

Relationship Between Feeding Method and Incidence of
Otitis Media in Infants Under One Year of Age

By

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A Master's Research Project

Presented to
Oregon Health Sciences University
School of Nursing
in partial fulfillment of
the requirements for the degree of
Master of Science

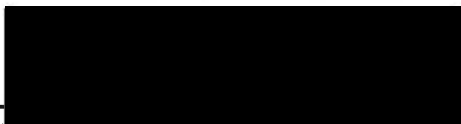
8 May 1998

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ACKNOWLEDGEMENTS

I wish to express my gratitude and sincere appreciation to Pam Hellings and Catherine Burns for carefully guiding me through the research adventure. Their knowledge of research, their patience, time, and encouragement that kept me going. And many thanks to the pediatricians at Grants Pass Clinic, Kelley Burnett, William Kohn, Barbara Sniffen, and Belinda Voit. Without their friendship and support this research endeavor would not have been possible. And finally, my thanks to Jonathan Fields for his patience and statistical guidance.

I also wish to thank my family for their interest and encouragement.

DEDICATION


This project is dedicated to the love and support of my husband. Without his unwavering patience and prodding, this Master's Research Project would have never reached the end.

ABSTRACT

Title: Relationship Between Feeding Method and Incidence of Otitis Media in Infants
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This is an exploratory study to examine the relationship of feeding method to the incidence of otitis media. Despite the high prevalence of otitis media and an understanding of some of the contributing factors, little progress has been made in preventing these infections. This study explores the possibility of breast feeding as a strategy of protection against ear infections. Method of feeding was divided into 4 categories: formula only, brief breast feeding (less than 2 months), intermediate breast feeding (2 to 6 months), and full breast feeding (6 to 12 months). Child care attendance and household smoking exposure was recorded as possible contributing factors.

The sample for the study was drawn from a rural pediatric practice in southern Oregon. Charts were reviewed for the first year of life. Infants who were breast fed even less than 2 months experienced significantly fewer episodes of otitis media. Also, breast fed infants experienced their first infections at a significantly older age.

Further study is needed to explore the financial savings and application of this data.

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CHAPTER ONE

Introduction

Each year in the United States, there are 30 million visits to pediatricians for otitis media, at a cost of one billion dollars (Walker, 1993, p. 97). Today's healthcare dollar is being stretched thin and cutbacks made at every turn. Prevention of such a common condition deserves attention. The direct cost of office visits for otitis media does not include missed pay for time off work to attend the office visits, cost of prescriptions to treat the infection, or cost to the employer for work lost or replacement worker. "In addition to the morbidity, potential complications, and adverse developmental effects caused by recurrent episodes of otitis media among children, these episodes entail major financial costs to the community in the form of medical visits, medication use, operations, and parental time off from work" (Paradise, 1992, p. 33).

Children with otitis media account for one third of all sick child visits to pediatric offices. Infections of the middle ear are second only to upper respiratory infections as the most common illness and are growing in incidence annually. The office visits for treatment of otitis media in children under the age of 2 years jumped 224% between 1975 and 1990 (Schappert, 1992).

Otitis media encompasses a spectrum of diseases, ranging from acute to chronic, that may or may not produce symptoms. It can affect all age groups but is most common during the first 2 years of life. Incidence peaks again around 4 years of age and decreases after 6 or 7 years of age. "Approximately 75% of children will have at least one episode of otitis media by their third birthday" (Teele, 1984, p. 83).

Otitis media occurs most often in the winter and early spring months. It occurs more frequently among children in low-income families. Other contributing factors identified with increased rates of otitis media in children include day care attendance, age, gender, season, low socio-economic status, heredity, smoking, and bottle-feeding (Alho, Laara, Oja, & Hannu, 1996; Niemela, Uhari, & Mottonen, 1995; Piekkala, 1987; Sipila, Karma, Pukander, Timonen, & Kataja, 1988). Attendance at day care centers has been linked to a higher incidence in otitis media among infants and young children, resulting in a disproportionate number of myringotomies and tympanostomy tube placements (Wald, 1988).

According to Paradise and Elster (1984), children who are breastfed in the first four months of life have approximately half as many ear infections as babies who don't breast-feed at all. This finding has been disputed by Howie, Forsyth, Ogston, Clark, & Florey (1990) and Niemela (1995) who found no relationship between breast feeding and otitis media.

Despite the high prevalence of otitis media and an understanding of some of the contributing factors, little progress has been made in preventing otitis media. Pediatric nurse practitioners, physicians, and pediatric nurses are still faced with managing acute otitis media and calming anxious parents on a daily basis. Although the literature provides contradictory evidence about the relationship between breast feeding and otitis media, it is important to further explore this possible strategy to decrease the incidence of otitis media.

Therefore, the purpose of this study is to examine the relationship between incidence of otitis media and method of infant feeding (breast versus formula) in infants under 1 year of age in a rural pediatric practice.

CHAPTER TWO

Review of Related Literature

Research has been inconclusive in regard to the role of breast feeding and breast milk in prevention of infection. According to Auerbach (1991, p. 115), “perhaps five percent of what we feel we need to know is now part of the knowledge base”. In addition, there are some strongly held opinions related to this issue-that breast feeding has, at most, a minimal protective effect in industrialized countries or that breast feeding, in fact, has an important protective effect. Both of these positions will be reviewed.

Breast feeding is described by Riordan (1996, p. 93) as “a unique process that provides ideal nutrition for infants which contributes to their healthy growth and development and reduces both the incidence and severity of infectious diseases.” She also states that “this protective effect of breast feeding is more striking in settings where poverty, malnutrition and poor hygiene are prevalent” (p. 93).

Breast Feeding and Immunity

Walker (1993) addressed the potential risks of formula feeding associated with higher rates of acute diseases with immune system disorders, and with possible related mortality. She goes on to state that breast feeding enhances responses to vaccines. “Infant formula is not a complete food because ingredients are added only when they are discovered to be important and already present in breast milk. The newborn is totally dependent on a single food during a critical time of growth and development. The amounts and types of nutrients can have both short- and long-term consequences on the growth and health of the child” (p. 100).

A study of the effect of breast feeding on childhood illnesses in Scotland collected data related to eight different illnesses (Howie et al, 1990). Twelve home visits per subject were made to collect data on occurrence of gastrointestinal illness, respiratory infections, ear infection, mouth infections, eye infections, skin infections, colic, and “nappy” rash between the ages of 1 and 24 months. Subjects ($n = 674$) were categorized as those who chose to bottle feed from birth, those who chose to breast feed but stopped before 13 weeks (early weaning group), and those who chose to breast feed for 13 weeks or more. The two groups who chose to breast feed were further subdivided into those who introduced supplements before 13 weeks (partial feeders) and those who did not (full breast feeders). The conclusion was that there were no significant differences during the first 13 weeks between bottle feeders and early weaners or between full and partial breast feeders against ear, eye, mouth, or skin infections, infantile colic, eczema, or diaper rash. They also concluded however, that breast feeding during the first 13 weeks of life did confer protection against gastrointestinal illness that persisted beyond the period of breast feeding itself.

Paine and Coble (1982) conducted a retrospective cohort study of 106 infants born in the period between 1972 and 1978 who attended a family practice clinic in Iowa. During the first 6 months of life, infants who were completely or partially breast-fed (with or without supplementation) had fewer months with office visits for illnesses. When diagnoses were reviewed, the results showed that otitis media occurred about equally in the two feeding groups during the first 6 months: 4.5 clinic visits per 100 infant-months for breast-fed and partially breast-fed compared with 5.8 clinic visits per 100 infant-

months for infants bottle-fed from birth (Paine, 1982). They found no appreciable differences between the demographic data of the two groups. The results showed that in the first 6 months of life, breast-fed infants had fewer office visits for illness than did bottle-fed infants. Bottle supplementation did not change this effect. The difference was most pronounced in the first month of life when breast-feeding was highest. After infants were weaned from the breast, they fared no better than those who were bottle-fed from birth.

In contrast Chandra (1979) conducted a prospective study of 30 breast-fed and 30 bottle-fed Canadian infants over the first 24 months of life. Breast-fed infants had significantly fewer episodes of otitis than bottle-fed infants: 0.3 episodes compared with 2.9 episodes.

A study conducted in Helsinki by Saarinen (1982) looked specifically at otitis media. Two hundred fifty-six healthy term infants were followed through their first 3 years of life. Two hundred twenty-two were available at the year-examination. Infant feeding was characterized as long breast feeding (only source of milk until 6 months of age), intermediate (2 to 6 months), and cow's milk (less than 2 months of breast feeding). Solids were not given until 3.5 months of age according to the protocol for infants in any of the feeding groups. "The incidence of otitis was inversely associated with the duration of breast feeding. Up to 6 months of age no infant who had had long breast feeding had otitis whereas ten percent of infants who were given cow's milk had otitis" (Kovar, 1984, p. 624). Early onset otitis (at less than 6 months of age) and recurrent otitis also occurred more frequently among the group given cow's milk.

Other Factors Affecting Otitis Media Incidence

Taylor, Golding, Wadsworth, and Butler (1982) studied the possible benefits of breast feeding on certain aspects of the health of children during the first 5 years of life in a national birth cohort. They proposed that it was possible that some of the benefits ascribed to breast feeding might not be due to breast feeding but to accompanying beneficial social influences known to affect children's health such as parents who were of high socio-economic status and less likely to smoke. Otitis media was not addressed directly, although a contributing factor, respiratory illness, was discussed. According to this study "increased duration of breast feeding was associated with reduced likelihood of respiratory illness. However, when allowance was made for other factors also associated with respiratory illness, the influence of breast feeding was non-significant" (Taylor, Golding, Wadsworth, & Butler, 1982, p. 1227).

According to Alho, Laara, and Oja (1996), nursery day care had the strongest effect on the prevalence of acute otitis media in their study. The same study concluded parental smoking had only a modest effect which started soon after the child's birth (Alho et al, 1996). Similar findings reported by Sipila, Karma, Pukander, Timonen, and Kataja (1988) found that "attending day-care at centers was the most important single risk factor in acute otitis media".

Niemela, Uhari, and Mottonen (1995) explored pacifier use as a risk factor of recurrent otitis media. They used a prospective methodology recording the use of a pacifier in 845 children attending day care centers in Finland. They concluded that the use of a pacifier is a significant risk factor for recurrent acute otitis media. The use of a

pacifier increased the annual incidence of otitis media from 3.6 to 5.4 episodes in children younger than 2 years and from 1.9 to 2.7 in children 2 to 3 years of age. It was calculated that the use of a pacifier was responsible for 25% of the attacks in children younger than 3 years of age. Breast feeding, parental smoking, thumb sucking, using a nursing bottle, and the social class of the family failed to show such strong associations with the occurrence of otitis media.

Parental smoking as a potential risk factor for otitis media is a relatively new observation. In a study by Sipila et al (1988) the mother's, but not the father's, smoking seemed to increase the risk of the baby contracting otitis media, and especially several recurrent attacks.

In summary, the results supporting the protective effect of breast feeding for otitis media are mixed. Therefore, this study will further examine the issue by evaluating the relationship between infant feeding methods and the incidence of otitis media in infants under 1 year of age in a rural pediatric practice.

CHAPTER THREE

Methods

The sample for the study is drawn from a rural pediatric practice in southern Oregon that consists of four pediatricians within a multi-specialty group of 31 physicians. Sixty percent of the pediatric practice patients receive insurance coverage from Oregon Health Plan, a capitated plan for low income Oregonians. Patients commute from the surrounding areas from as far as an hour away. The clinic is open 7 days a week and provides after hours coverage as needed. It is the policy of this practice to schedule a return appointment for all patients with otitis media under 2 years of age in order to confirm that the infection has cleared.

Charts were reviewed for all infants who were at least 12 months of age but no older than sixty months of age by October 1997 and then proceeding back until 100 charts with complete records, those with data available from birth to 12 months of age, were reviewed. Infants with congenital anomalies of the upper respiratory system and those who were immunocompromised due to disease process or medication therapy were excluded from the study.

Data were collected on current subject age, incidence of otitis (if occurred, age of first infection and how many in first year of life), feeding method and duration, day care attendance, and smoking exposure.

Variables

Incidence of otitis media consisted of the actual count of each new episode of acute otitis media occurring after a documented clearing, diagnosed in the office or

emergency room. Age in months at first infection was noted. For the measurement of type of feeding, there were four categories: formula only, brief breast feeding (less than 2 months), intermediate breast feeding (2 to 6 months), and full breast feeding (6 to 12 months) were utilized. Day care attendance was recorded as a yes, no, or information not available. Smoking exposure was also recorded as whether father, mother, or anyone else in the home environment was a smoker, or unknown (see data collection tool, Appendix A).

Analysis

The data were analyzed using the CRUNCH program. Analysis consisted of frequencies and T tests used to test the significance of differences in means between the variables of interest, particularly method of feeding and number of otitis media infections.

Human subjects approval was obtained through Oregon Health Sciences University Institutional Review Board. Approval was also obtained from the practice whose charts were being reviewed.

CHAPTER FOUR

Results

Description of Sample

One hundred one charts (n=101) which met the inclusion criteria of complete records from birth to 12 months of age, no craniofacial anomalies, and no immunocompromised status were reviewed. Current age of the patients ranged from 14 to 25 months. However, the data were recorded only for the first 12 months of life for each subject. There were 16 infants who were exclusively formula fed. Twenty-three were breast fed less than 2 months, while 29 were breast fed between 2 and 6 months, with 33 breast fed greater than 6 months (see Table 1).

Table 1

Method of feeding

Variable	N	Percent
Formula only	16	15.8
Breast fed <2 months	23	22.8
Breast fed 2-6 months	29	28.7
Breast fed >6 months	33	32.7

There were no occurrences of otitis media for 17.8% of the sample (n=18). Of those 18, only two were exclusively formula fed. There were four infants who were breast fed less than 2 months and four who were breast fed between 2 and 6 months. The largest group of infants who had no occurrence of otitis was the group of eight infants breast fed greater than 6 months (see Table 2).

Table 2

Feeding method of infants with no occurrence of otitis media

Variable	N	Percent
Formula fed only	2	11.1
Breast fed <2 months	4	22.2
Breast fed 2 -6 months	4	22.2
Breast fed >6 months	8	44.4

For the remaining 82.2% (n=83), the incidence of otitis media ranged from 1 to 8 occurrences with a mean of 2.5 infections per child (see Table 3). The first infection occurred at less than one month of age for 3%, while 27% did not have an episode of otitis media until after 7 months of age (see table 4).

Incidence of Otitis Media

Table 3

Incidence of otitis media

Number of infections	N	Percent
0	18	17.8
1	40	21.8
2	21	20.8
3	14	13.9
4	9	8.9
5	5	5.0
6	4	4.0
7	6	5.9
8	2	2.0

n = 101

Table 4

Age of first infection

Age in months	Frequency	Percent
<1	3	3.0
1-2	6	6.0
2-3	1	1.0
3-4	4	4.0
4-5	14	13.9
5-6	8	7.9
6-7	19	18.8
7-8	6	5.9
8-9	7	6.9
9-10	3	3.0
10-11	3	3.0
11-12	6	5.9
12	3	3.0

n = 83

Day Care Attendance and Feeding Method

Fifteen of the infants attended day care, 22 did not. The data were not available in 64 of the charts. Of the 15 infants who attended day care, three were fed only formula, three were breast fed less than two months, five were breast fed between 2 and 6 months, and four were breast fed greater than six months. Of the 22 infants who did not attend

daycare nine were formula fed only, four were breast fed less than 2 months, seven were breast fed 2 to 6 months, and two were breast fed greater than 6 months (see Table 5).

Table 5

Feeding method and day care attendance

Day care attendance	Feeding Method	Frequency	Percent
Yes N=15	Formula only	3	3.0
	Breast fed <2 months	3	3.0
	Breast fed 2-6 months	5	5.0
	Breast fed >6 months	4	4.0
No N=22	Formula only	9	8.9
	Breast fed <2 months	9	8.9
	Breast fed 2-6 months	4	4.0
	Breast fed >6 months	2	2.0
Unknown N=64	all methods	64	63.4

Household Smoking and Feeding Method

Smoking in the household was recorded for mother, father, or other household member. There were 15 households where father was noted as a smoker and 55 with father as a non-smoker. Father's smoking status was not recorded in 31 of the charts. The numbers were the same for smoking exposure by the infant's mother, although these were not from the same households. There were 15 households in which the mother was a smoker, 55 in which she was a non-smoker, and 31 households in which the data was

unavailable. For the other potential smoke exposure in the home, only two charts noted the presence of other residents of the household who smoked while the other 99 charts stated either no smoking exposure or the data were unknown (see Table 6).

Table 6

Smoking in the home

Household member	N	Percent
Mother smoker	15	14.9
non-smoker	55	54.5
Unknown	31	30.7
Father smoker	15	14.9
non-smoker	55	54.5
unknown	31	30.7
Other household smoker	2	2.0
non-smokers	67	66.3
unknown	32	31.9

Feeding Method and Otitis Media

The mean number of infections in the first 12 months of life varied from 1.7 for the breast fed greater than 6 months group to 4.2 for the formula only group (see Table 7).

Using the T test, there was a significant difference in the mean number of infections between infants who were formula fed and infants who were breast fed greater than 6 months with breast feeding infants having fewer infections. The difference in means was

also significant for formula as compared to breast fed 2 to 6 months, as well as breast fed less than 2 months (see Table 8).

Table 7

Incidence of otitis media and feeding method

Feeding Method	N	Mean Number of Infections	Standard Deviation
Formula only	16	4.2	2.6
Breast fed <2 months	23	2.3	2.2
Breast fed 2-6 months	29	2.5	1.9
Breast fed >6 months	33	1.7	1.4

Table 8

Comparison of P - values for groups compared using the T – test

Feeding methods compared	T statistic	P value
Formula only > Breast fed < 2 months	2.40*	0.0216
Formula only > Breast fed 2 - 6 months	2.48*	0.0172
Formula only > Breast fed > 6 months	4.23*	0.0001
Formula only > Any breast feeding	4.04*	0.0001

(* significant at $p < 0.05$)

Comparison of age in months of first infection with feeding method shows a mean difference of approximately 2 months in the age at the first infection between formula feeding and any of the breast feeding groups. For a formula fed infant, the mean age of first infection was 4.2 months (sd 2.3 months). For infants given breast milk less than 2

months, the mean age went up to 6.2 months (sd 3.3 months). The mean age of infection for an infant breast fed 2 to 6 months is 6.5 months (sd 2.8 months). For an infant given breast milk greater than 6 months, the age of first infection was 6.2 months (sd 2.9 months). Differences in the mean age of first infections were significant between formula fed and each of the three breast feeding groups (see Table 10).

Table 9

Age in months of first otitis media and feeding method

Feeding Method	N	Mean age of First OM	Standard Deviation
Formula only	14	4.2	2.3
Breast fed <2 months	19	6.2	3.3
Breast fed 2 - 6 months	25	6.5	2.8
Breast fed >6 months	25	6.2	2.9

Table 10

Comparison of P - values for groups compared using the T-test

Feeding Method	T statistic	P value
Formula only > Breast fed < 2 months	1.915	0.0648
Formula only > Breast fed 2 - 6 months	2.541*	0.0154
Formula only > Breast fed > 6 months	2.243*	0.0310
Formula only > any breast feeding	2.504*	0.0143

(* significant at $p < 0.05$)

Day Care Attendance and Otitis Media

For the 37 children who had documented day care attendance, the mean number of infections for the day care attendee was 3.4 while those who did not attend day care had a mean number of 3.2 infections (see Table 11). The differences in these means were not tested by the T-test as there was no clinically significant difference in the means.

Table 11

Daycare attendance and otitis media

Attends Daycare	N	OM Mean	Standard Deviation
yes	15	3.4	1.5
no	22	3.2	2.7

Household Smoking and Otitis Media

In households where the mother smoked, the infants experienced a mean of 2.7 infections. The infants in mother non smoking households also experienced a mean of 2.7 infections. In contrast, in households where the father smoked, the infants experienced a mean of 3.6 infections; but if the father did not smoke the mean number of infections was 2.6. Although there is a mean difference of 0.8 infections in the father smoking groups, this difference was not statistically significant ($t=1.247$, $p=0.2167$) (see Table 12).

Table 12

Household smoke exposure and otitis media infections

Household member	N	OM Mean	Standard Deviation
Mother smoker	15	2.7	2.2
Mother non-smoker	55	2.7	2.2
Father smoker	15	3.4	2.2
Father non-smoker	55	2.6	2.3

Summary

In this sample, breast feeding was associated with a significant decrease in the number of episodes of otitis media in the first 12 months of life and a significant increase in the age of the first infection. There were no significant differences in the incidence of otitis media related to day care attendance or household smoke exposure. Eighty-eight percent of the 18 infants who had no episodes of otitis media in the first year received some breast milk.

CHAPTER FIVE

Discussion

It is interesting to note the high incidence of breast feeding in this sample. Only 15% were formula fed. The remaining 84.2% received breast milk for less than 2 months, 2 to 6 months, and greater than 6 months. In addition, the number of episodes of otitis media was high in this sample as 82.2% of infants had one to eight infections in the first year of life. It is not known whether the incidence would have been as high in other parts of Oregon or in other practices.

Limitations

In the sample reviewed, there was a strong relationship between feeding method and incidence of otitis media. Breast feeding infants had approximately half as many ear infections as formula fed infants. The significant differences in the incidence of otitis media related to feeding method support the argument that breast feeding does provide a protection against otitis media. However, the size of this sample and the unequal numbers in each group make it difficult to expand the results beyond this sample.

Although it is generally not recommended to do multiple T-tests, they were done to assess differences between formula feeding and each of the breast feeding groups. The results proved interesting as there were significant differences between formula feeding

and each of the breast feeding groups on mean number of infections and age in months of first infection.

Although the literature (Alho et al, 1996) suggested a relationship between day care attendance and otitis media, this study did not find a significant relationship. However, the lack of significant findings may be related to the small percentage of infants enrolled in day care in this sample or the lack of information about actual day care enrollment.

Implications for Clinical Practice

Breast feeding promotion would appear to be a worthwhile endeavor based on the result of this study. Pediatric nurse practitioners should consider implementing breast feeding support programs to encourage mothers to initiate and continue breast feeding. The literature suggested that a stronger relationship between smoking in the home and incidence of otitis media than was found in this sample (Alho et al, 1996, Sipila et al, 1988). An infant whose mother smokes was no more likely to have an infection than infants whose mother did not smoke. The data in this study showed that an infant whose father smoked was more likely to have an infection than an infant whose father was a non-smoker, although this difference was not statistically significant. This lack of difference may be related to small sample size, missing data, or lower rates of smoking in the home. However, smoking cessation remains an area of intervention which health care providers should actively support. At the very least, pediatric practices should document household smoking and consider smoking cessation programs to improve the environment for infants

and children. It would be interesting to measure smoking exposure by the number of packs per day smoked by household members to test the effect of “dosing” exposure to small or large amounts of smoke.

Implications for Further Research

This study was limited in its retrospective aspect, an inability to control for variables such as pacifier use, socio economic status, smoking exposure, or co-morbidity of conditions. Some variables of interest were not able to be studied due to missing data or incomplete data on the charts. A well controlled prospective study on a similar population from several areas in the northwest including urban as well as rural practices might provide further data for evaluation. Participants would be enrolled at discharge from the hospital or at the first office visit after discharge. They would be followed at a regularly scheduled interval of visits as well as urgent care appointments. Change in social conditions should be assessed regularly to evaluate change in socio-economic status and life stresses as a possible influence on health. It would be interesting to document the financial savings from fewer office visits and prescriptions related to breast feeding.

Conclusions

In summary, this study lends support to the theory that breast feeding decreases the incidence of otitis media and increases the age of the first infection. Primary care providers should more strongly encourage mothers to initiate breast feeding as well as to maintain breast feeding until at least 12 months. Parents should be informed of the health

benefits of breast feeding an infant so that they may make an informed decision about the care of their child.

Further study is recommended in a variety of settings both urban and rural to compare data for generalized use as well as further explore the protective effects of breast milk, other contributing factors, and possible financial savings related to breast feeding.

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Appendix

Appendix A
Data Collection Tool

1. Subject # ____

2. Current age in months ____

3. **Method of feeding**

1.) formula only 2.) breastfed <2 m/o 3.) breastfed 2-6 m/o 4.) breastfed 6-12 m/o

Incidence of Otitis Media

4. Actual number OM infections ____

5. Age in months of 1st infection ____

6. **In Child Care**

1.) yes ____

2.) no ____

3.) NA/uncertain ____

Smoking

7. Father 1.) yes 2.) no 3.) unknown

8. Mother 1.) yes 2.) no 3.) unknown

9. Other family member who resides in household

1.) yes 2.) no 3.) unknown