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Effects of Second Hand Smoking on the Health of School Children in Awendo, Kenya

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Abstract: Exposure to secondhand smoke (SHS) can cause diseases and deaths among children. Yet children continue to be exposed especially among the low income countries. Epidemiological evidence shows that children of smoking parents have increased risk of neuro-behavioral deficits, neurodevelopmental deficits and childhood cancer. The aim of this study was to find out if children living in low-income countries are still exposed to SHS and its additional burden on the health and school absenteeism among children in the rural setting. A cross-sectional survey was conducted in February-March 2016. A 2-stage cluster-sample design was used to obtain a representative sample (N=600) of private and public primary day school students year 7 and 8 (aged 12-15 years old) in Awendo. A higher proportion (55.5%) of the younger children lived with one or more than two smokers in the home. A modest proportion of children reported complete restriction of smoking at home. The risk of Asthmatic attack increased by more than three fold and more than ten fold among children living with one smoker and among those living with more than two smokers respectively. Smoking has been associated with poor dietary intake, in this case children living with smokers were found to be significantly malnourished. Successful smoking cessation among residents living with children could contribute to decreased asthmatic attacks, malnutrition and school absenteeism.

Keywords: Secondhand Smoke, School Children, Health Effects

1. Introduction

Secondhand smoke exposure occurs when smoke exhaled by a smoker and the smoke that comes from the end of a burning cigarette are inhaled by the nonsmoker. Third hand smoke is the invisible yet toxic brew of gases and particles clinging to smokers' hair and clothing, not to mention cushions and carpeting, that linger long after secondhand smoke [SHS] has cleared from a room. [1] Inhaled fresh side stream smoke is about 4 times more toxic than mainstream smoke. [2] Yet thousands of children remain unprotected from involuntary exposures to SHS from adult smoking. [3]

Non-Smokers are frequently exposed to smoke when someone nearby is smoking especially in an enclosed place. There is no safe amount of secondhand smoke. Even low levels of it can be harmful. The only way to fully protect nonsmokers from secondhand smoke is not to allow smoking indoors.

Second-hand smoke causes lung cancer in adults who have never smoked. Non-smokers who are exposed to second-hand smoke at home or at work increase their risk of developing lung cancer by 20–30%. As with active smoking, the longer the duration and the higher the level of exposure to secondhand smoke, the greater the risk [4].

Children are particularly at risk for the effects of second-hand smoke because their bodies are still growing and they breathe at a faster rate than adults. Global Youth Tobacco Survey [5] showed that almost half of the world's children are exposed to second-hand tobacco smoke (SHS). Children in vulnerable populations are at greatest risk for SHS exposure. It has been reported that thirty-four percent of children live with a smoker. [6] If parents or elderly siblings smoke at home, children are frequently exposed and children are especially sensitive to the toxins in second-hand smoke. [7] A study carried out in Bangladesh showed that 55% of

households in the sample had at least one regular smoker whereas in the same study nearly 40% of children were exposed to SHS. [8] Strong association has been shown between SHS exposure and living with smokers among children. In the same study there was a negative association between SHS exposure and smoking restrictions at home. [9] A study carried out in 20 low income countries showed that about three in four children under the age of 15 years, living with at least one smoker, were exposed to SHS in the homes. [10]

Children overall experience an estimated 61% of the disease burden from SHS. [11] Epidemiological evidence shows that children of smoking parents have increased risk of neuro-behavioral deficits, neurodevelopmental deficits and childhood cancer. Scientific evidence revealed that second-hand smoke/passive smoking among children leads to acute respiratory illness in children as pneumonia, bronchitis, middle ear problem, cough & wheeze. [12] In addition the risk of developing acute respiratory illnesses increases by 60%, chronic respiratory symptoms by 24 – 40%, asthma and exacerbation of asthma symptoms by 21%, recurrent otitis media (repeated ear infection) by 50% and cleft palate by 60-100 %.[13] Asthma is the most prevalent chronic condition affecting children. [14] Sufficient Evidence to infer a causal relationship between parental smoking and ever having asthma among children of school age is suggestive of a causal relationship between second hand smoke (SHS) exposure from parental smoking and the onset of childhood asthma. [15] SHS exposure has previously been associated with asthma severity based on symptom reporting, school absence and illness frequency. [16]

Not surprisingly, children who are exposed to household tobacco smoke also miss more school days per year than do children who live in smoke-free homes. [17] School absenteeism may be used as a general marker of morbidity that is easily assessed using survey methods. [18] Geographically and demographically limited studies indicate that SHS exposure leads to school absenteeism in young children. [19, 20] A study by Douglas et al, [21] found out that children living with 1 or ≥2 adults who smoked in the home had 1.06 (95% confidence interval [CI]: 0.54–1.55) and 1.54 (95% CI: 0.95–2.12) more days absent from school per year, respectively, than children living with 0 smokers in the home. The number of days a child was absent from school was significantly higher for those living in homes in which smoking took place than for those living in smoke-free homes, and greater numbers of household smokers led to increased absenteeism.

SHS exposure has been associated with increased risk of malnutrition among children.

Increased severe wasting of 17% was associated with SHS exposure among children of poor urban families in Indonesia. [22]

Children have little control over their environment and are dependent on their caregivers to protect them from SHS exposure. The children bear the biggest burden of disease due to SHS exposure than any other age group. However, children living in many high-income countries have had a sharp decline in their exposure to SHS in recent years. What remains unknown is if children living in low-income countries are still exposed to SHS and it's additional burden on the health and school absenteeism among children in the rural setting. This study sort to determine the effects of Second Hand Smoking on the Health of School Children in the households in Awendo, Kenya

2. Methodology

2.1. Sampling and Sampling Design

A cross-sectional survey was conducted in February-March 2016. A 2-stage cluster-sample design was used to obtain a representative sample (N=600) of private and public primary day school students year 7 and 8 (aged 12-15 years old) in Awendo. In Kenya primary school education begins in class one with a minimum age of 7 years and ends in class 8, with an average age of 14 years. In stage 1, schools were stratified into public and 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.

All students in the selected classes, regardless of whether they smoked, were eligible to participate in the survey. Children with mental and physical disabilities; learning difficulties; behavioral problems and/or conduct disorders; and serious medical conditions were excluded. The school prepared a list of eligible children who were then recruited by obtaining parental consent on an opt-out basis. Children's assent was also obtained.

2.2. Data Collection and Analysis

The analyzed sample was restricted to children aged 12 to 15 years who were attending school. Children older than 15 years were excluded to reduce the likelihood that tobacco smoke exposure was due to the child's own smoking. All students who chose to participate completed an anonymous, self-administered survey that included questions about the smoking status of their parents and other adults living in the household, in addition to questions assessing the smoking restriction levels exercised at home, if any. We also assessed their Body Mass Index (BMI) and self reported asthma attack in the last seven days preceding the survey. Children with BMI below 16.0 were considered severely malnourished. Those with BMI between 16.1 and 18.5 were considered to be moderately malnourished and those between 18.6 to 25.0 were considered normal. Data were weighted to account for nonresponses at both student and school levels and to ensure statistical representation of the public 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 and the number of

missed school days. Absenteeism was defined as the number of school days missed because of illness during the previous three school terms preceding the interview.

The study hypothesized that asthma which is a respiratory condition and subnormal BMI would be related to home smoke exposure. Pearson χ^2 statistics were used to compare the characteristics of children who lived in homes with and without smoking and to make unadjusted comparisons of health states across household smoking values. The study estimated adjusted odds ratios (aORs) using logistic regression models. The mean number and the percentage of school days missed because of household smoking were calculated among children living in smoking households using predicted values from the estimated generalized linear model regressions. Data was analyzed using SPSS version 17 p-values< 0.05 were considered as evidence of statistical significance.

3. Results

3.1. Socio-demographic Characteristics

In this survey, data for 600 respondents was analyzed. A higher proportion (55.5%) of the younger children lived with one or more than two smokers in the home. More than 38% had 1 household member who smoked in the home, and more than 16% had 2 household members who smoked in the home. Demographic distinctions between children were significantly different in sex and family structure but similar in age and type of school (Table 1).

Table 1. *Socio-demographic characteristics of survey respondents.*

Characteristic	No of children Residents smokers at home				p- Value
	0 (n=267, 44.5%)	1 (n=233, 38.8%)	≥2 (n=100, 16.7%)	Total N (%)	
Age (years)					
12-13	148	123	67	338 (56.3)	0.05
14-15	119	110	33	262 (43.7)	
Sex					
Female	74	113	72	259 (43.2)	0.00
Male	120	193	28	341 (56.8)	
Type of school					
Privately owned	84	82	34	200 (33.3)	0.67
Government owned	183	151	66	400 (66.7)	
Family structure					
One or both parents	149	137	41	327 (54.5)	0.000
Neither	118	96	59	273 (45.5)	

[a] P values reflect a test of the hypothesis that the distribution of values for a characteristic was equal across all 3 smoking categories.

3.2. SHS Exposure and Smoking Restrictions at Home

More than 55% of children in our sample, lived in a household in which at least 1 resident smoked inside the home; Of those exposed to SHS, more than 29% had 1 household member who smoked in the home, and 26.3% had ≥2 household members who smoked in the home.

Children who lived with ≥2 household members who smoked were more than forty eight times (95% CI: 25.43 - 91.85) more likely to be exposed to SHS compared with those who lived in smoke free households. (Table 2). Similarly, children who lived in households where smoking was not restricted were three times (95% CI: 2.31 -4.53) more likely to be exposed to SHS compared with those who lived in smoking restricted households.

Table 2. *SHS exposure and smoking restrictions at home.*

No. of resident smokers	Exposed N (%)	Unexposed N (%)	Totals N (%)	aOR (95% CI)
0	14 (2.3)	253 (42.2)	267 (44.5)	Reference
1	72 (12)	103 (17.2)	175 (29.2)	12.63 (6.82-23.4)*
≥2	115 (19.2)	43 (7.2)	158 (26.3)	48.3 (25.43-91.85)*
Overall Prevalence	201 (33.5%)	399 (66.5%)	600 (100%)	
Restriction of smoking at home				
Visitors / residents allowed to smoke in the presence of children	175 (29.2)	93 (15.5)	268 (44.7)	3.23 (2.31-4.53)*
Visitors / residents not allowed to smoke in the presence of children	122 (20.3)	210 (35.0)	332 (55.3)	Reference

[a] represents values adjusted for age, sex, type of school and family structure
* $p<0.05$

3.3. Children's Health and Number of Smoking Residents

The risk of an asthmatic attack increased by more than threefold (95% CI: 0.93 -16.81) and more than tenfold (95% CI: 2.87 - 38.15) among the children who lived with one smoker and more than two smokers respectively, compared with those living in smoke-free homes. The risk of being severely malnourished increased by 16% (95% CI: 0.10 - 12.88) among children who lived with one smoker. However this risk significantly increased by more than six fold (95% CI: 1.30 - 35.50) among the children who lived with more than two smokers compared with those living in smoke-free

homes (Table 3).

Table 3. *Children's Health and Number of smoking residents.*

Status of children's Health (n)	Unadjusted % outcome				aOR (95% CI)[a]	
	Residents smoking in the home				No of smoking residents in the home [b]	
	0	1	≥2	P[c]	1	≥2
Prevalence of Asthma	3.4*	6.2*	9.3*	0.001*	3.96 (0.93 - 16.8)*	10.46 (2.87 - 38.15)*
BMI						
Severe (<16.0)	6.7	5.3	15.9	0.09	1.16 (0.10 - 12.88)	6.80 (1.30 - 35.50)*
Moderate (16.1 -18.5)	6.6*	10.3*	13.8*	0.001*	4.38 (1.44 - 13.31)*	7.50 (2.62 - 21.51)*
GAM	5.9*	11.1*	16.1	0.008*	3.48 (1.30 - 9.34)*	7.71 (3.14 - 18.97)*
Normal (18.6 - 25.0)	6.5*	7.1*	8.7*	0.000*	0.28 (0.11 - 0.77)*	0.13 (0.05 - 0.32)*

[a]Values were adjusted for type of school, sex, family structure and child's age
[b] Reference is 0 household smoking residents
[c]*P* values reflect comparisons across all 3 residents smoking categories.
* p< 0.05

3.4. Children's Health and Number of Smoking Household Residents

Living with a smoker was associated with both of our measures of children's health (Table 4). The number of children who suffered Asthmatic attacks was significantly higher for those living in homes in which smoking took place than for those living in smoke-free homes, and greater numbers of household smokers led to increased asthmatic attacks among children. More than 47% of Asthma prevalence was attributed to living with exactly 1 person smoking in the home (95%: CI 47.4 –48.6), while prevalence of asthma among those living with ≥2 smokers increased by 89.8% (95% CI: 89.8-90.0) more than if they lived in smoke-free homes. Among children living with exactly 1 or with at least 2 smokers, 38.9% (95% CI: 38.7 –39.0) and 85.4% (95% CI: 85.2–85.6), respectively, of malnutrition was attributable to residents' smoking.

Table 4. *Relationship between Children's Health and number of smoking household residents.*

No. of smoking residents in the home	Attributable risk Asthma attacks among children in smoking households (95% CI)	Attributable Risk Percentage of Asthma Prevalence (95% CI) Among Children in Smoking Households	Attributable Risk of GAM among children in smoking households (95% CI)	Attributable Risk percentage of GAM (95% CI) among children in smoking households
1	0.01 (0.01-0.04)*	47.6 (47.4-48.6)*	0.02 (0.01-0.03)*	38.9 (38.7-39.0)*
≥2	0.01 (0.01-0.03)*	89.8 (89.8-90.0)*	0.15 (0.14-0.17)*	85.4 (85.2-85.6)*

[a]Values were adjusted for type of school, sex, family structure and child's age
[b] Reference is 0 household smoking residents
* p< 0.05

3.5. Smoking Household Residents and School Absenteeism

The likelihood of missing any school day was 81% higher for those living in homes in which there was one person who smoked in the home (95% CI: 1.17 –2.56) than in homes where no one smoked indoors (Table 5). The number of days a child was absent from school was significantly higher for those living in homes in which smoking took place than for those living in smoke-free homes. Increased absenteeism was also associated with greater numbers of household smokers. Children living with exactly one person smoking in the home missed 30% (95% CI 0.74 –1.89) additional school days per year (approximately 3 months of schooling), and those living with more than two smokers missed 63% (95% CI: 0.91–2.33) more days of school per year than they would have if they lived in smoke-free homes. Among children living with exactly one or with at least two smokers, 28% (95% CI: 17 – 39) and 41% (95% CI: 33–49), respectively, of school days missed were attributable to residents' smoking.

Table 5. *Relationship between smoking household residents and absenteeism.*

No. of smoking residents in the home	Days missed, No sickness OR (95% CI)[a]	SHS Attributable days missed among children in smoking households (95% CI)	SHS Attributable % of days (95% CI) missed among children in smoking households
1	1.81 (1.17-2.56)*	1.3 (0.74-1.89)*	28 (17-39)*
≥2	0.89 (0.56-1.23)	1.63 (0.91-2.33)*	41 (33-49)*

Values were adjusted for type of school, sex, family structure and child's age
[a] Reference is 0 household smoking residents
* p< 0.05

4. Discussion

Although scientific evidence provides a strong rationale for protecting children against SHS, this study revealed their continued exposure. More than fifty five percent of the children lived with a smoker. This proportion was less than what was reported by Mbulo et al. [10] In this study, higher proportion of younger children was exposed. Similar to the study done in Bangladesh, the odds of SHS exposure increased with the increase with the number of resident smokers living with the children. [9] In the same study there was a negative association between SHS exposure and smoking restrictions at home. Similarly more males compared with females were exposed to SHS. This finding differs with those of a study in Ethiopia where females were more exposed to SHS compared to Males. [23] The findings were however similar to the GYTS in Kenya. [5] 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.

A modest proportion of children reported complete restriction of smoking at home. The odds of SHS exposure increased by three fold among children who live in household where smoking was not restricted. This shows that restricting smoking in the home conferred SHS exposure protection to the children as observed by Sawart et al. [9]

We established a relationship between household smoking and Asthma, which is known to be associated with SHS exposure, and malnutrition. We identified modest evidence that these outcomes increased as the number of residents smoking in the home increased. Household smoking was associated with increased absenteeism overall, and as the number of residents smoking in the house increased, so did the number of school days missed by the children. This is consistent with the findings of the study by Douglas et al, in which he observed that the number of days a child was absent from school was significantly higher for those living in homes in which smoking took place than for those living in smoke-free homes, and greater numbers of household smokers led to increased absenteeism. [21] This represents an additional burden on children and their caretakers who may be struggling with other socioeconomic challenges.

The risk of Asthmatic attack increased by more than three fold and more than ten fold among children living with one smoker and more than two smokers respectively. More than 47% of Asthma prevalence was attributed to living with exactly 1 person smoking in the home, while more than 89% of asthma prevalence was attributed to living with ≥2 smokers. This is in tandem with previous association of SHS exposure with asthma attacks in children living with smokers. [16]

Similarly, the risk of malnutrition increased by more than three fold and by more than seven fold among children living with one smoker and more than two smokers respectively. Among children living with exactly 1 smoker, more than 38%, and among those living with at least 2 smokers, more than 85%, prevalence of malnutrition was attributable to SHS exposure. This increase in risk of malnutrition was significant for both the Odds and attributable risk. In Indonesia, paternal smoking was associated with malnutrition in children. [22] The argument presented in this survey was that paternal smoking diverts household money from food to tobacco and exacerbates child malnutrition. In addition to this argument, we postulate that increased asthma attacks could have resulted in high prevalence of malnutrition in our sample.

Smoking has been associated with poor dietary intake, in this case children living with smokers were found to be significantly malnourished. This could be attributed to poor appetite and consequently low dietary intake associated with the smoke. These results are consistent with Gariballa, and Foster [24] who found an association between smoking and poor nutritional status including low body weight and micronutrient deficiency. Nicotine in cigarette acts as an appetite suppressant. Nicotine can also lower insulin levels in the blood stream hence reduce cravings for sugary foods[25]. Furthermore studies show that nicotine triggered effects of adrenaline on the stomach musculature leads to temporary subsiding of hunger.

We postulate that out of ten children, every four to eight asthmatic attacks and every three to eight cases of malnutrition were due to living with smokers at home. We also postulate that one –third to one-quarter of school days missed among children living with smokers was due to residents' smoking.

4.1. Conclusion

The primary place in which involuntary SHS exposure still occurs is now the home. SHS exposure is a modifiable risk factor. Therefore, if we are able to show that SHS exposure is associated with increased asthma attacks, Malnutrition and school absenteeism, it will provide further evidence supporting the importance of smoking cessation interventions for family members as well as protecting children with asthma. Successful smoking cessation among residents living with children could contribute to decreased asthmatic attacks, malnutrition and school absenteeism.

4.2. Limitations of the Study

The exposure to SHS in many studies is based on self-report measures instead of confirmed biological markers such as serum cotinine, which may be subject to recall bias and lead to over- or underestimation of exposure. As with any observational study, there may be confounding factors that were not measured and not included in the analysis.

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