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The Marshfield Youth Health Study: Design, Objectives and Cohort Characteristics

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ABSTRACT

Problem: The Marshfield Youth (MY) Health Study was designed to identify parental and infant factors associated with childhood and adolescent overweight.

Methods: The study examined 867 children (age 5–17 years) from the Marshfield Public Schools. Heights and weights were measured by standard methods. Age- and gender-specific body mass index (BMI) percentiles and z-scores were determined. Definitions of overweight from the Centers for Disease Control and Prevention were applied. Family characteristics were self-reported by questionnaire and included parents' BMI, employment, education, smoking, physical activity; and child's daycare attendance, and television/computer use. Maternal and child medical records were reviewed.

Results: The MY Health cohort included 361 families. The mean ± SD age of the children was 12.1 ± 3.0 yrs; 511 (59%) were born in Marshfield, Wis. Of the children studied, 70% had a healthy body weight (BMI >5th and <85th percentile); 14.4% were at risk of overweight (BMI ≥85th and <95th percentile) and 13% were overweight (BMI ≥95th percentile). There were no differences in gender or weight status between the study cohort and all Marshfield school children (n=2782).

Conclusions: Children in the MY Health Study are representative of all school-age children in Marshfield. This cohort will be studied to identify factors associated with overweight among children.

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INTRODUCTION

Since the 1970s, the prevalence of adult obesity has more than doubled, from 14% to 30%[1] and the prevalence of overweight in children ages 6-11 years has more than tripled, from 4% to 15%.[2] In 1999-2000, more than 64% of the US population was overweight or obese, with a body mass index (BMI) greater than 25 kg/m^2.[1] Among adults, overweight is associated with increased risk of premature mortality and morbidity through coronary heart disease, type 2 diabetes mellitus, gallbladder disease, joint disease, and certain cancers.[3]

Overweight in childhood and adolescence is now a national public health priority.[4] Not only does childhood and adolescent obesity track to adult obesity,[5-7] it is also associated with lowered fitness levels, hypertension, dyslipidemia,[8,9] and certain respiratory, skin, and orthopedic conditions,[10,11] as well as possible problems with psychological adjustment and lack of self-esteem in childhood and adolescence.[12,13]

Obesity is a significant problem in central Wisconsin. Wood County exceeded the rest of the state as a whole in the percentage of adults lacking physical activity and the percent of adults who are overweight or obese.[14] In the population-based Rural Women's Health Study (n=1500) conducted in the Marshfield Epidemiologic Study Area (MESA), the age-adjusted rate of overweight (BMI >27.3 kg/m^2) was 45% locally, compared to 35% nationally.[15]

The Marshfield Youth (MY) Health Study was designed to determine the degree to which parental and infant factors are associated with childhood overweight and to calculate the attributable risk fraction for these variables. In this paper, we describe the study design, objectives, and characteristics of the MY Health cohort.

METHODS

Subject Recruitment

The Marshfield Wisconsin public school district is located in Wood County in central Wisconsin. Total district enrollment for the 2003-2004 school year was 4050 students, 95% of whom were white, non-Hispanic.[16] The remaining 5% were Asian/Pacific Islander (2%); black, non-Hispanic (1%); Hispanic (1%); and American Indian/Alaskan Native (0.5%).[16] Study participants were recruited by mailing a package to the parents of all kindergarten through 10th grade students in the district. Mailings were sent out between May 15 and June 4, 2003. Names, addresses, and telephone numbers of the parents were obtained from the school district administrative office or individual schools. The computerized mailing list was sorted so that parents with more than 1 child in school would receive only 1 package; 1956 recruitment packages were mailed. The package included a letter of introduction, consent form, brief questionnaire for the parents to complete, and a postage-paid addressed envelope for returning the consent and questionnaires. Follow-up telephone calls to parents to encourage completion of the forms were made within 2 weeks of the initial mailing. Up to 5 attempts were made to reach parents by telephone, with 1 call in the morning, 1 in the afternoon, and 3 in the evening. If it was determined that the mailing either was not received, or was lost, a second mailing was sent out and a subsequent telephone call was made 5 days after mailing.

The study protocol was reviewed by the Marshfield Clinic Research Foundation Institutional Review Board, and approved by the Marshfield Public School Board of Directors and the District Superintendent.

Measures in Parents

Parents who provided consent were asked to complete a brief, self-administered questionnaire. Data collection included demographic information (parents' education levels and employment status), number of people in the family, mother's and father's self-reported BMI, smoking history, and physical activity. Questions were also included regarding whether the child attended daycare, for how long, and what meals, if any, were served at daycare. Questions regarding smoking and physical activity were adapted from the Behavior Risk Factor Surveillance Survey.[17]

Anthropometric Measurements

Children's heights were determined using a stadiometer according to standard methods.[18] Weights were collected on a digital medical scale (Seca, Hanover, MD) using standard methods.[18] The scale was located in the health office or privately screened off area in each of the Marshfield public schools. After training by a study investigator, the health nurse and school volunteers measured the heights and weights. Measurements occurred after students removed shoes, hats, and bulky clothing, such as coats or sweaters. Scales were placed in the "zero" position prior to weighing each child. Weights were recorded to the nearest ¼ pound (100 grams). Heights and weights were collected on 2782 students for physical education fitness assessments. Body mass index was calculated (kg/m^2) and age- and gender-specific percentiles and z-scores were determined using 2000 Centers for Disease Control and Prevention (CDC) growth data[19] at the Marshfield Clinic Research Foundation using de-identified data. Standard CDC definitions of overweight for children were also applied (overweight BMI $\geq$95th percentile and at-risk overweight BMI $\geq$85th and $<$95th percentile).[20] Underweight was defined as BMI $\leq$5th percentile.[20]

Medical Record Abstraction

Parental and child consent were obtained to participate in MY Health. This consent included releasing school BMI data to the investigators and abstracting medical records for the students born in the Marshfield area, as well as the associated maternal pregnancy medical record. Standardized abstraction forms were developed and pilot tested at the Marshfield Epidemiology Research Center. Variables abstracted from maternal medical records included demographic information; height; weight gain during pregnancy; history of diabetes, hypertension and/or asthma; use of tobacco; dates and weights for each pregnancy check-up visit; diagnosis of gestational diabetes; age of onset of menarche; and gravida/para.

For child participants, birth weight and gestational age were recorded, as well as weight, length/height, and method of feeding (breast fed, formula fed, solid intake) for each well-child examination (performed at ages 1 week, 1 month, 2 months, 4 months, 6 months, 9 months, 12 months, 15 months, 18 months, 2 years, and yearly until kindergarten). For duration of breastfeeding or formula feeding, start date was assumed to be at birth unless otherwise stated; the last well-child examination at which breast or formula feeding was documented was used as the stop date.

Quality Assurance

To estimate the reliability of data collection, 5 records were abstracted by 8 research coordinators prior to initiating the project. All abstractions were completed independently, differences were discussed, and a study

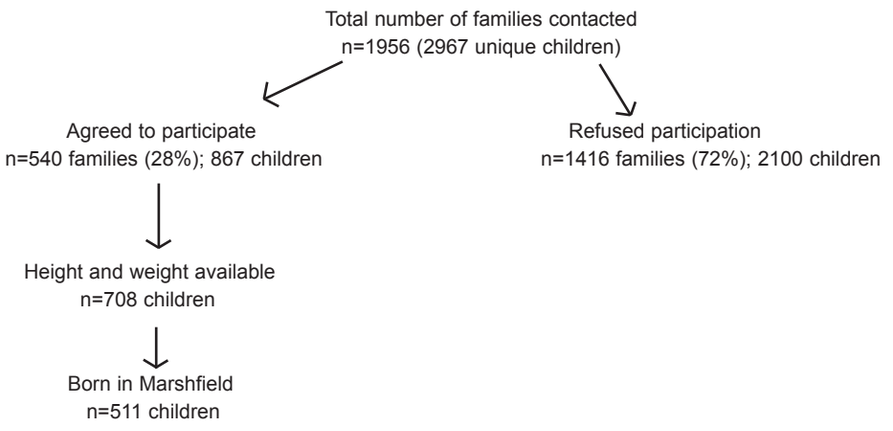

Figure 1. Marshfield Youth Health Study participant response rates.

glossary was developed, providing guidelines for research coordinators to follow. A lead research coordinator was assigned to record all differences on quality assurance forms, including number of variables abstracted, total number of differences, and question numbers with differences. The overall reliability rate for the MY Health Study was 97% between 8 research coordinators.

Data Entry

Procedures for data entry included the development of data entry screens in The SAS System for Windows, version 9.1 (SAS Institute, Inc, Cary, NC) and Microsoft Access 2000. The data entry screens had built-in range and consistency checks; independent double data entry; and programs written to identify invalid data, missing forms or fields, and inconsistencies within or between forms. All data from the parent questionnaire, consented student identification form, and height/weight form were double entered for accuracy. For the child's medical record abstraction and prenatal medical record abstraction forms, 10% were double entered for accuracy. A total of 4104 forms, with 40,784 items, were double entered. The accuracy rate was 99.9%, with only 42 errors.

Statistical Analysis

Descriptive statistics were generated for all variables. Frequency statistics were conducted to identify data entry errors or invalid data ranges. Comparisons between the MY Health cohort and all Marshfield school children were made using chi-square and t-tests. A 2-tailed P value of <0.05 was used to determine statistical significance. All data analysis was performed using The SAS System for Windows, version 9.1.

RESULTS

Recruitment

A flow chart of subject recruitment and response rates is shown in Figure 1. Of the 1956 recruitment letters mailed, 540 families (28%) with 867 children agreed to participate. A comparison between study participants and all Marshfield school children revealed that there were slight differences between the 2 groups of students in age range (fewer 5-7 year olds in the cohort, 11.3% versus 15.4%, respectively), BMI (mean BMI of MY Health cohort was slightly lower, 19.6 ± 4.0 versus 19.9 ± 4.6, respectively) and number of school-aged children in the family (fewer families with 1 child and more with multiple children in the MY Health cohort, 53.3% versus 60.7%, respectively). The percentage of children in each of the BMI categories did not differ between the MY Health cohort and all school children, nor did the gender distribution.

Child Characteristics

Child characteristics are shown in Table 1. Children in the MY Health cohort ranged in age from 5-17 years (12.1 ± 3.0 yrs, mean ± SD) and were 99% white, non-Hispanic. All resided within the Marshfield public school district at the time of assessment (April-June 2003). Of the 867 children whose parents provided consent, 710 (82%) had their height and weight measured at school. Five hundred and eleven children (59%), from 361 unique families, were born in Marshfield. For the majority of the children for whom parental consent was obtained, we also had access to the child's (n=624) and/or mother's (n=618) medical records. A total of 6858 well-child examinations, 6783 prenatal check-ups, and

Table 1. Subject Characteristics

	Marshfield Youth Health Cohort (n=867)	Marshfield Public School District, All Children (n=2782)	*P*-value
Age, years*	12.1 (3.0)	11.4 (3.2)	<0.001
Age Categories, Years			
5-7	98 (11.3%)	512 (15.4%)	<0.001
8-10	232 (26.8%)	750 (27.0%)	<0.001
11-13	263 (30.3%)	840 (30.2%)	<0.001
14-17	274 (31.6%)	680 (24.4%)	<0.001
Gender			
Boys	444 (51.2%)	1421 (51.1%)	0.95
Girls	423 (48.8%)	1361 (48.9%)	0.95
BMI, kg/m^2*	19.6 (4.0)†	19.9 (4.6)	0.04
BMI Categories			
Overweight	92 (13.0%)	399 (14.3%)	0.15
At risk overweight	102 (14.4%)	454 (16.3%)	0.15
Desirable weight	493 (69.6%)	1869 (67.2%)	0.15
Underweight	21 (3.0%)	60 (2.2%)	0.15
School-Aged Children in Family (n)			
1	288 (53.3%)	1200 (60.7%)	<0.005
2	187 (34.6%)	597 (30.2%)	<0.005
3	55 (10.2%)	147 (7.4%)	<0.005
4	10 (1.9%)	33 (1.7%)	<0.005

BMI=body mass index (kg/m^2)
*Mean (standard deviation)
†Heights and weights available for 708 children

1223 past pregnancy visits were recorded. For the families with children born in Marshfield, 234 (65%) had 1 child in the study, 108 families (30%) had 2 children, 15 families (4%) had 3 children, and 4 families (1%) had 4 children.

Anthropometric Measures

Of the children who agreed to participate in the MY Health Study (n=867) 13% were classified as overweight (n=92) and 14.4% were at risk for overweight (n=102). Three percent were considered underweight (n=21). The majority, 69.6% (n=493), had a desirable BMI. This distribution is similar to that for all school children in the Marshfield public school district, where 14.3% were overweight, 16.3% were at risk for overweight, 2.2% were underweight, and 67.2% were at desirable weight (*P*=0.25).

Parent Characteristics

Parents had a relatively high level of education; 19% of mothers had a high school degree, 34% had some college, 32% had a college degree, and 14% had a post-graduate degree. Among fathers, 32% were high school graduates, 24% had some college, 21% were college graduates, and 18% had a post-graduate degree. Over 85% of parents were employed. Based on self-report, 49% of mothers and 75% of fathers were either obese (BMI ≥30 kg/m^2) or overweight (BMI ≥25 and <30 kg/m^2).

DISCUSSION

In this retrospective cohort study of school children from Marshfield, Wis, participants were generally representative of all children in the Marshfield public school district regarding gender distribution and body weight status (percent overweight or at risk for overweight). Furthermore, the proportion of childhood overweight or at risk for overweight is comparable to that found among non-Hispanic white children/adolescents in the United States. Data from the National Health and Nutrition Examination Survey (NHANES) suggest that, in 1999-2000, 31% of children aged 6-19 were at risk for overweight or overweight, and 16% were overweight.[21] In the current study, 27.5% of children were at risk for overweight or overweight, and 14.4% were overweight.

The current obesity epidemic is the result of a complex interplay of behavioral, sociocultural, economic,

and environmental factors acting within the framework of genetics and biology.[4] Some modifiable risk factors include a sedentary lifestyle (including increased use of television and computer games), increased convenience and fast food consumption, and early-life influences (breastfeeding history, behavioral patterning). A better understanding of the factors associated with or predictive of childhood overweight could help in designing programs aimed at the prevention of obesity and related diseases.

The lack of racial/ethnic diversity in our study population will limit the generalizability of our study findings. Participants were overwhelmingly non-Hispanic, white, which is consistent with the central Wisconsin population as a whole. While the current study may not contribute information regarding racial/ethnic disparities in the childhood obesity epidemic, it provides an advantage for future follow-up studies involving genetic analyses. A relatively homogeneous population limits the problem of population stratification. From an epidemiological perspective, studying a homogeneous population can also be viewed as a strength as it can reduce residual confounding due to race.

It would also have been desirable to obtain other data from our participants: dietary, behavioral, and biological data (blood lipids, glucose levels), for example. These areas are beyond the scope of the current study, but future efforts may focus on expanding the information that we obtain from this cohort.

CONCLUSION

Children participating in the MY Health Study are largely representative of all school-age children in Marshfield, Wis. Furthermore, this cohort is comparable to US children as a whole regarding weight status. The MY Health cohort will be studied further to identify sociodemographic and biological factors associated with overweight among children in the community.

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