CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

INFANT EXPOSURE TO POTENTIAL
FOOD ALLERGENS AND HONEY

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Science in
Home Economics
by
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With love and gratitude to my mother, Kiki, whose persistent encouragement made my education feasible, and to Richard and my two children whose support, help and inspiration contributed to the completion of my Master's degree.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEDICATION</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>ix</td>
</tr>
<tr>
<td>Chapter</td>
<td></td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>1</td>
</tr>
<tr>
<td>Justification</td>
<td>1</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>2</td>
</tr>
<tr>
<td>Assumptions</td>
<td>4</td>
</tr>
<tr>
<td>Limitations</td>
<td>4</td>
</tr>
<tr>
<td>Glossary</td>
<td>5</td>
</tr>
<tr>
<td>2. REVIEW OF LITERATURE</td>
<td>6</td>
</tr>
<tr>
<td>Definition of Allergy</td>
<td>6</td>
</tr>
<tr>
<td>Food Allergy in Infancy</td>
<td>6</td>
</tr>
<tr>
<td>Symptomatology of Infantile Food Allergies</td>
<td>8</td>
</tr>
<tr>
<td>Prevention of Infant Food Allergies</td>
<td>10</td>
</tr>
<tr>
<td>Honey, Allergies and Infant Botulism</td>
<td>11</td>
</tr>
<tr>
<td>3. METHODOLOGY</td>
<td>13</td>
</tr>
<tr>
<td>Selection of Sample</td>
<td>13</td>
</tr>
<tr>
<td>Method of Collecting Data</td>
<td>13</td>
</tr>
<tr>
<td>4. RESULTS AND DISCUSSION</td>
<td>14</td>
</tr>
<tr>
<td>Milk Feeding</td>
<td>14</td>
</tr>
<tr>
<td>A. Demographic Relationships</td>
<td>14</td>
</tr>
<tr>
<td>B. Practices</td>
<td>18</td>
</tr>
<tr>
<td>Solid Feeding</td>
<td>25</td>
</tr>
<tr>
<td>A. Demographic Relationships</td>
<td>25</td>
</tr>
<tr>
<td>B. Practices</td>
<td>26</td>
</tr>
<tr>
<td>Honey</td>
<td>28</td>
</tr>
<tr>
<td>Chapter</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS</td>
<td>30</td>
</tr>
<tr>
<td>Summary</td>
<td>30</td>
</tr>
<tr>
<td>Conclusions</td>
<td>32</td>
</tr>
<tr>
<td>Recommendations</td>
<td>33</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>35</td>
</tr>
<tr>
<td>APPENDIX: QUESTIONNAIRE</td>
<td>44</td>
</tr>
</tbody>
</table>
**LIST OF TABLES**

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ETHNICITY VS. DURATION OF BREAST FEEDING, INTRODUCTION OF COW'S MILK FORMULA AND SOLIDS</td>
<td>15</td>
</tr>
<tr>
<td>2. INFANTILE ALLERGIES INDUCED BY SPECIFIC TYPES OF FOOD</td>
<td>19</td>
</tr>
<tr>
<td>3. TIME OF INTRODUCTION OF VARIOUS SUPPLEMENTARY FOODS TO MATERNAL MILK</td>
<td>23</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>1. Duration of Breast Feeding</td>
<td>21</td>
</tr>
</tbody>
</table>
ABSTRACT

INFANT EXPOSURE TO POTENTIAL FOOD ALLERGENS AND HONEY

by

Maria George Davaris

Master of Science in Home Economics

The purpose of this study was to determine how early introduction of common food allergens affects the occurrence of allergic disorders in infancy, how mothers' awareness of infantile food allergies influences the time of introduction of these foods, and how demographic differences between mothers influence the feeding practices of their infants early in life. A survey was designed for mothers taking their children to nursery schools in Riverside. Seventy-two questionnaires were analyzed to assess the relationship of these variables.

The results indicated that early introduction of cow's milk formula during the period of physiological immunologic immaturity in infancy affected significantly the subsequent development of allergic diseases. Although early ingestion of solid foods, wheat products, and orange juice induced allergic symptoms to a number of infants, the data were not significant. Eggs, peanut butter, and fish were generally withheld from the children's diets in early infancy.
Among the ethnic groups, Hispanics breast fed for significantly shorter periods of time and introduced cow's milk formula significantly earlier in life than whites. Mothers' awareness of potential allergic reactions from certain foods did not significantly influence the time of their introduction. Honey could be a cause of allergies as well as a source of botulism spores.
Chapter 1

INTRODUCTION

Purpose of the Study

The purpose of this study was to determine if there was any relationship between the early introduction of common food allergens in infants' diets to incidence of allergic diseases, and whether mothers were aware of such infantile allergic conditions.

The relationship between family history of allergies and the early introduction of different foods in infants' diets was also investigated. In addition, ethnicity, socioeconomic status, and educational level of mothers were assessed in relationship to their feeding patterns of infants. Finally, the use of honey in relation to incidence of allergy and infantile botulism and the knowledge of mothers about this were evaluated.

Justification

During recent years there has been a rapidly growing recognition of the number and causes of infantile allergic diseases. Physiological and immunologic immaturity of the gut exists in the early months of life and may result in sensitization which can lead to clinical symptoms caused by absorption of unaltered proteins (Wilson and Walzer, 1935; May and Bock, 1978; Galant, 1980).

Food sensitivity is the most common etiologic factor in cases of infantile perennial allergic rhinitis, urticaria, perennial bronchial asthma, atopic dermatitis, and gastrointestinal allergy (O'Keefe,
1920; Tuft, 1946; Randolph, 1948; Johnstone, 1977). Jenkins and associates (1984) suggest that food allergy is also the major cause of infantile colitis.

Allergic response to food may be immediate after a food is eaten, mediated by Immunoglobulin E (IgE) and other circulating antibodies (May, 1976; Goldman and Heiner, 1977; Van Asperen, Kemp, and Mellis, 1983) or delayed when antigens cause tissue damage through cellular immunity (Feeney, 1969). Milk, eggs, and peanut butter are the most common causes of immediate hypersensitivity reactions (Kemp, 1984). In addition to these foods, berries, fish and shellfish induce hives by IgE-mediated mechanisms (Shapiro, 1980).

Any food is potentially allergenic. However, cow's milk, eggs, wheat and orange juice are most frequently involved in early infant allergy (Feeney, 1969). Other foods, such as fish, chocolate, strawberries, and peanuts also have reputations as common allergic offenders, especially in infancy (Speer, 1975; Kalisz and Ekvall, 1978; Taylor and Luean, 1983). Cow's milk has been reported to be the most common cause of allergic disease in infancy (Glaser, 1966).

Honey, which is known to cause allergies, has also been implicated as a source of botulism spores and consequently a cause of infantile botulism (Barkin and Rosen, 1984; Berman, 1985).

Hypotheses

Alternate Hypotheses

1. There is a significant difference in incidence of allergic diseases between infants who were breast fed and infants who were
introduced to cow's milk early in life.

2. There is a significant difference in incidence of allergic conditions between infants who were offered common food allergens and infants who were not offered these food allergens early in life.

3. There is a significant difference between mothers who were aware of potential allergic reactions and mothers who were not aware of potential allergic reactions from certain foods in withholding these foods from their infants during the early months of their lives.

4. There is a significant demographic difference between mothers in the feeding practices of their infants early in life.

Null Hypotheses

1. There is no significant difference in incidence of allergic diseases between infants who were breast fed and infants who were introduced to cow's milk early in life.

2. There is no significant difference in incidence of allergic conditions between infants who were offered common food allergens and infants who were not offered these food allergens early in life.

3. There is no significant difference between mothers who were aware of potential allergic reactions and mothers who were not aware of potential allergic reactions from certain foods in withholding these foods from their infants during the early months of their lives.

4. There is no significant demographic difference between mothers in the feeding practices of their infants early in life.

Objectives

In addition to the hypotheses noted above, the following objective was also a part of this research:
To determine whether mothers were aware that honey could be a cause of infant botulism.

**Assumptions**

For the purpose of this study it was assumed that

1. The time foods were introduced to the infants was reported accurately by mothers.

2. Mothers associated allergic reactions to the responsible food sources accurately.

3. Mothers recorded their perceptions regarding food allergies and causes of infant botulism accurately.

4. Mothers recorded their demographic data accurately.

**Limitation**

Laboratory data of hypersensitivity and allergic symptoms were not available. Therefore, the data presented were based solely on the responses of the mothers to the questionnaires.
Glossary

allergen M The most consistently shown active allergen occurring in a large group of fish muscle proteins in considerable quantity.

anaphylaxis A hypersensitive state dependent upon antigen-antibody reaction and marked by intense systemic reaction.

antigen A substance capable of stimulating an immune response.

atopy Allergic reactions distal to the contact surface, having a basis of hereditary predisposition.

dalton A unit of mass that designates 1/16th of the mass of oxygen-16, the lightest and most abundant isotope of oxygen. The dalton is equivalent to 0.9997 mass unit.

immunoglobulin Any one of the proteins of animal origin having known antibody activity.

immunoglobulin A (IgA) Although it is the second most abundant immunoglobulin in serum, it is the principal immunoglobulin in exocrine secretions such as milk, respiratory and intestinal mucin, saliva, and tears.

immunoglobulin E (IgE) Present in trace amounts in normal serum and it is important in forming reagin, antibody associated with atopy and severe allergic reactions.

immunoglobulin G (IgG) Principal immunoglobulin in human serum and is present in significant concentrations in both the vascular and extravascular spaces. It moves across the placental barrier and therefore is important in producing immunity in the infant prior to birth.

rhinitis Inflammation of nasal mucosa.

urticaria (hives) Subcutaneous and/or intracutaneous fluid accumulation.
Chapter 2

REVIEW OF LITERATURE

Definition of Allergy

In the United States, diet-related problems are no longer primarily those of deficiency but those of dietary excesses and intolerance (Breneman, 1984). Von Pirquet has been credited with the introduction of the concept of allergy in 1906 (Goldstein and Heiner, 1970; May, 1975) whereas diagnosis of food allergy was reported to be first mentioned in the American literature in 1916, and in the English literature in 1958 (Freier, Finelt, Seban, Cohen, and Brautbar, 1980).

Allergy generally implies an immunologic or antigen-antibody reaction (May, 1981). The word allergy is derived from two Greek words... "allos" meaning 'other', and "ergon" meaning 'action' (Crook, 1974). Food allergens are glycoproteins with molecular weights between 18,000 and 35,000 daltons. Many are resistant to heat and proteolytic action (Furukawa, 1984).

Food Allergy in Infancy

It is generally agreed that in most instances in infancy the allergy is due to ingested antigens (Jeans and Marriot, 1947; Walker, 1975) and is a result of immunological immaturity as well as a tendency during early infancy to absorb unaltered proteins (Feeney, 1969; Burman, Perham, and Clothier, 1982). Consequently sensitization develops through stimulation of antibody production (May, 1980). The permeability of the gut is highest in infancy and decreases
noticeably after six months of age (Zeman, 1983; Furukawa, 1984). Production of local immunological barriers, such as secretory IgA antibodies, is low in the neonate and does not reach appreciable levels until about seven months of age (May, 1974; Barnes et al., 1980). However, colostrum and human milk contain very high concentrations of IgA. Such antibodies from the mother resist proteolytic digestion in the gastrointestinal tract of the infant. This can prevent or at least diminish, the contact between antigens and the lymphoid system of babies. Infants who had been eating a mixed feeding of human and cow's milk were also able to benefit from IgA antibodies against cow's milk proteins contained in the human milk (Hanson, Ahlstedt, Carlsson, and Fallstrom, 1977).

Although more than 20 antigens have been identified as being active in cow's milk, the ones most often implicated in cow's milk allergy are casein, alpha-lactalbumin, beta-lactoglobulin, and bovine serum albumin (Bachman and Dees, 1957; Lessof and Buisseret, 1981; Berman and Ross, 1983). Coombs and McLaughlan (1984) discussed the possible effect of heat-treatment of milk as a way to reduce the sensitizing capacity to beta-lactoglobulin and casein.

It was found that 96 percent of infants who were fed cow's milk formula had circulating immune complexes to bovine milk proteins, as compared to 8 percent of breast fed infants (Lessof and Buisseret, 1981). Approximately seven percent of newborns who were formula fed were or became allergic to cow's milk proteins (Deamer, Gerrard, and Speer, 1979). According to Fletcher and Avery (1984), the incidence of cow's milk allergy in infancy ranged from 0.3-8 percent, whereas other sources estimated the incidence at from 0.4-7.5 percent of the
infant population in the first two years of life (Woodruff, 1976). Additional information revealed that cow's milk allergy ranges from 2-30 percent in allergic children in the United States (Berman and Ross, 1983).

Symptomatology of Infantile Food Allergies

Clinical intolerance to proteins of cow's milk causing gastrointestinal symptoms has been recognized for many years (Walker-Smith, 1978). Wilson, Heiner, and Lahey (1964) first provided evidence that infants with iron-deficiency anemia were shown to have abnormal occult intestinal bleeding induced by whole cow's milk (see also Fomon, Ziegler, Nelson, and Edwards, 1981). Common manifestations of milk allergy in infants also encompass diarrhea, vomiting, colic (Speer, 1958), regurgitation (Parish and Barrett, 1960), dermal and respiratory symptoms (Morris, 1958; Gerrard, Heiner, Ives, and Hardy, 1963; Fletcher and Avery, 1984) and primary malabsorption syndrome (Visakorpi and Immonen, 1967; Kuitunen, Visakorpi, Savilahti, and Pelkonen, 1975; Bierman et al., 1978).

Waldman, Wochner, Laster, and Gordon (1967) first reported an allergic gastroenteropathy which was characterized by hypoproteinemia. Glaser and Johnstone (1953) observed that atopic eczema occurred seven times more frequently in babies fed cow's milk than in breast fed babies. Eighty percent of infants with atopic dermatitis in infancy were reported to have a major respiratory or other allergy by the age of six to ten years. Ratner, Collins-Williams and Untracht (1951) speculated that 59 percent of children who developed atopic eczema
eventually developed asthma and allergic rhinitis. Several investigators concluded that milk or other food allergy was oftentimes an important cause of chronic otitis media and recurrent ear infections that led to hearing loss (Leeks, 1961; McGovern, Haywood, and Fernandez, 1967; Phillips, 1972; Ziering, 1973). Cow's milk formula and other food allergens may also be a major cause of infantile colic (Speer, 1958; Lothe, Lindberg, and Jakobsson, 1982). Matsumura, Kuroume and Amada (1971), among others, found that lactose intolerance and allergy to milk protein were closely related (Harrison, Kilby, Walker-Smith, France, and Wood, 1976). In addition, some cot deaths in infancy have been attributed to anaphylaxis from milk allergy (Parish, Barrett, Coombs, Gunther, and Camps, 1960; Coombs and McLaughlan, 1982).

Gluten sensitive enteropathy characterized by primary malabsorption syndrome in infancy was also found to be linked to wheat gluten (Katz and Falchuk, 1975; Strober, Falchuk, Rogentine, Nelson, and Klaeveman, 1975). Coke (1932) first reported that infants could be sensitized by ingestion of wheat. He also indicated that 74 percent of children who became sensitive to wheat during infancy suffered from eczema before the asthma developed. Van de Kamer, Weijers and Dicke (1953) established that the gliadin fraction of gluten contains the major concentration of antigen activity causing symptoms. More than 50 percent of the peptide-bound amino acids of gliadin are proline and glutamic acid (Colbert, 1980).

In addition, egg-white ovomucoid and allergen M in codfish have been characterized as active antigens (Lietze, 1969; Apold and Elsayed, 1979; Elsayed, Titlestad, Apold, and Aas, 1980; Baer, 1983).
Some researchers hold the view that ovalbumin, encompassing 60 percent of the egg white protein, may be considered as the active allergenic component (Bleumink, 1970). Persistent clinical egg white sensitivity is frequently associated with atopic eczema (Schur, Hyde, and Wypych, 1974; Church, Kleban, and Bellanti, 1976; Cavani, Hyde, and Moore, 1978).

Two principal peanut proteins, arachin and conarachin, can likewise cause immediate hypersensitivity reactions such as angioedema and asthma (Nordlee, Taylor, Jones, and Yunginger, 1981). The roasting of peanuts, as in preparation of peanut butter, produces little overall change in allergenicity (Barnett, Baldo, and Howden, 1983). However, Heiner and Neucere (1975) claimed that the reactivity of peanut antigens may be influenced by plant maturity and by the heat ordinarily employed in commercial processing.

Although some children do "outgrow" their symptomatic sensitivity to foods, many do not (Bock, 1982). Despite the prevalence of allergic disease in pediatric practice, milk sensitivity, as well as sensitivity to other foods, is often overlooked or misdiagnosed (Crook et al., 1961; Wood, 1962; Goldstein and Heiner, 1970; Buisseret, 1978).

Prevention of Infant Food Allergies

Several sources suggested that infants be exclusively breast fed and that total elimination of notoriously allergenic products and solid foods for the first six or nine months of life would be prophylactic for allergic diseases in children (Clein, 1951; Taylor et al., 1973; Kumar, 1981; Lessof and Buisseret, 1981; Kajosaari and
Saarinen, 1983; Saarinen, Juntunen, and Backman, 1983). Moreover, human milk and breast feeding should be recognized as having profound nutritional, anti-infective, economic, and contraceptive significance (Jelliffe and Jelliffe, 1975).

Recommendations for, and practices of, feeding solid foods to infants are widely divergent in the United States and in other countries. However, feeding patterns appear to be governed by the socio-economic status and the educational level of the mother (Parihar, Kumar, Puri, and Kumar, 1984). Hide and Guyer (1982) reported colic more frequently in infants fed solids in the first three months and in infants from professional or skilled social groups.

**Honey, Allergies, and Infant Botulism**

Arnon et al. (1979) noted that honey was a popular sweetener for infants and was given to 25% of control infants at various ages. Some pediatricians recommended honey as an alternative to cane sugar or corn syrup.

Although honey has been described as an infrequent cause of allergies (Breneman, 1984), it has also been reported as a cause of gastrointestinal allergy, urticaria, diarrhea, nausea, vomiting, abdominal pain, migraine, symptoms of anaphylactic shock, convulsions, edema in the small intestine and bronchial symptoms (Bousquet, Campos, and Michel, 1984; Rowe, 1937). Additional sources revealed that honey could be used in normal infants in moderate amounts, but could produce marked systemic reactions in allergic infants (Strem and Stoesser, 1958). The nectar, or the pollens from
which honey is made have been recognized to be the etiology of these symptoms rather than the honey per se (Cooke, 1947; Vaughan and Black, 1954).

Although infant botulism is not a new disease, it has been recognized only recently (Mangione, 1983). Spores of Clostridium botulinum introduced to infants will germinate prior to the inception of normal secretions into the gastrointestinal tract and the establishment of normal gut flora (Brown, 1979; Mundt, 1982). After absorption and hematogenous distribution, botulinal toxin binds at the neuromuscular junction, thereby preventing acetylcholine release. Toxin production could lead to rapid paralysis of airway and respiratory muscles that may result in sudden death (Arnon, 1980).

Of all recognized cases of botulinal toxin in infants, 98 percent have occurred between one and six months of age. The oldest known case was a nine-month-old child (Arnon, 1980). Several organizations, such as the California Health Department, the Centers for Disease Control, and others, recommend that honey not be fed to infants under one year of age (Anon, 1978; Arnon et al., 1979; Barkin and Rosen, 1984; Brawley, 1984).
Chapter 3

METHODOLOGY

Selection of Sample

The sample used for this study consisted of mothers with a child who was at least one year old. This age is a threshold when children are recommended by pediatricians to consume any foods available.

The questionnaires were designed to yield information regarding the feeding practices of the mother, the incidence of allergic responses in the child, the awareness of mothers about infantile allergies and infant botulism, and the relationship of these factors to feeding practices. Additional information such as family history of allergies, socioeconomic status of the family, and education of mothers in relationship to the early introduction of certain foods in infancy were also evaluated.

Method of Collecting Data

A pre-test was distributed to ten mothers whose children were attending a nursery school that serves a middle class neighborhood in Riverside. As a result of parental response, a few questions were slightly modified for better comprehension. The final questionnaire was divided into two areas: 1) 15 questions dealing with feeding practices and manifestations of allergies, and 2) eight questions regarding demographic information. The survey was designed for mothers taking their children to medium-priced nursery schools in Riverside. The chi square test was used to establish dependence or independence of variables at the 0.05 level of significance.
Chapter 4

RESULTS AND DISCUSSION

Questionnaires were returned by 83 of the 150 mothers of children attending six nursery schools in Riverside. Eleven of these were not suitable for use due to incomplete responses. Therefore, a total of 72 questionnaires were analyzed for this study. The age of the children studied ranged from 12 months to four years. The group comprised 46% girls and 54% boys.

Milk Feeding

A. Demographic Relationships

Fifty-five (76%) of the entire population belonged to the "white" ethnic group, 12 (17%) to the "Hispanic" group, three (4%) to the "black" group, and two (3%) to some other group. The relationship of ethnicity to the duration of breast feeding, and the introduction of cow's milk formula is shown in Table 1.

Of the white population, five (9%) mothers never breast fed their infants, and ten (18%) never introduced cow's milk formula to their children's diets. Among the Hispanics, four (33%) respondents never breast fed their babies, and among the blacks, one (33%) baby was never introduced to cow's milk formula.

It is difficult to deduce and generalize from the limited size of the Hispanic and black populations. However, the data show a significant trend toward shorter breast feeding periods among Hispanics and earlier introduction of cow's milk formula compared to whites.
### TABLE 1

**ETHNICITY VS. DURATION OF BREAST FEEDING, INTRODUCTION OF COW'S MILK FORMULA AND SOLIDS**

<table>
<thead>
<tr>
<th>Time (mo.)</th>
<th>White</th>
<th></th>
<th></th>
<th></th>
<th>Hispanic</th>
<th></th>
<th></th>
<th></th>
<th>Black</th>
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<tbody>
<tr>
<td></td>
<td>Br.milk</td>
<td>Formula</td>
<td>Solids</td>
<td>Br.milk</td>
<td>Formula</td>
<td>Solids</td>
<td>Br.milk</td>
<td>Formula</td>
<td>Solids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2.9</td>
<td>50 91</td>
<td>26 47</td>
<td>9 16</td>
<td>8 67</td>
<td>10 83</td>
<td>1 8</td>
<td>3 100</td>
<td>- -</td>
<td>1 33</td>
<td></td>
<td></td>
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<tr>
<td>3-5.9</td>
<td>28 51</td>
<td>38 59</td>
<td>34 62</td>
<td>1 8</td>
<td>12 100</td>
<td>8 67</td>
<td>3 100</td>
<td>1 33</td>
<td>1 33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-8.9</td>
<td>14 25</td>
<td>43 78</td>
<td>51 93</td>
<td>- -</td>
<td>12 100</td>
<td>11 92</td>
<td>2 67</td>
<td>1 33</td>
<td>3 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-11.9</td>
<td>7 13</td>
<td>45 82</td>
<td>53 96</td>
<td>- -</td>
<td>12 100</td>
<td>12 100</td>
<td>2 67</td>
<td>1 33</td>
<td>3 100</td>
<td></td>
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<tr>
<td>12 and over</td>
<td>5 9</td>
<td>45 82</td>
<td>55 100</td>
<td>- -</td>
<td>12 100</td>
<td>12 100</td>
<td>- -</td>
<td>2 67</td>
<td>3 100</td>
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**N** = cumulative number of responses
The sample was too small to form conclusive trends on breast feeding and time of introduction of formula milk among blacks. The inadequate sample of respondents among the ethnic groups may be related to a language barrier or illiteracy or to lack of interest in completing the questionnaire.

The educational level of mothers was analyzed in terms of the duration of breast feeding, and the time of introduction of cow's milk formula. Three (4%) mothers had remained in school for less than 12 years, 19 (26%) had high school diplomas, 31 (43%) had some college education and 19 (26%) had a college diploma.

There was a rather consistent pattern developed regarding the educational level of parents versus the duration of breast feeding. Although a higher percentage of more educated mothers adhered to the practice of breast feeding for longer periods of time than mothers of lower educational level, the relationship was not significant. These findings were not in agreement with the deductions made by Parihar, Kumar, Puri and Kumar (1984) that mothers who were graduates are liable to restrain from the traditional and natural feeding pattern. Similarly, a slight inconsistent pattern revealed that a larger percentage of mothers of lower educational level tended to offer cow's milk formula to their infants earlier than mothers with more education; however, the data were not significant.

The annual income of families versus breast feeding and time of introduction of cow's milk formula was likewise examined. Ten (14%) participants belonged to an income bracket of less than $10,000 per year; 11 (15%) between $10,000-19,999; 14 (19%) between $20,000-$29,999; 21 (29%) between $30,000-39,999; and 16 (22%) $40,000 or
more. Approximately 50 percent of mothers discontinued breast feeding by four months and 75 percent by eight months independent of income.

Parents earning the lowest salary persisted longest in breast feeding, up to 12 months or more. However, the analysis of data revealed no significance. Families belonging to a low income bracket may refrain from purchasing in abundance expensive commercially available baby foods and therefore resort to breast feeding for longer periods of time. It is also possible that the non-working mother has ample time for breast feeding.

There was no real trend in the introduction of cow's milk formula to income level. However, approximately 45 percent of subjects refrained from giving cow's milk formula until after three months regardless of earnings.

Sixty-six (92%) mothers stated that they were informed about certain foods that may cause allergies if introduced early in infancy, whereas six (8%) claimed lack of awareness. Fifty-nine (82%) respondents were familiar with the symptoms of infantile allergies and 13 (18%) were not. The 18 percent also included five of the people who were not aware of infant food allergies. The source of information on symptoms of infantile allergies was primarily the family pediatrician (47%). Additional sources contributing to this awareness were printed media (31%) and family members (7%).

Mothers' awareness of infant food allergies versus the time of introduction of cow's milk formula was analyzed at the .05 level of significance. Thirty-four (47%) mothers received general information on what to feed infants from printed media, such as baby books or magazines. Nine of these respondents also chose the family
pediatrician as a primary source of information. Thirty-two (44%) were exclusively informed by the pediatrician, whereas four (5%) were advised on infant nutrition by family members.

The family history of allergies was investigated in terms of its effect on the children's diet during their first year. Twenty-eight (39%) of respondents had a positive family history of allergies, although ten did not let this factor influence incorporation of common food antigens such as cow's milk in their infant's diet. Sixteen (57%) children who were associated with a family history of allergies suffered some kind of allergic disorder themselves when introduced to offending food allergens as compared to 20 (45%) children who were not born in allergic families. This trend appears to confirm Buisseret's (1978) contention that higher incidence of allergies is expected where a positive family history is present.

B. Practices

Of the 72 mothers who completed the questionnaires, 60 gave initial colostrum to their infants compared to 10 who did not. One mother discontinued breast feeding her child after she passed her colostrum.

Cow's milk formula caused 22 (38%) cases of allergic disorders (Table 2). The remaining 36 (62%) infants who were also introduced to cow's milk formula had no unfavorable reactions. Cow's milk formula was never offered to 14 (19%) babies of the total sample. Five of these 14 were given Isomil, a soy-based formula. Three of the neonates were given Isomil probably because of family history of allergies. The remainder were either breast fed up to a year or
TABLE 2
INFANTILE ALLERGIES INDUCED BY SPECIFIC TYPES OF FOOD

<table>
<thead>
<tr>
<th>Time of introduction (mo.)</th>
<th>Cow's milk formula N %</th>
<th>Pasteurized cow's milk N %</th>
<th>Solids N %</th>
<th>Wheat N %</th>
<th>Egg N %</th>
<th>Orange juice N %</th>
<th>Peanut butter N %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2.9</td>
<td>14 38</td>
<td>-</td>
<td>3 27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3-5.9</td>
<td>5 38</td>
<td>-</td>
<td>4 12</td>
<td>3 13</td>
<td>-</td>
<td>4 36</td>
<td>-</td>
</tr>
<tr>
<td>6-8.9</td>
<td>2 40</td>
<td>2 28</td>
<td>2 9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 28</td>
</tr>
<tr>
<td>9-11.9</td>
<td>1 50</td>
<td>4 23</td>
<td>1 25</td>
<td>1 12</td>
<td>-</td>
<td>1 8</td>
<td>-</td>
</tr>
<tr>
<td>12 and over</td>
<td>-</td>
<td>-</td>
<td>3 7</td>
<td>-</td>
<td>-</td>
<td>2 7</td>
<td>6 25</td>
</tr>
</tbody>
</table>

N = number of infants experiencing allergic reactions
% = number of infants who were introduced
disliked formula.

The above findings exceed the percentage of the incidence of cow's milk allergy in infancy revealed by Deamer, Gerrard and Speer (1979) by approximately 30 percent. However, according to Lessof and Buisseret (1981) it was found that 96 percent of infants who were fed cow's milk formula had circulating immune complexes to bovine milk protein, as compared to 8 percent of breastfed infants.

Of the 22 infants who experienced allergies due to ingestion of cow's milk formula, 14 (64%) reacted to it unfavorably at some time between 0-2.9 months. According to Goldman and Heiner (1977) in one of the largest studies reported, the onset of symptoms due to cow's milk sensitivity appeared in the first month of life in 57% of patients. Gastrointestinal, respiratory, and dermal symptoms are the most frequent manifestations.

The number of mothers breast feeding their babies after birth, and the duration of breast feeding in regular month intervals, are illustrated in Figure 1. Nine children (12%) never received maternal milk. It is of interest to note that of the percentage of mothers (88%) who nourished their babies with breast milk, 50% discontinued the practice of breast feeding as early as four months. Two respondents stated that they breast fed their children for two and four years, respectively.

The percentage of children offered breast feeding exclusively decreased progressively with age. Of the 63 infants who were breast fed, 52 (83%) had nothing but human milk for food for various periods from one week to eight months. One mother exclusively breast fed until
Figure 1

Duration of Breast Feeding

(N = 72)
eight months. Fifteen percent of all mothers introduced supplementary foods to their infants' diet before the completion of one month, increasing to 47% by three months (Table 3).

When mothers were asked if they offered their infants mixed feedings of breast milk and formula milk after birth, 11 (17%) of the 63 respondents who breast fed stated that they did. Five mothers claimed that their newborns received mixed feedings for less than one week, four reported one to three weeks, and two reported three weeks or more.

Hanson, Ahlstedt, Carlsson, and Fallstrom (1977) observed that infants receiving mixed feedings of human and cow's milk for less than one week had significantly higher serum levels of IgG antibodies against cow's milk proteins than those receiving mixed feedings for more than three weeks. This suggests that secretory IgA antibodies in human milk may protect the infant's lymphoid system from exposure to cow's milk proteins.

Pasteurized cow's milk was given to 69 (96%) children. Two children never had it and one child was consuming evaporated milk after six months. Pasteurized cow’s milk was responsible for the manifestation of allergies in nine (12%) children who primarily suffered diarrhea. Six of them were offered this form of milk prior to 12 months and the remaining three at 12 months (Table 2).

Literature findings revealed the useful properties of human colostrum which gives many immunological advantages to the infants (Hanson, Ahlstedt, Carlsson, and Fallstrom, 1977). Eighty-three percent of mothers in this sample passed human colostrum to their babies, whereas 14 percent did not. Two infants were breast fed
### TABLE 3

**TIME OF INTRODUCTION OF VARIOUS SUPPLEMENTARY FOODS TO MATERNAL MILK**

<table>
<thead>
<tr>
<th>Months</th>
<th>N</th>
<th>N*</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.9</td>
<td>11</td>
<td>11</td>
<td>15.3</td>
</tr>
<tr>
<td>1-1.9</td>
<td>13</td>
<td>24</td>
<td>33.3</td>
</tr>
<tr>
<td>2-2.9</td>
<td>10</td>
<td>34</td>
<td>47.2</td>
</tr>
<tr>
<td>3-3.9</td>
<td>7</td>
<td>41</td>
<td>56.9</td>
</tr>
<tr>
<td>4-4.9</td>
<td>2</td>
<td>43</td>
<td>59.7</td>
</tr>
<tr>
<td>5-5.9</td>
<td>8</td>
<td>51</td>
<td>70.8</td>
</tr>
<tr>
<td>6 and over</td>
<td>1</td>
<td>52</td>
<td>72.2</td>
</tr>
</tbody>
</table>

N = number of babies offered supplementary foods
N* = cumulative number of babies offered supplementary foods
for a brief period after colostrum was denied to them by their mothers because it was considered unhealthy or stale milk.

Many literature sources suggested that infants be exclusively breast fed and that complete elimination of notoriously allergenic products and solid foods for the first six or nine months of life might prevent or diminish the incidence of allergic disorders in children (Taylor et al., 1973; Lessof and Buisseret, 1981; Saarinen, Juntunen and Backman, 1983). However, 50 mothers (69%) in this study introduced cow's milk formula prior to six months of age, contrary to eight (11%) mothers who introduced it later in life. Twenty-four (33%) mothers breast fed their infants for the first six months of life or longer compared to 38 (53%) who breast fed for shorter periods of time. Moreover, only eight (15%) respondents offered exclusively breast milk for six months contrary to 51 (71%) who incorporated various kinds of supplementary foods into their infants' diet prior to six months.

Some of the reasons for earlier introduction of supplementary foods could have been the desire of mothers to see their infants gain weight rapidly, the ready availability of convenient forms of various foods, and the mistaken assumption that supplementary foods help the infant to sleep through the night.

The majority (62%) of mothers introduced pasteurized cow's milk to their children at 12 months or later. A high percentage (74%) of these subjects began offering this form of milk to their children at 12 months of age. This is probably the time the family pediatrician recommended incorporation of pasteurized cow's milk into the children's diet.
Where there are genuine difficulties in breast feeding the neonate, artificial feeds may be resorted to. Apparently fresh milk is regarded to be less safe compared to processed milk formula in relation to onset of allergic disorders and therefore should be introduced later in life. During processing of milk formula, prolonged heating reduces anaphylactic sensitizing capacity considerably by making both β-lactoglobulin and casein less sensitizing. It has also been suggested that heat causes protein polymerization and thus degrades and reduces the amount of intact protein absorbed (Freier et al., 1969).

Solid Feeding

A. Demographic Relationships

The relationship of ethnicity to the introduction of solid foods is shown in Table 1. The time of introduction of solid foods among Hispanics was approximately similar to the white population. The sample among blacks was too small to form conclusive trends on the time of introduction of solids.

The educational level of mothers was additionally analyzed in terms of the time of introduction of solids. However, the data among the various educational levels of mothers were highly inconsistent and therefore its interpretation was not feasible. Regarding the introduction of solids versus income earned, there was likewise a highly inconsistent pattern without revealing any trend. Thus, it was not possible to compare these data with the suggestions made by Parihar, Kumar, Puri, and Kumar (1984) that mothers of upper socio-economic status tend to use commercially available foods such as
fruit juices or semisolids in early infancy more frequently or readily than others.

Mothers' awareness of infant food allergies versus the time of introduction of wheat products and orange juice was analyzed at the .05 level of significance and shown to be independent. The time of introduction of whole eggs, peanut butter, and fish in relation to mothers' awareness of infant food allergies was not statistically analyzed due to the small number of mothers incorporating these foods into their children's diets early in life.

B. Practices

Ten children (14%) experienced adverse reactions due to ingestion of solid foods consisting primarily of hives, eczema, and diarrhea (Table 2). Four (6%) infants responded allergically to foods containing wheat with symptoms of eczema whereas none of the subjects suffered symptoms of allergies when offered whole eggs prior to one year. Seventeen (25%) of all infants who consumed orange juice reacted unfavorably with the majority experiencing symptoms of diarrhea and skin rash. Four (5%) of the children involved in the study never had orange juice. The discrepancy of data on allergic reactions due to ingestion of solids and orange juice is probably because mothers did not consider orange juice a solid food. Four (6%) children were never offered peanut butter and eight (11%) were never offered fish, of which one adhered to a vegetarian diet. Of the 17 who were offered peanut butter prior to one year, one infant experienced eczema at six months. None of the 11 subjects who were introduced fish earlier than 12 months reacted to it unfavorably.
Several researchers recommended that solid foods should not be introduced to infants until the age of six months in order to prevent onset of allergic diseases in children (Kajosaari and Saarinen, 1983; Glaser and Johnstone, 1953). Twenty-eight (39%) of the respondents were in agreement with the literature recommendations, in contrast to 44 (61%) who introduced solids prior to six months. Similarly, 25 (35%) who offered wheat products to their infants prior to six months were not in agreement with the literature findings compared to 47 (65%) who offered these food allergens later in life. Moreover, two (3%) mothers introduced whole egg to their infants earlier than six months, whereas 41 (57%) who offered it prior to 12 months did not comply with the suggestions made by the Committee on Nutrition of the American Academy of Pediatrics (1979) to avoid egg white until the end of the first year of life because of its suspected allergenic properties. Orange juice which has been frequently involved in early infant allergy, according to Feeney (1969), was nevertheless given to 11 (15%) babies in this study prior to six months.

Peanut butter and fish which are two of the most common causes of immediate hypersensitivity reactions (Kemp, 1984; Kalisz and Ekvall, 1978) have been generally withheld in this study from the children's diets by the majority of mothers until 12 months. Apparently one-fourth of the respondents offered their infants peanut butter prior to 12 months. As the number of children experiencing allergies due to ingestion of eggs, peanut butter, and fish is very small, the data was not subjected to statistical analysis for significance.
Honey

Thirty (42%) mothers never gave honey to their children. Fifteen (21%) parents who incorporated honey in their infants' diet prior to 12 months were not in agreement with the recommendations of the California Health Department that honey should not be fed to infants under one year of age in order to prevent the incidence of infant botulism. One subject revealed symptoms of eczema when given honey after 12 months.

Four (80%) mothers who introduced honey between 0-3 months were not aware that honey could be a cause of infant botulism. One subject, although she was aware of the risk involved, offered it to her child anyway. When honey was given to infants between 3-6 months, all four mothers claimed lack of awareness of the risk involved. Even though one person (50%) was aware of honey and its implications as a cause of infant botulism, she offered honey to her child at eight months. Similarly, three (75%) mothers exposed their infants to honey between 9-12 months, despite their awareness of infant botulism and its sources. In brief, five (33%) respondents of the 21 percent who incorporated honey to their infants' diet earlier than 12 months were actually aware of its association with infant botulism.

Of the 30 (42%) people who never introduced honey to their infants, four (13%) stated a lack of awareness of the relationship between honey and infant botulism. Of the 27 people who offered honey after 12 months, eight (30%) were unfamiliar with its relationship to botulism. In conclusion, 30 percent of the overall sample were not aware that honey could be a source of botulism spores.
Twenty-three (46%) of the mothers who were aware of honey as a cause of infant botulism had acquired this information primarily from printed media such as magazines or baby books. Twelve (24%) were informed by their pediatrician, six (12%) by television and radio, five (10%) by other sources and four (8%) by family members.
Chapter 5
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The data for this study were collected from a survey for mothers taking their children to nursery schools in Riverside. The questionnaires were given to mothers whose children were at least one year old. The feeding patterns of some foods in infancy affected the subsequent development of allergic disorders. "Getting back to nature", in the form of exclusive breast feeding for the first six months of life, is probably conducive to a healthier baby.

Eighty-three percent of mothers passed colostrum to their infants, whereas 12 percent never breast fed. A low percentage (15%) of neonates were exclusively breast fed for up to six months compared to 71 percent who were introduced supplementary foods prior to six months.

Of the 58 infants who were introduced cow's milk formula, 38 percent experienced allergic reactions, more than was anticipated. In the 0-6 months age group, there was a significant difference in the rate of allergic disorders among infants exclusively breast fed and those fed cow's milk formula. Pasteurized cow's milk was introduced to 62 percent of children at 12 months or later. Of the entire infant population, 13 percent manifested allergies from this form of milk. When pasteurized cow's milk was offered later in life, a lower percentage of children experienced adverse reactions from it.
Solid foods were introduced to 61 percent of infants prior to six months, affecting seven (16%) of them unfavorably. The earlier the age at which solid foods were introduced, the higher the percentage of infants who were afflicted with food allergies. When wheat products were introduced earlier than six months, three (12%) neonates experienced adverse reactions. However, early introduction of wheat products revealed no significance in the incidence of allergic disorders at the 0.05 level.

Whole eggs were offered to 57 percent of the infants before the completion of one year, fish to 15 percent, and peanut butter to 24 percent. The number of children who revealed allergies due to the consumption of these foods was very low. Orange juice was consumed earlier than 12 months by 61 percent of children, 11 (25%) of these showed symptoms of allergies. The data revealed no significance at the 0.05 level.

Of the 21 percent of the infants who were introduced to honey prior to 12 months, none revealed symptoms of allergies or infant botulism. Ten (67%) respondents who offered honey to their children earlier than 12 months were not aware that honey could be a cause of infant botulism.

Among the ethnic groups, Hispanics breast fed for significantly shorter periods of time and introduced cow's milk formula significantly earlier in life than the white population. Mothers of higher education were shown to breast feed for longer periods of time and offered cow's milk formula later than mothers with less education. Similarly, parents earning the lowest salary seemed to breast feed the longest. However, these data did not reveal significance. Moreover,
mothers' awareness of potential allergic reactions from certain foods did not influence significantly the time of their introduction.

Conclusions

This study was designed to determine whether early introduction of cow's milk formula and other common food allergens influences the incidence of allergic disorders in infancy, whether mothers' awareness of infantile food allergies influences the time of introduction of these foods, and whether demographic differences between mothers influence the feeding practices of their infants early in life.

1. Null Hypothesis: There is no significant difference in incidence of allergic diseases among infants who were breast fed and infants who were introduced to cow's milk early in life. The null hypothesis was rejected following chi-square analysis at the .05 level. Infants who were introduced to cow's milk early in life had a significantly higher incidence of allergies than infants who were breast fed.

2. Null Hypothesis: There is no significant difference in incidence of allergic conditions among infants who were offered common food allergens and infants who were not offered these food allergens early in life. Following chi-square analysis, the null hypothesis was accepted.

3. Null Hypothesis: There is no significant difference among mothers who were aware of potential allergic reactions and mothers who were not aware of potential allergic reactions from certain foods in withholding these foods from their infants during the early months of
their lives. The null hypothesis was accepted after chi-square statistical analysis.

4. Null Hypothesis: There is no significant demographic difference between mothers in the feeding practices of their infants early in life. The null hypothesis in relation to ethnic background between whites and Hispanics versus duration of breast feeding and time of introduction of cow's milk formula was rejected following chi-square analysis at the .05 level. Hispanics breast fed for significantly shorter periods of time and introduced cow's milk formula significantly earlier in life compared to whites. However, part of the null hypothesis was accepted in relation to the educational level of mothers and the family income versus the feeding practices of their babies. The values of chi-square revealed no significance among these variables.

Recommendations

The following recommendations might provide a further insight in relation to the occurrence of infantile allergic disorders.

1. Questionnaires on this topic should be conducted by direct interview. The return survey of nursery schools in this study resulted in a biased sample in which illiterate people or people from ethnic minorities were reluctant to respond.

2. The sample size should be sufficiently large to obtain a greater cross-section of society and various ethnic groups.

3. Consideration of mother's age as a factor in feeding food allergens early in life.
4. Information on the working status of mothers in relation to early introduction of offending food allergens.
BIBLIOGRAPHY
BIBLIOGRAPHY


QUESTIONNAIRE

Dear Mother:

I am a student at California State University, Northridge. For my master's degree, I am doing a survey on the feeding patterns of children nearest to one year of age to find if there is any relationship of different foods in infant's diet to incidence of allergic responses. Do you have a child who is at least one year old? As you know, feeding during infancy is very important as all mothers want to have strong babies. Therefore, I hope you will take the trouble to complete the enclosed questionnaire. All answers will be confidential and only the overall results of all answers will be used in this study.

If you have any questions concerning this study, my home phone number is (714) 788-9363. Thank you very much for your time.

Sincerely,

Maria Davaris
Department of Home Economics
in Foods and Nutrition
California State University
Northridge, California
The following questions refer to your youngest child who is at least one year of age.

1. How old is your child? ____________

2. Is your child a boy or a girl? ____________

3. Did you give your infant colostrum? (the initial fluid that comes from the breast before the maternal milk arrives)
   [ ] yes [ ] no

4. Did you ever breastfeed your child? (if no, go to question 7)
   [ ] yes [ ] no
   For how long? _____ weeks, or _____ months

5. After your baby was born was there a period when he/she had nothing but breast milk for food?
   [ ] yes [ ] no
   For how long? _____ weeks, or _____ months

6. Was your newly born infant on mixed feeding of breast milk and formula milk after birth?
   [ ] yes [ ] no
   a. less than one week
   b. one week to three weeks
   c. three weeks or more. Please specify ____________

7. How old was your baby when he/she first had cow's milk-based formula, such as Enfamil, Similac, or another brand?
   [ ] yes [ ] no
   Please specify ____________ weeks, or ____________ months. Did he/she experience any allergic reaction to it such as hives, cough, wheezing, inflammation of the skin, skin lesions, skin redness or rashes, eczema, respiratory illness, vomiting, diarrhea, asthma, inflammation of the nasal membranes, intestinal disease, or other?
   [ ] yes [ ] no
   Please specify ____________
8. How old was your baby when he/she first had pasteurized cow's milk?

_______ months. Did he/she experience any allergic reaction to it?

☐ yes  ☐ no

↓

Please specify ____________________

9. How old was your baby when he/she first started eating solid foods such as cereals, fruit juices, etc.?

_______ months. Did he/she experience any allergic reaction to them?

☐ yes  ☐ no

↓

Please specify ____________________

10. How old was your baby when you have him/her wheat products as in wheat or mixed cereal, wheat bread, toast and crackers, teething biscuits, cookies, or in any other form?

_______ months. Did he/she experience any allergic reaction to them?

☐ yes  ☐ no

↓

Please specify ____________________

11. How old was your baby when you first offered him/her a whole egg with the egg-white?

_______ months. Did he/she experience any allergic reaction to it?

☐ yes  ☐ no

↓

Please specify ____________________

12. How old was your baby when he/she first had orange juice?

_______ months. Did he/she experience any allergic reaction to it?

☐ yes  ☐ no

↓

Please specify ____________________
13. How old was your baby when he/she was first offered peanut butter?
______ months. Did he/she experience any allergic reaction to it?

☐ yes  ☐ no

Please specify _______________________

14. How old was your baby when he/she first had fish in any form?
______ months. Did he/she experience any allergic reaction to it?

☐ yes  ☐ no

Please specify _______________________

15. How old was your baby when he/she was given honey either dissolved in water or straight?
______ months. Did he/she experience any problems with it?

☐ yes  ☐ no

Please specify _______________________

Finally, I need to know a little about yourself and your background. If you feel any question is too personal, please go to the next one. However, all answers will be confidential and it is hoped that you will answer every question. Please circle the appropriate answer:

1. To what ethnic group do you belong?
   a. white
   b. black
   c. Hispanic
   d. other. Please specify _______________________

2. How many years of education do you have?
   a. less than 12 years
   b. high school diploma
   c. some college education
   d. college diploma
3. About how much money did your family earn last year?
   a. less than $10,000
   b. 10,000 to 19,999
   c. 20,000 to 29,999
   d. 30,000 to 39,999
   e. 40,000 or more

4. Do you know that certain foods can cause allergies if introduced early in infancy?
   [ ] yes   [ ] no

5. Where do you get most of your information on what to feed infants? (circle one)
   a. printed media as baby books or magazines
   b. television, radio
   c. friends
   d. family
   e. pediatrician
   f. other. Please specify _______________________

6. Is there a history of allergies in your family?
   [ ] yes   [ ] no
   Did this have any effect on what you fed your child during his/her first year of life?
   [ ] yes   [ ] no

7. Did you know any of the symptoms of infantile allergies before this questionnaire was given to you?
   [ ] yes   [ ] no
   What was the source of your information? _______________________

8. Are you aware that honey can be a cause of infantile botulism if given early in life?
   [ ] yes   [ ] no
   What was the source of your information? _______________________