Prevalence of Obesity in Adult Population of Former College Rowers

John W. O'Kane, MD, Carol C. Teitz, MD, Santana M. Fontana, MD, and Bonnie K. Lind, MS

Background: **The prevalence of adolescent and adult obesity in the United States is increasing at an alarming rate. This study examined the prevalence of obesity in adults aged 20 through 60 years, comparing established national norms with a selected population of former college rowers.**

Methods: **Selected for study were 4,680 male and female former intercollegiate rowing athletes who graduated in 1928 through 1998. The participants were surveyed regarding duration of rowing career and training methods, current and college height and weight, and questions regarding lifetime episodes of back pain. After two mailings, 2,165 (46%) questionnaires were returned. Our study data were compared with national cross-sectional survey data obtained through the National Health and Nutritional Examination Survey III (NHANES III).**

Results: **Male and female former rowers had a significantly lower prevalence of obesity than the general population both in college and through their lifetime ($P < .001$). For rowers of both sexes, there was a trend of slightly higher body mass index (BMI) in each older age-group ($P < .001$).**

Conclusions: **Former collegiate rowers were less obese than the general population. BMI increases with age, and encouraging athleticism for those who are of college age and younger might be an effective method to decrease adult obesity. (J Am Board Fam Pract 2002;15:451–6.)**

Obesity has become an American epidemic. Data for men and women combined from the National Health and Nutrition Examination Surveys II and III indicate that for 10 years from the mid 1980s through mid 1990s, the prevalence of obesity has increased from 14.5% to 22.5%.[1] The percentage of overweight adolescents has doubled in the last 30 years,[2] and obese children are more likely to become obese adults.[3] Adult obesity is a serious health concern and is associated with many chronic diseases, including cardiovascular disease, diabetes, arthritis, gall bladder disease, certain cancers, and respiratory diseases.[4]

Body mass index (BMI: weight (kg)/height (m) squared) is currently the most widely used standard to define stages of elevated body weight. Class 1 obesity is defined as a BMI of 30 or higher with preobesity defined as BMI 25 to 29.9. Class 2 obesity is a BMI of 35 and higher, and class 3 obesity is defined by a BMI of 40 and higher.[5] Health risks are elevated with class 1 obesity and increase as BMI elevates. Because BMI does not differentiate between lean mass and fat mass, particularly muscular athletic individuals will have a higher BMI than an average person with the same body fat.

Increasing obesity is a function of increased caloric intake and decreased energy expenditure. Physicians and others with an interest in public health are appropriately alarmed by trends of decreasing physical activity in the face of increasing evidence that physical activity is an essential component of a healthy lifestyle.[6] Different remedies have been suggested, including the exercise prescription as part of routine health care and more widespread public education emphasizing a healthier lifestyle that includes regular exercise. Education in adulthood seems to be of limited benefit because one half of all adults who start an exercise program stop within 6 months to 1 year.[7] The best strategy to prevent adolescent obesity and subsequent adult obesity might be to emphasize more physical activity for children through organized sports and active recreation.[8]

Our study evaluated that theory by examining the prevalence of obesity in adults aged 20 through 60 years, comparing established national norms with a selected population of former college row-

Submitted, revised 17 January 2002.

From the Department of Orthopaedics and Sports Medicine (JWO, CCT), the Department of Family Medicine (JWO, SMF), and the Department of Biostatistics (BKL), University of Washington, Seattle. Address reprint requests to John W. O'Kane, MD, Department of Orthopaedics and Sports Medicine, Box 354060, University of Washington, Seattle, WA 98195-4060.

ers. We hypothesized that the former rowers would have a significantly lower prevalence of obesity from college through adulthood, possibly secondary to positive attitudes regarding physical fitness and exercise developed in conjunction with adolescent and young adult participation in an aerobic sport.

Methods

The study design was approved by the University of Washington Human Subjects Review Committee. Questionnaires were sent to 4,680 former intercollegiate rowing athletes who graduated between 1928 and 1998 from five college rowing programs. The participants were selected using the alumni records of the rowing programs. After two mailings, 2,165 questionnaires were returned (46%). Participants were surveyed regarding duration of rowing career and training methods, current and college height and weight, and questions regarding lifetime episodes of back pain. The back pain data are not part of this analysis. Height and weight were used to calculate body mass index (BMI). Data from the Centers for Disease Control and Prevention Third National Health and Nutrition Examination Survey (NHANES III) were used as a comparison group providing BMI and the percentage of adults classified as preobese (BMI 25 to 29.9) and obese (BMI $\geq$ 30).[1]

Statistical analyses were performed using SPSS (SPSS for Windows Version 10, 1999). The tests included paired t tests for testing differences in college and current BMI, independent sample t tests for comparing rowers' data with national normative data, chi-square tests for categorical comparisons, and the Mantel-Haenszel chi-square test for linear trend in categorical comparisons.

Results

For both sexes, current mean BMI was significantly higher than college BMI, but the increase was small (Table 1). For women, current mean BMI was well within the normal range, whereas current mean BMI for men just approached the lower end of the preobese range. For both sexes there was a trend of slightly higher BMI in each older age-group (for linear trend $P < .001$ for both men and women) (Table 2). Obesity was rare in every age-group, with 10% or fewer of the former rowers classified as obese.

Table 1. Average College and Current Body Mass Index (BMI).

Participants	Number	College BMI	Current BMI	P Value
Women	810	22.03	22.53	<.001
Men	1,251	23.01	25.09	<.001

Comparing current BMI among men who continued to row with those who no longer were rowing shows a significant ($P = .01$) trend toward less obesity in those who were still rowing; however, only 8% of the men were still rowing (Table 3). Five percent of the women were still rowing, and none of them was obese, whereas less than 2% of those no longer rowing were obese (P = NS) Additionally, the participants who were still rowing tended to be clustered in the younger age-groups, as about one half of the women who were still rowing were younger than 30 years. About one third of the men who were still rowing were younger than 30 years, with another one third aged between 30 and 39 years.

Comparing current BMI of former rowers with the general population (NHANES III) (Table 4) clearly shows a higher percentage of normal weight and a lower percentage of obesity among both male and female rowers ($P < .0001$). The female rowers were also less likely to be preobese ($P < .0001$), whereas the male rowers had a slightly higher prevalence of preobesity than the general population ($P = .05$).

When comparing the prevalence of obesity by decade, there is a significantly lower percentage of obese rowers in every age-group (Table 5). The percentage of obese persons increased with age in

Table 2. Current Obesity Based on Body Mass Index (BMI), by Decade.

Participants, by Age	BMI < 25 No. (%)	BMI 25–29.9 No. (%)	BMI 30 + No. (%)
Men			
≤29 years	155 (59.6)	103 (39.6)	2 (0.8)
30–39 years	286 (53.6)	223 (41.8)	25 (4.7)
40–49 years	171 (48.2)	154 (43.4)	30 (8.5)
50–59 years	12 (34.3)	20 (57.1)	3 (8.6)
60 + years	25 (36.8)	36 (52.9)	7 (10.3)
Total	649 (51.8)	536 (42.8)	67 (5.4)
Women			
≤29 years	192 (90.1)	21 (9.9)	0 (0.0)
30–39 years	339 (86.0)	50 (12.7)	5 (1.3)
40–49 years	157 (77.3)	37 (18.2)	9 (4.4)
Total	688 (84.9)	108 (13.3)	14 (1.7)

Table 3. Current Obesity of Participants According to Current Rowing Status.

Participants	Still Rowing	BMI < 25 No. (%)	BMI 25–29.9 No. (%)	BMI 30 + No. (%)	Total
Men	No	558 (50.2)	493 (44.3)	61 (5.6)	1,112
	Yes	61 (66.3)	28 (30.4)	3 (3.3)	92
Women	No	637 (84.9)	100 (13.3)	13 (1.7)	750
	Yes	34 (87.2)	5 (12.8)	0 (0.0)	39

BMI—body mass index.

both groups. The rate of increase was similar for men (Figure 1), whereas for women, the rowers rate of increasing obesity was lower than that of the general population until the age of 40 years. From 40 to 49 years, the female rowers' rate of increasing obesity was similar to the general population (Figure 2).

Discussion

This study compared the prevalence of obesity in former crew athletes with established national trends from the NHANES III data. The results clearly show that the former rowers had a significantly lower prevalence of obesity starting at the end of their collegiate rowing careers and lasting through their fourth to fifth decades. The study strengths include the great number of respondents and the ability to assess an outcome for a period of decades. Recall bias is clearly a weakness of the survey study design, although current height and college height should not be significantly different. We believe the participants' recall of college weight is likely to be accurate because of the importance of training weight to an elite competitive athlete. Rowing also has weight classes in many programs, increasing the importance of body weight for the competitors and increasing the likelihood the participants accurately recalled their college weight.

A mailing return of nearly 50% is good, and the survey instrument asked many questions beyond height and weight, including questions regarding back pain, training methods, and rowing experience before college. The main thrust of the survey was back pain associated with rowing. Because height

Table 4. Former Rowers Compared with National Health and Nutrition Examination Survey III (NHANES III) Findings by Percentage of Participants in Each Body Mass Index (BMI) Group.

	Men			Women		
Characteristic	NHANES III*	Rowers	*P* Value	NHANES III†	Rowers	*P* Value
Number	6,368	1,252		4,803	810	
BMI < 25, %	40.0	51.8	<.0001	56.3	84.9	<.0001
BMI 25–29, %	39.8	42.8	.05	21.5	13.3	<.0001
BMI 30+, %	20.2	5.4	<.0001	22.2	1.7	<.0001

*All men aged 20–69 years in NHANES III sample.
†All women aged 20–49 years in NHANES III sample.

Table 5. Rowers Compared with National Health and Nutrition Examination Survey III (NHANES III) Findings by Percentage of Individuals with a Body Mass Index of 30 or Higher, by Decade.

Characteristics	≤29 Years No. (%)	*P* Value	30–39 Years No. (%)	*P* Value	40–49 Years No. (%)	*P* Value	50–59 Years No. (%)	*P* Value
Men								
NHANES III	1,639 (12.5)	<.0001	1,470 (17.5)	<.0001	1,222 (23.1)	<.0001	858 (28.9)	.02
Rowers	265 (0.8)		542 (8.5)		364 (8.5)		35 (8.6)	
Women								
NHANES III	1,669 (4.7)	<.0001	1,776 (25.8)	<.0001	1,358 (2.7)	<.0001		
Rowers	213 (0.0)		394 (1.3)		203 (4.4)			

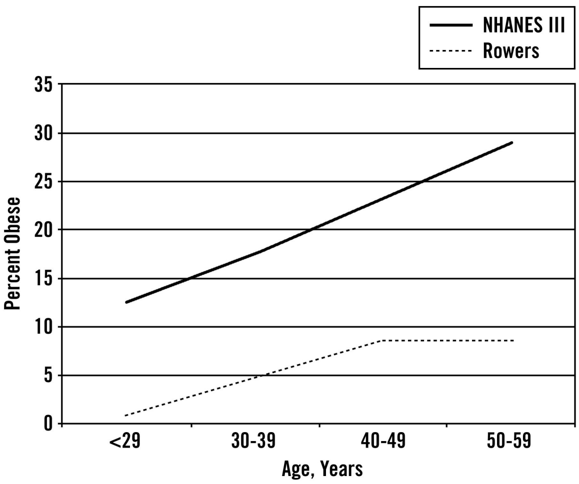

Figure 1. Percentage of obese men, by decade.

and weight questions were a small part of the survey, we believe it is unlikely large groups of heavier or lighter participants would fail to respond.

BMI has been used as a standard to define obesity. One interesting finding in the data highlighting the limitations of BMI as a health assessment tool, however, is that male rowers were significantly more likely than the general population to be in the preobese (BMI 25–29.9) group. The data do not suggest such preobesity is a precursor to obesity in later decades; rather, they indicate that the elevation in BMI might be caused by exceptional lean body mass in the male rowers. Athletes in sports for which increased body weight is not a disadvantage can compete successfully despite being overweight. Kujala et al[9] found former power-sport athletes had elevated BMIs when compared with the general population, endurance athletes, and mixed-sport athletes. As do most endurance athletes, rowers tend to have a low percentage of body fat, but more of our participants than the general population were preobese. The potential for a falsely elevated BMI must be considered when assessing lean athletic individuals falling into the preobese group.

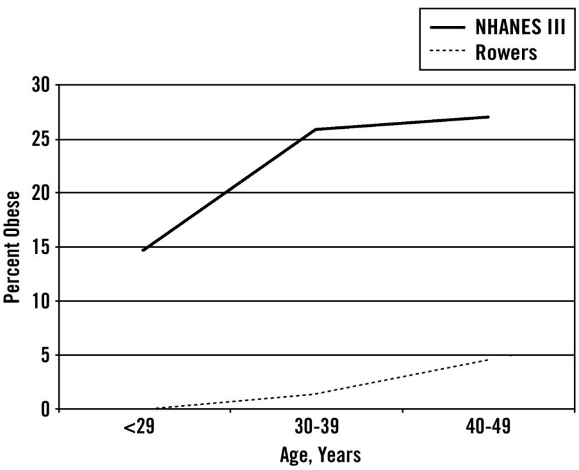

Figure 2. Percentge of obese women, by decade.

Pihl and Jurimae,[10] in a recent study of 150 former top-level athletes in Estonia, found that very few of the former athletes' current BMIs reached the threshold for obesity, and none of the athletes' BMIs was greater than 32. Former endurance and power-sport athletes were included, and their average current age was 40 to 50 years. Their findings are consistent with the results for former rowers, with only 5.4% of men and 1.7% of women reaching a BMI of 30 or greater.

The percentage of currently obese male and female participants was significantly less than the general population for all age-groups. Figures 1 and 2 show that from ages 30 through 50 years, the rate of increasing obesity for male rowers nearly parallels the rate for the general population. The prevalence of obesity increased in both groups with age, but only 0.8% of the male rowers exited college with an elevated BMI compared with 12.5% of the general population. Despite a trend of increasing weight with time, by starting lean, most male rowers remained below the obesity threshold.

The female rowers also started lean, and most of them stayed lean, with only 4.4% reaching a BMI of 30 by the age of 49 years. This finding is in sharp contrast with the steep increase in the prevalence of obesity for the general female population from the age of 29 to 40 years. Previous studies of BMI trends in former athletes have not included women, but these data suggest that sports participation in the late teens and early twenties might help prevent future obesity, particularly from the ages of 30 to 40 years. This study was not designed to assess other contributing variables, but in light of the sharp contrast between the former rowers and the general population, further research into lifestyle differences between the groups would likely be revealing.

The former rowers' lower prevalence of obesity suggests that they had lower caloric intake or increased caloric expenditure compared with the general population. During college training, the rowers' daily caloric expenditure was high. Most of the participants did not row beyond college; only 8%

of the men and 5% of the women were still rowing. Male current rowers were less obese than the rest of the male former rowers, whereas among the women, the difference between the groups is not significant, and obesity was rare in both groups.

Most of the participants were not current rowers, so another explanation exists for their lower prevalence of obesity. Former rowers might be more active than the general population, and they might consume fewer calories. These data do not allow such a comparative analysis, but previous studies of former athletes shed light on this issue. Studies done in Finland and Estonia show that more than 60% of the former elite athletes engage in regular leisure-time physical activity or competitive sports throughout their adult life, and that weight gain is significantly related to a lack of regular physical activity.[10,11] Former endurance athletes were the most likely to still be exercising regularly. A similar proportion of our participants, all whom were endurance athletes, probably continued to exercise regularly even if they no longer were rowing. Prospective assessment of former rowers' daily calorie consumption and expenditure could be the subject of future analyses.

Our study findings show that former college rowers are less likely to be obese adults and confirm other studies suggesting that a more active lifestyle is a contributing factor. One must then ask what started the rowers along their paths to elite athleticism, and can less-elite young adult athletes obtain similar benefits from their athleticism? The evidence shows that an active lifestyle and subsequent healthy BMI are widely obtainable, but it is essential to intervene at an early age. O'Loughlin et al[12] showed that for children aged 9 to 12 years, a high BMI was a predictor of continued excessive weight gain at 1- to 2-year follow-up. Not participating in organized sports other than at school was also significantly associated with weight gain and obesity.

Genetics and environment likely play a role in childhood obesity, but good evidence exists showing that environment, namely, less exercise, is responsible for recent trends toward increasing obesity. Troiano et al,[6] in an analysis of national survey data, found that despite an increasing prevalence of childhood obesity from the 1970s through 1990s, the children's caloric intake had not significantly changed. Their conclusion was that decreasing physical activity was the major contributor to the increasing obesity. Guo et al,[3] in an analysis of 555 whites, found that a high BMI at age 18 years is an excellent predictor of high BMI at age 35 years. An obese 18-year-old is very likely to remain obese through adulthood, and childhood sports participation helps prevent obesity. In an effort to prevent adult obesity, an appropriate intervention would be to encourage physical activity for children and adolescents before they become obese 18-year-olds.

Our study participants represent a highly successful subset of young athletes who were able to compete at the collegiate level. Probably their commitment to training, not their level of competition, contributed to their lower prevalence of obesity. The participants' ability to avoid obesity through adulthood is likely multifactorial, but maintaining an active lifestyle is clearly important. Regardless of the number of elite athletes, a society valuing childhood sports participation and encouraging adult active lifestyles is apt to experience less obesity in its general population.

References

1. Flegal KM, Carroll MD, Kuczmarski RJ, Johnson CL. Overweight and obesity in the United States: prevalence and trends, 1960–1994. Int J Obes Relat Metab Disord 1998;22:39–47.
2. Troiano RP, Flegal KM, Kuczmarski RJ, Campbell SM, Johnson CL. Overweight prevalence and trends for children and adolescents. The National Health and Nutrition Examination Surveys, 1963 to 1991. Arch Pediatr Adolesc Med 1995;149:1085–91.
3. Guo SS, Roche AF, Chumlea WC, Gardner JD, Siervogel RM. The predictive value of childhood body mass index values for overweight at age 35 y. Am J Clin Nutr 1994;59:810–9.
4. Pi-Sunyer FX. Medical hazards of obesity. Ann Intern Med 1993;119:655–60.
5. Health implications of obesity: National Institutes of Health Consensus Development Conference Statement. Ann Intern Med 1985;103(6 Pt 2):1073–77.
6. Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the national health and nutrition examination surveys. Am J Clin Nutr 2000; 72(5 Suppl):1343S–1353S.
7. King AC, Blair SN, Bild DE, et al. Determinants of physical activity and interventions in adults. Med Sci Sports Exerc 1992;24(6 Suppl):S221–36.
8. Trost SG, Kerr LM, Ward DS, Pate RR. Physical activity and determinants of physical activity in obese and non-obese children. Int J Obes Relat Metab Disord 2001;25:822–9.
9. Kujala UM, Kaprio J, Taimela S, Sarna S. Prevalence of diabetes, hypertension, and ischemic heart

disease in former elite athletes. Metabolism 1994;43:1255–60.
10. Pihl E, Jurimae T. Relationships between body weight change and cardiovascular disease risk factors in male former athletes. Int J Obes Relat Metab Disord 2001;25:1057–62.
11. Sarna S, Sahi T, Koskenvuo M, Kaprio J. Increased life expectancy of world class male athletes. Med Sci Sports Exerc 1993;25:237–44.
12. O'Loughlin J, Gray-Donald K, Paradis G, Meshefedjian G. One- and two-year predictors of excess weight gain among elementary schoolchildren in multiethnic, low-income, inner-city neighborhoods. Am J Epidemiol 2000;152:739–46.

Correction

In the September–October article by Ferrante et al (Empiric Treatment of Minimally Abnormal Papanicolaou Smears with 0.75% Metronidazole Vaginal Gel. J Am Board Fam Pract 2002;15:347–54), the headings of the first two columns of Table 3 on page 351 were inadvertently reversed. The Table should be displayed as follows:

Table 3. Comparison of Patients with Normal Cytologic Findings on Follow-Up Papanicolaou Examination, by Treatment Groups and Findings on Initial Papanicolaou Report.

Findings on Initial Papanicolaou Report	Control (n = 60) Normal Findings No. (%)	Treatment (n = 54) Normal Findings No. (%)	Total (n = 114) Normal Findings No. (%)	*P* Value
Inflammation	13 (62.0)	11 (61.1)	24 (61.5)	.96
ASCUS	6 (46.2)	1 (12.5)	7 (33.3)	.17*
Reactive cellular changes	14 (73.7)	9 (45.0)	23 (59.0)	.07
Benign cellular changes	4 (66.7)	3 (37.5)	7 (50.0)	.59*
Total	37 (61.7)	24 (44.4)	61 (54.0)	.07

**P* value obtained using Fisher's exact test.
ASCUS = atypical squamous cells of undetermined significance.