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# An Epidemiological Overview Of Pediatric Obesity: A Global Perspective Of A Growing Problem

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## Abstract

In the past childhood obesity has been identified as a health problem facing the developed nations, particularly those of North America, Europe and Australia. Childhood obesity and its latent impact on adult health has become a global health problem. This study presents a broad evaluation of global childhood obesity, a descriptive epidemiology literature review, and an analytical epidemiology literature review. A review of current hypotheses related to its causes and a review of effective/evidence based/successful public health interventions targeting childhood obesity is provided.

## INTRODUCTION

According to the World Health Organization (WHO) at least 20 million children under the age of 5 years were overweight globally in 2005. The WHO further projects that by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese (World Health Organization, n.d.). The effects of childhood obesity are far reaching from a health and social standpoint. It is well known that obesity increases the risk of high blood pressure, heart disease, stroke, asthma, cancer, skeletal disorders, and sleep apnea. There is often a social stigma in some cultures that obese individuals are lazy as compared to non-obese subjects.

## DESCRIPTIVE EPIDEMIOLOGY LITERATURE REVIEW

### PREVALENCE OF PEDIATRIC OBESITY

According to the World Health Organization, overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A crude population measure of obesity is the body mass index (BMI), a person's weight (in kilograms) divided by the square of his or her height (in metres). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight (World Health Organization Obesity, n.d.).

A 2002 epidemiological study of children between the ages of 6 and 18 concluded that childhood obesity rates worldwide were on the rise (Cristol, 2002). The study

revealed that while American children led the way with an obesity rate of 25%, 16% of Russian children were obese. Chinese children demonstrated an obesity rate of 7%.

Cristol's study concluded that there was some association between economic status and obesity rates particularly in the Chinese population. Children of affluent Chinese parents were more likely to be obese than were children of parents unable to purchase energy rich foods. In contrast Cristol concluded that obesity in the U.S. was more prevalent among children living in low income families. The author suggested that even poorer children in affluent countries can still afford to overeat and they are either unaware of healthier alternatives or are aware yet choose to ignore the alternatives. Regarding obesity among Russian children, Cristol noted that children of Russian middle class parents were at lower risk for pediatric obesity when compared to the risk for children of lower or higher Russian socioeconomic parents. While Cristol concluded a relationship between childhood obesity and socioeconomic status existed, that link may not be as strong as once believed. Childhood obesity is emerging as a global problem that cannot be easily predicted solely by socioeconomic status (Cristol, 2002).

Bruss, Morris, and Dannison (2003) identified factors that they believed related to childhood obesity. They concluded that conflicts existed between the child's primary caregiver's sociocultural values, family expectations, traditional dietary beliefs and attitudes, and knowledge about food and disease.

While their study was conducted in Saipan, they noted that different ethnic groups held different perceptions about body image and weight.

Onis, Mercedes, and Blosser (2000) performed a cross sectional study of data from 94 countries. They concluded that, based upon the WHO definition of obesity, countries with the highest prevalence of obesity were located mainly in the Middle East, Africa, and Latin America. A paradox between childhood obesity and wasting was noted in Africa.

Warden and Warden (1997) conducted a study that concluded that the prevalence of pediatric obesity is increasing throughout the United States despite national efforts to promote weight reduction. Their study indicated that childhood obesity has increased at least 50% since 1976. The study further demonstrated that approximately 80% of children that are obese grow up to become obese adults. The authors concluded that effective treatment for obesity must start during childhood, but that healthcare providers initiate treatment for less than 20% of the obese pediatric population.

Tremblay and Willms (2000) facilitated a study in Canadian children that compared the number of children in the 85<sup>th</sup>-95<sup>th</sup> percentile of Body Mass Index (BMI) between the years of 1981 and 1996. "The study revealed that since 1981, BMI has increased at the rate of nearly 0.1 kg/m<sup>2</sup> per year for both sexes at most ages, indicating a clear secular trend toward an increase in BMI of Canadian children. The prevalence of overweight among boys increased from 15% in 1981 to 28.8% in 1996 and among girls from 15% to 23.6%. The prevalence of obesity in children more than doubled over that period, from 5% to 13.5% for boys and 11.8% for girls (p.11)." The authors' conclusions were that Canadian children between the ages of 7 and 13 are becoming more overweight with each passing year.

### **CAUSES OF PEDIATRIC OBESITY**

While childhood obesity can develop as a condition secondary to other disorders including hypothyroidism, Cushing's syndrome and hypothalamic lesions and genetic disorders (Laurence Moon Bardet Biedl syndrome, Prader Willi syndrome) much of the current research focuses on non-physiological determinants of health including behavioral and sociological causes (Koletzko, Girardet, Klish, and Tabacco, 2002). The authors noted that "dietary habits of children and adolescents are influenced by parents and other household members, peers, advertisements and media, the social context of eating, and possibly early

feeding experience in infancy and genetic variation in taste preferences (p. S207)."

Robinson (2001) performed a study of children in the United States that demonstrated a relationship between hours of television watched per day and childhood obesity. The findings showed that children who watched more than 4 hours of television per day made poorer food choices, led more sedentary lifestyles, and participated in less rigorous physical activity than children who watched television less than 4 hours daily.

Similarly Plourde (2006) concluded that the primary causes of obesity in Canadian children was a decrease in physical activity due to an increase in time spent watching television and playing video games. Plourde also concluded that the sedentary lifestyle coupled with increased carbohydrate intake from soft drinks and juices posed a formidable health threat for Canadian children.

### **EFFECTS OF CHILDHOOD OBESITY**

While the physiological effects of childhood obesity are well documented, psychosocial effects are also noted. For example, Friedlander, Larkin, Rosen, Palermo, and Redline (2003), explored childhood obesity and its impact on quality of life measures. Their study concluded that obese children scored lower on the Psychosocial Health Summary and its subscales on self esteem and physical functioning.

Pediatric obesity increases the risk of heart disease and diabetes in children due to an accumulation of excess body fat. "These children are also at a much higher risk for various cancers, stroke, depression, incontinence, and numerous other health ailments, according to the Centers for Disease Control and the National Institute of Diabetes and Digestive and Kidney Diseases (Cristol, 2002, p.10)". In addition, children that are obese a 50-100% greater mortality rate than children that are not overweight (Cristol, 2002).

Fonseca (2003) conducted a familial study on obese children in Eastern Europe. The study looked at 285 obese children with and without a family history of heart disease. The results showed that 28% of the obese children had a positive family history for heart disease and early signs of cardiovascular disease were present in another 8.7% of the families tested. The author concluded from the study that an association with a family history of obesity and cardiovascular disease in children exists and that there may be a genetic link.

Researchers at Italy's University of Verona concluded that childhood obesity led to latent health problems that increased risks for morbidity and mortality. Maffei and Tato (2001) noted that childhood obesity was suggested as a risk factor for morbidity and mortality later in life. They concluded that adults who were obese as adolescents were at increased risk for diabetes, coronary heart disease, atherosclerosis, hip fracture and gout. Females who were obese in late adolescence demonstrated higher rates of several relevant psychosocial consequences in adulthood.

### **ANALYTICAL EPIDEMIOLOGICAL LITERATURE REVIEW OF CHILDHOOD OBESITY AS A GLOBAL HEALTH PROBLEM**

#### **CURRENT HYPOTHESIS**

#### **PHYSIOLOGICAL ORIGIN FOR CHILDHOOD OBESITY**

Hoppe, Molgaard, Thomsen, Juul., and Michaelsen, (2004) explored the potential link between protein intake as an infant and body size as well as body weight. This Danish study of 142 health term infants conclude that while protein intake (PI) in infancy was a predictor of future childhood weight and height, PI was not a predictor of obesity. While the authors noted a positive correlation between PI and height and body size at 9 months and 10 years of age, there was no correlation between PI and body fat at 10 years of age. PI in infancy seem to stimulate early growth but these growth affects are not maintained throughout adolescence.

Armstrong and Reilly (2002) investigated the relationship between breast feeding and obesity in Scottish children. This large study of 32,200 children demonstrated that the prevalence of obesity was lower in breastfed children as compared to formula fed children. The data for this study (gathered from children 39-42 months of age) were adjusted to control for other variables such as socioeconomic status, gender, and birth weight. The authors also noted that childhood obesity was also significantly and positively correlated with birth weight.

Dorosty, Emmett, Cowin, and Reilly (2000) conducted a study of the association between adiposity rebound (AR) and dietary intake, parental BMI, socioeconomic status and childhood BMI. This longitudinal British study of 889 children followed from birth to 5 years concluded that while others reported evidence that AR, the time at which the body mass index increases after it's lowest point in childhood is a critical period for the development of obesity, the authors could not substantiate the evidence. In addition the study's

authors concluded that there was no association between high protein intake (or any other dietary variable) and the timing of AR. The authors suggest that parental obesity was a better predictor of very early (at or before 43 months) or early (from 49 to 61 months) AR and childhood obesity as measured by BMI..

#### **SOCIOECONOMIC ORIGIN FOR CHILDHOOD OBESITY**

While adult obesity may be outside the limits of this review, researchers have looked to childhood obesity as a predictor of obesity in adulthood. Pengelly, Viner, and Cole (2005) conducted a study in Great Britain that evaluated the long term psycho-social health of adults who were obese as children. They concluded that although the psycho-social stigma of obesity affected the child during the years they were overweight, if the obesity did not extend into adulthood, there were no long term adverse psycho-social effects. However the study did conclude that child to adult obesity in women was linked to poor employment outlook and relationship outcomes. The researchers concluded from their data that efforts should be focused on preventing the persistence of obesity from childhood to adulthood.

Moffat, Galloway, and Latham (2005) tested the hypothesis that children's body size and shape vary depending on their neighborhood. This Canadian study concluded that there was no difference between neighborhoods, but there were differences in body shape and size among children of varying socioeconomic backgrounds. Those authors found that children in the two lowest socioeconomic classifications were more likely to be obese.

Burdette and Whitaker (2005) studied the relationship between neighborhood safety, outdoor play, television viewing, and obesity in children. Their study of children living in 20 large U.S. cities concluded that the mother's perception of neighborhood safety was related to their children's TV viewing time but not related to outdoor play time or risk for obesity.

#### **BEHAVIORAL ORIGIN FOR CHILDHOOD OBESITY**

While researchers search for physiological and socioeconomic origins for childhood obesity, a substantial volume of research supports the theory that childhood obesity is behavioral in origin. Researchers have focused on both parental behaviors and the behaviors of children.

## **PARENTAL BEHAVIORS AS AN ORIGIN FOR CHILDHOOD OBESITY.**

Montgomery, and Ekblom (2002) conducted a retrospective study of approximately 17,000 British children born between March 3 and March 9, 1959. Using a retrospective chart review 11,359 children born during those years were evaluated in adulthood in their 33<sup>rd</sup> year. The authors concluded that in utero exposure to smoking during pregnancy did increase the likelihood for obesity in adulthood. The authors suggested that this could be the result of a phenomenon they called programming that resulted in “lifelong metabolic dysregulation, possibly due to fetal malnutrition or toxicity (p. 27).”

Parental restriction of children’s eating was one variable included in an American study of pediatric obesity (Faith, Dennison, Edwards, and Stratton, 2006). The study of 2801 New York children concluded that parents who had children at risk for obesity were more likely to restrict feeding. Interestingly, the study noted that parental behavior was not influenced by their exposure to nutritional messages. The study further concluded that parental offering of whole fruits was associated with reduced adiposity gain.

Settler, Kumanyika, Katz, Zemel, and Stallings (2003) investigated the relationship between rapid weight gain in infancy and obesity in young adulthood. They concluded that in their study of African Americans young adults, rapid weight gain as infants was a predictor of obesity in young adulthood. They proposed that nutrition during early infancy was key to preventing obesity.

## **CHILD BEHAVIORS AS AN ORIGIN FOR CHILDHOOD OBESITY**

Many studies of child behaviors resulting in obesity focus on physical activity. For example, Drennan (2007) developed a nursery based physical activity intervention for Scottish infants. The author concluded that this early intervention with physical activity had no association with childhood obesity. The study concluded that there was no impact on BMI, nor on “habitual physical activity (p.6).”

Some but not all researchers note a link between breakfast skipping and childhood obesity. Dialekatakou and Vranas (2008) investigated the causes for conflicting studies of breakfast skipping and its impact on BMI and/or obesity. The authors noted that many studies have found an association between breakfast skipping and BMI/obesity while several have found no relationship. Their study of 811 Greek students demonstrated that the discrepancies were

attributable to methodological differences in the studies, particularly differences in researchers definitions of breakfast skipping.

Craeynest, Crombez, Deforche, Tanghe, and De Bourdeauhuij (2005) studied the link between childhood obesity and attitudes towards food and physical activity. Their study concluded that there was no difference in children’s attitudes toward healthy food and intense physical activity based upon the presence of obesity. Their study did find that children suffering from obesity had a more pronounced positive attitude towards food in general; the perception of healthy food and unhealthy food was not relevant for these children.

Dixon (2006) reported that obese children eat less when they are provided larger, but less frequent meals. In a study of 18 normal weight and 8 obese children, obese children consumed more when given frequent smaller meals than when given less frequent larger meals.

## **SUMMARY OF CURRENT HYPOTHESES**

Contemporary theories regarding childhood obesity focus on three primary causes for the current worldwide epidemic. These foci are: physiological causes, socioeconomic causes and behavioral causes. Behavioral causes for childhood obesity are rooted in both choices of the child and choices of the parent.

Leading researchers are not in agreement on a single cause of childhood obesity and a review of the literature leads us to conclude that regardless of culture most believe the epidemic is rooted in dietary choices and sedentary lifestyles.

## **GAPS**

The study of worldwide obesity has centered on populations in North America and Europe. While some studies have been conducted on African and Asian children a notable gap in the body of knowledge is present for these populations.

## **AREAS FOR FURTHER RESEARCH AND APPRAISAL OF DATA**

Without question, more information regarding causes of obesity among African and Asian children is needed. Because there is some agreement among researchers that childhood obesity is linked to poor dietary choices and sedentary lifestyles, additional research centered on these choices would be valuable. Additional research perhaps of a qualitative nature of subcultures with minimal childhood obesity could generate theories of interest.

## **EVALUATION OF INTERVENTIONS TARGETING CHILDHOOD OBESITY**

### **CHILD FOCUSED INTERVENTIONS**

A number of interventions targeting childhood obesity are child focused. These child focused interventions target nutrition, physical activity or some combination of the two.

Children in Leeds, England were the focus of a intervention designed by Sahota, Rudolf, Dixey, Hill, Barth, and Cade (2001). The researchers program was a school based (but multiagency) health promotion program. While the authors stated that their intervention was child focused, the program actually targeted the school ethos (defined as school, family, and community). The study demonstrated the effectiveness of the program's education but did not evaluate its impact on childhood obesity in the study's population.

In the United States the feasibility of sharing high school athletic facilities with after-school physical activity programs is under investigation. The parameters and feasibility of such programs is debatable (In light of the Obesity Epidemic, 2007).

While debated in the U.S. the Australian government launched a child focused intervention targeting obesity in 2004. This program encouraged community based partnerships whose goal was to increase after-school physical activity of 150,000 children. The program's effectiveness (as measured by its impact on obesity) has not been reported (Allison, 2004).

A second Australian child focused intervention targeted the nation's preschoolers. The study concluded that "an inclusion of physical activity principles in their Quality Improvement Accreditation System and Family Day Care Quality Assurance systems would assist in the development of programs specific to LDC [long day care] and FDC [family day care]" Lawlis, Mikhailovich, and Morrison, 2008, p. 32).

In New York, a 4-H Club based child focused intervention focused on walking as a means to increase physical activity and impact childhood obesity. This 4-H focus is refreshing as one of the Hs in the acronym stands for Health. An interesting paradox in this intervention was that while nutrition information was available for these children, it was delivered via a computer based information program (Winter, 2008). Other studies (Burdette and Whitaker, 2005) have pointed to video games and television viewing as potential factors contributing to childhood obesity.

### **PARENT FOCUSED INTERVENTIONS**

In some instances interventions were developed that partnered schools and families. For example, Bloom-Hoffman, Wilcox, Dunn, Leff, and Power (2008) described the development and implementation of a literacy-based family component of a school based health program. This intervention used interactive children's books so that parents, teachers and students received consistent nutrition information. Using the number of additional servings of fruits and vegetables per day (compared to a control group), the preliminary results of this intervention did not demonstrate significance.

Golley, Magarey, Baur, Steinbeck and Daniels (2007) studied the relative effectiveness of parenting skills training and its impact on obese Australian children. The authors' intervention did not target nutrition education, but rather focused on improving the parenting skills needed to result in behavior modifications in children. After 12 months, the participant's children's BMI scores were reduced by approximately 10% compared with a 5% reduction in the control group. The authors concluded that parenting skills combined with promoting a healthy lifestyle may be an effective approach to reducing childhood obesity.

Similarly Golley, Perry, Magarey, and Daniels (2007) reported a case study focused on how general parenting principles could be used as a part of a family focused weight management program. The child whose parents participated in this case study saw a decrease in BMI from 23.4 to 22.3 and there was no increase in waist circumference during this 12 month study.

### **ANALYSIS OF A SUCCESSFUL PARENT FOCUSED INTERVENTION**

Childhood obesity presents an interesting dilemma for public health practitioners. Successful public health programs correctly narrow the unit of analysis (individual, family, neighborhood, etc.) and develop appropriate units of solution targeting the unit of analysis. Many interventions targeting childhood obesity focus on either behavior changes in the child, the family or a combination of both. It may be difficult to make improvements in childhood obesity rates with focus on a single unit of analysis, however a parent focused intervention with an emphasis on parent skills rather than parent education (nutrition and exercise content) seems promising.

Golley, Magarey, Baur, Steinbeck and Daniels (2007) intervention drew upon many tenants of the widely used

health belief model (HBM) of individual health behavior. Central to the HBM model is the concept that “behavior is a function of the subjective value of an outcome and of the subjective probability, or expectation, that a particular action will achieve that outcome (Glanz, Lewis, and Rimer 1997, p. 42).” Further,

The HBM is a value expectancy theory. When value expectancy concepts were gradually reformulated in the context of health-related behavior, the translations were (1) the desire to avoid illness or to get well (value) and (2) the belief that a specific health action available to a person [or in this example a person’s child] would prevent (or ameliorate) illness (expectancy) (Glanz, Lewis, and Rimer, 1997, p. 43).

The intervention developed by Golley, Magarey, Baur, Steinbeck, and Daniels is somewhat innovative in that it relies on the application of the HBM to impact the behavior of the parent resulting in changes in behavior of their children. While the outcome measures of many obesity intervention programs target the effectiveness of education efforts, this study’s outcome measures (BMI and waist circumference) parallel those of the global health issue of childhood obesity.

While this intervention appears promising, it was a small study (111 overweight children ages 6 to 9 years) and was conducted among Australian children. The study’s authors made no attempt to evaluate the impact of gender on their results.

## **CONCLUSIONS AND RECOMMENDATIONS**

Interventions designed to teach children about choices of diet and exercise have had mixed success. Such interventions absent parental involvement often result in a lack of social, physical activity, and food choice improvement. Recognition of the family as the starting point (unit of analysis) has led to improved interventions (units of solution) targeting childhood obesity.

While a family focused intervention has led to marginal success, it may be that the correct unit of analysis for childhood obesity is actually the parent. Parental involvement shapes children’s behavior. Providing parents with behavior modification strategies may prove the most effective way to address childhood obesity.

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