Original Research Article

Cooking fuel as a risk factor for adenoid hypertrophy in children aged less than five living in an informal settlement, Nairobi County, Kenya

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ABSTRACT

Background: Fuels used for cooking are major sources of household air pollution, which lead to increased prevalence of upper respiratory tract infections and allergic conditions especially in children. The aim of present study was to investigate whether fuels used for cooking were risk factors for adenoid hypertrophy in children.

Methods: Authors used a case-control study design where the exposure was cooking fuel and the disease was adenoid hypertrophy. Cases were children where a post nasal space x-ray showed enlargement of the adenoids. The controls were children with no adenoid hypertrophy or related diseases. The sample consisting of 112 children was hospital based. Parent-administrated questionnaires were used to collect information on cooking fuel.

Results: Cooking gas and charcoal were associated adenoid hypertrophy. Adjusted odds ratio (OR) were 1.092 for charcoal and 3.516 for gas. Children in households where gas was predominantly used for cooking were three times more likely to have enlarged adenoids.

Conclusions: Exposure to cooking gas which emits nitrogen dioxide was a primarily risk for adenoid hypertrophy. Larger community-based studies are recommended to come up with evidence that guides policy concerning use of household fuels and adenoid hypertrophy.

Keywords: Adenoid hypertrophy, Cooking fuel, Children, Informal settlement, Kenya

INTRODUCTION

Fuel used for cooking such as electricity, natural gas, or clean LPG and biomass fuel are major sources of household air pollution.¹ Natural gas which is primarily methane requires less air for combustion (an air-to-gas ratio of 10:1). On the other hand, LPG which is primarily propane or a mixture of propane and butane requires more air for combustion (an air-to-gas ratio of 25:1), releasing almost three times the energy released by burning natural gas. LPG gas leakage tends to settle in the household at human levels, whereas leakage of natural gas ascends toward the ceiling, thus reducing health effects. Biomass fuel which includes wood, crop

residue, animal dung cakes, and wood charcoal has very high levels of particulate matter, gaseous air pollutants and high levels of carbon monoxide (CO), especially during the burning of charcoal.² Use of natural gas as a source of cooking fuel increases the levels of nitrogen dioxide NO₂ in the household air and has been associated with an increased prevalence of viral infections of the upper respiratory tract, especially in children.³ NO₂ exposure might produce changes in cell-cell and cell-pathogen interactions that could result in altered upper airway physiology.⁴

Children's are highly susceptible to the harmful effects of air pollution because their airway epithelium is more

permeable to air pollutants and the lung defense system is not adequately evolved. Children also have a differential ability to metabolize, detoxify, and excrete environmental agents thereby making them prone to infections.⁵ Younger children are more prone to infection because of the higher volumetric adenoids/rhino pharynx ratio, which peaks between 2 and eight years.⁶ Children, thus have to increased incidences of upper respiratory conditions, as cooking fuels are irritants to the airway, and frequent exposure to them causes various respiratory problems such as asthma and adenoid hypertrophy. Respiratory infections (comprising both upper and lower respiratory tract infections with viruses, bacteria, and mycobacteria have been associated with exposure to household air pollution.⁷

Adenoids are constantly exposed to viral and bacterial agents as well as to allergens. Because of both their immunological function and their specific location, adenoids are considered reservoirs of viruses and bacteria.

The few studies we came across focused on habitual snoring, a prominent symptom of sleep-disordered breathing. Habitual snoring and breathing through the mouth in children is mainly caused by adenoid hypertrophy and allergic rhinitis. Environmental exposure has been found to be a potential predisposing factor for habitual snoring.⁸

A meta-analysis of eight studies found that children were more than three times likely to have respiratory infections when exposed to solid biomass fuel smoke compared to non-exposed children.⁹ Another study in Australia looked at snoring among primary school children aged between about their domestic environments showed that respiratory problems associated with, adenotonsillar hypertrophy was a significant risk factor for habitual snoring (odds (OR = 2.17). Prevalence of snoring was also significantly associated with exposure to nitrogen dioxide during winter. There was a positive dose-response association when nitrogen dioxide (NO₂) concentration levels were compared between houses with and without gas heaters. They found that the higher the dose of exposure greater the incidence of snoring in the children who lived in these households.⁴

To our knowledge, besides the study conducted in Australia.⁴ Authors found virtually no survey which focused on fuels used for cooking and adenoid hypertrophy. Studies are needed to understand better the relationship between allergies and infections and the influence they play on adenoids during childhood.

Authors hypothesized that exposure Biomass fuel which has high levels of carbon monoxide (CO), especially during the burning of charcoal and natural gas as a source of cooking fuel increases the levels of nitrogen dioxide NO₂ could increase the risk adenoid hypertrophy. The

aim of our study, therefore, was to investigate whether cooking fuel was a risk factor for adenoid hypertrophy.

METHODS

We used a case-control hospital-based study design to establish whether exposure to specific cooking fuels is a risk for adenoid hypertrophy.

Study site/population source

The study was carried out at Mbagathi county hospital. It is a high-volume level 4 Hospital with above 100,000 turnovers of patients annually. Adenoid hypertrophy constitutes the highest cause of hospital visits when compared to the other ear, nose, and throat (ENT) conditions. In 2014, there were 228 new cases of adenoid hypertrophy and 140 revisits indicating more than 50% revisits. In the same period, only 44 patients were treated for acute ear infections, 519 patients were treated for tonsillitis with 68 revisits. The hospital services offer daily child clinics with an emergency section where all emergencies are seen and stabilized before admission to the wards. Children who are found with ENT conditions are referred to the Ear Nose and Throat Clinic.

The hospital's main catchment area is an informal urban settlement. A study carried out in this informal settlement found that kerosene was the predominant cooking energy option, (90%), followed by charcoal, (11%) while only 3% of the households used LPG for cooking. Electricity was rarely used for cooking.¹⁰

Study population

Children aged between 6 months and five years who had lateral view of post nasal x-ray showing enlarged adenoids were considered cases. Children who presented with clinical features related to adenoid hypertrophy such as common colds, snoring, mouth breathing, and nasal blockage were not included as cases. Controls were children aged below five years without adenoid hypertrophy or related clinical features selected from the same population source as cases. After picking a case, the following two children down the register of the same age and sex were picked as controls. Thus, for every case, two controls were selected.

Sampling and sample size

The formula used to calculate sample size for case-control designs gave a sample size of 112 children using a ratio of 1:2. These consisted of 37 cases and 75 controls.

Children were selected from a register in the pediatric outpatient department. According to data obtained from the hospital health records, 20,502 (10,635 males and 9867 females) children less than five years were seen at the outpatient pediatric department in 2015. This was the

source for both the cases and controls. The first case appearing in the register on the first day of the study was recruited, followed by two controls. The process was repeated until all the sample was arrived at.

Data collection and analysis

Data was collected using a questionnaire with questions on socio-demographics and cooking fuels. Exit interviews were conducted after obtaining informed consent. The respondents were presented with a list of common cooking fuels and were required to respond in the affirmative regarding the fuel they mainly used. The options included kerosene, Liquid Petroleum Gas (LPG), firewood and charcoal with an option for others.

All the data collected was entered into an excel spreadsheet and analysis was done using SPSS (statistical package of social sciences) version 20. We calculated the measures of association which compared the odds of exposure to the various cooking fuels among the cases to the odds of exposure among the controls. Odds ratio (OR) was used to estimate the strength of the association between exposure and outcome.

Ethical approval was sought from GLUK Ethical committee. This was followed by permission from Mbagathi District Hospital which was obtained from the medical superintendent and the hospital ethical board. The purpose of the study was explained to the parents/guardians of children enrolled in the study. They were requested to sign an informed consent form after understanding what the study entailed.

All the patient information was confidential, and names of children were not used in the questionnaires. Parents had the autonomy to withdraw from the study at any time they desired. No medical care was withheld for those who declined to participate in the study. No risks were expected, and no compensation was given to participate.

RESULTS

The total number of children studied was 112. One third (33.6%) of these children had adenoid hypertrophy confirmed by PNS and were used as cases. The mean age of the index child was 10.42 ± 2.47 months. Most (56.5%) of the children in the study were less than two years. The proportion of households using the various cooking fuels was: kerosene, (9.1%), charcoal, (14.5%); firewood, (29.1%), gas, (19.1%), and others (15.5%).

Following factors were associated with an increased risk adenoid hypertrophy: charcoal (adjusted odds ratio (OR = 1.092 CI, 0.491-2.431) and gas (OR = 3.516 CI, 1.452-8.517). The rest of the cooking fuels had OR of less than 1. These included: electricity, (OR = 0.323 CI, 130-0.801), kerosene (OR = 0.402 CI, 0.170- 0.949), firewood, (OR = 0.180 CI, 0.033-0.979).

DISCUSSION

Present results suggest that high exposure to nitrogen dioxide (NO₂) from the cooking gas could increase the risk of adenoid hypertrophy three times. LPG which is used in this community releases almost three times the energy released by burning natural gas and tends to settle in the household at human levels seems to be a risk to AH. Our results are comparable to earlier studies which linked NO₂ exposure from gas appliances to the prevalence of allergic conditions.^{4,11}

This study was limited by a scarcity of literature on studies on cooking fuels as risk factors for adenoid hypertrophy. However, our study is significant in that it is pioneering research on cooking fuels and adenoid hypertrophy.

CONCLUSION

In conclusion, gas fuel increases the risk of adenoid hypertrophy in children. Use of LPG gas and its significant association with adenoid hypertrophy raises debate on whether it is the better cooking fuel option as advised in the ear, nose and throat clinic. Due to the recognition that gas cooking fuel might increase complications adenoid hypertrophy, these findings should be confirmed by further prospective studies. Thus, recognizing that the primary source of indoor NO₂ could be the gas cooker, health education programmes on indoor pollution associated with various cooking fuels needs to be undertaken. Larger community-based studies need to be carried out to come up with interventions that can be used for policy change concerning the use of household fuels. The population needs to be enlightened on the health hazards that are associated with the use of some of these fuels and encouraged to use alternatives.

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