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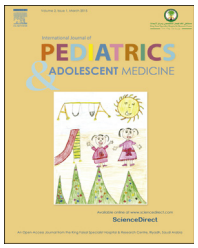

ORIGINAL RESEARCH ARTICLE

The obesity epidemic in children: Latino children are disproportionately affected at younger ages

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Abstract *Background and objectives:* National surveillance clearly illustrates that U.S. children are becoming increasingly overweight. However, the timing of the onset of childhood overweight has not been well-described.
Patients and methods: An accelerated failure time (AFT) model was used to describe the emergence of overweight based on a 12-year collection of height and weight data of over 40,000 children. Race, sex, insurance status and their interactions were specifically examined as predictors of earlier onset of overweight. The outcome of interest was an estimate of the age at which the model predicted that a subgroup would attain a 20% prevalence of overweight.
Results: The three-way interaction of race, sex, and insurance status was a significant predictor of onset of overweight. The model estimated that the publicly insured Latino male subgroup had the earliest onset of overweight, attaining a prevalence of 20% overweight by 4.3 years of age. The emergence of overweight in Latino subjects was significantly earlier than that for black or white subjects, irrespective of sex or insurance status.
Conclusion: Regardless of sex or insurance status, overweight emerges at significantly younger ages in Latino children when compared to black and white children. Substantial numbers of Latino male children are predicted to develop overweight at preschool ages. Obesity

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prevention may need to be directed toward parents or children well before children enter grade-school.

1. Introduction

National surveillance has convincingly demonstrated that the incidence of pediatric obesity in the U.S. is increasing [1—3]. This is concerning because this rise in pediatric obesity is associated with increased risks of co-morbid health conditions, including type 2 diabetes and cardiovascular disease [4—6]. In addition, overweight children are reported to have a lower health-related quality of life [7,8] and lower high school performance, educational attainment, psychosocial functioning, and socioeconomic attainment [9].

The increase in overweight coupled with the presence of risk factors for type 2 diabetes and cardiovascular disease in childhood indicate the need for primary prevention of obesity in children [10—13]. Targeted prevention efforts may prove beneficial for subsets of children defined not only by family history and metabolic risk factors but also by environmental, cultural, and socioeconomic factors that increase the risk of overweight at younger ages.

Although several large studies have examined the emergence of overweight in children, they had important limitations. National surveillance studies have been limited by widely spaced time points in data collection, indirect observation (e.g., parental or self-report of height and weight), insufficient follow-up to track weight patterns from early childhood through adolescence, and limited enrollment and follow-up of minority children [14—18]. We addressed some of these limitations by investigating the age of emergence of overweight in a large cohort of children who received primary care in an urban pediatric clinic system. In addition, we examined the relationships between insurance type, race/ethnicity and sex, and age of onset of obesity.

2. Patients and methods

2.1. Cohort identification

We queried the Regenstrief Medical Record System (RMRS) to identify children between the ages of 3 and 16 years that had been seen at a network of seven urban primary care clinics (Indiana University Medical Group) in Marion County, Indiana between the calendar years of 1993 and 2004. The RMRS is one of the oldest and largest electronic medical record systems in the United States [19]. We identified a subset of these children whose height and weight had been measured on the same day. We excluded children with medical documentation suggestive of pregnancy, congenital heart disease, chromosomal abnormalities, anomalies of the adrenal gland, multiple congenital anomalies, cystic fibrosis, and cerebral palsy. We extracted demographic information, including birth year, race/ethnicity, gender, and health insurance status, for all children meeting these study criteria. The race/ethnicity categories used were Latino, non-Latino white, and non-Latino black, which represent the major race/ethnic populations in the region. For simplicity, we refer to these groups as Latino, white, and black. Health insurance status was categorized as either publicly (i.e., Medicaid only) or privately insured.

2.2. Definitions of overweight

We used the Centers for Disease Control and Prevention (CDCP) definition of overweight in children, which is a body mass index (BMI) greater than or equal to the 95th percentile for age and sex [20]. SAS codes available on the website of the CDCP (www.CDC.gov) were used to first flag biologically implausible values for height and weight measures and subsequently calculate age and sex-adjusted BMI percentiles. There are no BMI-for-age references or consistent definitions for overweight for children younger than 2 years; thus, children younger than 3 years of age were excluded.

2.3. Accelerated failure models of onset of overweight

SAS 9.1 (Procedure LIFEREG; SAS Institute Inc., Cary, NC) was used to generate an Accelerated Failure Time (AFT) model describing the risk of overweight as a function of age in our cohort [21—23]. Similarly, AFT modeling was previously used to compare differences in the onset of obesity between black and white children among a smaller cohort assembled for studying hypertension [24]. To generate the AFT models, we established rules for censoring the data based on whether a study subject never became overweight during the data collection period, was overweight when entering the study, or transitioned from being normal weight to overweight. For those children who never became overweight during the entire study period, the data points were right censored at the last time the child was measured. If a child was observed as being overweight at the time of their first recorded measurement, the data points were left censored at the first measurement, and all subsequent measurements were ignored. If the child became overweight following at least one non-overweight measurement during the study period, the data points were interval censored. This interval starts from the last time the child was non-overweight to the first time the child's BMI exceeded the 95th percentile for age and sex so that the true date of onset of overweight lies within the