 31%

reduction at school among adolescents with knowledge about harmful effects of SHS exposure. In a Mumbai study, [27] there were increased odds of SHS exposure at home among adolescents who had no awareness about the harmful effects of SHS. This finding reiterates the importance of creating awareness about harmful effects of SHS exposure among non-smoking adolescents.

The present study has a number of strengths that include being school-based with a high response rate among the invited students, which supports the robustness of the study findings. Furthermore, the study addressed SHS exposure both at home and at school. Finally, the results presented in this study were precisely estimated, as indicated by the observed narrow confidence intervals. However, the limitations should not be overlooked. Firstly, the study did not assess biomarkers of tobacco smoke exposure such as cotinine levels in study participants who reported exposure to SHS. As the study participants were asked to report past 7 day exposure, this would have been possible to detect in urine. [28] Also data were collected from students who attended school on the day of the survey. No attempt was made to seek out those who did not attend at the day of data collection. Finally, this was a self-report questionnaire. There is therefore potential for mis-reporting by study participants

V. Conclusion

This study revealed a considerably high prevalence of adolescents being exposed to SHS in Awendo, Migori County. One of the main findings of this study was that the highest risk ofexposure at home and at school was associated with parental smoking, sibling smoking and living with neither of the parents. Few students had knowledge of the harmful effects of SHS exposure. This could have contributed to the insignificant decrease in risk among those with knowledge about the harmful effects of SHS exposure among adolescents. This signifies the need for schools and families to increase awareness of their students towards the hazards of SHS exposure. The risk of SHS exposure in this study was related to the siblings' and parents' smoking status. This finding reflects the need to design an appropriate and effective antismoking education program addressing smoking predictors and targeting not only school students but also their families, and school members. Also, the study findings provide a significant alarm to national policymakers regarding the need to promote more preventive strategies in addition to the present smoking legislation.

Adolescents are exposed to SHS inside homes and at school, so parental education is of paramount importance. Health advocacy toward adopting smoke-free policies for homes and schools is highly needed. This study recommends sensitization of risks of SHS exposure which can be achieved by setting a day similar to the Hand washing day in Kenya which is conducted annually, targeting the children and adolescents in primary and secondary schools in collaboration with tobacco control government agencies as well as nonprofit organizations.

Conflict of Interests

The authors declare that they have no competing interests regarding the publication of this paper.

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Authors' contributions

The corresponding author designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. The second author managed the analyses of the study and proof read the first draft. The two authors managed the literature searches, read and approved the final manuscript.

Ethical approval

This survey was approved by Great Lakes University of Kisumu (GLUK), GLUK Research Ethics Committee (GREC) , Ref: No. GREC/004/242/2016

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