San Mateo County Health Services Agency

Report on Overweight and Obesity in Children and Adolescents

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Executive Summary

The objective of this study was to evaluate the prevalence of overweight and obese children and adolescents in San Mateo County, to begin understanding the weight of the problem in order to make appropriate recommendations.

Key Findings

- The overall prevalence of obese children and adolescents in San Mateo County in 2001 was 16.6%, which was slightly higher than the national prevalence of 16% in 1999-2002.

- An additional 17.7% of children and adolescents in San Mateo County in 2001 were overweight, bringing the total overweight and obese prevalence to 34.3% in the county.

- There were racial/ethnic differences in prevalence of overweight and obesity.
  - The lowest rates of overweight and obesity were in Asian (20.5%) and White (26.7%) children and adolescents.
  - Filipino (35.0%) youth had moderate rates of being overweight or obese.
  - African American (42.9%), Hispanic (43.3%), Pacific Islander (56.1%), and American Indian/Alaskan Native (54.3%) students had the highest rates of overweight and obesity.

- Low socioeconomic status was associated with increased prevalence of overweight and obese children and adolescents.

Addressing the overweight and obesity epidemic in our county's children and adolescents must be achieved through cooperative partnerships between public health, schools, local and state government, communities, and families. Each entity plays a significant role and must work together in order to have a penetrable effect.

Introduction

In the past several decades, there has been a dramatic rise of overweight and obese individuals in the United States. More than 60% of American adults aged 20 years or more are overweight or obese, with 25% of American adults considered obese (**1**). Overweight and obesity are labels for ranges of weight that are greater than what is generally considered healthy for a given height. (**2**) Overweight and obesity ranges are determined by using weight and height to calculate a number called the "body mass index" (BMI). BMI is used because, for most people, it correlates with their amount of body fat. (**2**)

Overweight and obesity can lead to significant health problems and increase risk for serious medical conditions including Type II diabetes, heart disease, hypertension, and

stroke (**3**). Being overweight or obese may also be associated with increased risk for certain types of cancer (**4,5**). In addition to physical health, being overweight or obese can affect the mental, emotional, and social health of individuals who suffer from it. Overweight and obesity carry with them consequences on an individual's overall quality of life.

Obesity also has a larger economic impact. It was estimated in 2000 that physical inactivity, obesity, and overweight cost California an estimated $21.7 billion a year (direct and indirect medical care, $10.2 billion; workers' compensation, $338 million; lost productivity, $11.2 billion) (**6**). Six percent of national health care costs are attributed to obesity. The remaining economic cost of American obesity was due to loss or decrease in productivity at work due to obesity-related morbidity and mortality.

Obesity does not cause problems only in adults. The prevalence of obesity in American children and adolescents aged 6-19 years has risen from 5% in the 1960's to 16% in 1999-2002 (**7**). There is growing concern about the increasing prevalence of children and adolescents who are overweight or obese.[*] This increase has applied to children of all ages, sexes, and race/ethnicity, suggesting that overall changes in diet and physical activity are largely responsible for the epidemic (**8**).

Children and adolescents can not only suffer from the same obesity-related health problems as adults, but the development of health conditions early in life can lead to poor outcome in terms of future health. Overweight children have a one-and-a-half to two-fold greater risk of becoming overweight adults than normal weight children (**9**), with adolescence being the period of greatest risk for developing obesity in adulthood (**10**). In other words, overweight and obese children tend to become overweight and obese adults.

Obesity is a multi-factorial condition that is influenced by genetic, environmental, behavioral, psychological, and other factors such as underlying illnesses. However, the majority of obesity can be prevented with a healthful lifestyle that includes appropriate nutrition and physical activity.

Because weight loss in adulthood is difficult to achieve and maintain, prevention of overweight and obesity in childhood and adolescence is an optimal strategy to prevent overweight and obesity in adulthood, as well as prevention of the development of serious health-related consequences. Implementation of prevention methods during childhood may be more effective in reducing the risk for obesity during adolescence.

To develop effective prevention approaches, it is important to understand the prevalence of overweight and obese children and adolescents. This study evaluated the prevalence of overweight and obese children and adolescents in San Mateo County during the 2000-2001 academic year.

Methods

Data Source

The primary data used in this study were obtained from results of the 2001 California Physical Fitness Test (CPFT) (Education Data Systems, Morgan Hill, California). The CPFT is required for all students enrolled in grades five, seven, and nine in California public schools. There are three components of physical fitness that are measured by the CPFT: (1) aerobic capacity, (2) body composition, and (3) muscular strength, endurance, and flexibility.

Measurement of Obesity

For the purposes of this report, the component of interest was body composition. Two options were available to schools to determine body composition: (1) skinfold measurements, which require the use of a caliper to measure body fat, and (2) body mass index, which provides an indication of a student's weight relative to his or her height. Although Body Mass Index (BMI) is not as accurate an indicator of body composition, skinfold measurements are more difficult to obtain and ensure accuracy of measurement than weight and height. The majority of schools in San Mateo County measured weight and height for body composition.

BMI for individual students in the study was calculated according to the formula in Appendix A1. In adults, a BMI ≥ 30 is considered obese and a BMI ≥ 25 is considered overweight. These BMI measurements correspond to the 95th and 85th percentiles of the standard growth charts used in the medical field, respectively. In children and adolescents, the percentile measurements vary according to age and sex; thus a BMI ≥ 95th percentile for a specific age and sex is considered obese, and a BMI between the 85th and 95th percentiles is considered overweight.

Calculation of Body Mass Index

To calculate BMI percentiles, z-scores (Z) for BMI were first calculated using the equation in Appendix A2. Z-scores for BMI are a number that allows for comparison across groups of children with different ages and sizes. To convert z-scores to BMI percentiles, the conversion equation in Appendix A3 was applied.

Data Analysis

Demographic characteristics of overweight and obese students were evaluated for San Mateo County as a whole and also by school district. Demographic characteristics included age, grade level, sex, and race/ethnicity.

Relationships of overweight and obesity with socioeconomic status (SES) were also examined. Because SES for individual students was not available for this study, an

ecological analysis was conducted using information on the school district level. Student enrollment in the federal Free or Reduced Price Meal Program administered by the Department of Agriculture was used as an indicator of SES, as eligibility for the program is based on the income of the child's parent or guardian. Income guidelines for eligibility in the 2000-2001 program are shown in Appendix B. School district data on participation in the program was obtained for the academic year 2000-2001 from DataQuest (**11**).

Statistical Analysis

Ninety-five percent confidence intervals (95%CI) were used to indicate the range of statistically possible values that could occur. Chi-squared (χ^2) values were calculated to evaluate differences between proportions of students overweight or obese across groups. P-values were calculated for the chi-squared values and considered statistically significant if $p<0.05$. A method of obtaining summary measures for the prevalence estimates above is logistic regression analysis. Bivariate logistic regression models were performed modeling overweight and obesity and potential risk factors that are associated with higher rates of being overweight or obese. Odds ratio estimates for bivariate analyses serve as an indicator of the increased (or decreased) likelihood of obesity given a comparison group. Nested multivariate models were also performed to adjust for multiple factors that could influence each other. These models, however, did not change appreciably the odds ratio estimates obtained from the bivariate models.

How to Read The Figures

The large gray bars represent the proportion of students within a specific group and the thin t-bars represent the 95% CIs for those proportions. When the 95% CIs of various groups do not overlap, it can be interpreted that there is a statistically significant difference between the categories.

Limitations

When reading this report, some caution must be taken before making definitive conclusions.

Representative Population

This study aimed to assess the overweight and obesity problem for children and adolescents in San Mateo County. The data used to make this assessment, however, was limited to students in grades five, seven, and nine in the public school system. Children with alternative schooling (e.g., private schools, home schooling) are not included in the sample population. Furthermore, students from four school districts did not have any information available on which to conduct an analysis.

It is possible that the study population was somehow different from the underlying population and thus the results of this study may not apply directly to all children and adolescents in the county. Because of the large proportion of children and adolescents in the county surveyed through the public school districts these differences were not

believed to be significant and were likely to be representative of the county's children and adolescents.

BMI

The use of BMI as an indicator of overweight and obesity has multiple limitations. First, it is not a direct measure of fat mass as BMI cannot distinguish between lean muscle mass and fat mass. On an individual basis, it is possible that a very muscular person with little body fat may have the same BMI as an obese individual. BMI is, however, a good indicator of obesity when studying populations.

Second, adolescence (ages 10-19) is a time marked by unpredictable growth spurts that can mean different measurements of height and weight even by a difference of a day. Although the BMI-for-Age growth charts account for variability in BMI due to puberty, the BMI percentile measurement may be inaccurate for individual children who are early or late maturing (**12**).

Additionally, BMI does not measure the distribution of fat around the body. For example, the simple BMI measurement would not capture fat distribution in the abdominal region, which can increase risk for heart disease (**13**).

Variability in Measurement

There was likely variability in measurement of height and weight. This variability would have occurred within schools and between schools. For example, there may have been slight differences in height measurement technique between individuals measuring height within one school or a particular school could have used an incorrectly calibrated weighing scale throughout the administration of the CPFT. Systematic differences in measurement may have affected the results of the analyses in a biased, but unknown, manner.

Similar variations in measurement, or definition, were possible for demographic characteristics, fitness measures, and SES. For SES in particular, it is possible that not all eligible student families applied for and enrolled in the Free or Reduced Price Meal Program and thus the enrollment figures are an inaccurate reflection of actual income-based SES.

Correlation Analyses

There are two main limitations to correlation analyses. First, the analyses were based on aggregate data: ecologic analyses of obesity and SES and of obesity and physical fitness measures were conducted. On the individual level, it is possible that students had different characteristics than on the school district level. For example, it could be that students with a higher SES were more likely to be overweight or obese, but this is not reflected on the school district level.

Second, correlation does not necessarily mean causation. When two variables are correlated, it may be incorrect to interpret that the condition of one variable causes the condition of another. It is possible that a third variable (a confounder) is affecting the

relationship between the two correlated variables, with the third variable often being unknown or unmeasured. For example, in early studies of lung cancer, coffee drinking was found to be correlated with lung cancer. Upon further investigation, it was determined that coffee drinking was in fact a confounder; cigarette smokers were also more likely to be coffee drinkers (these studies were conducted during a time when coffee drinking was not as popular as it is today).

Thus, when two variables are correlated, one can conclude only that there is a simple association with no direction or influence implied. Additionally, when two variables are not correlated, one cannot assume that there is no relationship between them – the relationship may be more complicated than can be observed on the simple level.

Results

Study Population

In San Mateo County, during the 2000-2001 academic year, there were 25,022 students enrolled in grades five, seven, and nine. The majority of students (85.1%) were enrolled in public schools. The breakdown by grade level and type of school is displayed in **Table 1**.

There were 18,202 student records in the 2001 CFPT data file, representing 85.5% of public school students in grades five, seven, and nine. Participation and reporting in San Mateo County was similar to the overall state participation and reporting of approximately 90% (**14**). **Table 2** shows a comparison of basic demographic characteristics of students participating in the CFPT and the overall enrollment figures. There were some slight differences between these two groups. Students in the younger grades were more likely to have been tested with the CFPT. There were also apparent racial/ethnic differences between enrolled and tested students. However, these differences may largely be explained by the differences in the race/ethnicity designations made by schools and school districts for different purposes. For example, it is evident that the proportion of students in the white, other/multiracial, and unknown categories were similar in both all-county (n=8736, 4.0%) and CFPT students (n=8194, 45.0%).

Exclusion Criteria Criteria for exclusion from analysis in this study were: (1) unrecorded grade, (2) unrecorded sex, (3) unrecorded date of birth, (4) unrecorded height, and (5) unrecorded weight. There were 4,067 (22.3%) records that were missing either one or more of these data points. Additional exclusion criteria were based on aberrations due to irreconcilable or apparent data entry errors: (1) height < 42 inches or > 80 inches, (2) weight > 300 pounds, (3) weight < 50 pounds, (4) age < 84 months, and (5) z-score lying outside the range of –3.8 and 3.8.

In the CFPT data file, there were four school districts for which data specifically related to the outcomes of interest for this report were unavailable. Because these whole districts were missing information, it may explain the differences seen in the characteristics between the all-county enrollment and CFPT participant groups. **Table 3**

shows demographic characteristics of the 13,961 (76.6%) students who meet the inclusion criteria for the study in comparison to the population of CFPT with the exception of the four school districts for which data were missing. The obesity study population did not differ significantly from the CFPT participants except that children in the younger grades were more likely to have had BMI indicator measurements recorded on the CFPT than students in the higher grades.

Table 4 shows age and physical characteristics of students in the study population. Of note is the mean BMI percentile for all grades (65.7) which was greater than the 50th-percentile, indicating that San Mateo County children and adolescents were more overweight or obese than the national reference population (50.0). **Figure 1** illustrates the distribution of the BMI percentiles in the obesity study population. There was a shift towards the right of the curve, with more children and adolescents being overweight or obese, which was also seen with the nationwide population.

Prevalence of Overweight and Obese Students

By Grade Overall, there were 2,323 (16.6%) obese children and adolescents in the county, which was slightly higher than the national prevalence. An additional 2,469 (17.7%) were overweight, again 1.7% higher than the national prevalence of children and adolescents at risk for obesity. There were more students in grade five (37.0%) who were either overweight or obese than those in grades seven (35.0%) and nine (30.1%) (X^2_{trend}=42.8, $p_{trend} < 0.01$) (**Table 5**). The proportion of children who were either overweight or obese does not differ significantly from grade to grade, but students were slightly more likely to be overweight than obese (p=0.003) (**Table 6**).

The prevalence of overweight and obese children by school district for all grades are shown in **Figures 2-5** and **Table 7**. The 95% Confidence Intervals (95% CIs) are also shown, indicating a statistical range of values in which the true proportion of overweight and obesity lies. When examining students whose BMI is $\geq$ 95th percentile (obese), there were four school districts that had a statistically higher prevalence of obesity than the overall San Mateo County prevalence (16.6%) and national prevalence (16.0%). When examining students who are overweight and obese, there were six school districts that had a statistically higher prevalence of overweight and obesity than the overall San Mateo County prevalence (34.3%). Corresponding figures and tables for students in grade five are shown in **Figures 6-7** and **Table 8**, grade seven in **Figures 10-13** and **Table 9**, and grade nine in **Figures 14-17** and **Table 10**.

By Sex Male students were more likely to be obese than female students (**Table 11**). The prevalence of overweight, however, was not significantly different between male and female students. This observation held for each grade level (**Tables 12-14**).

By Race/Ethnicity The prevalence of overweight and obese students in all grades by race/ethnicity is shown in **Figure 18**. American Indian/Alaskan Native students were more likely to be overweight or obese than Asian, Filipino, White, and multiracial students. The rate of overweight or obesity in American Indian/Alaskan Native students was not statistically different from African American, Hispanic, and Pacific Islander

students. Conversely, Asian students were the least likely to be overweight or obese compared to students of all other races or ethnicities. **Table 16** shows the same information in a numeric format. Figures and tables for overweight and obese students separately, and by individual grade level are shown in **Figures 19-29** and **Tables 16-20**.

Racial and ethnic differences in prevalence of overweight and obese students were apparent in all grades. In general, the lowest prevalence of overweight and obesity was among Asian and White students. African American, American Indian/Alaskan Native, Hispanic, and Pacific Islander students had the highest rates of overweight and obesity.

Risk Factors for Overweight and Obesity

The odds of overweight or obesity was higher for younger students (grade five OR:1.37, 95%CI: 1.25,1.51; grade seven OR: 1.26, 95%CI: 1.14, 1.38) compared to those in grade nine (**Table 21**). Male students were 20% more likely to be overweight or obese than female students (OR: 1.22, 95%CI: 1.13, 1.31). Race was statistically associated with overweight or obesity when using White students as the referent category.

Socioeconomic Status and Obesity

Statistically significant correlations were found between overweight and obesity indicators and socioeconomic status (SES) for students in both grades five and seven with correlation coefficients ranging from 0.52 (moderate correlation) to 0.80 (strong correlation). The trend was similar for students in grade nine but not statistically significant, possibly due to the small number of school districts included in the study with students in grade nine. In general, low SES was associated with both increased prevalence of overweight students and increased prevalence of obese students. Stronger associations were observed for obese students and SES than for overweight students. **Figures 30-32** illustrate the scatterplots for SES and overweight and obese indicators for students in all grades.

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Appendix

Data management, statistical calculations, conversions, and analyses of data were conducted using SAS software v8.02 (Cary, North Carolina) and EpiInfo v6.04d (Centers for Disease Control and Prevention, Atlanta, Georgia).

Formulae used to calculate BMI and BMI percentiles

(1) $$= \left[\frac{\quad}{(\quad)^2} \right] \quad 703$$

(2) $$= \frac{\left(\left(\quad / \quad\right)\right)-1}{\quad} \neq 0 \text{ or } = \frac{\ln\left(\quad / \quad\right)}{\quad} = 0$$

(3)
```
P=1-1/SQRT(2*3.14159265)*EXP(-(ABS(Z)**2)/2)*(0.4361836*(1/(1+0.33267*ABS(Z)))
-0.1201676*(1/(1+0.33267*ABS(Z)))**2+0.937298*(1/(1+0.33267*ABS(Z)))**3)
    If Z > 0 then Centile=P*100; else Centile=100-P*100
```

The *LMS* parameters are statistical parameters referring to the median (*M*), the generalized coefficient of variation (*S*), and the power in the Box-Cox transformation (*L*) of the BMI calculation for a specific age and sex. Each student's age was calculated from recorded date of birth to April 1, 2001, the average time at which the CFPT was administered. The *LMS* parameters for BMI by age and sex were obtained from the Centers for Disease Control and Prevention (Kuczmarski RJ, Ogden CL, Guo SS, et al. 2000 CDC growth charts for the United States: Methods and development. National Center for Health Statistics, Vital Health Stat 11(246), 2002).

Income eligibility guidelines for federal Free or Reduced Price Meal Program, July 1, 2000-June 30, 2001

Household Size	Weekly ($)	Monthly ($)	Annual ($)
1*	298	1288	15448
2	401	1735	20813
3	504	2182	26128
4	607	2629	31543
5	710	3076	36908
6	813	3523	42273
7	917	3970	47638
8	1020	4417	53003
For each additional add:	104	448	5365

* Household size of one indicates a child who is his/her own sole means of support