Childhood ial asthma:

Effects of passive smoking and breast-feeding on age at onset and severity..
Childhood bronchial asthma: Effects of passive smoking and breastfeeding on age at onset and severity

By

MARY SLESSOR LIMBE, M.D.
Senior House Officer,
Department of Paediatrics and Child Health,
University of Nairobi,
Nairobi, KENYA.
(1995)

A dissertation presented as part of the fulfillment for the degree of Master of Medicine in Paediatrics at the University of Nairobi.
Declaration:

I hereby certify that this thesis is the result of my original work and has not been presented for a degree in any other university.

Signed.

Mary Slessor Limbe, MD.

This thesis has been submitted with our approval as supervisors.

Signed.

Francis E. Onyango, MBCHB, MMed (Paed.), MPH.
Associate professor of paediatrics and child health,
University of Nairobi,
Nairobi, Kenya.

Signed.

Ezekiellfo. Wanaula, MBCHB, Mmed (Paed.).
Associate professor of paediatrics and child health,
University of Nairobi.

Signed.

Ruth Nduati, MBCHB, Mmed (Paed.), MPH (EPI).
Senior lecturer,
Department of paediatrics and child health,
University of Nairobi.
Dedication

To my loving son, Greg, who patiently put up with my long periods of absence as I worked on the project. May God richly bless you, Grego.
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## Abbreviations

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<th>Description</th>
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<tr>
<td>ARI</td>
<td>acute respiratory infection</td>
</tr>
<tr>
<td>C.I.</td>
<td>confidence interval</td>
</tr>
<tr>
<td>D.f.</td>
<td>degrees of freedom</td>
</tr>
<tr>
<td>H/o</td>
<td>history of</td>
</tr>
<tr>
<td>KNH</td>
<td>Kenyatta National Hospital</td>
</tr>
<tr>
<td>N</td>
<td>number studied</td>
</tr>
<tr>
<td>OR</td>
<td>odds ratio</td>
</tr>
<tr>
<td>P value</td>
<td>significance level</td>
</tr>
<tr>
<td>P.E.W.</td>
<td>paediatric emergency ward</td>
</tr>
<tr>
<td>S-economic</td>
<td>social economic</td>
</tr>
<tr>
<td>Sq.</td>
<td>square</td>
</tr>
<tr>
<td>$X^2$</td>
<td>chi square</td>
</tr>
</tbody>
</table>
Abstract

Introduction
Bronchial asthma is a disease characterized by hyper-reactivity of respiratory airways to gaseous and particulate matter in the air. Cigarette smoke is an important source of indoor air pollution and an increased rate of bronchitis and pneumonia in children of smokers is well documented. The association between bronchial asthma and passive smoking is not well defined. Although breast milk is known to protect against respiratory infections, the association between breast-feeding and asthma is not well described. It was with these unanswered questions in mind that this study was carried out.

Objectives
The objectives of the study were to determine the effects of passive smoking and breast-feeding upon the age of onset and severity of bronchial asthma in children.

Materials and methods
A case control study was carried out at Kenyatta National Hospital, Nairobi, between December 31st 1992 and April 27th 1993 on 450 children aged between 1 and 120 months. Children with bronchial asthma were matched by age to two different groups of controls in a 1:1 ratio. Cases and controls were subjected to a standardized questionnaire to gather information on age at onset of wheezing, frequency of asthmatic attacks, duration of breast-feeding and history of cigarette smoking in the family.

Results
There was a significant association between passive smoking and onset of bronchial asthma in the first year of life, OR=3.5 (95% C.I. 1.4, 8.7), P<0.004. There also appeared to be a significant association between passive smoking and asthma
severity. No association was found between breast-feeding and age at onset of asthma, but exclusive breast-feeding significantly reduced chances of developing severe forms of bronchial asthma, $O.R.=0.37$ (95% C.I. 0.14, 0.98, $X^2=4.62$, $p=0.05$.

Conclusions and recommendations
Passive smoking predisposes not only to early onset of bronchial asthma, but possibly also to more severe forms of the disease. This study has found that breast-feeding appears to be protective against severe forms of asthma.

It is strongly recommended that young children should not be exposed to cigarette smoke. A prospective study is recommended for further evaluation of the association between breast-feeding and severity of bronchial asthma in childhood.
Bronchial asthma, a major cause of morbidity both in children and adults the world over is a disease that has been recognized since antiquity. References to it go back to at least 5,000 B.C. Asthma is derived from a Greek word meaning "to pant" and was originally used to describe a condition manifested by episodic shortness of breath. With increased knowledge and understanding of the pathophysiology of the disease modifications of the definition of asthma have occurred.

Asthma may be defined as an obstructive disease of the pulmonary airways resulting from spasm of airway smooth muscles, increased mucus secretions, mucosal oedema and inflammation. Both large (>2 mm. diameter) and small (<2 mm. diameter) airways are involved to varying degrees.

Bronchial asthma is a disease of polygenic aetiology with multifactorial determination. Hyper-reactivity of respiratory airways to diverse stimuli is a hallmark of the disease. Although the hyper-responsiveness is due mainly to genetic predisposition, autonomous, psychologic, immunologic, infectious and endocrinologic factors are also involved to varying degree in different individuals.

Attacks of bronchial asthma are precipitated not only by exposure to allergens like house dust mites, pollen and animal dander but also to environmental stimuli, including cold or dry air, atmospheric irritants like sulphur dioxide, tobacco smoke, inert dusts and particulate matter less than 10 \( \mu \text{m} \) in diameter.

The prevalence of bronchial asthma is difficult to determine due to uncertainties regarding definition of the disease. It varies a lot.
throughout the world, being lowest in rural Gambia and New Guinea (0%), 0.1% among the Eskimos of Canada, 1.4% in Stockholm, Sweden, 8% in Tanzania and New Zealand and 5-10% in USA\(^1\). In Kenya, a pilot study carried out among primary school children in Nairobi by the Kenya Medical Research Institute in 1992 found a prevalence of 10.5\(^\circ\).

Asthma affects all ages but it occurs predominantly in early life\(^2\). Although in the past there has been a reluctance to diagnose asthma in children under two years of age it is now evident that early age of onset is characteristic in all series\(^2\). Asthma is the commonest cause for admission to children's ward in the United Kingdom, and is associated with considerable morbidity. At Kenyatta National Hospital (KNH), Nairobi, in 1991 bronchial asthma accounted for 0.84% of total adult and paediatric admissions, with a female to male ratio of 1.1:1\(^\circ\). Out of 4,543 patients admitted to the Paediatric Emergency Ward at the same hospital between January and June, 1992 2,317 (or 51%) had acute respiratory infections. Acute asthma accounted for 15.6% of the admissions for that year\(^\circ\). Acute asthma has been reported as the most frequent medical emergency at the casualty unit of this hospital\(^12\). Asthma mortality in different countries between 1970 and 1984/85 ranged from 0.2 per 100,000 in Sweden to 4 per 100,000 in New Zealand\(^13\). At KNH asthma mortality in 1992 for both children and adults was 0.2\(^\circ\).

Passive smoking
One of the earliest references to the relationship between air pollution and asthma dates from the 12\(\text{th}\) century: Maimonides in his "Treatise on asthma" noted the importance of "keeping clean the air you breathe"\(^14\). Asthma is associated with hyper-responsiveness to cigarette smoke, which is an important source of domestic air pollution. There is paucity of data regarding the prevalence of smoking and hence, of the extent of exposure of children to
environmental tobacco smoke.

Tobacco smoke in the environment may be from mainstream smoke or sidestream smoke\(^1\). The smoke from the end of the cigarette which would normally be inhaled by the smoker is called mainstream smoke. It emerges into the atmosphere having been drawn through the cigarette, filtered by the smoker's lungs and then exhaled. On the other hand the smoke from all points of the cigarette, arising from the burning of the cigarette in between puffs and entering the environment directly is called sidestream smoke. Different temperatures of combustion, filtration, and amount of tobacco consumed all lead to marked differences in the concentrations of mainstream and sidestream smoke. Nearly 85% of smoke in a room results from sidestream smoke\(^1\). The concentration of gaseous and particulate constituents of tobacco smoke are higher in the sidestream than in the mainstream\(^1\). Non-smokers suffer adverse effect of cigarette smoke from inhaling the sidestream and exhaled smoke from the smokers. It has been proposed that differential responsiveness to the organic vapour phase of tobacco smoke and the induction of airway hyper-responsiveness are genetically controlled either at or proximal to the muscarinic receptor.

There is universal medical consensus regarding adverse health effects of active smoking. However, health effects of passive smoking on children are less well established\(^16\)\(^-\)\(^20\). In the fifteen years between the first Surgeon General's report in 1964 on adverse effects of smoking and its 1979 edition, more than 20,000 articles exploring the effects of cigarette smoking on human health were published\(^15\)\(^-\)\(^21\). Only 1% of these articles examined the adverse effects of passive smoking\(^15\).

It is estimated that passive smoking is second only to active smoking as the most frequent cause of respiratory diseases\(^6\). Children whose parents smoke have been found to suffer more
frequently from pneumonia and bronchitis, than those whose parents do not smoke. This phenomenon is most marked during the first year of life. The correlation of passive smoking with asthma has been studied less frequently and with less consistent results: whereas cross-sectional studies by Grotmaker, Weitzman, Weiss and their coworkers demonstrated an association, others by Lebowitz, Schilling, Schencher and their colleagues did not. Prospective studies of some populations have also failed to demonstrate an increase of asthma among the children of smokers.

A major deficiency in the examining of effects of parental cigarette smoking on childhood asthma has been failure by some researchers to consider the contribution of other exposure, such as other household member smoking and the type of cooking or heating fuel used by the family. Bronchial asthma has not only been associated with exposure to cigarette smoking, but also with other sources of domestic air pollution, including heating and cooking fuel such as charcoal. The acute respiratory effects of air pollution were studied in two small non-industrialized communities in Netherlands by G. Hoek and associates between 1990 and 1991. Exposure to air pollution was characterized by the ambient concentration of sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), black smoke (BS), and respirable particulate matter ($PM_{10}$). Small, but significant decrease of pulmonary function, increased rate of wheezing and use of bronchodilator were observed at high concentrations of $PM_{10}$, BS and $SO_2$ but not $NO_2$. Other studies have associated $PM_{10}$ exposure with increased hospitalization for asthma.

In 1986 Wafula and associates carried out a study in Maragua area in Muranga district, Kenya, on indoor air pollution within rural households and its relationship to acute respiratory infections among children below 5 years of age. They found evening peak levels of respirable suspended particles of 3600 mg. per cubic meter in 36 randomly selected houses where most of the cooking was
done on open fires using firewood and crop residues as fuel. This indicated the potential for deleterious health effects due to exposure to excessive levels of toxic pollutants in smoke from biomass combustion existed, especially among the preschool children and women in this population\textsuperscript{14}.

Cigarette smoke and wood smoke have many similarities, since they are both generated by burning biomass. Particles emitted by wood and cigarette smoke are on average $<$0.2 micrometers. Other than wood and cigarette smoke particulate matter is also produced when coal is burnt\textsuperscript{35}.

Cow's milk protein intolerance
Bronchial asthma has also been associated with cow's milk protein intolerance, and high levels of circulating antibodies to cow's milk protein have been demonstrated in patients with chronic lung disease\textsuperscript{36-37}. Ingestion of cow's milk by neonates has been found to predispose to allergic conditions later in life\textsuperscript{38}. This is due to the fact that the physiologically immature neonate's gut absorbs disproportionately large amounts of immunologically intact proteins and there is inadequate secretory Ig A, which has an important role of preventing absorption of foreign macromolecules in the neonate's gut\textsuperscript{38}.

Breast milk
Breast milk is not only non-allergenic but also immunologically beneficial for the baby\textsuperscript{39}. Breast milk protects against bacterial and viral infections of the gastrointestinal tract and respiratory system. The risk of dying from respiratory tract infection is nearly four times higher among infants who are not breast-fed in the urban environment of developing nations\textsuperscript{4n2}. Even in fully industrialized nations with low infant mortality rates, breast-feeding's protection against dying of respiratory infections is an important consideration. Breast-feeding advantages are most
evident during the first six months of life but are still evident through the second year\textsuperscript{43-46}.

The findings on the correlation of breast-feeding with wheezing and non-wheezing respiratory illnesses have been inconsistent, with some studies demonstrating a protective role and others not\textsuperscript{47,48}. It is not known whether breast-feeding has a mitigating effect when attacks of wheezing are triggered off by smoking.

Study rationale

Childhood asthma has been associated with exposure to cigarette smoke. Asthma is a major cause of morbidity both in children and adults and is not only expensive but also difficult to control. It is, therefore, important to look into risk or ameliorating factors that can be used to reduce its prevalence and severity. The study was carried out to establish whether asthma morbidity was connected with exposure to cigarette smoke and if breast-feeding had a protective effect in children predisposed to bronchial asthma.

Objectives

To determine the effects of passive smoking and breast-feeding on bronchial asthma with respect to age of onset and severity of the disease.
MATERIALS AND METHODS

Study area
The study was carried out at Kenyatta National Hospital (KNH), Kenya's main referral hospital. It is also a teaching hospital for the University of Nairobi Medical School. The total bed capacity is 1,306 out of which 377 are paediatric (general and surgical).

Study design
This was a case-control study, with bronchial asthma as the disease and passive smoking and breast-feeding as exposure variables. It was carried out between December 31st 1992 and April 21st 1993.

Study population
The study was carried out among children aged between 1 and 120 months seen at KNH. Cases were children with bronchial asthma. A diagnosis of bronchial asthma was made on condition of the child having had at least two episodes of wheezing in the past, as reported by the accompanying adult and/or as indicated in the notes of the clinician(s) who saw the child. A child was considered to have acute asthmatic attack if there were features of airway obstruction at the time of recruitment: audible wheezing or rhonchi on auscultating the chest. Non-acute asthmatics were those children without features of airway obstruction at the time of recruitment. The cases were further graded as having mild, moderate or severe disease using a modification of grading of bronchial asthma suggested by Phelan:

1) Mild - <1 asthmatic attack in two months
2) Moderate - 2 - 3 attacks in two months
3) Severe - >4 attacks in two months.

The information on frequency of asthmatic attacks was validated by clinical records of hospital attendance, or, where these were not available, validity of attacks was verified by ascertaining from
the informant how each attack had been managed.

Controls were children of similar age range as the cases, who had no history of wheezing in the past. Two sets of controls were selected: medical (first) controls were children admitted with non-respiratory, non-surgical illnesses, while surgical (second) controls were children in the said age group with surgical conditions and who did not have a respiratory illness at the time of recruitment. The two controls were used, because studies had shown that children exposed to cigarette smoke were more likely to suffer not only from persistent wheeze, but also other respiratory illnesses\textsuperscript{15,27}. The rationale was to see whether there was any difference between those children seen with asthma and those with non-respiratory illnesses. The choice of the surgical controls was on the theory that they were children who would otherwise have been healthy, but for the trauma or other surgical condition that caused them to be hospitalized. The two controls were to be compared separately with the cases.

Inclusion and exclusion criteria
Children who satisfied the above given criteria for cases and controls were included into the study after obtaining an informed verbal consent from their parents or guardians. Children with cervical, intrathoracic and intra-abdominal tumors and any other conditions which were associated with wheezing or difficulty in breathing, were excluded from the study.

Sampling techniques
Cases were recruited by consecutive sampling, whereby every child who satisfied the inclusion criteria was recruited, on a daily basis from the P.E.W. and once weekly, from the paediatric chest clinic until the required sample size was reached. Medical controls were selected systemically on a daily basis from the P.E.W. and general paediatric wards. Every second child on the
admission register who satisfied the inclusion criteria was recruited. Surgical controls were recruited from the paediatric surgical wards by consecutive sampling. This was to facilitate matching in recruitment time between cases and controls, so as to avoid temporal bias, as the turn-over rate in the surgical wards was lower than in the general wards.

**TERMINOLOGY**

Cigarette smoking was defined and categorized using the definition by Tager et al. A "current" smoker was anyone who had smoked at least one cigarette per day within a month of examination; for purposes of quantification for this study, a light smoker was one who smoked up to ten cigarette sticks in a day, a moderate smoker, 11-20 cigarette sticks in one day and a heavy smoker one who smoked more than 20 cigarette sticks in one day. An "ex-smoker," was anyone who had stopped smoking more than one month prior to examination. An involuntary (passive) smoker was anyone who was exposed to cigarette smoke in the environments-

Breast-feeding was divided into exclusive, partial and none. A child was considered exclusively breast-fed if given breast milk only in the first four to six months of life, partially breast-fed if breast milk and some other food were given during the first 4 months of life and never breast-fed if the child received no breast milk at all.

The socioeconomic status of an individual was defined as his standard of living, as evaluated relative to the that of others in the society. The concept of standard of living is complex, as it embraces a number of criteria, including income, housing, education and nutrition among others. Two commonly used criteria for assessing socioeconomic state are income and
occupation, whereby all occupations are divided into five classes: administrative, industry and retail trades, skilled, semi-skilled and unskilled occupations (McKeown T. An introduction to social medicine. Blackwell Scientific Publications, 1974:67-68). Both of these can be hampered with difficulties where the informant is either reluctant to disclose, is untruthful about or simply does not know (as is often the case in our set up), how much the bread winner earns, in some cases even the occupation is not known.

For these reasons an index was devised that would easily and reliably discriminate between social classes, using housing, sleeping index and family size (appendix A). A summation of scores from all three categories formed the socioeconomic status index, with a maximum possible score of 9 points.

Sample size

The sample size was calculated using the formula of different proportions as shown in appendix B. Using a significance level of 0.05 and a study power of 0.9 the minimum number of cases needed was 144 giving a total sample size of at least 432.

Data collection and measurements

Cases and controls were interviewed to obtain information on demographic data, breast-feeding and smoking practices. Among asthmatic children information was also obtained on the age at which the first wheeze occurred, frequency of asthmatic attacks and their seasonal nature. Breast-feeding history was only obtained from parents and guardians of children up to five years of age so as to avoid recall bias. The information was documented on a precoded study instrument (appendix C). To ensure accuracy of responses some questions were asked in more than one way.
Both cases and controls underwent a complete physical examination and the information was documented in the second part of the questionnaire. Features suggestive of allergy (eczema, conjunctivitis, papular urticaria) and of an asthmatic attack (audible wheezing, rhonchi on auscultating the chest) were sought for.

Ethical considerations

The study was approved by the Kenyatta National Hospital Ethical and Research Committee. Confidentiality was maintained on all information received. Counseling was given to the parents or guardians of the asthmatic children.

Data analysis

Data obtained was entered into Olivetti computer M 240, using SPSS data entry programme and analyzed using SPSS/PC+ programme. The data was summarized in frequency tables. Comparisons of demographic and social characteristics between cases and controls were done using T-tests for mean age and chi square tests for other variables. Associations between age at onset and severity of asthma with exposure to cigarette smoke and breast-feeding were examined using chi squares, Fisher's exact tests or Pearson's correlation co-efficient. The level of statistical significance was set as 0.05. Multivariate logistic regression and Mantel-Haenszel test were used to study the independent effects of passive smoking and breast-feeding on age at onset and severity of bronchial asthma respectively.
RESULTS

Demographic and social characteristics of the study population. A total of 450 children were recruited into the study. They included 150 cases, 150 medical controls and 150 surgical controls. Their demographic distribution and social characteristics were as shown in Tables 1 and 2.

Table 1: General demographic and social characteristics of cases compared to medical controls.

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Medical controls</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=150</td>
<td>N=150</td>
<td></td>
</tr>
<tr>
<td>Mean age (months)</td>
<td>46.8</td>
<td>35.7</td>
<td>0.001</td>
</tr>
<tr>
<td>Male:female ratio</td>
<td>1.5:1</td>
<td>1.6:1</td>
<td>0.68</td>
</tr>
<tr>
<td>S-economic state</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>21 (14)</td>
<td>21 (14)</td>
<td>0.87</td>
</tr>
<tr>
<td>middle</td>
<td>98 (65.3)</td>
<td>106 (70.7)</td>
<td>0.38</td>
</tr>
<tr>
<td>high</td>
<td>31 (20.7)</td>
<td>23 (15.3)</td>
<td>0.29</td>
</tr>
<tr>
<td>Domestic fuel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>charcoal/kerosene</td>
<td>136 (90.7)</td>
<td>147 (98)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>gas</td>
<td>12 (8)</td>
<td>3 (2)</td>
<td>0.02</td>
</tr>
<tr>
<td>electricity</td>
<td>2 (1.2)</td>
<td>0 (0)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

As seen in Table 1 above, medical controls were generally much younger than the cases (p=0.001). The mean age for cases was 46.8 months, while that of medical controls was 35.7 months. With regards to cooking fuel,
cases used less of charcoal and kerosene group of fuels than did medical controls.

Table 2 shows that surgical controls did not significantly differ in mean age from cases (mean age for surgical controls was 45.6 months). Again, cases used less of charcoal group of fuels than did surgical controls.

Table 2. General demographic characteristics of cases compared to surgical controls.

<table>
<thead>
<tr>
<th></th>
<th>Cases N=150</th>
<th>Surgical controls N=150</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age</td>
<td>46.8</td>
<td>45.6</td>
<td>0.97</td>
</tr>
<tr>
<td>Male:female ratio</td>
<td>1.5:1</td>
<td>1.4:1</td>
<td>0.68</td>
</tr>
<tr>
<td>S-economic state</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>21 (14)</td>
<td>13 (8.7)</td>
<td>0.20</td>
</tr>
<tr>
<td>middle</td>
<td>98 (65.3)</td>
<td>104 (69.3)</td>
<td>0.54</td>
</tr>
<tr>
<td>high</td>
<td>31 (20.7)</td>
<td>33 (22)</td>
<td>0.89</td>
</tr>
<tr>
<td>Domestic fuel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>charcoal/kerosene</td>
<td>136 (90.7)</td>
<td>146 (97.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>gas</td>
<td>12 (8)</td>
<td>4 (2.7)</td>
<td>0.04</td>
</tr>
<tr>
<td>electricity</td>
<td>2 (1.2)</td>
<td>0 (0)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

As can be seen in the two preceding tables neither control group used electricity alone for cooking, unlike cases. This difference, however, was not statistically significant (p=0.25).
There was no statistically significant difference between medical and surgical controls in all parameters, including cooking fuel, with p values of 0.5, 0.5 and 1.0 for highly polluting, less polluting and non-polluting fuels respectively.

Age at onset of wheezing among cases

As shown in Fig. 1 below, 76 (51%) out of the 150 asthmatic children studied experienced their first wheeze during the first year of life. In 52 (68.4%) of these patients, the attack occurred during the first six months of life. The child with the earliest onset of wheezing was a male, whose symptoms started at two weeks of age. Only 10 (6.7%) cases had onset of asthma symptoms after the age of five years. There was no significant difference between male and female patients with regards to age at onset of wheezing.

Passive smoking and age at onset of wheezing
The overall prevalence of smoking in the study population was 41.1%. Of the 185 actively smoking adults, 157 (84.8%) were fathers, 4 (2.2%) were mothers and 24 (13%) were other household members. The majority were light smokers.

Out of the 65 asthmatic children who were exposed to household cigarette smoke, the degree of exposure was not known for four (6.2%), as the informants did not know how many cigarette sticks were smoked per day by the person who smoked. The same applied to 2 (3.3%) and 10 (17.3%) of the medical and surgical controls respectively. These children were, therefore, excluded from further analyses related to degree of cigarette smoke exposure. Fifty five (84.6%) of the 65 asthmatic children exposed to household cigarette smoke, were exposed to paternal smoking, 1 (1.5%) to maternal and 9 (13.9%) to other household member's smoking. The distribution of cases and controls exposed to cigarette smoke was as shown in Table 3.
Fig. 1: Age at onset of wheezing among cases.
Table 3. Exposure to cigarette smoke among cases and controls

<table>
<thead>
<tr>
<th>Degree of exposure to cigarette smoke</th>
<th>Cases</th>
<th>Medical controls</th>
<th>PI</th>
<th>Surgical controls</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number exposed</td>
<td>65</td>
<td>62</td>
<td>0.82</td>
<td>58</td>
<td>0.48</td>
</tr>
<tr>
<td>light</td>
<td>34</td>
<td>40</td>
<td>0.28</td>
<td>34</td>
<td>0.27</td>
</tr>
<tr>
<td>moderate</td>
<td>19</td>
<td>11</td>
<td>0.19</td>
<td>8</td>
<td>0.6</td>
</tr>
<tr>
<td>heavy</td>
<td>8</td>
<td>9</td>
<td>0.92</td>
<td>6</td>
<td>0.95</td>
</tr>
</tbody>
</table>

PI - Significance levels for cases compared to medical controls.  
P2 - Significance levels for cases compared to surgical controls.

There was no significant difference between cases and controls in the rates of smoking, with p values of 0.82 when cases were compared to medical controls and 0.48 when they were compared to surgical controls.

Forty one (63%) of the 65 cases exposed to household cigarette smoke started wheezing during the first year of life in contrast to 35 (41.2%) of the 85 who were not exposed. None of the ten (6.7%) cases who started wheezing after five years of age had been exposed to household cigarette smoke.

Cases were considered to have early onset of asthma if they started wheezing during the first year of life and late onset if the onset of signs and symptoms occurred after the first year. There was a strong association between exposure to cigarette smoke in the household and early onset of bronchial asthma as shown in Table 4.
Table 4. Association between passive smoking and age at onset of wheezing among cases.

<table>
<thead>
<tr>
<th>Exposure to cigarette smoking</th>
<th>Age (month) at onset of wheezing</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;12</td>
<td>&gt;12</td>
</tr>
<tr>
<td>Exposed</td>
<td>41</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>(63.1)</td>
<td>(36.9)</td>
</tr>
<tr>
<td>Not exposed</td>
<td>35</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>(41.2%)</td>
<td>(58.8)</td>
</tr>
</tbody>
</table>

\[ x^2 = 6.22, \quad p = 0.012 \]

0.R. = 2.44, 95% C.I. 1.2, 5.0.

The risk of early wheezing was 2.4 (95% C.I. 1.2, 5.0), p=0.012 in children exposed to cigarette smoke compared to those who were not exposed. The number of cigarette sticks smoked per day and the place where most smoking was done—whether inside or outside the house—did not have significant association with age at onset of wheezing (p=0.66).

Multivariate analysis
The role of smoking in inducing early wheezing was examined while controlling for other potential environmental pollutants.

Children were classified into three groups according to the type of cooking fuel used by the household where they lived: non-polluting fuel (electricity), moderately polluting fuel (gas) or highly polluting fuel (wood, charcoal, kerosene and others). A logistic regression was used with variables added stepwise in a forward and then backward regression. As shown in Table 5, only smoking had a significant association with age at onset of bronchial asthma.
Table 5. Multivariate modelling of factors affecting age at onset of wheezing.

<table>
<thead>
<tr>
<th>Variate</th>
<th>Onset of wheezing</th>
<th>Onset of wheezing at &gt;12 months</th>
<th>0.R. (C.I.)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>included in the model</td>
<td>&lt;12 months</td>
<td>&gt;12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=76</td>
<td>N=74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>smoking</td>
<td>47 (61.8)</td>
<td>18 (24.3)</td>
<td>2.5 (1.2,4.9)</td>
<td>0.009</td>
</tr>
<tr>
<td>firewood/kerosene</td>
<td>70 (92.1)</td>
<td>65 (87.8)</td>
<td>0.9 (0.06,15.9)</td>
<td>1.0</td>
</tr>
<tr>
<td>gas</td>
<td>5 (6.6)</td>
<td>7 (9.5)</td>
<td>0.6 (0.6,8.2)</td>
<td>0.8</td>
</tr>
<tr>
<td>electricity</td>
<td>0 (0)</td>
<td>2 (2.7)</td>
<td>0.03 (0.0,4X10^10)</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Children exposed to cigarette smoke had twofold increased chances of developing bronchial asthma during the first year of life.

Effect of breast-feeding upon age at onset of wheezing
There were 317 children aged five years and below who were interviewed concerning breast-feeding. Among them were 107 cases, of whom 4 (3.7%) never breast-fed, 112 medical controls, of whom 5 (4.5%) never breast-fed and 98 surgical controls, of whom 9 (9.2%) never breast-fed. These differences were not statistically significant (p=0.19). Table 6 shows breast-feeding patterns among the children who breast-fed.
Table 6. Breast-feeding patterns among cases and controls.

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Medical controls</th>
<th>PI</th>
<th>Surgical controls</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast-feeding experience</td>
<td>103</td>
<td>107</td>
<td>0.94</td>
<td>89</td>
<td>0.19</td>
</tr>
<tr>
<td>exclusive</td>
<td>36</td>
<td>36</td>
<td>0.93</td>
<td>31</td>
<td>0.88</td>
</tr>
<tr>
<td>partial</td>
<td>67</td>
<td>71</td>
<td>0.98</td>
<td>58</td>
<td>0.71</td>
</tr>
</tbody>
</table>

* - This table excludes the 18 children who never breast-fed.

When cases were compared with the two controls in turn regarding breast-feeding experiences no statistically significant difference was found.

As shown in Table 7 there was no significant association between exclusive breast-feeding and onset of bronchial asthma.
Table 7. Association between breast-feeding and age at onset of wheezing among asthmatic children aged 1 to 60 months.

<table>
<thead>
<tr>
<th>Breast-feeding pattern</th>
<th>Age (months) at onset of wheezing</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;12</td>
<td>&gt;12</td>
</tr>
<tr>
<td>Partial</td>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>(58.2)</td>
<td>(41.8)</td>
</tr>
<tr>
<td>Exclusive</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>(61.1)</td>
<td>(38.9)</td>
</tr>
</tbody>
</table>

X² = 0.006  \quad p = 0.94

O.R. = 0.9 \quad 95\% C.I. = 0.4, 2.2.

Of the 103 breast-fed children, 36 (35%) were exclusively breast-fed for the first 4 to 6 months of life. Twenty two (61.1%) of these 36 children started wheezing during the first year of life compared to 39 (58.2%) of those who partially breast-fed. This difference was not statistically significant (p=0.94).

Severity of bronchial asthma

Out of the 150 cases seen, 48 (32%) had mild asthma, 71 (47.3%) moderately severe disease and 31 (20.7%) severe disease (Fig.2). The male to female ratios were 1.4:1 for mild asthma, 1.6:1 for moderate and 1.4:1 for severe asthma. The differences observed were not statistically significant (X² \quad p value=0.9).
Fig. 2: Degrees of asthma severity among cases
Effect of passive smoking on severity of bronchial asthma

As seen in Table 8 below, although there seemed to be a greater tendency for children exposed to cigarette smoke to develop moderately severe asthma than those who were not, this difference did not achieve statistical significance.

Table 8. Association between Passive smoking and asthma severity.

<table>
<thead>
<tr>
<th>Exposure to cigarette smoke</th>
<th>Asthma severity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>moderate</td>
<td>mild</td>
</tr>
<tr>
<td>Exposed</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>36</td>
<td>(55.3)</td>
<td>16</td>
</tr>
<tr>
<td>Not exposed</td>
<td>35</td>
<td>32</td>
</tr>
<tr>
<td>(41.2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ x^2 = 2.842 \quad p = 0.09 \]
\[ \text{O.R.} = 2.1 \quad 95\% \text{ C.I.} = 0.9, 4.73 \]

No association was found between severe asthma and passive smoking \( (x^2=0.29, p=0.59) \).

Breast-feeding and asthma severity

Table 9 below shows the association between breast-feeding and severity of bronchial asthma. Exclusively breast-fed children had significantly reduced odds of developing moderate to severe forms of asthma compared to the partially breast-fed. The children with moderate and those with severe disease were combined into one group because of the small numbers involved.
Table 9. Association between breast-feeding and asthma severity among cases aged 1 to 60 months.

<table>
<thead>
<tr>
<th>Breast-feeding pattern</th>
<th>Severity of asthma</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moderate to severe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Exclusive</td>
<td>21 (58.3)</td>
<td>15 (41.7)</td>
</tr>
<tr>
<td>Partial</td>
<td>53 (79.1)</td>
<td>14 (20.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>67</td>
</tr>
</tbody>
</table>

X² = 4.02         p = 0.045
O.R. = 0.4         95% C.I. = 0.14, 0.93

On controlling for cooking fuel using Mantel-Haenszel test, only breast-feeding was found to have a significant association with severity of bronchial asthma.
Although all children studied were aged between 1 and 120 months, the medical controls were generally younger than either cases or surgical controls. This was because, with respiratory illnesses excluded, the commonest reasons for hospitalization were diarrhoeal diseases and malaria, both of which were more prevalent in the younger children.

Majority of the cases studied (93.3%) started wheezing before five years of age. This finding is consistent with what is reported in literature\textsuperscript{1-7}. Anatomic and physiologic characteristics of early life which predispose to obstructive airway disease include, among others: a decreased amount of smooth muscle in the peripheral airways compared to adults, which may lend less support; mucus gland hyperplasia in the major bronchi, which favours increased mucus production; disproportionately narrow peripheral airways up to five years of age: a highly compliant rib cage and a decreased number of fatigue resistant skeletal muscle fibres in the diaphragm\textsuperscript{7}. The finding of a male to female ratio of 1.5:1 was also comparable with that of other researchers\textsuperscript{6}. Generally a preponderance of asthma in boys over girls is reported with ratios varying from 1.3:1 to 3.3:1. Seventy one percent of cases in this study experienced their first wheeze during the first two years of life. This figure is a little higher than that found by Macharia and coworkers at the same hospital between 1986 and 1988 (55.1%) and that of Blair (57\%)\textsuperscript{52m}.

Exposure to cigarette smoke within the household was associated with significantly increased odds of early onset of wheezing, with 63% of the 65 children exposed to passive smoking experiencing their first wheeze during infancy compared to 41% of the 85 who were not exposed. It has been shown that the deposition and absorption of air contaminants depend on the breathing rate,
whether mouth or nose-breathing is occurring, and the condition of the respiratory system\textsuperscript{23}. The greater susceptibility of infants to the effects of cigarette smoke, therefore, can be explained on the basis of their having a more rapid respiratory rate and also suffering more frequently from respiratory tract infections than the older children. There is evidence that smoking produces a short-term impact on clearance mechanisms through ciliostasis and lowered mucociliary transport, thus predisposing the individual to higher rates of respiratory tract infections\textsuperscript{23}. Infections can, in turn, precipitate attacks of bronchial asthma. Both particulate and vapour parts of cigarette smoke are known to be ciliotoxic\textsuperscript{23}.

The finding of a positive association between onset of wheezing and exposure to cigarette smoke in a set-up where the majority of active smokers are fathers differs with the observations made by Fergusson and coworkers\textsuperscript{*} that maternal smoking contributed significantly in exposing children to cigarette smoke, while paternal smoking did not. The difference observed can be explained by the higher proportion of smoking mothers in that study. In their cohort of 1262 children followed up from birth to one year, the percentage of smoking mothers for children presenting with wheezy chest was 17\%, whereas in this study it was only 0.7\%. It is important to note that although most of the men were absent from home most of the day, they still contributed significantly in exposing the children to cigarette smoke and they may be the only source of cigarette smoke in populations where women rarely smoke.

On cooking fuel, the fact that cases used more of cooking gas and electricity than did either control group was found to be the result of behavioural modification in attempt to use less polluting fuel, either of their own initiative as parents began to associate asthma attacks in their children with exposure to smoke or on advice upon diagnosis of asthma in the family (see questions 21 &
We have demonstrated that compared to partially breast-fed children, exclusively breast-fed infants have significantly reduced odds of developing severe forms of bronchial asthma, \( OR=0.4 \) (95\% C.I. 0.14, 0.98), \( p=0.04 \).

Breast milk is known to protect, not only from gastrointestinal, but also respiratory illnesses\(^5^5\). The protective effect of breast-milk in the exclusively breast-fed child is attributed to a variety of factors. Breast milk contains immunoglobulins, predominantly Ig A, whose concentrations are highest in colostrum\(^3^9\). The Ig A in breast milk is thought to protect the lower respiratory airway by coating the pharyngeal entrance to the lower airway\(^5^6,^5^7\). There is data supporting the existence of a general system of mucosa associated lymphoid tissue (MALT) which includes the gut, lungs and mammary glands. In this system, immunization at one site may be an effective means of producing immunity at distant sites\(^5^8\). There is evidence suggesting that many glands may act as extension of the gut associated lymphoid tissue (GALT) and possibly the broncho-associated lymphoid tissue (BALT)\(^3^9\). In the bronchopulmonary axis, antibody-producing cells from the maternal bronchus migrate to the breasts, producing antibodies against respiratory pathogens\(^5^,^1^\). The respiratory pathogen that has consistently been associated with wheezing illness is respiratory syncitial virus (RSV)\(^6^7\). Viral agents may induce reflex bronchoconstriction by causing mucus membrane injury and stimulation of irritant receptors of the vagus, which terminate in the epithelial cells lining the airway\(^6\). Fishant and associates studied immune response of 26 nursing mothers prospectively over several months\(^5^8\). Whereas antiviral Ig M and Ig G were rarely found in colostrum or milk, RSV specific Ig A was identified in 40% - 75% of specimens. Since RSV appears to replicate only in the respiratory tract, the authors suggest that viral-specific antibody activity in the mammary gland
may be derived from BALT.

Human breast milk is also known to contain several viral inhibitors. Breast milk T lymphocytes can produce interferons, which inhibit viral growth. Breast milk also contains oligosaccharides, glycoproteins and other lipid components that bind microorganisms and inhibit their activity.

Since the severity of asthma is gauged by frequency of the asthmatic attacks, and it is known that most attacks of wheezing are commonly precipitated by viral respiratory infections, the infant who is breast-fed would suffer less from such infections and hence less frequent asthmatic attacks and thus have less severe disease. It has been shown that protection by breast milk is most evident against serious diseases like wheezing, bronchitis, bronchiolitis and pneumonia rather than uncomplicated respiratory tract illnesses.

The partially breast-fed infant, on the other hand, might not have similar benefits from the breast milk, since protection from breast milk declines in proportion to the degree of supplementation with cow's milk or formula. Early weaning exposes the baby to a variety of foreign substances some of which offer allergenic challenge to him. Commonly cited offending foodstuffs include cow's milk, eggs and citrus fruits. Food allergy in such a child would not only predispose to development of bronchial asthma, which has a strong allergic component, but also contribute to disease severity, since frequency of attacks might be related to the rate of exposure of the child to the offending food substance(s).

Study limitations and their solutions
This study was in a tertiary care hospital, and as such one would expect an over-representation of children with severe forms of bronchial asthma. The controls were drawn from both medical and
surgical wards and sampled differently in an attempt to have a representative group.

The study lacked enough numbers of children who never breast-fed for adequate comparison. The way to overcome such a limitation would be to choose the children who exclusively breast-fed and those who never breast-fed from the outset. However, since over 95% Kenyan women initiate breast-feeding, it would be difficult to accrue enough asthmatic children who never breast-fed.

**Conclusions**

Infants exposed to cigarette smoke have an increased risk of developing bronchial asthma during the first year of life. Passive smoking also appears to predispose to development of more severe forms of bronchial asthma.

Although breast-feeding does not influence the age of onset of bronchial asthma, it appears to protect the asthmatic child from developing severe forms of the disease. The cross-sectional study design used here, due to limited time available for the study, however, does not provide conclusive evidence.

**Recommendations**

It is strongly recommended that exposure of children, especially those less than two years of age, to cigarette smoke in the households be discouraged as much as possible.

A prospective study is recommended for further evaluation of the association between breast-feeding and asthma severity.
Appendix A

Evaluation of the socioeconomic state

Type of house

A.0 Roof

<table>
<thead>
<tr>
<th>Material</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thatched</td>
<td>1</td>
</tr>
<tr>
<td>Corrugated iron sheets</td>
<td>2</td>
</tr>
<tr>
<td>Tiles/concrete slabs</td>
<td>3</td>
</tr>
</tbody>
</table>

A.1 Walls

<table>
<thead>
<tr>
<th>Material</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud</td>
<td>1</td>
</tr>
<tr>
<td>Wood</td>
<td>2</td>
</tr>
<tr>
<td>Tiles/concrete</td>
<td>3</td>
</tr>
</tbody>
</table>

A.2 Floor

<table>
<thead>
<tr>
<th>Material</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud</td>
<td>1</td>
</tr>
<tr>
<td>Wood</td>
<td>2</td>
</tr>
<tr>
<td>Tiles/concrete</td>
<td>3</td>
</tr>
</tbody>
</table>

The house was then categorized as temporary, semipermanent or permanent, by adding the scores from sections "A.0 - A.2" above.

<table>
<thead>
<tr>
<th>Type of house</th>
<th>Score</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary</td>
<td>up to 4</td>
<td>1</td>
</tr>
<tr>
<td>Semipermanent</td>
<td>5-7</td>
<td>2</td>
</tr>
</tbody>
</table>
A.3 Sleeping index

This was the number of people sleeping in the same room as the child.

1. Three or more 1
2. Two 2
3. One 3
4. None 4

A.4 Family size

1. More than four 1
2. Up to four 2

<table>
<thead>
<tr>
<th>Socioeconomic status</th>
<th>Total number of points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low</td>
<td>Up to 4</td>
</tr>
<tr>
<td>2. Middle</td>
<td>5-6</td>
</tr>
<tr>
<td>3. High</td>
<td>7-9</td>
</tr>
</tbody>
</table>
Sample size

The sample size for the study was calculated using the formula of different proportions:\textsuperscript{52}

\[ n = \frac{(Z_{a/2} + Z_{p/3})^2 \cdot P \cdot (1-P) \cdot (r+1)}{d^2 \cdot r} \]

Where:

\( n \) = The number of cases
\( d \) = The minimal difference detected to be considered significant, 0.1
\( r \) = The ratio of the number of controls studied to the number of cases studied, 1:1:1.
\( P \) = Weighted average of \( P \), and \( P_0 \)
\[ P = \frac{P + rP_0}{1 + r} \]

Where:

\( P \), - the prevalence of smoking among asthmatics = 9.3%
\( P_0 \) - the prevalence of smoking in the general population = 5.5%

The prevalence of smoking was used, since the prevalence of breast-feeding among asthmatics gave a smaller sample size as mentioned below.

\( Z_{a/2} \) = Two-tailed test of the difference
\( Z_{fl} \) = The standard normal deviate

For this study a significance level (a) of 0.05 was chosen. The power of study (1-\( \alpha \)) was 0.9. For this combination of a significance level of 0.05 and power of 0.9 the value of \((Z_{a/2} + Z_{ft})^2\) was found to be 10.507.

Thus:

\[
P = 0.093 + 0.055 = 0.148 = 0.074
\]

Consequently:

\[
n = 10.507 \times 0.074 \times (1-0.074) \times (1+1) \times (0.1)^2 \times 1
\]

\[= 143.9\]

Thus a minimum of 144 cases were needed for the study.

When calculated using the prevalence of exclusive breast-feeding, which is approximately 5.2% for asthmatic children, while in the general population it ranges from 4.7% to 10.7% (average 7.7%), the minimum number of cases needed was found to be 127, which was too small for studies on passive smoking. The sample size based on the prevalence of smoking was, therefore, used. With a case to control ratio of 1:1:1 the two control groups were also to have not less than 144 children each, giving a total minimum sample of 432.
Appendix C

Data collection sheet

Code: 1 - Cases
2 - 1st control
3 - 2nd control

Part 1: Questionnaire

1. Study number.............................................[ ] [ ] [ ]
   Date of data collection.........................[ ][ ][ ][ ][ ][ ]
2. Name of the child
3. Age of the child (months).........................[ ] [ ] [ ]
   Date of birth.......................................[ ][ ][ ][ ][ ][ ]
4. Sex of the child....................................[ ]
   1. Male 2. Female
5. Residence

6. Father's education (yrs)..........................[ ] [ ]
7. Mother's education (yrs).........................[ ] [ ]
8. Does the child attend any institution of
teaching or day care?.................................[ ]
1. No 2. Yes

9. On average how many hours does the child spend away from home per day?.................................[ ]
   1. Up to 6 hrs (half day)
   2. More than 6 hrs (full day)

10. Are there any pets in the house?............................[ ]
   1. No  2. Yes
   If "yes," please specify type of pet..............................[ ]
      1. Dog  2. Cat  3. Rabbit
      4. Other mammal  5. Fowl  6. Reptile
   For cases proceed to No 11, controls to No 23.

11. At what age (months) did the child have the first episode of wheezing?.................................[ ][ ][ ]

12. Has he/she had any attack of wheezing in the last two months?.................................................[ ]
    1. No  2. Yes
    If "yes," please, answer q. 13. If "no" proceed to No 14.

13. How many wheezing attacks has he/she had in the past two months?............................................[ ]

14. Generally when do the attacks most commonly occur?..............[ ]
    1. Late in the evening
    2. At night
    3. Early in the morning
4. Day time  5. Variable

15. During which season do the asthmatic attacks most often occur? .......................................... [ ]
   1. Cold/wet season
   2. Hot/dry season
   3. Cold/dry season  4. Variable

16. Please answer "yes" or "no": During the attacks does he/she get an injection? ......................... [ ]
   1. at times?
   2. most of the time?
   3. never?

17. Which medicine is the child on? .............................. [ ]
   1. Ventolin
   2. Franol  3. Zaditen

18. How does the child take his/her medication? ............. [ ]
   1. Every day
   2. Intermittently (during colds/coughs)

19. Before he/she begins to wheeze does the child ever get any of the following (code 1.No  2. Yes)

   a) Fever
   b) Unusually runny nose
   c) Sore throat
   d) Painful/discharging ears
   e) cough
20. Does the child attend any clinic for this condition?.................................[ ]

1. No  2. Yes

If "yes," for how long (months) has he attended the clinic?.................................[ ] [ ]

21. Has any advice been given to you regarding the child's condition?.........................[ ]

1. No  2. Yes

If "yes," please state what you were told

1

2

3

4

5

Code: 1. Concerning medication.................................................[ ]

2. On avoiding allergens/provocative situations, like strenuous exercises

3. On feeding habits.................................................................[ ]

4. On air pollution......................................................................[ ]

5. Other (specify)........................................................................[ ]

22. Have any changes been made as a result of the suggestions in question 21?...............[ ]

1. No  2. Yes

If "yes," please, state which ones.
23. Has the child been hospitalized in the past six months because of an asthmatic attack or cough? ......................[ ]
   1. No 2. Yes
   If "yes," how many times? .................................[ ] [ ]

24. Does the child suffer from any of the following at any time? (Code: 1. No 2. Yes)
   a) Sneezing alternating with running nose/blocked nostrils. .................[ ]
      (allergic rhinitis)
   b) Eczema. .....................................................[ ]
   c) Allergic conjunctivitis. .................................[ ]
   d) Papular urticaria. .................................[ ]
   e) Allergy to certain food(s). .................................[ ]

25. Does any member of the family suffer from any of the conditions listed in No 24? .................................[ ]
   1. No 2. Yes
   If "yes," please state who. (1. No 2. Yes)
   1. Father. .........................................................[ ]
   2. Mother .........................................................[ ]
3. Sister/brother...........................................[ ]
4. Aunt/uncle.............................................[ ]
5. Grand parent (s).......................................[ ]

26. Has the child been seen at the out-patient
department in the last two months?....................[ ]
   1. No  2. Yes
   If "yes," how many times?...........................[ ][ ]

27. Feeding:
   a) For how long was the child fed with
      only breast milk?...................................C ]
      1. Never  2. <4 mo  3. 4-6 mo
      4. >6 mo  7. I do not know
   b) At what age (months) was he/she supplemented?....[ ]
   c) What supplements were given?.......................[ ]
      1. Cow's milk
      2. Powdered milk
      3. Other (specify)
   d) At what age was he/she weaned?.....................[ ]
   e) what was the weaning diet?........................[ ]

28. Does any member of the household presently smoke
cigarettes?.............................................C ]
   1. No  2. Yes
   If "yes," please state who...........................[ ]
      1. Mother...........................................[ ]
      2. Father...........................................[ ]

38
3. Other (specify) ..............................................[ ]

and proceed to questions 29-33.
If "no" advance to No 34.

29. Did the person smoke yesterday?.................................[ ]
   1. No  2. Yes

30. On average how many cigarette
    sticks does he/she smoke per day..........................[ ][ ]
    How many cigarette sticks did they smoke yesterday?....[ ][ ]

31. Where does he/she smoke most often?........................[ ]
    1. In the house
    2. Outside the house
    3. Away from home
       Where did he/she smoke yesterday?.......................[ ]

32. If they smoke in the house, where in the
    house do they usually smoke?...............................[ ]
    1. Sitting room
    2. Bed room
    3. Kitchen
    8. Not applicable
       Where in the house did they smoke yesterday?..........[ ]

33. When does he/she usually smoke most?......................[ ]
    1. Day time  2. Night time
    And yesterday, when did they smoke most?.............[ ]

39
34. Did any member of the household once smoke but stopped? ...........................................[ ]
   1. No  2. Yes

If "yes," please state who........................................[ ]
   1. Father
   2. Mother
   3. Sister/brother
   4. Aunt uncle
   5. Grand parents

35. How long ago (months) did they stop smoking..............[ ]
   1. <6 mo
   2. 6-12 mo
   3. 13-24 mo
   4. > 24 mo

36. What type of house does the child live in?
   Code: 1. no  2. Yes

   Roof: .................................................................[ ]
   1. thatched
   2. corrugated iron sheets
   3. tiled/concrete

   Floor: .................................................................[ ]
   1. mud
   2. wood
   3. concrete/tile

   Walls: .................................................................[ ]
38. Cooking fuel used by the family:

Code: 1. No  2. Yes

<table>
<thead>
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<th>often used</th>
<th>used yesterday</th>
</tr>
</thead>
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<tr>
<td>Crop residue/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>firewood/charcoal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerosene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

39. Where is the cooking facility located? ....................[ ]
   
   1. In the living room
   2. In the bed room
   3. In a separate kitchen
   4. In an attached kitchen

40. Type of ventilation in the house.

   Code: 1. None
   2. One window
   3. More than one window
   8. Not applicable

<table>
<thead>
<tr>
<th>Sitting room</th>
<th>Bed room</th>
<th>Kitchen</th>
</tr>
</thead>
</table>
Part II: Examination

1. Height (to the nearest 0.1 cm)
2. Weight (to the nearest 0.1 kg)
3. Respiratory rate
4. Fever
5. Physical deformity
6. Cyanosis
7. Conjunctivitis
8. Eczema
9. Papular urticaria
10. Breathlessness
11. Restlessness
12. Audible wheezing
13. Flaring of alae nasi
14. Chest indrawing
15. Reduced air entry
16. Expiratory rhonchi
17. Inspiratory rhonchi
18. Crepitation
19. Inspiratory stridor
20. Inflamed throat
21. Enlarged, inflamed tonsil(s)

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