Abhiraj Chowdhury

Adolescents who exercise regularly are less likely to be overweight or obese.

Section 1: E = mc2 Scientific Paper Write-up

During the summer of 10th grade I was looking to do a research project. During my research, I became more interested in research concerning obesity, a field in epidemiology and looked at the profiles of winning researches in Robert Johnson YES Epidemiology competition. I met Dr. Jay Bhattacharya, Professor of Medicine at Stanford University, who introduced me to epidemiology (study of diseases, obesity research is part of epidemiology) and the STATA statistical package. He also inspired me to read several articles from research magazines in epidemiology, and thus I became interested in adolescent obesity research. Another reason was the prevalence of obesity among teens in the USA.

I researched several articles from research publications (Pubmed, New England Journal of Medicine, Obesity, Lancet etc). I also used public data files from the California Health Information Survey (CHIS) and the California Healthy Kids Survey (CHKS) in my research study. I also conducted survey of 300 teens in three schools in my city but I couldn't use the survey due to technicality. I used my home computer and STATA software to analyze data.

My research was then presented to the Pleasanton Unified School District and the City of Pleasanton. This research will hopefully help motivate adolescents to prevent obesity. I was awarded a US Congress commendation, Governor's commendation and an award from the Center of Disease Control (CDC) for my obesity research. I used my home computer to analyze the data.

This research project has helped build my interest in science and mathematics. Using the STATA statistical software, I extended myself to computer programming, statistics, science and mathematics and learned how to use them in real life problems. I also used MS Excel for plotting charts. This project did make science and math more alive for me. I also learned general concepts of epidemiology (study of diseases).

I would like to advise other high school students to start to explore scientific research early in late middle school or early high school years. My interest in scientific research grew since I was nine and I have participated in science fairs since then. My main curiosity in science grew in eighth grade when I participated the Regional Robotics competition. During my high school years, I have taken seven science courses and five math courses (including 4 Advanced Placement courses). These courses have sparked my interest in science and math and have helped me to explore scientific research.

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Section 2: Research Section

ABSTRACT AND INTRODUCTION

Adolescents who exercise regularly are less likely to be overweight or obese. The population chosen is adolescents in the age group of 12 to 19. Adolescent overweight and obesity is very prevalent in the United States. Results of National Health and Nutrition Examination Survey (NHANES, 2) 2003-04 study points out that 16% of adolescents nationwide are overweight. It is a huge human health issue because obesity increases the risk of serious health conditions like type 2 diabetes, high blood pressure and high cholesterol. Obese and overweight adolescents may also prone to low self-esteem that stems from being teased and bullied. Other diseases related to obesity are liver & gall bladder disease, depression, sleep disorders, bone and joint problems.

This project analyzes the exercise data for overweight and obese from the public data files of California Health Information Survey (CHIS, 1) from 2001-2007 and California Healthy Kids Survey (CHKS, 3) using STATA Statistical software (Stata, 4). The sample size of CHIS data was 17,404 and CHKS was 37,216. We analyzed exercise measures, along with overweight and obesity data, by sex and by race. The new and important aspect in this study was that overweight has been increasing for Hispanics and African Americans. Among all adolescents in California, 70% of them do exercise regularly. Another new finding is that there is a 33% increase of female overweight rates from 2001-2007. Most adolescents are doing exercise regularly as a part of mandatory Physical Education (till 10th grade) in California. Also, in California, 11% of adolescents are overweight compared to 16% nationwide. In Pleasanton schools, the low overweight rate of 4.6% is commendable. I also found correlation of high percent of exercise rate to lower overweight rates. This can be a positive motivator to curb obesity among adolescents. This research was shared with the local school districts (Pleasanton, Dublin, Livermore), City of Pleasanton and Alameda County Health Department.

METHODS

Design:

The design of the project started with my curiosity about studying obesity. Thanks for the guidance from my mentor, Dr. Jay Bhattacharyya who inspired me to look into the National Center for Health Statistics (NCHS) & National Health and Nutrition Examination Survey (NHANES, 2) data. I worked with these datasets using Stata Statistical software (Stata, 4) (Acock, 5) (Stata User, 6). While browsing the internet for research I came across the California Health Information Survey (CHIS, 1).

The CHIS questionnaires were used in my analysis. CHIS datasets are also in Stata format, which enabled me to analyze the data faster without conversion. I have used the CHIS public datasets (2001-2007) and California Healthy Kids Survey (CHKS) as my sources. The age group chosen for the analysis was adolescents from 12 to 19 year old. The analysis includes overweight & obesity rates for total sample as well as their exercise & gymnasium data. The percentages of sex and race were calculated and depicted in the bar charts (in the Results section).

Procedure for Data Collection:

For my source, I used California Health Information Survey (CHIS, 1) datasets from 2001-07 for California adolescents (17,104 adolescents) and California Healthy Kids Survey from 2004-06 (CHKS, 3) (37,216) for Alameda County & Pleasanton City School adolescents. CHIS examined the physical and emotional health of ages 0 thru adult. CHIS included questions on health status, healthcare, insurance, exercise, physical activity, fast food data, depression, tobacco use, TV & Computer use per day, etc.

I have used Stata (Stata, 4) Statistical software for my analysis. Couple of the books - Alan Acock's book for Stata (Acock, 5) and Stata User Guide (Stata User, 6) were very useful in analyzing data. These CHIS datasets are also in Stata format. Since CHIS datasets are very

large and have hundreds of data elements, I created subsets of CHIS 2001-2007 datasets in Stata and only used data elements pertinent to my project. I have used Stata to analyze data for both primary and secondary sources.

The analysis is based on Body Mass Index (BMI) (BMI, 7). We used data on self reported weight and height to calculate the BMI. BMI is defined as follows:

$$BMI = (Weight) / (Height * Height) \text{ and its units are } Kg/meter2$$

Since our weight is in lbs and height is in inches, the BMI is thus defined as:

$$BMI (Lbs/inch2) = (Weight * 703) / (Height * Height)$$

If the BMI index is greater than or equal to 25, it is defined as overweight and if BMI is greater than or equal to 30 then it is termed as Obese. Our total sample size is 17,404 (CHIS data) and 37,216 (CHKS data).

The primary outcome of the study is that obesity among adolescents is around 11% in California and only 4.6% in Pleasanton (my local area) compared to 17% based on 2003 NHANES study nationwide (NHANES, 2). In certain races (Hispanics and African Americans) the overweight and obesity is increasing, which is alarming. Also, men are doing more exercise than women. The obesity rate in California among females is increasing. Females are also exercising 14% lower than males. There is a correlation between lower exercise rate and high overweight rate. 11th graders in Alameda County (CHKS, 3) and Pleasanton schools are doing less exercise than their 7th & 9th graders. I plan to use this study to positively motivate adolescents by sharing the study with local school district and city personnel.

RESULTS

My analysis of survey only data are as follows:

(In adolescents, I have used actual BMI >= 25 for overweight (BMI, 7) and BMI>=30 for obese.

But in the scientific research studies, they consider 95th percentile of these figures for
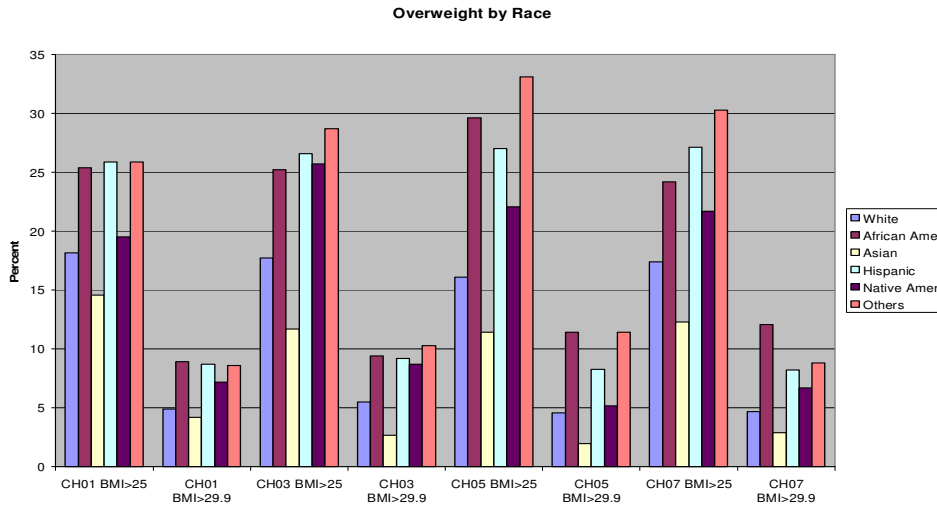
adolescents)

CALIFORNIA, ALAMEDA COUNTY & PLEASANTON CITY ANALYSIS (CHIS & CHKS DATA):

1. This is beginning of the analysis of California Adolescents data (CHIS, 1). This analysis below is for percent overweight & obese by sex. Among males, the percent of overweight ranges 21-24% whereas for females, it ranges 15-17%. Female overweight percent is rising from 2001-07. In 2007, the female overweight percent increased to 20%, close to males. The obese percent remain in 6-7% for males and 4-6% for females.
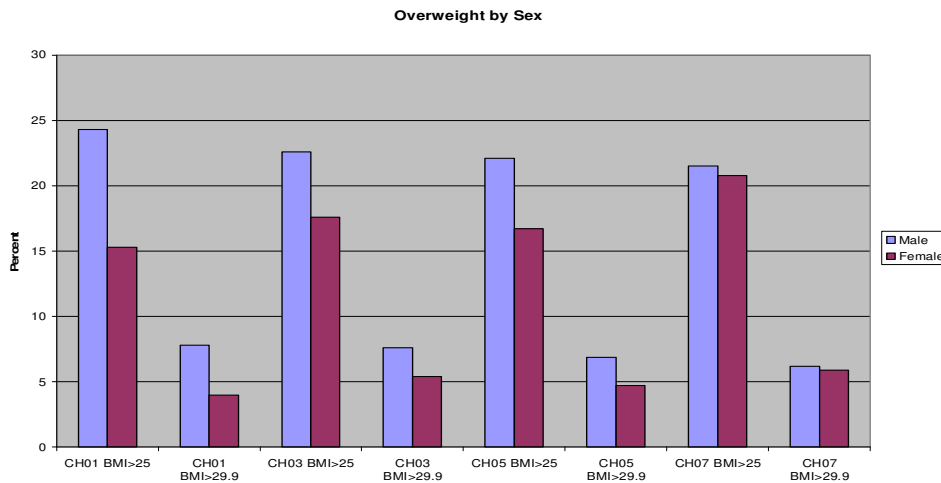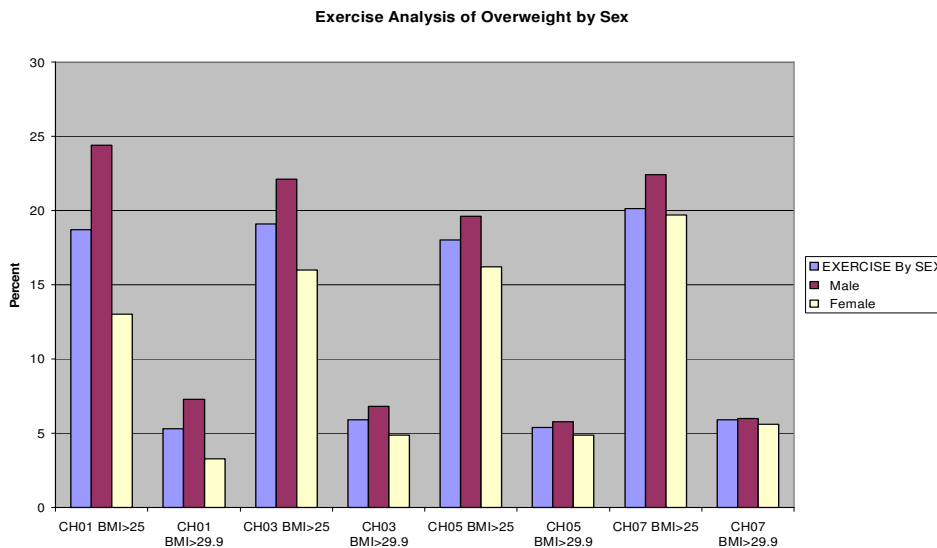

Overweight (BMI >= 25) and Obese (BMI >= 30) percent by Sex for CA Adolescents 2001-07

2. This analysis below is the analysis of California Adolescents (CHIS, 1) for overweight &

obese by race. In 2001 & 2003, percent of overweight for Hispanics was 26-27% and African

Americans around 25%. The trend changes in 2005 when the African Americans were 29%

overweight but in 2007, the Hispanics were in the lead again with 27%.

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Overweight by Race

Overweight (BMI >= 25) and Obese (BMI >= 30) percent by Race for CA Adolescents 2001-07

3. This analysis below is of California Adolescents (CHIS, 1) who exercise regularly for percent overweight and obese by sex. Percent of overweight males who exercise regularly are in the range 19-24% and females in 13-16%. In 2007, females were 19.7% overweight close to males 22%.

Exercise Analysis of Overweight by Sex

Exercise Analysis by Sex for California Adolescents doing regular exercise for Overweight (BMI >= 25) and Obese (BMI >= 30)

4. This comparative analysis of California Adolescents who exercise regularly for Overweight and Obese percent by race (CHIS, 1). The analysis depicts that Hispanics overweight percent was in range 25-27% and for African Americans it was in 22-27% range. The trend changed in 2007 where African Americans had the lead. Both these races kept increasing BMI from 2001-07, which is alarming.

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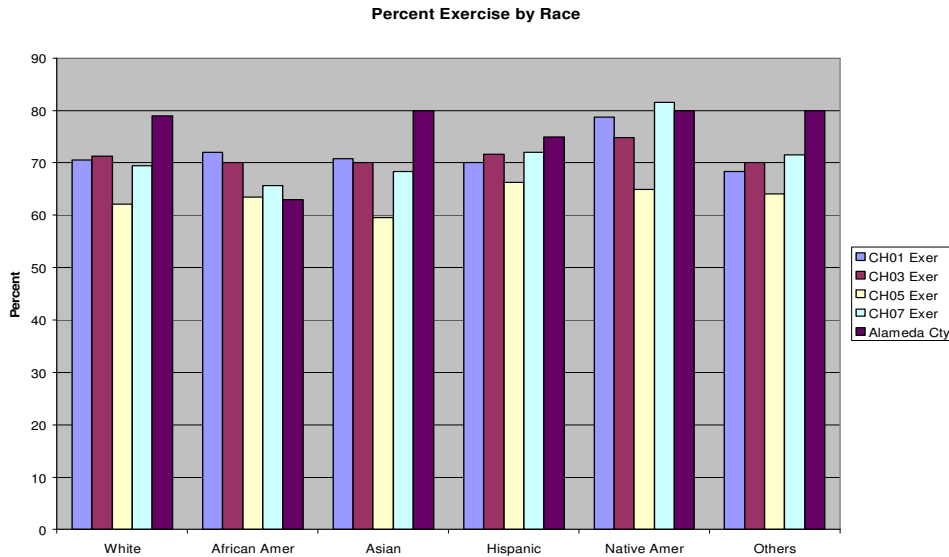**Exercise Analysis of Overweight by Race**
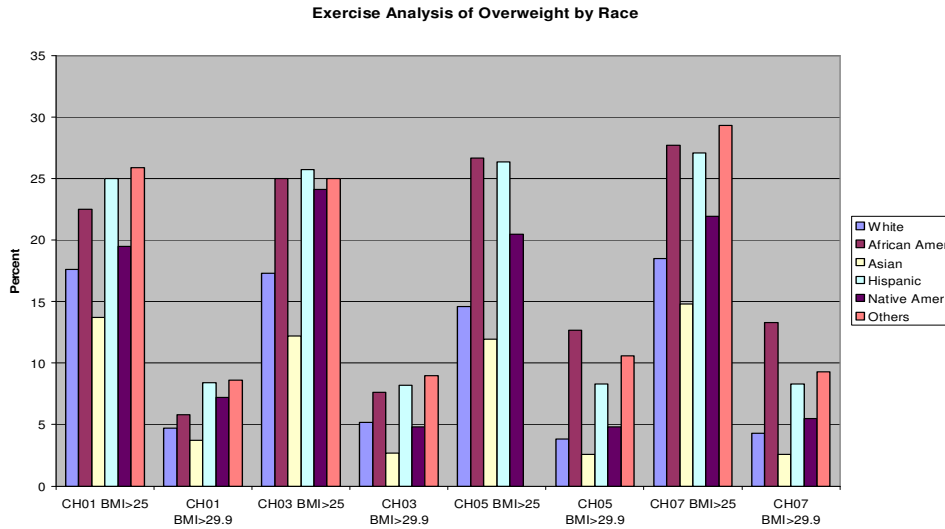
Exercise Analysis by Race doing regular exercise for Overweight (BMI >= 25) and Obese (BMI >= 30)

5. The analysis below is for California and Alameda County data for percent of adolescents who exercise regularly by sex. In 2001, 03 & 07 percent of males were 74% & females were 65%. Only in 2005, the rate dropped to 66% for males & 58% for females. Alameda county rate for males are 78% and females at 69%, both higher than the California rates.

Percent Exercise by Sex
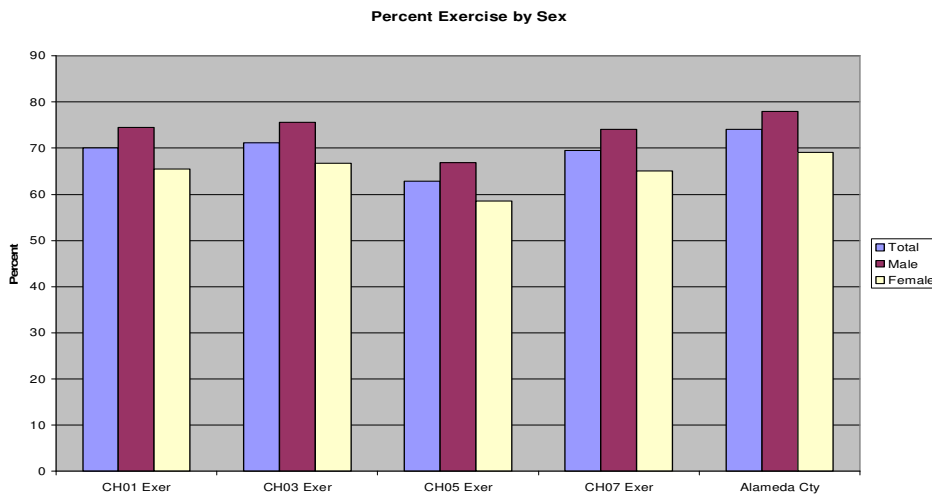
Percent of California & Alameda County Adolescents who exercise regularly by Sex.

6. The analysis below is for California and Alameda County data for percent of adolescents who exercise regularly by race. In this analysis, most races were in 70% range. With the exception of African Americans in Alameda County (63%), other races did exercise in 80% range, 12.5% higher than their California counterparts.

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Percent Exercise by Race

Percent of California & Alameda County Adolescents who exercise regularly by Race.

7. The analysis below is for California, Alameda County and Pleasanton City for overweight. On the average, around 11.5% of respondents are overweight in California, compared to 12.3% in Alameda County & only 4.6% in Pleasanton.

Overweight Percent
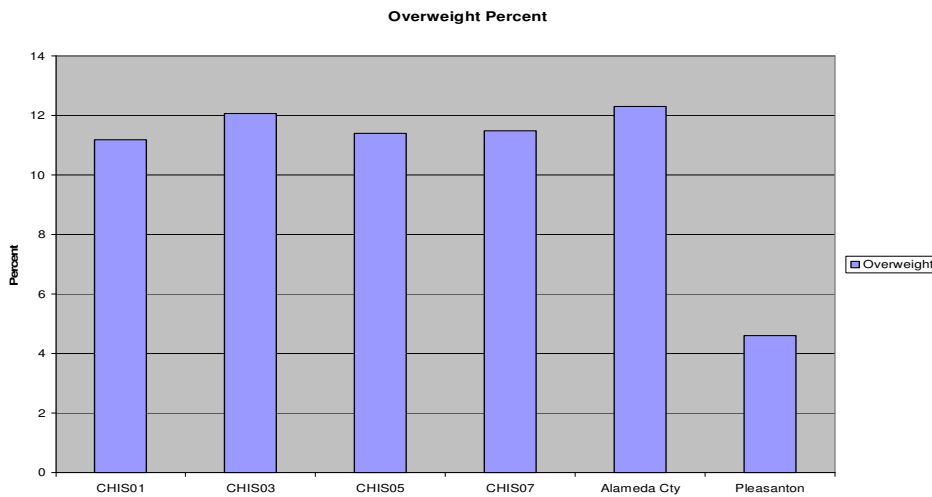
Overweight (BMI >= 25) percent for California, Alameda County & Pleasanton City Adolescents

ALAMEDA COUNTY AND PLEASANTON CITY ANALYSIS (CHKS DATA):

8. The analysis below is for Alameda County and Pleasanton City (CHKS, 3) for 2004-5 & 2005-

6. I found that 60% of 11th graders regularly exercise at least 20 min a day more than 3 days a

week, 25% less than 7th and 9th graders (75% range). In non traditional school, it drops to 50%

rate. These drops could be due to mandatory Physical Education in 7th and 9th grade but not in 11th grade.

Exercise Measures by Sex and Grade - Alameda County
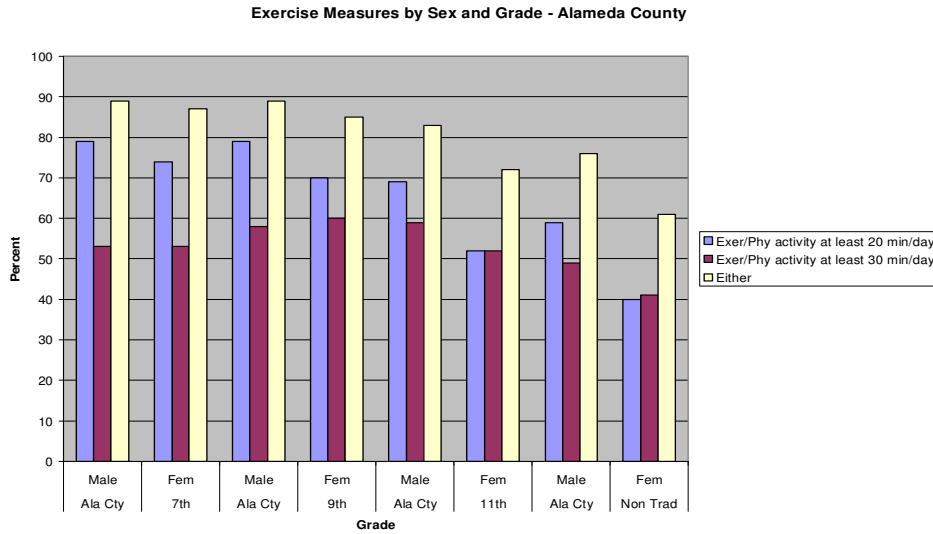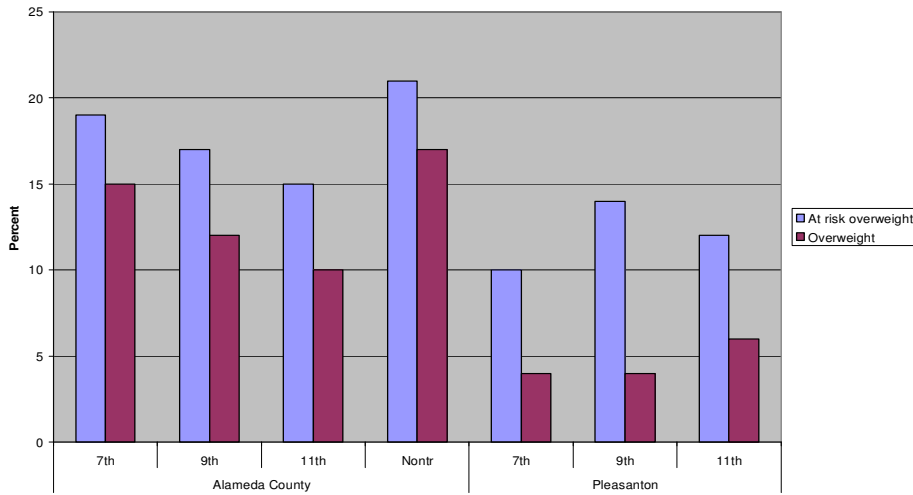

Exercise Measures by Sex and Grade for Alameda County

9. In Pleasanton City (CHKS, 3) 75% of 11th graders are doing exercise more than 3 days a week compared to 90+% for 7th and 9th graders, a difference of 20%. But this number is much higher than Alameda County 11th graders with only 60%. This shows that regular exercise is more prevalent in the City of Pleasanton compared to the Alameda County.

Exercise Measures by Grade - Alameda County and Pleasanton City
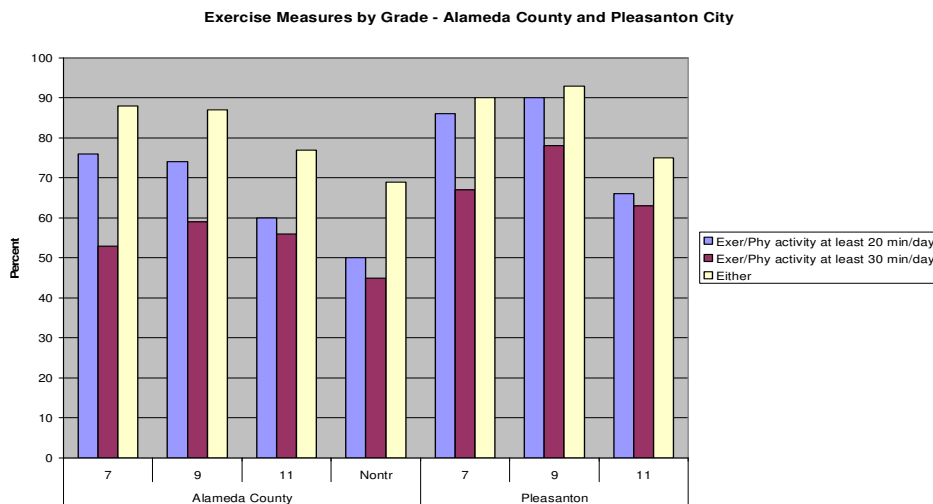
Exercise Measures by Grade for Alameda County and Pleasanton City

10. In at risk overweight category, Alameda County 11th graders with 15% are

in better shape than 7th (19%) and 9th (17%) graders. But in non-traditional schools, their 21% rate is alarming. 11th graders in Pleasanton schools with 12% level are less at risk overweight than their counterparts in the Alameda County.
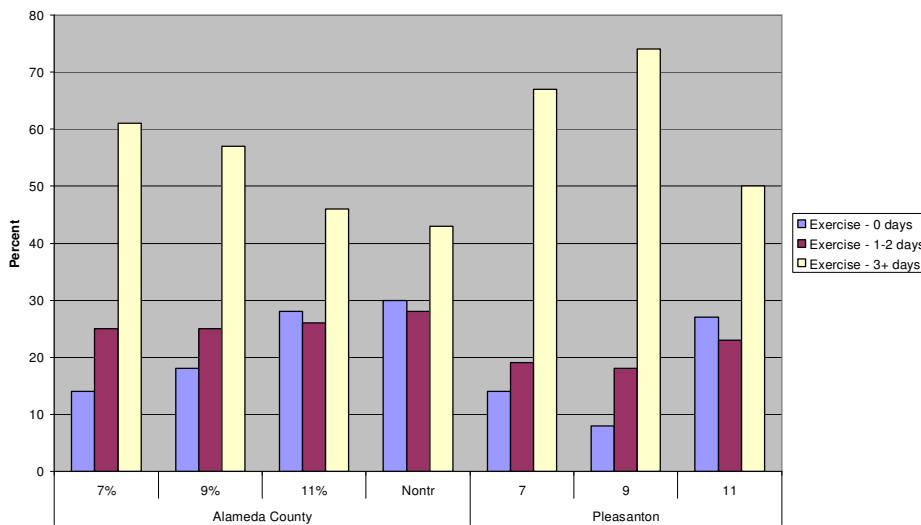
Overweight Analysis by Grade - Alameda County and Pleasanton City

Overweight Measures by Grade for Alameda County and Pleasanton City

11. This analysis below is for Alameda County and Pleasanton City frequency of exercise by grade. Most adolescents are doing exercise for 3 or more days per week. The 9th graders in Pleasanton with 74% are the best in this category. On average, 63% of Pleasanton adolescents are doing 3 days or more exercise per day, 8% above the Alameda County average.

Frequency of Exercise by Grade - Alameda County and Pleasanton City

Frequency of exercise by Grade for Alameda County and Pleasanton City

DISCUSSION

There are several results which I would like to elaborate.

1. There is a trend for increasing overweight and obesity rates among female depicted in California Adolescents (CHIS, 1). Female overweight increased from 15.3% (2001) to 20.8% (2007), a 33% increase. Similar pattern was for obese female where the increase was from 4% (2001) to 5.9% (2007), a 50% increase, which is alarming. In 2007, overweight rate in female (20.8%) became very close to their male counterparts (21%).

2. California Adolescents who exercise regularly, males exercise around 74% of time while females do exercise 65% of the time. The average rate is around 70%. Only exception was in 2005, when the average rate dropped to 62.8%. Alameda County Adolescent males do exercise 78% of time while female rate is 69%. Both are around 5.5-6% higher than their counterparts in their state.

3. In California, overweight and obesity rates among Hispanics and African Americans are on the rise. In California Adolescents, Hispanics overweight rate increased from 25.9% (2001) to 27.1% (2007). Their obesity rate was in the range of 8.2-9% during 2001-07.

4. In California, African Americans overweight rate increased from 25.2% (2001) to 29.4% (2005) then decreased to 24.2% (2007). But for those regularly exercising category, the overweight rate increased from 22.5% (2001) to 27.7% (2007), a 23% rise, surpassing Hispanics. Also obesity increased from 5.5% (2001) to 13.3% (2007), an alarming 142% rise in that period. In Alameda County, their exercise rate is only 63%, much lower than 79% for other races. Thus, there is a correlation between their high overweight rates and low exercise rate.

5. For Native Americans in California, it was a reduction of 16% in overweight rate from 25.9% (2001) to 21.7% (2007). This is great healthy news. Their obesity rate decreased from 7.2% (2001) to 6.7% (2007). For regular exercise category, their overweight first increased from 19.5% (2001) to 24% (2003) but decreased to 21.9% (2007). Though their obesity rare for

regular exercise category decreased from 7.2% (2001) to 5.5% (2007). Native Americans average exercise rate is around 80% (2001-07). There is a correlation between their high exercise rate (80%) and low overweight (21%) rate.

6. Overweight rate of California Adolescents is around 11.5%, much lower than (NHANES 2003) nationwide overweight rate of 16%. Thus, the mandatory physical education in schools in California seems to be working well. Alameda County Adolescents has overweight rate of 12.3% while Pleasanton schools overweight rate is only 4.6% (67% less than Alameda County), over 3.5 times lower than the national average and 2.5 times lower than the California rate. This shows that exercise regimen and eating nutritional foods are keeping BMI index in check for Pleasanton and to a certain extent the 11th graders in Alameda County.

7. For Alameda County (CHKS, 3) for 2004-5 & 2005-6 periods, I found that only 60% of 11th graders regularly exercise at least 20 min a day more than 3 days a week, 25% less than 7th and 9th graders (75% range). In non traditional schools, the rate of exercise drops to 50%, a 16.6% drop. These drops could be attributed to mandatory Physical Education in 7th & 9th grade but not required in 11th grade. For Pleasanton schools, the rate of exercise for 11th graders who exercise at least 20 minutes a day more than 3 days a week id 66%, 10% higher than the Alameda County rate. But their 7th & 9th graders exercise rate is around 88%, lot higher than 75% for Alameda County 7th & 9th graders.

8. In the category of doing exercise at least 30 min a day, all three grades (7, 9 & 11th) in Alameda County are in the range of 55%, whereas, Pleasanton City schools are on the average 69%, 20% higher than the Alameda County.

9. In Pleasanton schools, exercise rate for 11th graders who exercise at least 3 days a week is 75% compared to 77% in Alameda County. The 7th & 9th graders in Pleasanton have exceptional rate of 91.5% compared to 87% for Alameda County. This shows that regular exercise is more prevalent in Pleasanton schools compared to the Alameda County. 11th

graders still are doing 20% less exercise in Pleasanton than their 7th & 9th graders, while 11th graders in Alameda County are doing 13% less exercise than their 7th & 9th graders. These drops could be attributed to mandatory Physical Education in 7th & 9th grade but not required in 11th grade.

10. In at risk overweight category, Alameda County 11th graders with 15% are in better shape than their 7th (19%) & 9th (17%) graders. But in non-traditional schools, their 21% at risk overweight rate is truly alarming. Pleasanton schools11th graders with 12% level are 25% less at risk overweight than their counterparts in the Alameda County.

I would also like to mention one key statistical point, which is selection bias. My main finding is that exercise reduces obesity**.** However, it might also be possible that obese people find it more difficult to exercise. There is still a correlation between exercise and obesity. We would need further analysis for this category.

My research is confined to the analysis with the California data using CHIS (2001-07),

Alameda County (California) & Pleasanton City (California) data using CKHS (2004-07). Follow up research could be done with conducting surveys in other cities of California and other states to analyze these issues deeper. Other aspects of obesity – fast food, soft drinks intake and TV/Computer usage also should be researched. Due to alarming rate of increase of overweight and obesity rates among Hispanics and African Americans, more surveys are needed in their predominant neighborhood schools.

These conclusions will be very useful to my local school districts (Pleasanton, Livermore, Dublin, San Ramon etc) as well as to the local Pleasanton School District & City government. This study will motivate more adolescents to exercise regularly and to stay healthy.

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