Investigating trends in feeding practices and anthropometric indices in infants and children on Montserrat, 1993-2002.

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DEDICATION

This research is dedicated to my family:

To my parents, Blondena and Easton for your eternal love and selfless sacrifices, and for instilling in me the importance of learning and reaching for it no matter what and most of all for your support in my every endeavours.

To Sherwood, Jasmine, my sisters, my best friends, our lives have changed recently, but we have stuck together.

And to Shaynae, better known as Nana's Pumpkin or Shaynaenae, the family gem – you have captivated us and brought sunshine to our lives.

Each day I'm thankful to the almighty for surrounding me with such eternal love.

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ABSTRACT

The prevalence of obesity in the paediatric population is on the increase and there is speculation that suboptimal breastfeeding patterns may be contributing to the present obesity epidemic. We described the prevalence and trends in underweight and overweight among 3 052 school aged children over a ten year period, and patterns of exclusive and any infant breastfeeding among 671 mothers over a 6 year period on Montserrat a small British colony which forms part of the chain of Caribbean islands, and experienced the eruption of the Soufrière Hills volcano in July 1995.

The results revealed for 11 year old children there was an excess risk of being overweight in the post volcanic period compared to the pre volcanic period (OR=2.1, 95% CI 1.5-2.7).

The rate of exclusive breastfeeding at 6 months of age was exceptionally low (3.4%) in relation to the international recommendations, but the prevalence of any breastfeeding at 4-6 months was relatively high 67.1%. Maternal age was the only significant variable associated with exclusive breastfeeding.

These findings highlight the need for promoting and prolonging exclusive breastfeeding and that overweight is increasing in the children on Montserrat.

RÉSUMÉ

La prévalence de l'obésité chez la population pédiatrique s'accroît et certains spéculent que des patrons d'allaitement maternel sous-optimaux peuvent contribuer à cette présente épidémie d'obésité. Nous avons décrit la prévalence et les tendances de sous et sur-poids chez 3052 enfants d'âge scolaire, au cours d'une période de dix ans, ainsi que des patrons d'allaitement maternel exclusifs et non-exclusifs chez 671 mères, au cours d'une période de 6 ans, au Montserrat. Montserrat, une petite colonie Britannique faisant partie de la chaîne d'îles du Caraïbe dispersée sur la mer Caraïbe, a vécu l'éruption du volcan Soufrière Hills en juillet 1995.

Les résultats ont relevé que le risque de faire de l'embonpoint était plus élevé pendant la période post-volcanique comparativement à la période pré-volcanique chez les enfants âgés de onze ans (OR 2.1, 95% IC 1.5-2.7).

Le taux de prévalence pour l'allaitement maternel exclusif à 6 mois était exceptionnellement bas (3.4%) par rapport aux recommandations internationales de l'alimentation des jeunes enfants, quoique la prévalence de l'allaitement maternel non-exclusif à 4-6 mois était relativement élevée à 67.1%. L'âge maternel était la seule variable significativement associée avec l'allaitement maternel exclusif.

Ces résultats soulignent le besoin pour la promotion et la prolongation de l'allaitement maternel exclusif et montrent que l'embonpoint s'accroît chez les enfants au Montserrat.

CHAPTER I

INTRODUCTION

Sustaining proper growth and development in the early years of life is critical as the growth pattern of children is one of the most functional and universally acceptable indicators for monitoring health and nutritional status of a population (Akeson et al, 1998; CDC Report, 2000; de Onis & Blossner, 2003). It has been recognized that the rapid changes in dietary, lifestyle, economic and other population characteristics in many developing countries, have negatively impacted on child rearing practices (Popkin, 2001; Uauy et al, 2001; Dennis, 2002; Kain et al, 2002) and have resulted in a decline in the proportion of infants exclusively breastfed for greater than 4 months, as well as in overall breastfeeding duration (Grummer-Strawn, 1996; Moodley et al, 1999). Also observed are higher proportions of overweight preschoolers in developing countries when compared with proportions in the developed world (de Onis & Blossner, 2000; Uauy et al, 2001). Recent epidemiological evidence suggests that the benefits of breastfeeding are not restricted to promoting an infant's present health but extend beyond this to the prevention of childhood and adolescent obesity and its associated complications in later life (Dewey et al, 1992; 1993; 1995; 1998a; Victora et al, 1998; von Kries et al, 1999; Butte et al, 2000; Hediger et al, 2000; Butte, 2001; Gillman et al, 2001; Kramer et al, 2002a; Dewey, 2003; Victora et al, 2003). It is therefore important that well established paediatric nutrition surveillance systems are implemented and utilized to monitor trends thereby defining the overall nutritional status of populations and predicting future health outcomes.

With the exception of some countries of Sub-Saharan African and Latin America, limited and current nutritional surveys have been conducted in developing countries (de Onis et al, 2000; Martorell et al, 2001). Therefore, public health information regarding the nutritional status of child bearing women, infants and school aged children is lacking in many developing countries and especially in the English speaking Caribbean countries. This limits the ability of health planners to properly identify specific nutrition related problems pertaining to these vulnerable groups and hence the ability to develop policies and intervention strategies.

The eruption of the Soufrière Hills Volcano in the small British dependent Caribbean island of Montserrat in 1995, affected every aspect of the country's economy and social living conditions. Currently, the country is undergoing tremendous transformation as a result of the present restructuring process. The overall health goal as outlined in the Country's Sustainable Development Plan (2000-2004) is to establish appropriate health services to the remaining population. However, with the economy heavily dependent on UK budgetary aid, and a decrease in the total health budget, health planners are forced to direct capital resources to priority health services (Government of Montserrat CPP Document, 2000). Therefore, having access to accurate information through population based nutrition research would provide valuable information as to the nutritional status of vulnerable groups and assist health policy planners to effectively prioritise health and nutrition interventions and services appropriate to the remaining population.

CHAPTER II

LITERATURE REVIEW

2.1 GROWTH TRENDS

In parallel with the worldwide epidemic of obesity in adults (Mokdad et al, 1999; Filozof et al, 2001) the prevalence of overweight and obesity in young children is increasing rapidly in both developed and developing countries (Seidell, 1999; Martorell et al, 2000; Livingstone, 2001; Strauss & Pollack, 2001; Wang et al, 2002). Globally, approximately 22 million children under 5 years of age are overweight with girls being more affected (Deckelbaum & Williams, 2001; Hulens et al, 2001).

Obesity in childhood is important since childhood obesity is a risk factor for hypertension, dyslipidemia, insulin resistance and psychological imbalance, leading to increased morbidity and mortality (Power et al, 1997; Dietz, 1998b; Freedman et al, 1999; Deckelbaum & Williams 2001). Furthermore, childhood obesity has more widespread implications and substantially long term health consequences as overweight and obese children experience comorbidities similar to those of their adult counterparts resulting in increased duration of morbidity and an increase in the number of risk factors for adult onset diseases (de Onis, 2000; Deckelbaum & Williams, 2001). Consequently overweight and obesity have both clinical and public health significance as they have the potential to place considerable burden on health care services, health costs, and the economy (Deckelbaum & Williams, 2001; Garis et al, 2002).

2.2 CHILDHOOD PREDICTORS OF OVERWEIGHT

A child's growth is regulated by multifactorial conditions (Parsons et al, 1999). Studies tracking obesity from childhood to adulthood suggest that intrauterine environment, birth weight, parental stature, socioeconomic status, method of infant feeding, timing of maturation and physical activity are the most pronounced factors contributing to persistent overweight and adiposity later in life (Serdula et al, 1993; Dewey, 1998b; Parsons et al, 1999; Power & Parsons, 2000; Bergmann et al, 2003).

2.2.1 Parental Stature and Birth Weight

Intrauterine growth involves a complex interaction between parental genes and the intrauterine environment and is tightly controlled by the maternal frame to ensure fetal weight does not exceed what is appropriate for a mother's skeletal size (Loveridge & Noble, 1994; Wright et al, 1994). Therefore, birth weight is a crude indicator of fetal environment and subsequently fetal nourishment (Seidman et al, 1991; Whitaker & Dietz, 1998; Whitaker et al, 1998; Parsons et al, 1999). Studies conducted to test the influence of foetal nutrition on birth weight and adult adiposity observed a "J" shaped relationship (Seidman, 1991; Curhan et al, 1996a; 1996b; Whitaker & Dietz, 1998). Children with low or high birth weight are at higher risk of subsequent adiposity which can persist into young adulthood and as a consequence might be implicated in the development of obesity later in life (Huttley et al, 1991; Barker, 1995; Simondon et al, 2001). Also evident is a positive association between genetic determination, parental height and body mass index (BMI) and child's growth or body mass index (Adair et al, 1993; Lake et al, 1997), as

children with both parents obese are at strongest risk of obesity in adulthood (Parsons et al, 1999).

2.2.2 Social factors

Several factors including socioeconomic status, family structure and functioning and age of mother at birth are implicated in obesity and under-nutrition. However, the most distinct variable when analysing the risk of obesity and under-nutrition from infancy into childhood and subsequently into adulthood is socioeconomic status, generally measured by household income, maternal education (highest level attained) and occupation (Parsons et al, 1999; Dennis, 2002). A consistent relationship exists between low socioeconomic status and nutritional status since lower socioeconomic status corresponds with lower education levels and disposable incomes and higher rates of poverty and food insecurity (Drewnowski & Specter, 2004). These factors result in poor food choices and low quality diets and hence the over consumption of energy dense and fat foods, and lower consumption of fruits and vegetables. This is owing to the differential cost of energy dense and healthy foods and translates into lower percentages of disposable income spent on food budget (Parsons et al, 1999; Gillman et al, 2001; Hediger et al, 2001; Drewnowski & Specter, 2004).

2.2.3 Critical periods

Many observations suggest that during the life course three critical periods exist for the development and persistence of obesity and its complications (Dietz, 1997; Guo et

al, 2000; Power et al, 2000). The concept of critical period embodies two main principles, the first is that an experience that occurs at a specific time will significantly affect development and that the effect persists throughout life (Allison et al, 1995). Sensitive periods include gestation (prenatal) and early infancy, the period of adiposity rebound (ages 4-7 years), and early adolescence (Dietz, 1997; Whitaker & Dietz, 1998).

2.2.3.1 Prenatal and Infancy Period

The prenatal and early infancy period is critical since the environmental stimuli experienced in utero may have a lifetime effect on the propensity to develop obesity as manifested by rapid increases in body fat and adipocyte replication (Dietz, 1998b; Whitaker & Dietz, 1998; Metges, 2001). A review conducted by Dietz (1997) highlighted several mechanisms for this effect including metabolic memory, hypothalamic responsiveness, insulin sensitivity, fat cell number, size and the regulation of appetite by the central nervous system.

The earliest and most convincing evidence to support prenatal programming is derived from the Dutch Famine and the Pima Indian Studies. Power et al (2000) reported findings on the work of Ravelli et al (1976) on the effects of timing of intrauterine exposure to famine and the relation to the prevalence of obesity later in life. Exposure to famine during the last trimester and the first month of life reduces the risk of obesity in contrast to an increased risk during the first two trimesters. Furthermore, infants of diabetic mothers represent an important variant of the effect on birth weight and subsequent adiposity. Study of the Pima Indians highlighted the varying effects of altered intrauterine environment compared to inherited genes for obesity (Pettitt et al, 1983).

Examining the association between gestational diabetes and birth weight found that an increase in maternal amniotic fluid insulin contributes to increased foetal insulin production resulting in increased birth weight and increased weight later in life (Dietz, 1997; Whitaker & Dietz, 1998).

2.2.3.2 Adiposity rebound

The adiposity rebound occurs between ages 4-7 years. At this point, body mass index, which usually increases during infancy and declines in early childhood, begins to increase again (Siervogel et al, 1991; Prokopec et al, 1993; Whitaker & Dietz, 1998). The timing of adiposity rebound is critical for the development of obesity since earlier adiposity is associated with higher body mass index in adolescence, independent of both body mass index at adiposity rebound and parental obesity (Rolland-Cachera et al, 1984; Dietz, 1998b; Whitaker & Dietz, 1998). Acquired and manifested behaviours related to food intake and activity, consumption of high protein intake (g/day), exposure to gestational diabetes and early accelerated maturation are the potential mechanisms to explain the pattern of adiposity rebound and subsequent obesity (Dietz, 1997; Guo et al, 1997; 1998; Akeson et al, 1998; Power & Parsons, 2000; Wang et al, 2001).

2.2.3.3 Adolescence

Generally there is a stronger association with long term adiposity and an increase in body mass index observed at this critical period especially in girls (Guo et al, 1994). This corresponds to an increase in obesity related co-morbidities and mortality in later life

(Power et al, 1997; Guo et al, 2002). Potential premorbid effects that may promote the risk of obesity during adolescence are changes in the quantity, location and distribution of body fat and exposure to other environmental factors including stress, tobacco, alcohol and physical activity (Tremblay et al, 1990; Goran et al, 1995; Dietz, 1997).

2.3 MODE OF INFANT FEEDING AND GROWTH PATTERNS IN INFANCY AND CHILDHOOD

A difference in the growth patterns between breastfed and formula fed infants has been accepted and is attributed to the differences in nutrient intake (WHO, 1995; Butte et al, 2000). At one month, breastfed infants tend to be heavier than formula fed infants (Dewey, 1995; Dewey, 1998b; Victora et al, 1998; Eckhardt et al, 2001; Bergmann et al, 2003). However after four months, studies demonstrated that formula fed infants have higher adiposity indices than breast fed infants (Dewey, 1993; Dewey, 1995; Bergmann et al, 2003). Even after the timely introduction of complementary foods, breastfed infants have slower growth during the first year of life (Dewey, 1995; Dewey, 1998b; Kramer & Kakuma, 2002). Therefore, early feeding practices and duration indicate significant association with child growth, as breastfed children are at reduced risk of overweight in childhood and in adolescence (Armstrong, 1995; von Kries et al, 2000; Gillman et al, 2001; Hediger et al, 2001; Armstrong et al, 2002; Kramer et al, 2002a; Ruel & Menon 2002; Toschke et al, 2002; Dewey, 2003; Victora et al, 2003).

2.3.1 Potential explanations for differences in growth patterns

2.3.1.1 Breastfeeding and growth

There is little controversy about the innumerable benefits of breast feeding in the first year of life to the mother, infant and society as a whole (Victora et al, 1992; Brown et al, 1995; American Academy of Paediatrics 1997; WHO, 2001). However, questions still abound as to its benefits after infancy and into childhood and its protective effects against later obesity. Several mechanisms have been proposed to explain the protective effect of breastfeeding. Breastfed infants have more discretion over the amount of milk they consume because of the unique ability to self regulate their energy intake (Heining et al, 1993; Hediger, 2001). Consequently, breastfed infants consume less energy, less protein and fewer micronutrients; therefore, the amount of energy metabolised is lower (Dewey, 1992; Heining et al, 1993). Additionally, given the high bioavailability of the nutrients in breast milk and the higher contributions to the diet, the low breast milk intake does not affect the infant's nutritional status (Rogers et al, 1997b). Moreover, breast milk contains bioactive factors, which modulate epidermal growth factors, which inhibit adipocyte differentiation in vitro (Xiao et al, 2002; Lonnerdal, 2003). Several studies showed that exclusive breastfeeding for a maximum of four months and continued breastfeeding into the first year of life might confer protection against overweight among school age children and there is a dose dependent effect of its duration (Toschke et al, 1991; Dewey, 1993; Dewey, 1994; Dewey, 1998b; von Kries et al, 2000; Butte, 2001; Gillman, 2001; Hediger et al, 2001; Armstrong et al, 2002; Kramer et al, 2002a; Dewey, 2003). Furthermore, this practice has been shown to improve the nutritional status of

infants especially in developing countries where there is a high incidence of morbidity and mortality from malnutrition and gastrointestinal infections (Victora et al, 1984; Brakohiapa et al, 1988; Habicht, 2000; Martin, 2001).

2.3.1.2 Formula feeding and growth

Several studies suggest that infants fed only or mostly formula are 15-20% more likely to become overweight compared with breastfed infants because of the higher nutrient intakes from the consumption of formulas with higher nutrient density and protein (von Kries et al, 1999; Dietz, 2001; Gillman et al, 2001). The increased nutrients consumed alter several endocrine responses and metabolic routes resulting in higher and prolonged plasma insulin concentration, altered leptin metabolism and greater leptin resistance (Dewey, 2003). These pathways stimulate greater fat deposition, early multiplication of adipocytes and increased retention of nitrogen and minerals. This contributes to the maturation of lean tissues and an increase in the number of fat cells, subsequently leading to weight gain and obesity (Fomon, 1958; Southgate et al, 1966; Lucas et al, 1981; Akeson et al, 1998; Butte et al, 2000; Singhal et al, 2002; Dewey, 2003). Recent studies have illustrated a positive correlation between high protein intake (g/day) and earlier adiposity rebound and obesity during early childhood (Akeson et al, 1998).

2.4 BREASTFEEDING PRACTICES

Breastfeeding is internationally recognized as a meritorious practice because of its innumerable benefits not only to the infant and mother but on the society as a whole (Dettwlyer & Fishman, 1992; WHO, 1995; UNICEF, 1998). Therefore exclusive breastfeeding for the first 6 months of a child's life is the gold standard for young child feeding as it has generally been accepted as providing adequate nutrition to satisfactorily support growth (Rogers et al, 1997b). Moreover, recent studies indicate that breastfeeding protects against long term health consequences including the development of diseases later in life (Caulfield et al, 1996; Butte, 2000). World Health Organization (1995) used the terms '*simplest*' '*cost effective*', '*health promoting*' and '*disease preventing activity*' to emphasize the multifactorial nature of breastfeeding practices. There are a number of breastfeeding categories used to describe the various breastfeeding patterns observed among lactating women (Appendix A). Exclusive breastfeeding, the preferred method, is defined as a feeding pattern whereby the infant is receiving all fluids, energy and nutrients via breast milk thus excluding any other liquids and solids (WHO, 2002).

Nearly all women in the developing world initiate breastfeeding with an average rate of 91.6% (Nagy et al, 2001). However, the most common feeding practice in the majority of developing countries is a combination of breastfeeding with milk substitutes as early as 6-8 weeks of age (Forman, 1984; Dettwyler & Fishman, 1992). An analysis conducted by Grummer-Strawn (1996) on breastfeeding duration trends in 15 developing countries showed a decline in breastfeeding rates and the increase use of supplementary foods. Although modest improvements in exclusive breastfeeding rates (48 % to 52%) occurred in the developing world during the late 1990's (UNICEF Country Data, 2001),

the rates for exclusive breastfeeding remained low in Latin America and the Caribbean region with only 38% of the children being breastfed for greater than 4 months (Moodley et al, 1999; UNICEF Country Data, 2001). A recent review by Lauer et al (2004) demonstrated how the Latin Americas and the Caribbean region ranked lowest using UNICEF's breastfeeding indicators, given that the rates of exclusive breastfeeding and never breastfeeding for infants < 6 months were 30.8% and 18.0% respectively.

Considerable changes in the social and economic characteristics of populations, the utilization of western health care techniques and technologies and the rise in milk distribution through aid programmes have resulted in the adoption of modern practices and the rapid abandonment of traditional approaches to child rearing in the Latin Americas and the Caribbean region (Perez-Escamilla et al, 1994; Mulford, 1995, Grummer-Strawn, 1996; Dennis, 2002).

2.4.1 Factors influencing initiation and duration of breastfeeding

It is well recognized that child feeding practices encompass a series of complex interrelated behaviours that influence the extent and duration of breast feeding practices (Rogers et al, 1997a; Popkin et al, 2001). Recent data have indicated a global resurgence of breastfeeding and consequently an increase in breastfeeding initiation and duration rates following the drastic decline in the mid 1980's (Ryan, 1997; Dennis, 2002). Most infant feeding studies have found that approximately 35-50% of lactating women discontinue breastfeeding before 4 months and the introduction of complementary food along with breast milk commonly occurs as early as 4 to 8 weeks postpartum (Dettwyler

& Fishman, 1992; Styen, 1993; Dennis, 2002; Lauer et al, 2004). In an effort to increase the rates of exclusive breastfeeding and fulfill the international recommendations, awareness and knowledge of the factors associated with breastfeeding is essential. According to Rogers et al, (1997a) in a review of determinants of breastfeeding, rates vary based on geographical and temporal locations of populations, as well as differences in maternal and infant characteristics. These determinants include cultural norms, attitudes and practices of health care professionals, maternal and infant demographic, biological and behavioural factors, psycho-social factors and community factors, and media and market policies (Rogers et al, 1997a; Avery et al, 1998; Abada et al, 2001; Yngve et al, 2001; Cernadas et al, 2003).

2.4.1.1 Psychosocial factors

These determinants are considered potentially modifiable characteristics and therefore are highly ranked as factors which can significantly influence breastfeeding initiation and duration (Scott & Binns, 1999; Dennis, 2002; Cernadas et al, 2003). These include cultural attitudes, attitudinal and intrapersonal characteristics such as maternal prenatal intentions, attitude and confidence together with the presence of a support system.

Maternal perception or confidence, cultural norms and attitudinal characteristics more distinctly influence the choice of the infant feeding method rather than nutritional value (Rogers et al, 1997a; Scott & Binns, 1999; Dennis, 2002). Studies have shown a strong association between prenatal intentions, maternal attitude, maternal confidence (self esteem) and social support in the initiation and duration of breastfeeding. The

general consensus is that an early decision to breastfeed, strong maternal commitment, positive attitude of mother and father towards breastfeeding preference, and the support and presence of the extended family increases the likelihood of breastfeeding initiation and extended duration of breastfeeding (Jones et al, 1986; Dettwyler & Fishman 1992; Quarles et al, 1994; Rogers et al, 1997a; Scott & Binns, 1999; Dennis 2002; Perez-Escamilla et al, 2003).

2.4.1.2 Maternal Demographic Characteristics

Internationally, maternal age, education, occupation, socioeconomic status and ethnicity are atypical maternal demographic characteristics that have been identified as being significantly associated with initiation and exclusive breastfeeding for greater than 4 months (Landman 1973; Grummer-Strawn et al, 1993; Avery et al, 1998; Dennis, 2002; Nicols et al, 2002).

Evidence suggests the effect of maternal age and highest level of education attained on breastfeeding varies between developed and developing countries (Rogers et al, 1997a; Scotts & Binns, 1999; Dennis, 2001; Cernadas et al, 2003). In developed countries, single women, young women with lower education level and hence of a lower socioeconomic status tended to wean earlier. Whereas in developing countries, more specifically Latin America and the Caribbean, older women (although less likely to breastfeed), women with higher education levels and increase socioeconomic status have increased breastfeeding initiation and longer exclusive breastfeeding duration rates (Rogers et al, 1997a; Cernadas et al, 2003).

Changes in the role of women has led to greater integration of women in the labour force consequently placing many obstacles in the path of women who wish to combine breastfeeding with employment outside the home (Wright & Schanler, 2001). Studies found that few employed women breastfeed exclusively for greater than 4-6 months (Rogers et al, 1997a; Popkins et al, 2001) as there is competition between work and breastfeeding. The return to paid and full time employment at 3 months post partum further decreases the probability of breastfeeding and significantly lowers duration rates (Greiner, 1994; Fein & Roe, 1998). Constraints contributing to the declining rates of breastfeeding in developing countries are the lack of childcare in the work environment, the short length of maternity leave, and the social attitudes of employers and co-workers towards breastfeeding (Wright & Schanler, 2001).

2.4.1.3 Biomedical Factors

Maternal Biological

The literature on the association between birth order, the initiation and duration of breastfeeding is mixed since few studies have explored specific breastfeeding patterns and duration by parity (Jones et al, 1986; Cernadas et al, 2003). The data suggest that previous experience with breastfeeding has a powerful effect on the chance of breastfeeding (Becerra et al, 1990; Victora et al, 1992; Hill et al, 1997). Nagy et al, (2001) concluded that maternal or '*mothering*' skills improve with social learning, and successful breastfeeding experiences result in optimal breastfeeding duration.

Some early postpartum difficulties identified by many cultures that are positively related to the early termination of breastfeeding are child birth experience, hospital

practices, nipple conditions and belief of insufficient milk (Forman, 1984; Scott & Binns, 1999; Cernadas et al, 2003).

Infant biological

The health status of infants is also a primary factor for influencing breastfeeding practices (Rogers et al, 1997a). Breastfeeding prevalence increases gradually throughout the range of birth weights, as low birth weight babies are significantly less likely to be breastfed than those with normal birth weight (Barros et al, 1986; Dennis, 2002). Greater doubts by the mother about the adequacy of milk, the strength of breast stimulus by infant and the demand for breast milk are some of the possible explanations to support the negative association between infant health problems and the initiation and duration of breastfeeding (Dennis, 2002).

2.4.1.4 Health care practices and attitudes

Physicians and other health professionals play a vital role in the encouragement of breastfeeding practices and the rate of weaning (Forman, 1984; Dennis, 2002). The literature suggests that lactation management is not incorporated in the medical education curriculum and therefore many physicians are not adequately prepared to offer professional support, to teach breastfeeding techniques, manage lactation problems and to educate women sufficiently on the benefits of exclusive breastfeeding practices (Avery et al, 1998; Wright & Schanler, 2001; Dennis, 2002). Furthermore, the literature provided to assist women in making informed feeding choices is usually donated by formula

companies (Avery et al, 1998). Further studies have shown that a variety of hospital practices including the type of delivery and prolonged separation of infants from mothers, make initiation of lactation very difficult to establish and might compromise the decision to establish and maintain successful breastfeeding (Grantham-McGregor et al, 1980; Cunningham et al, 1990). Therefore this illustrates the need for adequate, accurate and consistent information disseminated by health care providers. Additionally, the observance of *'Baby-Friendly Hospital Initiative'* has been shown to positively influence breastfeeding and ensure resurgence of breastfeeding trends (WHO/UNICEF 2001; Dennis, 2002).

Child feeding practices encompass a series of complex interrelated behaviours that influence the extent and duration of breastfeeding and will inevitably affect weaning practices. Therefore, understanding the decisions influencing infant feeding practices, and highlighting the superiority of breast milk to infant's health and development can assist in developing strategies to prolong breastfeeding among women with increased risk of premature weaning.

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STUDY RATIONALE

Like most other developing countries information on trends is lacking on Montserrat. The extent of underweight and overweight among children is unknown, due to poor or non existent paediatric surveillance systems and the exclusion of school aged children from nutrition research. Given the childhood obesity epidemic now seen in both developed and developing countries, and the strong evidence suggesting that method of infant feeding may be implicated in the early determinants of persistent overweight and adiposity in later life, investigating trends in growth and infant feeding practices are essential in understanding the origins and implications for developing countries.

Since Montserrat is still undergoing transformation during the rebuilding stages following the devastation caused by the volcanic crisis, identifying and describing risk factors, and providing baseline data to policy makers and health planners is important for the prioritization, development and implementation of suitable public health policy and nutrition intervention programmes to benefit future generations.

RESEARCH QUESTIONS

1. What is the prevalence of under and over nutrition in infants and children on Montserrat for both pre and post volcanic periods?
2. What are the breastfeeding trends on Montserrat during the first 6 months of life and how does it compare to international recommendations?
3. What are the maternal determinants influencing breastfeeding?

PURPOSE

To evaluate and describe the current health situation of children on Montserrat by investigating trends in infant and child nutritional status indices.

STUDY OBJECTIVES

A. The study objectives covered in Manuscript 1, Thesis Chapter 3 are:

(1) To explore trends in anthropometric indices of children ages 1, 5 and 11 years of age over a 10 year period (1993-2003).

(2) To evaluate the prevalence of underweight and overweight between pre and post volcanic periods.

B. The study objectives covered in Manuscript 2, Thesis Chapter 4 are:

(1) To analyze and describe breastfeeding trends in the first 6 months of life during the period 1993-1998 and compare trends with international recommendations.

(2) To identify the maternal determinants influencing breastfeeding practices at a population level.

CHAPTER 3

MANUSCRIPT 1

Childhood obesity following the onset of a volcanic crisis in Montserrat.

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3.1 ABSTRACT

Objective: To investigate trends in anthropometric indices over a 10 year period, (1993-2003) and to determine the prevalence of underweight and overweight among children at different developmental stages, and between pre and post volcanic periods.

Design: Cross-sectional study.

Setting: Montserrat.

Subjects: A total of 3 049 children ages 1, 5 and 11 years of age.

Measurements: Height/length, weight, weight-for age z-score (WAZ), weight-for-height z-scores (WHZ) and height-for-age z-scores (HAZ) for assessing growth for 1 year olds with overweight defined as z-score of > 1 SD above the mean for WHZ. For 5 and 11 year olds CDC age and gender specific body mass index (BMI) percentile cut-off values were used: those below 5th percentile were defined as underweight and those with a BMI $\geq$ 85th percentile were defined as overweight.

Results: Eleven year old children were twice as likely to be overweight during the post-volcanic period compared to the pre volcanic period (OR = 2.1 95% CI 1.5-2.8). Weight-for-height and height-for-age z-scores for 1 year olds and BMI percentiles for 5 year olds did not vary significantly over time.

Conclusion: These findings illustrate shifts in growth patterns among older children following the volcanic crisis and may increase the risk of being overweight in adulthood. Since Montserrat is currently in the rebuilding phase, these data are useful to assist policy makers in identifying priority areas and developing appropriate health and nutrition interventions.

Keywords: Montserrat, childhood, obesity, volcanic crisis,

3.2 INTRODUCTION

Many developing countries are undergoing rapid dietary, lifestyle and economic changes (Popkin, 2001; Uauy et al, 2001; Kain et al, 2002). Epidemiological literature suggests that these patterns of change are fuelling a progressive increase in the prevalence of obesity because of increasing consumption of high energy foods and sedentary behaviours (Forrester et al, 1996; Caballero, 2001; Uauy et al, 2001; Kain et al, 2002). Evidence indicates that some middle income countries of Latin America and the Caribbean have higher proportions of overweight preschoolers than the United States of America (de Onis & Blossner, 2000; Uauy et al, 2001). Murray & Lopez (1999) predicted that by 2020, the disease burden and mortality resulting from non-communicable chronic diseases will be approaching 60% as populations become '*heavier*'. Furthermore, in 2002 World Health Organization (WHO) reported overweight as the fifth most serious risk factor for mortality in developing countries.

Montserrat, a British colony in the Caribbean, experienced the eruption of the Lange Soufrière Hills Volcano in 1995 which resulted in the disruption to every aspect of social life and economic development. Relocation to the northern safe zone of the island resulted in changes in overall living conditions and led to massive off island evacuation to neighbouring Caribbean islands and the United Kingdom. With expenditure for the restructuring process heavily dependent on UK budgetary aid, having accurate information about growth trends is critical for prioritizing initiatives.

Therefore, the aim of this study is to investigate the trends in anthropometric indices of children ages 1, 5 and 11 years of age over a 10 year period, and to determine

the prevalence of underweight and overweight and also to compare prevalence between pre and post volcanic periods.

3.3 SUBJECTS AND METHODS

3.3.1 Study Area

Montserrat, the Emerald Isle of the Caribbean is a small mountainous island 12 miles long, 7 miles wide and approximately 39.5 square miles. The pearl shaped island situated in the northern part of the Lesser Antilles, forms part of a chain of volcanic islands known as the Eastern Caribbean. The eruption of the Lange Soufrière Hills volcano in July 1995 led to massive evacuation and relocation in the latter part of 1996 causing a decrease in the population from 12 000 to approximately 5 000 in 2002. The island has an average birth rate of 10.4 per 1000 live births, and an infant mortality rate and a maternal mortality rate of 0 (National Census, Montserrat, 2001).

3.3.2 Study Design

This is a descriptive study of all children 1, 5 and 11 years of age in Montserrat over a successive 10 year period (1993 to 2003). Available data were collected from infant, childhood and annual school health monitoring programmes conducted by the Ministry of Education, Health and Community Services.

3.3.3 Subjects

Data on sex, date of birth, height and weight were collected from hospital medical records and child welfare clinic records for 1 year old infants each year. All 1 year old infants with completed anthropometric and demographic data with regular periodic check ups (attended monthly child welfare clinic at least 4-5 times in 6 months) were included. Subjects were categorized into four zones based on the health centre and child welfare clinic attended. Data were collected on 922 subjects, however only 812, were included in the analysis, since some data variables were incomplete. This represented 88% for the total infant population.

At the end of each school year, between May and June, the Ministry of Health, Education and Community Service conducts an annual school health monitoring programme where trained health workers collect anthropometric measurements and other general health information on children (graduates from nursery and primary) to enter primary and secondary schools. During the study period, there were 5 900 children between 5-9 years of age (Department of Statistics, personal communication, July, 2004). In Montserrat, most primary school aged children attend government owned schools (90%), with a small number attending the only private school on the island and all children at the secondary level attend the only government owned secondary school. Data were collected over a 10 year period (1993-2003), from all nursery and primary school children attending both government and private schools who participated in the annual programme. Data on subjects were collected separately for both groups (5 and 11 year olds). Data were collected on date of birth, weight, height and sex. Those with

incomplete data were excluded from the present study: 4.8% (n=108) of subjects had missing information on height and were

excluded from the study population. The final sample for analysis included 2 240 children (96.2%) of students registered in all the programme databases used in the study.

3.3.4 Anthropometric Measurements and Definitions

Body weights were measured using a UNICEF approved scale. Infants (1 year olds) were weighed without clothing, shoes, jewellery or hair accessories. School aged children (5 and 11 year olds) were weighed without shoes. All weights were recorded to the nearest kilogram. Distance from crown to heel was used to measure infants' lengths using a non-flexible measuring tape. Height for school aged children was measured without shoes using a stadiometer. Measurements were recorded to the nearest centimetre.

Anthropometric indices for assessing growth for 1 year olds were weight-for-height z-scores (WHZ) and height-for-age z-scores (HAZ). Overweight was determined based on WHO criteria (WHO, 1995) and defined as z-score of 1 standard deviation above the mean for weight-for-height. For 5 and 11 year olds, adiposity was measured using body mass index (BMI), weight/height^2 and age-sex specific BMI percentile cut-off values defined according to CDC guidelines (CDC Report, 2000), those with BMI below the 5th percentile was used to define underweight, and BMI $\geq$ the 85th percentile was used define overweight.

3.4 STATISTICAL ANALYSIS

Statistical analyses were performed using SPSS version 11.5 (SPSS Inc, Chicago, 2002). Weight-for-height z-scores and BMI percentiles for age and gender were calculated using EPI INFO (CDC, Atlanta, 2000) and then imported into the SPSS database for further analysis. Chi square tests ($\chi 2$) were conducted separately for 1, 5 and 11 year olds to examine differences in proportions and trends in underweight and overweight over time. Due to small sample size, overweight was defined as BMI $\geq 85^{th}$ percentile combining both overweight and obesity categories. Multivariable logistic regression analysis was conducted to examine determinants of overweight ($\geq 85^{th}$ percentile) using age (months), sex, pre and post volcanic periods and time period (years). BMI percentiles were evaluated in a linear regression analysis as another approach to examining trends over time. Because of the small number of children in any given year, year was examined in 2 year groupings. Due to the volcanic crisis and its potential effect, years were also grouped as pre and post volcanic. The years 1993-1996 were defined as pre volcanic, and 1997-2003 were defined as post volcanic: 1996 marked the height of the volcanic crisis, with major disruption of services and massive relocation. Sex by year and sex by pre and post volcanic periods interaction terms were examined in logistic regression analysis. A level of $p < 0.05$ was considered statistically significant.

3.5 ETHICS

Approval for the study protocol was obtained by the ethics committee of the Faculty of Agricultural and Environmental Sciences at McGill University whilst clearance to collect data was given by the Ministry of Education, Health and Community Services, Montserrat (Appendices B-D).

3.6 RESULTS

3.6.1 Main demographic characteristics of subjects

Characteristics of 812 - one year olds, 1060 - five year olds and 1177 - eleven year olds children with available anthropometric data between 1993 to 2003 are summarized in **Table 3.1.** The central zones had the highest proportion of children during the pre volcanic period, while during the post volcanic period the majority lived in the northern zones. The mean ages for the 3 age categories were 12.9 months ± 2.2 (1.1 years), 54.1 months ± 7.2 (4.6 years) and 142.3 months ± 6.2 (11.9 years) respectively. There was a higher male to female ratio in the 5 year old category which was statistically significant ($p < 0.05$) (Table 3.1).

3.6.2 Prevalence of underweight and overweight across age groups and pre and post volcanic periods

We examined WHZ and BMI distribution among children over a 10 year time period by age group. The mean height of 1 year olds, did not deviate significantly from standards, HAZ = -0.02; WHZ = 0.62 and there were no significant changes in WHZ and HAZ over time. Also for 5 year olds, BMI percentiles did not vary significantly over time. For the 11 year olds, differences in BMI percentiles were observed between males and females (BMI percentiles were 50.8 ± 29.9 and 55.6 ± 32.1 for males and females respectively), and overweight was more pronounced ($p < 0.05$) in older females (11 year olds) than males as indicated by chi-square test ($\chi 2$) for differences in proportions.

Furthermore for 11 year olds, BMI percentiles increased over time (β coefficient = 1.4; S.E. = 0.3; $p < 0.05$).

The proportions of underweight fluctuated by year in all three age groups. A significant decreasing trend in the prevalence of underweight was observed only in the 5 year olds ($p < 0.05$) as determined by $\chi 2$ test for differences in trends. There were no significant trends noted in the proportions of overweight by year for 1 and 5 year olds. Although a high prevalence of overweight was noted varying from 20.6% to 41.0% depending on year for 1 year olds. However, for 11 year olds the proportion of overweight children increased significantly over time ($\chi 2$ test for trend $p < 0.05$) (Table 3.2).

The proportion of underweight and overweight in the pre and post volcanic periods was evaluated in a logistic regression analysis, adjusting for age, sex, and year. For 11 year old children, there was an excess risk of being overweight in the post volcanic period compared to the pre volcanic period (OR = 2.0, 95% CI 1.5-2.7) (Table 3.3). No significant differences were observed in overweight or underweight among 1 year olds. However among the 5 and 11 year olds, a significant decrease in underweight was observed in the post volcanic periods. Analysis of sex by year and sex by pre and post volcanic periods interaction terms did not prove to be statistically significant for 1 and 5 age groups, but was significant for the 11 year old age group with higher proportions of overweight observed in females.

3.7 DISCUSSION

This is the first study to explore the prevalence and trends of growth among children over a 10 year period spanning a volcanic crisis. For 1 and 5 year old children, no significant trends over time were observed but an interesting finding among the 1 year olds was the high proportion of infants above the 85th BMI percentile by year (20.6% - 41.0%) (Table 3.2). This illustrates that babies are getting '*chubbier*', which may increase the chances of infants experiencing early adiposity rebound and ultimately long term adverse health effects. During the critical period of infancy, the exogenous factors related to feeding and weaning practices play an important role in determining growth and contribution to weight problems (Rao & Rajpathak, 1992; Dewey 1998b; Kramer & Kahuma, 2002). Overweight is most commonly observed in infants who were weaned at earlier ages and fed a more varied diet (Rao & Rajpathak, 1992; Heinig et al, 1993). Therefore over nutrition appears to be one factor in the multifactorial aetiology of obesity, hence educating mothers on the risk of over nutrition can help to reduce infantile obesity and subsequently adult obesity. To fully address these issues further longitudinal investigations are needed to examine the effect of infant feeding on overweight and total physical activity and also to verify what proportions of these infants may have persistent childhood obesity from ages 1 to 5 years.

During the pre and post volcanic periods the levels of overweight increased modestly from 14.8% to 17.2% in 5 year olds, however, among the 11 year olds, the results show a striking increase in the overall prevalence of overweight but more apparent following the volcanic crisis, 16.6% to 28.6% (Table 3.2). Also, the levels of overweight were more pronounced in older females (11 year olds) when compared to their male

counterparts. The observed finding of overweight in females is similar to those of Sinha (1995) in a review of the changes in the nutritional status of English speaking Caribbean populations where he reported decreases in malnutrition and the observation of larger proportions of the population, especially young females were obese.

The general standard of living on Montserrat was considered high prior to the onset of the volcanic crisis in 1995. The GDP decreased from US$51.5 (EC$139.18) in 1995 to US$32.6 (EC$87.96) in 2001 (Department of Statistics, Montserrat, personal communication, July 2003). The relationship observed between timelines pre and post volcano and overweight ($p<0.05$) may be attributed to the differences in health care, food availability and accessibility, donations of energy dense foods and uncommon foods by foreign countries, change in lifestyles due to disruption of regular lifestyle patterns since the eruption of the Volcano. Social factors such as dietary factors (Heining et al, 1993; Whitaker et al, 1998) and sexual maturation (Parsons et al, 1999; Gaskin & Walker, 2003) are related to being overweight and obese, and females are reported to be more inactive at this age (Ogden et al, 1997). Cultural norms in child rearing practices are another explanation, as young females have the tendency to be engaged in domestic duties and not in physical activities. Additionally, a reduction in the number of allocated playfields for children, and general secular changes affecting physical activity and diet may explain the increase in overweight from pre to post volcanic periods. These data indicate the need for further monitoring of trends given that childhood obesity is a strong predictor of adult obesity (Serdula et al, 1993; Dietz, 1998b), and changes in childhood adiposity are closely related to adult adiposity, especially in females (Guo et al, 1997).

Montserrat is presently in the rebuilding stages, therefore developing and initiating appropriate intervention strategies to reduce the prevalence of overweight

among children is imperative. Interventions that focus on parental behaviours, particularly dietary strategies that target the family as a unit for change, incorporation of healthy lifestyle practices through school based programmes for example inclusion in school curriculum and school lunch programmes in addition to enforcement and increase in the allocation of playfield areas in newly developing housing projects may be necessary.

Given that constitutionally all children 5 years of age and older must attend school, one of the strengths of the study is the high ascertainment and participation rate indicated by comparisons with the number of 5-9 year olds in the population, and our study sample size. Therefore, only children absent from school on the day of measurements were excluded.

Furthermore, migration during the crisis may have selectively influenced the results since reports indicate that families with younger children living in the exclusion zone, large families, families impacted financially by the disaster tended to accept off island relocation packages (Government of Montserrat, Sustainable Development Plan, 1997). Because of limited data it was difficult to differentiate and separately examine the determinants of overweight between those persons remaining on the island to those who relocated, and hence some of the changes observed in the rates of overweight among 11 year olds may be attributed to selective migration, suggesting that even though there may be increase in overweight trends, *'thinner'* children may have relocated. Additional risk factor information would have been advantageous in delineating secular trends from effects of relocation stressors.

Nonetheless, our findings provide some important insight into the childhood trends, and suggest that intervention programmes are needed. Currently, strategies

continue to focus on under nutrition, but our data indicate that overweight is an emerging problem in the paediatric population.

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Table 3.1: Main Demographic Characteristics of study participants in each age group

	Age Categories (Years)		
	1	**5**	**11**
Year of data collection	1993-2002	1993-2003	1993-2003
Sample Size (n)	812	1060	1177
Age in months (X, SD)	12.9 ± 2.2[a]	54.1 ± 7.2[a]	142.3± 6.2[a]
Gender (% male)	52.1	53.1*	50.9
District (%)			
Pre Volcanic -1993-1996 (n)	486	661	701
Central	44.9	50.8	52.5
Northern	32.5	22.7	23.3
Eastern	9.1	13.8	11.4
Southern	13.6	12.7	12.8
Post Volcanic-1997-2003 (n)	326	399	476
Central	0.0	3.5	5.7
Northern	99.7	96.5	94.3
Eastern	0.3	0.0	0.0
Southern	0.0	0.0	0.0

[a] Mean ± SD
*** $p < 0.05$, $\chi 2$ test for differences in proportion (sex).**

Table 3.2: Prevalence of Underweight[¶] and Overweight[§] by age, group year and pre and post volcanic periods

	Underweight No. (%)			Overweight/Obese No. (%)		
	Age Categories (Years)					
Time Period	**1**	**5**	**11**	**1**	**5**	**11**
Group Year						
1993-1994	16 (5.8)*	58 (14.7)**	23 (5.8)*	110 (39.6)*	66 (16.4)	73 (18.5)**
1995-1996	13 (6.3)	53 (20.9)	25 (10.2)	79 (38.2)	31 (12.3)	33 (13.5)
1997-1998	10 (14.7)	22 (14.3)	9 (5.4)	14 (20.6)	24 (15.6)	50 (29.8)
1999-2000	8 (5.8)	13 (15.7)	8 (7.7)	57 (41.0)	10 (12.0)	34 (32.7)
2001-2002	13 (11.1)	5 (4.7)	4 (3.1)	39 (33.3)	26 (24.9)	29 (22.1)
2003		4 (10.0)	1 (1.4)		6 (15.0)	23 (31.5)
Pre vs Post Volcanic Period						
Pre volcanic (1993-1996)	29 (6.0)	111 (16.9)*	48 (7.5)*	188 (38.8)	97 (14.8)	106 (16.6)*
Post volcanic (1997-2003)	31 (9.6)	44 (11.5)	22 (4.6)	110 (34.0)	66 (17.2)	136 (28.6)

¶ ≤5th percentile for weight-for-height for 1 year olds and body mass index for 5 and 11 year olds.
§ ≥85th percentile for weight-for-height for 1 year olds and body mass index for 5 and 11 year olds.
*** $p < 0.05$, X^2 test for differences in proportion by year and pre and post volcanic periods.**
**** $p < 0.05$, X^2 test for trends.**

Table 3.3: Odds Ratio and 95% Confidence Intervals for Underweight[a] and Overweight[b] among Montserratian children by age group, pre and post[c] volcanic periods

	Age Categories (Years)		
	1 yr	**5 yrs**	**11 yrs**
		OR (95% CI)	
Underweight			
Pre	1.0 (Ref)[d]	1.0 (Ref)[d]	1.0 (Ref)[d]
Post	1.7 (0.98-2.8)	0.6 (0.4-0.9)	0.6 (0.4-1.0)
Year (1 yr intervals)	0.9 (0.9-1.0)	1.1 (1.0-1.1)	1.1 (1.0-1.2)
Overweight			
Pre	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
Post	0.8 (0.6-1.1)	1.2 (0.8-1.7)	2.0 (1.5-2.7)
Year (1 yr intervals)	1.0 (0.9-1.0)	1.0 (1.0-1.1)	1.1 (1.0-1.1)

[a] Underweight defined as percentile ≤ 5th percentile for weight-for-height and body mass index.
[b] Overweight defined as percentiles ≥ 85th percentile for weight-for-height and body mass index.
[c] Model adjusted for age, sex.
[d] Reference category for covariate.

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BRIDGE

Assessment of growth rate is essential for evaluating the health and development of infants, and determining the adequacy of the country's obstetric, medical and social care systems (Donma & Donma, 1999; CDC Report, 2000). Increasing levels of childhood obesity are emerging in societies undergoing nutritional transition and with the widespread implications and substantially long term health consequences, understanding the origin of these outcomes would help policy markers to adequately target intervention strategies (Serdula 1993; Guo et al, 1994; Parsons et al, 1999; Martorell, 2000; Wang et al, 2002; Perez-Escamilla, 2003). The most pronounced factor influencing infant growth is the method of infant feeding (Donma & Donma, 1999). Different methods of infant feeding during the first year of life generate different growth patterns during childhood and adolescence (Dewey et al, 1993; Dewey, 1998b; Victora et al, 1998; Eckhardt et al, 2001; Bergmann et al, 2003). Breastfeeding with its multifactorial characteristics is the recommended method of feeding in early life, since the benefits derived from this practice extend beyond infancy into childhood and adolescence, and to society as a whole (Dettwlyer & Fishman, 1992; WHO, 1995; UNICEF, 1998).

The focus of the first manuscript was to explore trends in anthropometric indices of children at critical periods of development and to evaluate the prevalence of underweight and overweight between pre and post volcanic periods. The study results highlight that 11 year old children were at higher risk of becoming overweight, also a decrease in the prevalence of underweight observed among the 5 and 11 year olds during the post volcanic period compared to pre volcanic period. Moreover, there were no significant changes over time in weight-for-height (WHZ) and BMI percentiles in 1 and 5 year old children respectively. Additionally, the proportions of underweight fluctuated by

year in all three age groups, with a significant decreasing trend observed in the prevalence of underweight in the 5 year olds ($p < 0.05$).

Conscious of the early infant feeding culture in most developing countries, and the protective effects of breastfeeding against childhood obesity, the purpose of the second manuscript is to describe the breastfeeding trends on Montserrat in relation to international recommendations and to identify the determinants of breastfeeding in the first 6 months of life at a population level.

CHAPTER 4

MANUSCRIPT 2

Breastfeeding trends and the associated maternal characteristics in the first 6 months of life on Montserrat, 1993-1998.

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4.1 ABSTRACT

Objective: To provide information on breastfeeding trends over a six year period, 1993-1998 in relation to international recommendations and to identify the determinants of breastfeeding in the first 6 months of life at a population level.

Design: Cross-sectional study.

Setting: Montserrat.

Subjects: A total of 671 mothers and their infants.

Measurements: Feeding practices were defined as '*exclusive breastfeeding*' which are infants who receive only breast milk, '*any breastfeeding*' which include all breastfed infants whether or not infants received other feedings in addition to breast milk and '*no breastfeeding*' which is a total of infants who were not exclusively breastfed and received all their nutrition through formula and/ or complementary feeding. To identify maternal determinants, education level and age, employment situation at the time of delivery, parity and pre and post pregnancy weights were the covariates investigated.

Results: The most important finding of this study is that only 3.4% of mothers exclusively breastfeed and 67.1% continuing with any breastfeeding at 4-6 months. There were no significant differences over time in the prevalence of exclusive breastfeeding at 1, 1-3 and 4-6 months of age. Maternal age was the only significant association observed with exclusive breastfeeding at 4-6 months. Older mothers (> 27 years of age) were either more likely to exclusively breastfeed (RR= 5.30; 95% CI 1.44-24.57) or less likely to never breastfeed (RR=0.73; 95% CI 0.53-1.01) when compared to younger mothers (< 22 years of age).

Conclusion: These results illustrate that the present breastfeeding practices are suboptimal and highlights the need for breastfeeding promotion both antenatally and postnatally to establish a breastfeeding trend that would benefit future generations.

4.2 INTRODUCTION

Breast milk is the preferred food for infants and exclusive breastfeeding for the first 6 months of a child's life is considered the gold standard for nourishment, since it provides adequate nutrition to satisfactorily support normal growth and development (Rogers et al, 1997b; UNICEF 1998; WHO 2001; Cernadas et al, 2003). The health gains of breastfeeding in infancy are well documented (WHO, 1995; Brown et al, 1998; UNICEF, 1998) and recent studies have shown that these benefits extend beyond infancy and may assist in the prevention of obesity during childhood and adolescence (Kramer et al, 1981; von Kries et al, 1999; Gillman et al, 2001; Hediger et al, 2001; Armstrong 2002; Ruel & Menon 2002; Toschke et al, 2002; Dewey 2003; Victora et al, 2003).

Until three decades ago, nearly all women in the developing world initiated breastfeeding and for most cultures the average duration of breastfeeding was over one year (Forman, 1984; Marchione, 1990; Dettwyler & Fishman, 1992). An analysis conducted by Grummer-Strawn (1996) in 15 developing countries showed a decline in the proportion of infants being breastfed, and an increase in the early introduction of complementary foods. According to Perez-Escamilla (1994) the proportion of infants who were never breastfed is twice as high in Latin America and the Caribbean than in Africa. Recent studies indicate that breastfeeding trends in Latin America and the Caribbean region reported the rate of exclusive breastfeeding for 6 months is 30% (Lauer et al, 2004). Based on these findings, this region ranks lowest in the UNICEF's breastfeeding indicators (UNICEF Country Data Report, 2001). Hence, there is a striking difference between international recommendations and breastfeeding practices in the region and therefore, more attention is needed to fulfill the recommendations.

The aim of this study is to describe breastfeeding trends on Montserrat during the period 1993-1998 in relation to the international recommendations and to identify the determinants of breastfeeding in the first 6 months of life at a population level.

4.3 SUBJECTS AND METHODS

4.3.1 Study Area

Montserrat is a small island in the Eastern Caribbean, and is one of the few developing countries that is not characterized by malnutrition (Sinha, 1995). With a present population of ~6000 inhabitants and an annual birth rate of ~150/year, Montserrat boasts of high quality obstetric health care, whereby most pregnant women receive routine prenatal care and nearly all or most children receive monthly child check ups at local district clinic (Government of Montserrat, Sustainable Development Report, 1997). All district nurses are trained in standard practices for collecting maternal and child health data and so the information from each clinic record is reliable.

4.3.2 Study Design

This study is a cross sectional evaluation to characterize trends in breastfeeding practices and to identify maternal determinants of exclusive and no breastfeeding at 4-6 months post partum. Demographic data of mothers were obtained using hospital obstetric medical records and for infants from child welfare clinic records for the period 1993-1998. The scope of this paper is limited to the analysis of the data available on the records.

4.3.3 Sample

In Montserrat, the child welfare clinics monitor all children up to age 2 years. All infants are expected to attend monthly clinics during the first 12 months of life and follow up visits are done by appointments to coincide with immunization schedules. There were a total of 700 births over the study period, 1993-1998 (National Census, 2001) with 690 infants attending child welfare clinics. Infants between 37 and 42 weeks of gestational age with complete records were eligible for the study. Records with missing or invalid information, very low birth weight (VLBW) infants and those with any serious conditions which affect growth and irregular periodic check ups were excluded from the study. A final total of 671 infants with completed records were included. For maternal characteristics, data were not available on all for pre and post pregnancy weight, or working situation at the time of delivery.

4.3.4 Measures and Definitions

4.3.4.1 Gestational Age

Clinical estimates of gestational age were done using ultrasonography and neonatal examination. Weight for gestational age was calculated using the United States National Reference for Fetal Growth (Alexander et al, 1996). Infants with weight-for-gestational age below the 10^{th} percentile were defined as "*small*" for gestational age, those between the 10^{th} and 90^{th} percentile were defined as "*normal*" for gestational age while those $\geq 90^{th}$ percentile was defined as "*large*" for gestational age.

4.3.4.2 Anthropometry

Infants' birth weight and length were derived from mothers' obstetric hospital medical records and were verified using information from the 1st visit to child welfare clinic. Infants' birth weight reported as a continuous variable was categorized as < 2500g, 2500-3999 g and ≥ 4000 g. For infants, weight was measured without clothing and jewellery and recorded to the nearest 0.1 kg. Length was measured from crown to heel using a non-flexible tape and length recorded to nearest 0.5 cm. Maternal anthropometry pre and post pregnancy weights were assessed at first antenatal and at 6 weeks postpartum visits (Obstetrics Dept, MOH, Montserrat).

4.3.4.3 Feeding Practices

Data on feeding practices were collected at 1 month, 1-3 months; 4-6 months as reported by mothers during routine check ups at child welfare clinics. For these time periods infants were classified as either exclusively, partially or never breastfed according to WHO definitions. Due to the decline in the number of infants who were exclusively breastfed at 3 months and the worldwide low frequency of exclusive breastfeeding beyond the first few months of life (WHO 2001), 3 different types of breastfeeding categories were used in the analysis. The categories were defined as *'exclusive breastfeeding'* which are infants who received only breast milk, *'any breastfeeding'* which included all breastfed infants whether or not infant received other feedings in addition to continued breastfeeding. To differentiate between exclusive breastfeeding and other feeding practices at 4-6 months, a new category *'no breastfeeding'* was used and

included a total of the infants who were not exclusively breastfed and received all their nutrition through formula or complementary feeding. A total of 19 (2.8%) subjects were not analysed because of inconsistencies and missing information on infant feeding at data collection times.

4.3.4.4 Maternal Covariates

Mother's education level, age, occupation, employment status at time of delivery, nationality, maternal pre and post pregnancy weights, parity and district/clinic attended collected from obstetric hospital medical records were used in the analysis. The mother's highest education level coded by 4 categories was combined into three categories in the logistic regression analyses: <7 years, 7-12 years and ≥ 13 years. Maternal age and parity reported as continuous variables were categorized into quartile groups (< 22 years, 22-27 years, 28-34 years and >34 years) and primiparous and multiparous respectively.

4.4 STATISTICAL ANALYSIS

Statistical analyses were conducted using SPSS for Windows, version 11.5 (Chicago, 2002). Chi-squared ($\chi 2$) and t-test were used separately to evaluate demographic and maternal determinants of breastfeeding at 1 month, 1-3 months and 4-6 months and to examine trends in breastfeeding patterns over time. To determine the rates of breastfeeding, any breastfeeding and exclusive breastfeeding were analyzed separately at 1 month, 1-3 months and 4-6 months. The probability of exclusive breastfeeding and

no breastfeeding at 4-6 months as a function of the maternal variables (mother's age, education level, parity, employment status at time of delivery) was assessed using unadjusted odds ratios and 95% CI and in multivariable logistic regression analyses. Potential correlates of breastfeeding were examined as categorical and continuous variables when possible. Due to the volcanic crisis and its potential effect, years were also grouped as pre and post volcanic. The years 1993-1996 were defined as pre volcanic, and 1997-1998 were defined as post volcanic: 1996 marked the height of the volcanic crisis, with major disruption of services and massive relocation. Any and exclusive breastfeeding at 1 month, 1-3 months and 4-6 months by pre and post volcanic periods were examined in logistic regression analysis. All p values < 0.05 were considered statistically significant.

4.5 ETHICS

The research protocol was reviewed and approved by the Ethical Review Committee of the Faculty of Agricultural and Environmental Sciences at McGill University and clearance to conduct the research was obtained from the Ministry of Education, Health, Community Services and Labour, Montserrat.

4.6 RESULTS

4.6.1 Description of the sample

A total of 671 maternal and infant records fulfilled the eligibility criteria and were analyzed in the study. Almost three quarters (73.6%) of mothers were below 35 years with the mean age of 27 years ± 6.6. Parity ranged between 1 to 9 children, with a mean of 2 children and 33.2% of women being primiparous. The majority of women (65.4%) completed at least 12 years of education, 15.1% completed primary school and 11.2% reached university level. Montserratian nationals made up 82.0% of the study population and 60.6% were employed at the time of delivery. The mean birth weight was 3.2 kg ± 0.5 with a higher proportion (53.4%) of newborns being males. Mean gestation age of infant subject was 39.4 weeks ± 1.7 weeks with birth weight ranging from 1.7 kg to 5.2 kg and a mean of 3.22 ± 0.53 kg.

4.6.2 Breastfeeding patterns during the 1st 6 months of life

Figure 4.1 presents the results for any breastfeeding and exclusive breastfeeding during the first 6 months of life over the study period. Almost all mothers (98.1%) initiated breastfeeding and approximately 69.6% exclusively breastfed up to 1 month. However, the percentage of those exclusively breastfeeding declined to 3.4% by the 6th month post partum. Only 2% of the infants had never been breastfeed at 1 month of age. The most common type of infant feeding at 3 and 6 months was formula and or complementary foods with partial breastfeeding.

4.6.3 Breastfeeding trends overtime

We examined the prevalence of exclusive and any breastfeeding among infants over the study period by year, pre and post volcanic periods and age of infants (Table 4.1). There were no significant differences noted over time in the prevalence of exclusive breastfeeding at 1, 3 and 4-6 months of age. However, for the prevalence of any breastfeeding, significant differences by year were noted at 1-3 months of age but there was not systematic trend over time (Table 4.1). At 4-6 months, there was a significantly lower prevalence of any breastfeeding in 1998 compared to previous years (Table 4.1). There were no statistically significant differences in breastfeeding practices between pre and post volcanic crisis.

4.6.4 Determinants of Exclusive and No Breastfeeding at 4-6 months

Table 4.2 shows odds ratio (unadjusted data) for exclusive breastfeeding and no breastfeeding at 4-6 months. No significant association was observed between the outcomes of exclusive breastfeeding for any of the following variables: working situation at the time of delivery, birth weight, maternal education, parity, sex. Maternal age was the only significant variable for exclusive breastfeeding at 4-6 months. Analyses showed older mothers were more likely to exclusive breastfeed and least likely to not breastfeed. Older mothers ($\geq$ 22 years) were 3-5 times more likely to exclusively breastfeed and less likely to never breastfeed (RR= 0.71; 95%CI 0.53-0.96) when compared with younger mothers ($\leq$ 22 years).

In logistic regression, entering parity as a continuous variable, parity was positively and significantly related to any breastfeeding at 4-6 months of age ($\beta = 0.022$; SE= 0.11; p = 0.04). Further analysis illustrates that women with higher pre pregnancy weight were less likely to continue exclusive breastfeeding for greater than 3 months (OR 0.65; 95% CI 0.47-0.95).

4.7 DISCUSSION

The international breastfeeding recommendations extend the period of exclusive breastfeeding from 4 to 6 months of age (WHO, 2001). The data of this study indicated that while there was a 98.1% breastfeeding initiation rate there was a decline in exclusive breastfeeding from 1 month (69.6%) to 6 months (3.4%) post partum. These figures are below the international standards, however they are consistent with the low prevalence of breastfeeding observed in other developing countries (Moodley et al, 1999; Scott & Binns, 1999; UNICEF, 2001; Cernadas et al, 2003; Lauer et al, 2004). The high breastfeeding initiation rates observed are in part due to the undertakings of the obstetric department in becoming a certified "Baby Friendly Hospital" prior to the volcanic crisis (Ministry of Health Report, 1995). The combined breastfeeding and complementary feeding observed amongst mothers seem to be a common practice as these findings were earlier substantiated by O'Quinn et al, (1991) in a review of the lactation patterns of Montserratian mothers. The authors reported that 94% of women exclusively breastfeed for at least two weeks after delivery and 70% continue breastfeeding up to one year. Studies in other developing countries showed that virtually all women initiate

breastfeeding and continue breastfeeding for an average of one year, but breast milk along with complementary foods as early as 4 to 8 weeks postpartum is commonly observed practice in most cultures (Dettwyler & Fishman, 1992; Perez-Escamilla et al, 1994; Parsons et al, 1997; Nagy et al, 2001).

The low rates of exclusive breastfeeding and the increase in the number of children receiving formula and or complementary foods with breast milk at 3 and 6 months postpartum may be explained by the three month maximum maternity leave allocated to mothers on Montserrat. The literature highlights that few employed women breastfeed exclusively for 4-6 months and the return to paid and full time employment at 3 months post partum decreases the probability of breastfeeding and significantly lowers duration rates (Dettwyler & Fishman, 1992; Greiner, 1994; Rogers et al, 1997a; Fein & Roe, 1998). Furthermore, the lack of sufficient public childcare facilities and conducive work environment, restrictive employer policies for maternity leave, social attitudes of employers and co-workers towards breast-feeding are constraints for women in developing countries (McIntyre et al, 2002).

The significant effect of maternal age and parity on exclusive and no breastfeeding rates at 4-6 months post partum in this study are similar to findings in other developing countries. Studies on the rates of exclusive breastfeeding at 4 months in Latin America and the Caribbean were significantly positively associated with the mother's age and although older women were less likely to breastfeed, when undertaken, did so for longer periods than younger mothers (Landman & Shaw-Lyon, 1979; Grummer-Strawn et al, 1993; Rogers et al, 1997a). The findings are in agreement with those of developed and industrialized countries (Scott & Binns, 1999; Nicols et al, 2002; Lande et al, 2003). Older women are more inclined to obtain thorough prenatal medical attention, acquire

more information on child rearing practices, including breastfeeding, and therefore more inclined to be exclusively breastfeeding on hospital discharge and hence increases the chances of breastfeeding (Scott & Binns, 1999; Dennis, 2002).

The literature on birth order and breastfeeding highlights that a mother's previous experience with breastfeeding has a powerful influence on the chance of a child ever being breastfed (Hill et al, 1997; Nagy et al, 2001). Other studies highlight that multiparious mothers with 3 or more children tend to discontinue breastfeeding after 4 weeks (Jones et al, 1986; Becerra, 1990). In our study, parity entered as a continuous variable was positively correlated to breastfeeding at 4-6 months, which reinforces the findings of earlier studies.

The results of our study found no significant differences in breastfeeding trends over the study period. This may be elucidated by the fact that Montserrat has a homogenous middle-class population with little variability in education. Most mothers receive similar obstetric care and secondary level education is free for all. Moreover, even when prenatal care is conducted by a private physician, mothers still have contact with public health nursing staff as some maternal services are only offered at the island's lone hospital and there are constant interrelations between professionals from the private and public sectors. Additionally, community nurses periodically conduct breastfeeding education sessions aimed at promoting and encouraging breastfeeding practices.

The certainty of accurate data collection and the fact that the information was collected at the population level are major strengths of this study. The limitation of the breastfeeding data is that they were obtained for age ranges rather than at specific times therefore it was not possible to calculate breastfeeding duration. Further limitations of the study are the utilization of secondary data, as findings are restricted to records and

missing information on maternal height and pre pregnancy body mass index which would help to determine the maternal BMI could influence breastfeeding patterns and duration and contribution to infantile obesity. More in depth information could not be obtained on breastfeeding schedule and the type and exact age for introduction of complementary foods. One of the interests of the investigators was to determine how the different methods of feeding influenced growth in infancy and childhood but owing to the limited variability in feeding methods this objective could not be fully investigated. Therefore, better designed studies are needed to investigate how these early infant feeding practices influence health outcomes presently observed as the Caribbean regions continue to undergo nutrition and economic transition. Also to gain a better understanding of breastfeeding selection and delay introduction of complementary foods, acquiring information on maternal beliefs and attitudes would have been useful.

The most important finding of this study is that although breastfeeding initiation rates are high, and "*any breastfeeding*" practices are protected, exclusive breastfeeding at 6 months is below the international recommended standards. This highlights the importance of increasing the awareness of young women about the benefits of breastfeeding, for health professionals to concentrate efforts on promoting, supporting and educating on the benefits of exclusive breastfeeding from antenatal periods. Since there is an association between the type of feeding practices and growth and ultimately the risk of later obesity (Dewey, 1998b; Victora et al 1998; von Kries et al, 1999; Bergmann et al, 2003) breastfeeding appears to be the most powerful population based strategy in fighting the increasing levels of childhood obesity. These results are useful for future programming and measurement and to improve suboptimal breastfeeding practices on Montserrat.

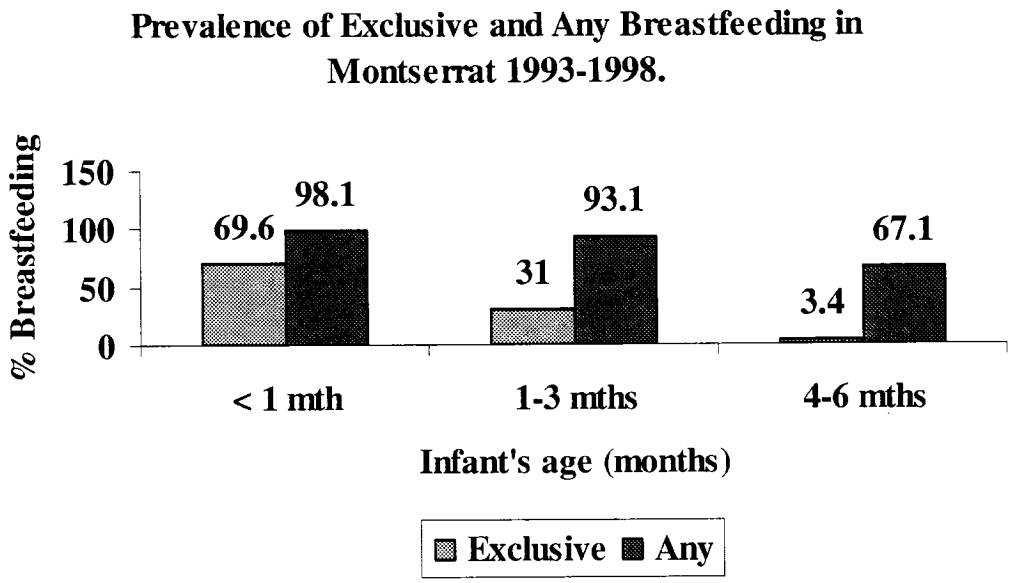

Figure 4.1 Prevalence† of any breastfeeding* and exclusive breastfeeding** in Montserrat, 1993-1998.

† The prevalence is based on the entire infant population, breastfed or not.
* Any breastfeeding includes all breastfed infants (exclusive plus partial).
** Exclusive breastfeeding includes infants receiving only breast milk (no water, formula, milk, juice or food).

Table 4.1: Rates of Exclusively and Any Breastfeeding at 1 month, 1- 3 months, 4-6 months by birth year and pre and post volcanic periods

		Exclusive No. (%)	Any No. (%)	Exclusive No. (%)	Any No. (%)	Exclusive No. (%)	Any No. (%)
		Age Categories (Months)					
Time Period		**< 1**		**1-3**		**4-6**	
Year	**No.**						
1993	158	117 (74.1)	147 (93.0)	53 (33.5)	140 (88.6)*	10 (6.3)	108 (68.4)
1994	148	101 (68.2)	147 (99.3)	41 (27.7)	143 (96.6)	0 (0.0)	100 (67.6)
1995	133	85 (63.9)	133 (100.0)	33 (24.8)	127 (95.5)	5 (3.8)	84 (63.2)
1996	132	97 (73.5)	132 (100.0)	48 (36.4)	126 (95.5)	6 (4.5)	94 (71.2)
1997	63	43 (68.3)	62 (98.4)	23 (36.5)	57 (90.5)	2 (3.2)	45 (71.4)
1998	37	24 (64.9)	37 (100.0)	10 (27.0)	32 (86.5)	2 (5.4)	19 (51.4)*
		NS	**NS**	**NS**	**$p < 0.05$**	**NS**	**$p < 0.05$**
Pre vs Post Volcanic Periods							
Pre (1993-1996)	571	400 (70.1)	559 (97.9)	175 (30.6)	536 (93.9)	21 (3.7)	386 (67.6)
Post (1997-1998)	100	67 (100.0)	99 (99.0)	33 (33.0)	89 (89.0)	4 (4.0)	64 (64.0)

*** $p<0.05$, $\chi 2$ tests for trends**

Table 4.2: Odds Ratio and 95 % Confidence Intervals for Exclusive and No Breastfeeding at 4-6 months

Characteristics[a]		Breastfeeding			
		Exclusive		No	
		N (%)	RR (95% CI)	N (%)	RR (95 % CI)
Maternal Characteristics					
Maternal age (yrs)					
< 22	179	2 (1.1)	1.00 (Ref)	69 (38.5)	1.00 (Ref)
22-27	153	9 (5.9)	5.26 (1.15-24.00)*	49 (32.0)	0.83 (0.60-1.12)
28-34	175	6 (3.4)	3.07 (0.63-15.00)	48 (27.4)	0.71 (0.53-0.96)*
>34	135	8 (5.9)	5.30 (1.44-24.57)*	38 (31.8)	0.73 (0.53-1.01)*
Parity					
Primiparous	216	9 (4.2)	1.00 (Ref)	75 (34.7)	1.00 (Ref)
Multiparous	435	15 (3.4)	0.83 (0.37-1.86)	136 (31.3)	0.90 (0.71-1.13)
Education Level (yrs)					
≤ 7	74	4 (5.5)	1.0 (Ref)	21 (28.8)	1.00 (Ref)
7-12	360	12 (6.6)	0.62 (0.20-1.86)	117 (63.1)	1.15 (0.77-1.69)
≥13	55	2 (3.6)	0.67 (0.13-3.54)	18 (32.7)	1.15 (0.68-1.95)
Work Situation @ Delivery					
Employed	342	14 (4.1)	1.00 (Ref)	111 (32.5)	1.00 (Ref)
Unemployed	222	7 (3.2)	0.77 (0.32-1.88)	68 (30.6)	0.94 (0.73-1.21)
Maternal Pre Weight (kg)					
Low	128	5 (3.9)	1.00 (Ref)	34 (26.6)	1.00 (Ref)
High	124	3 (2.4)	0.62 (0.15-2.54)	41 (33.1)	1.24 (0.85-1.82)
Infant Characteristics					
Infant Sex					
Male	358	10 (2.8)	1.00 (Ref)	116 (32.4)	1.00 (Ref)
Female	313	15 (4.8)	1.72 (0.78-3.76)	105 (33.5)	1.04 (0.83-1.29)
Birth Weight (kg)					
≤ 2.5	57	0 (0.0)	1.00 (Ref)	20 (35.1)	1.00 (Ref)
2.5-3.999	567	25 (4.4)	1.79 (0.6-5.35)†	187 (49.2)	0.94 (0.65-1.36)
≥ 4.0	46	0 (0.0)	0.00	13 (28.3)	0.81 (0.45-1.44)
B/W-for-gestational age					
Small (10^{th} percentile)	159	4 (2.5)	1.00 (Ref)	54 (34.0)	1.00 (Ref)
Normal (10^{th} – 89^{th})	430	19 (4.4)	1.76 (0.61-5.08)	144 (33.5)	0.99 (0.76-1.27)
Large (≥90^{th})	27	0 (0.0)	0.00 (0.00-9.41)	7 (25.9)	0.76 (0.39-1.50)
Volcanic Period					
Pre	571	21 (3.7)	1.00 (Ref)	185 (32.4)	1.00 (Ref)
Post	100	4 (4.0)	1.09 (0.38-3.10)	36 (36.0)	1.11 (0.83-1.48)

a Data from Obstetrics Department, Medical Records, Ministry of Health, Montserrat
* $p \leq 0.05$
† OR (95% CI)

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5.0 General Conclusion

This research thesis documents growth trends at different stages of development, breastfeeding trends and maternal characteristics of exclusive and no breastfeeding at 4-6 months. This is the first study to investigate trends spanning a volcanic crisis.

The first manuscript provides evidence that obesity is on the rise especially in older children (11 year olds) following the volcanic crisis. Emerging literature provides evidence to suggest that obesity at this stage of development persists into adulthood and subsequently translates into adverse health effects with extensive clinical and public health implications. This illustrates the significance of inculcating healthy lifestyle habits from an early age and achieving behavioural changes in parents.

Data presented in the second manuscript confirm high breastfeeding initiation rates followed by a decline in rates of exclusive breastfeeding at 6 months as observed in developing countries (Grummer-Strawn, 1996; Perez-Escamillia, 2003; Lauer et al, 2004). Furthermore it highlights the common practice of combining breastfeeding with complementary feeding and the existence of breastfeeding trends. These findings illustrate the striking gap between current practices and international recommendations, indicating that more aggressive population-based strategies are required to increase awareness of women with characteristics increasing the likelihood of early cessation of breastfeeding and to promote optimal breastfeeding practices. These findings contribute to the infant feeding literature of women in the developing countries with similar backgrounds.

Our data provide scientific baseline information critical to designing and improving a database for the management of maternal and child health programmes.

The noticeable strength of our study is that there is little missing data since research was population based. However, the fact that the study population is relatively homogenous, is the major limitation and therefore makes it is difficult to identify major predictors of breastfeeding practices. Further studies are needed in order to develop an understanding for maternal determinants of breastfeeding selection and practices by examining cultural beliefs, attitudinal and interpersonal characteristics and how these practices influence health outcomes and negative behaviours in Caribbean regions undergoing nutrition transition. Additionally prospective studies are needed to explore the relationship between infant feeding practices and adiposity at critical stages of growth and development. The outcomes of such studies would help to elucidate the origins of childhood obesity epidemic.

Our goal is to ensure the continued improvement in the promotion and protection of breastfeeding practices since research has shown that it is a powerful strategy for reducing the risk of nutritional deficiencies in infants and fighting the increasing levels of obesity in childhood (von Kries et al, 1999; Butte, 2000; de Onis et al, 2000; Kramer et al, 2003).

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Infant Feeding Categories as recommended by WHO

Appendix A

Feeding Patterns	Infant Receives	Infants *can* receive	Excluded
Exclusive breastfeeding	Breast milk only includes expressed or wet nurse feeding.	Vitamin/mineral supplements, medicines.	Anything else
Predominant breastfeeding	Breast milk is the major source of nourishment.	Fluids, ritual fluids and items as above.	Anything else non-human milk, food-based fluids.
Complementary breastfeeding	Breast milk and semi-solid or solid foods.	All foods or liquids.	
Breastfeeding	Breast milk	All foods and liquids.	
Bottle feeding	All liquids or semi-solid foods fed via bottle with nipple or teat.	All food or liquids, also allows breast milk by bottle.	

Adapted from Dettwyler & Fishman, 1992

NOTE TO USERS

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Infant Feeding Data Collection Form

Appendix E

Type of Food	1st month	1-3 months	4-6 months	7-9 months	10-11 months	>1 year
Breast Milk	( ) Fully ( )Partially ( ) None	( ) Fully ( )Partially ( ) None	( ) Fully ( )Partially ( ) None	( ) Fully ( )Partially ( ) None	( ) Fully ( )Partially ( ) None	**Age** **B:**
Fruit/ Veg/ Puree/ Juice	( ) Yes ( ) No (J, P, H, C)	( ) Yes ( ) No (J, P, H, C)	( ) Yes ( ) No (J, P, H, C)	( ) Yes ( ) No (J, P, H, C)	( ) Yes ( ) No (J, P, H, C)	**L:**
Thick Porridge/ Cereal	( ) Yes ( ) No (M,W,H,C)	( ) Yes ( ) No (M,W,H,C)	( ) Yes ( ) No (M,W,H,C)	( ) Yes ( ) No (M,W,H,C)	( ) Yes ( ) No (M,W,H,C)	**D/S:**
Multi Mix/ Family Meal			( ) Yes ( ) No	( ) Yes ( ) No	( ) Yes ( ) No	
Any other food						

J- Juice; P-Puree/Seive; M- Milk; H-Homemade; C-Commercially prepared

Adapted from Caribbean Food & Nutrition Institute (PAHO/WHO, 1984)

Maternal and Infant Data Collection Form **Appendix F**

									INFANT CHECK UPS FEEDING METHOD										MATERNAL CHARACTERISTICS														
ID #	HC	HD	DOB	GES	SEX	BW	LT	B/F	1				2			3			PAR	AGE	WT		EDU	OCC	NAT	PREG		1 YEAR					
BYR				AGE				INI	1st mth				1-3 mths			4-6 mths			#	DEL	PRE	POST				COM							
									DOM	FM	WT	LT	DOM	FM	WT	DOM	FM	WT									TYPE	DOM	HT	WT	HAZ	WAZ	WHZ

ID #	School	District/	DOB	DOM	Sex	Wt	Ht	Fld No	AGE	BMI	BMIZ
YR/AG/#		Zone				Kg	cm				

Appendix H

Odds Ratio and 95% Confidence Intervals for Any Breastfeeding at 1 and 1-3 months

Characteristics[a]		Any Breastfeeding			
		1 month		1-3 months	
		N (%)	RR (95% CI)	N (%)	RR (95 % CI)
Maternal Characteristics					
Maternal age (yrs)					
< 22	179	175 (97.8)	1.00 (Ref)	162 (89.5)	1.00 (Ref)
22-27	153	152 (99.3)	1.02 (0.99-1.04)	145 (94.8)	1.06 (0.99-1.13)
28-34	175	169 (96.5)	0.99 (0.95-1.02)	163 (93.1)	1.04 (0.98-1.11)
>34	135	134 (99.3)	1.02 (0.99-1.04)	129 (95.6)	1.07 (1.00-1.14)*
Parity					
Primiparous	216	209 (96.8)	1.00 (Ref)	197 (91.2)	1.00 (Ref)
Multiparous	435	429 (98.7)	1.02 (0.99-1.05)	411 (94.4)	1.04 (0.99-1.09)
Education Level (yrs)					
≤ 7	74	72 (97.2)	1.00 (Ref)	71 (96.5)	1.00 (Ref)
7-12	360	356 (97.1)	1.02 (0.98-1.06)	340 (89.0)	0.98 (0.93-1.04)
≥13	55	54 (98.2)	1.01 (0.96-1.06)	49 (89.1)	0.93(0.84-1.03)
Work Situation @ Delivery					
Employed	342	334 (97.7)	1.00 (Ref)	320 (93.5)	1.00 (Ref)
Unemployed	222	221 (99.5)	0.98 (0.96-1.00)	209 (94.2)	0.99 (0.95-1.04)
Maternal Pre Weight (kg)					
Low	128	128 (100.0)	1.00 (Ref)	126 (98.5)	1.00 (Ref)
High	124	115 (92.7)	0.97 (0.94-1.00)*	115 (92.7)	0.94(0.89-0.99)*
Infant Characteristics					
Infant Sex					
Male	358	352 (98.4)	1.00 (Ref)	330 (92.3)	1.00 (Ref)
Female	313	306 (97.8)	0.99 (0.97-1.02)	296 (94.6)	1.03 (0.99-1.07)
Birth Weight (kg)					
≤ 2.5	57	56 (98.2)	1.00 (Ref)	53 (93.0)	1.00 (Ref)
2.5-3.999	567	557 (98.3)	1.00 (0.96-1.04)	531 (93.0)	1.01 (0.93-1.09)
≥ 4.0	46	44 (95.4)	0.96 (0.91-1.04)	41 (89.1)	0.96 (0.85-1.08)
B/W-for-gestational age					
Small (10^{th} percentile)	159	155 (97.5)	1.00 (Ref)	147 (92.5)	1.00 (Ref)
Normal (10^{th} – 89^{th})	430	423 (98.4)	1.01 (0.98-1.04)	401 (93.0)	1.01 (0.96-1.06)
Large (≥90^{th})	27	26 (97.3)	0.99 (0.91-1.07)	24 (88.9)	0.96 (0.84-1.11)
		0 (0.0)			
Volcanic Period					
Pre	571	559 (97.9)	1.00 (Ref)	537 (94.0)	1.00 (Ref)
Post	100	99 (99.0)	1.01 (0.99-1.03)	89 (89.0)	0.95 (0.88-1.02)

a Data from Obstetrics Department, Medical Records, Ministry of Health, Montserrat

* $p \leq 0.05$

† OR (95% CI)

Appendix I

Odds Ratio and 95 % Confidence Intervals for Exclusive Breastfeeding at 1 and 1-3 months

Characteristics[a]		Exclusive Breastfeeding			
		1 month		1-3 months	
		N (%)	RR (95% CI)	N (%)	RR (95 % CI)
Maternal Characteristics					
Maternal age (yrs)					
< 22	179	119 (66.5)	1.00 (Ref)	48 (26.8)	1.00 (Ref)
22-27	153	112 (73.2)	1.10 (0.96-1.27)	59 (38.6)	1.44 (1.05-1.97)*
28-34	175	114 (65.1)	0.96 (0.84-1.14)	55 (31.4)	1.17 (0.85-1.62)
>34	135	102 (75.6)	1.14 (0.99-1.33)*	41 (30.4)	1.13 (0.80-1.61)
Parity					
Primiparous	216	151 (30.1)	1.00 (Ref)	71 (32.9)	1.00 (Ref)
Multiparous	435	303 (30.3)	1.00 (0.90-1.11)	132 (30.3)	0.92 (0.72-1.17)
Education Level (yrs)					
≤ 7	74	47 (63.0)	1.00 (Ref)	20 (27.0)	1.00 (Ref)
7-12	360	254 (70.6)	1.11 (0.92-1.34)	234 (65.0)	2.40 (1.64-3.54)*
≥13	55	39 (70.9)	1.12 (0.88-1.42)	17 (30.9)	1.14 (0.66-1.97)
Work Situation @ Delivery					
Employed	342	238 (69.6)	1.00 (Ref)	112 (32.7)	1.00 (Ref)
Unemployed	222	157 (69.6)	0.98 (0.88-1.10)	77 (34.6)	0.94 (0.75-1.20)
Maternal Pre Weight (kg)					
Low	128	87 (68.0)	1.00 (Ref)	54 (42.2)	1.00 (Ref)
High	124	86 (69.4)	1.02 (0.86-1.21)	35 (28.2)	0.67 (0.47-0.95)*
Infant Characteristics					
Infant Sex					
Male	358	248 (69.3))	1.00 (Ref)	112 (31.3)	1.00 (Ref)
Female	313	219 (53.1)	1.01 (0.91-1.12)	96 (30.7)	0.98 (0.78-1.23)
Birth Weight (kg)					
≤ 2.5	57	35 (61.4)	1.00 (Ref)	11 (19.3)	1.00 (Ref)
2.5-3.999	567	399 (70.4)	1.15 (0.93-1.42)	185 (32.6)	1.69 (0.98-2.91)*
≥ 4.0	46	33 (71.4)	1.17 (0.89-1.54)	12 (26.1)	1.35 (0.66-2.78)
B/W-for-gestational age					
Small (10^{th}percentile)	159	113 (71.1)	1.00 (Ref)	54 (34.0)	1.00 (Ref)
Normal (10^{th} – 89^{th})	430	299 (69.5)	0.98 (0.87-1.10)	130 (30.5)	0.89 (0.69-1.15)
Large (≥90^{th})	27	18 (66.7)	0.94 (0.71-1.25)	8 (29.6)	0.87 (0.47-1.62)
Volcanic Period					
Pre	571	400 (29.9)	1.00 (Ref)	175 (30.6)	1.00 (Ref)
Post	100	67 (33.3)	0.96 (0.83-1.11)	33 (33.0)	1.08 (0.79-1.46)

a Data from Obstetrics Department, Medical Records, Ministry of Health, Montserrat
*** p ≤ 0.05**
† OR (95% CI)