RESEARCH REPORT

Association between academic achievement and overweight of secondary school children in Hat Yai municipality

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ABSTRACT

Objective: To study the association between overweight and school performance of secondary school children in Hat Yai municipality.

Design: Longitudinal study, 5 years follow-up.

Setting: Secondary schools in Hat Yai municipality.

Subjects: 886 grades 7-12 students.

Measurements : Body mass index (BMI, kg/m^2) calculated from weight and height measured yearly from 1992 to 1997; parental education level and occupation and monthly income by questionnaire performed in 1992; grade-point-average (GPA) from the school records of final examinations in 1997.

Results: Overweight subjects (BMI value greater than 85^{th} percentile of the NHANES-I data for age and sex) in grades 7-9 had a mean GPA 0.20 point (95% CI = 0.0, 0.36) lower than that of the normal weight children after controlling for sex, school, mother's education and income. Being overweight in the previous year was also associated with a lower GPA, -0.24 point (95% CI = -0.07, -0.40). Being overweight in late adolescence over the five years did not associate with poor school performance. Becoming overweight in the current year or in the past five years had no effect on school performance either.

Conclusions: Our study showed that during early adolescence (grades 7-9), being overweight in the current year and the preceeding year was associated with poor school performance, whereas such an association was not significant in late adolescence (grades 10-12).

Key words: adolescent, overweight, school performance, longitudinal study, Hat Yai.

Introduction

Obesity in children is emerging as an epidemic worldwide. It is highly prevalent in both developed and developing countries.[1,2] Persistence of obesity into adolescence results in increasing risk of adult obesity.[3] Apart from health risks, obesity has been shown to be associated with social and economic disadvantages. The proportion of obese children placed in special education or remedial class settings was twice that for non-obese children.[4] In one study in the US, obese adolescents had poor high school performance,[5] possibly affecting their acceptance into colleges.[6] They also had fewer years of schooling than did their non-obese peers.[7] Later in adulthood, women who had been overweight during adolescence had lower incomes when compared with their non-obese counterparts, independent of their baseline social status and aptitude-test scores.[7-8]

A review of literature revealed an inverse relationship between obesity and socioeconomic status among women in industrialized societies, whereas in the developing countries the relationship was direct among men, women, and children.[9] In Thailand, though in transition from an agronomy-based to an industrial-based economy,[10] obesity-socioeconomic relation is like that of the developing countries. Obesity was more prevalent in the affluent urban dwellers.[11] From our previous study, children from the high income families were three times more likely to be obese than those from the low income group.[12]

The data on the school performance of obese children from the developing countries were scarce. A report from China showed that the moderately severe obese (> 50% overweight) school-aged children had average IQ scores 11 points lower than that of the non-obese controls.[13] Our own study showed that being overweight and becoming overweight during adolescence (grades 7-9 students) was associated with poor school performance over the two years follow-up, whereas such an association did not exist in children (grades 3-6 students).[14] In this report, we examined the association between body mass index (BMI) status and school performance among school children again in a longer period of follow-up i.e. 5 years.

Subjects and methods

Subjects A cohort of 2252 primary schoolchildren (grades 1-6) was recruited in 1991 and 1992 using two-stage sampling. Six schools (two municipality-operated and four private) were randomly selected from 13 primary schools in the Hat Yai metropolitan area, southern Thailand. Then, one or two classrooms of each grade were randomly selected from each school. Baseline demographic and family data including parental education, occupation and monthly income were obtained by questionnaire completed by parents. Weight and height were measured using a Detecto beam balance and stadiometer to the nearest 0.1 kg and 0.5 cm, respectively. Anthropometric data were then collected on an annual basis (in January) from 1993 to 1997. Parental consent was obtained and the study was approved by the Committee for Research in Human, Faculty of Medicine, Prince of Songkla University.

School performance Compulsory education in Thailand is 9 years, 6 years primary level (grades 1-6) and 3 years lower secondary level (grades 7-9). Children usually enter school at 7 years old and leave primary school at about 16 years old. Academic year opens in May and ends in March with a mid-year break in October. A grade system is used to score students' performance. Grades of a learning subject, in an ordinal scale of 0-4, are obtained mainly from written examinations. Teacher's subjective assessment of students' performance accounts for approximately 10% of total scores. Grade-point-average (GPA), a continuous value of 0-4, which reflects overall school performance, is calculated from grades of all subjects learned in that academic year. We obtained GPAs of our subjects from the school records at the end of March 1997.

Socioeconomic variables We used the baseline socioeconomic data collected in 1992 and assumed that there were no or relatively minimal changes of grouping in the two years. Parental education was classified as illiterate, primary, secondary and university level and occupation as casual worker, farmer, trader, government service and office worker. Parental income variable was categorized into 4 classes by using monthly income cut at <5,000, 5- <10,000, 1- < 30,000 and >= 30,000 baht (1 baht = 0.04 US dollar at the time of questionnaire).

Statistical analysis Association of school performance in 1997 with current (1997) and previous weight status over the five years was examined. Lower (grades 7-9 or mathayom 1-3) and upper (grades 10-12 or mathayom 4-6) secondary schoolers may have a different school performance-weight status relation. Subjects taken in these two levels were also different. Thus we did a separate analysis of grades 7-9 and grades 10-12 subjects. We used body mass index (BMI, the ratio of weight in kilograms divided by height squared in meters) to categorize weight status. Subjects were classified as underweight, normal, or overweight if their BMIs' were < 15^{th} percentile (<P_{15}), P_{15}-P_{85}, > P_{85} of the U.S. First National Health and Nutrition Examination Survey (NHANES I) data for age and sex.[15] Changes of BMI status from the preceeding year was categorized into four groups: stable-non-overweight, thinner (move from overweight to non-overweight), stable-overweight, and becoming overweight (move from non-overweight to overweight).

Since some subjects moved from Hat Yai, entered university, or moved to technical college, not all follow-up cases could provide school grade records. To check for selection bias, we used the chi-square tests to compare baseline variables of the selected cases and missing cases.

We used one-way ANOVA to describe the association among categorical baseline variables and GPA. In case of significant ANOVA, Bonferroni's test was performed to detect which category was significant diferrent from others. For ordinal variables, non-parametric test for trends was also permuted to investigate the linear response relationship.

To examine the association of yearly weight status from 1992-1997 with GPA, we computed multiple linear regression adjusted for gender, age, parental and family factors. Only factor with significant partial F-test was retained in the model. Since

standard scores are not available for comparison across schools, computation of association was also adjusted for schools. To minimize levels of each variable, levels that were not statistically different were collapsed and regroupped. Linear regression assumptions were examined by checking distribution of residual of each model using Swilk-Chapiro test and comparing the distribution of plots between residual and predicted values. Multiple linear regression was also performed accordingly to investigate the association between GPA with the yearly change in BMI status from the preceeding year from 1992-1997.

All analysis were performed using statistical software package STATA version 5.[16]

Results

Of 2252 subjects, 2153 (95.6 %) could be followed in 1993, 2003 (88.9 %) in 1994, 1784 (79.2 %) in 1995, 1459 (64.8 %) in 1996 and 1290 (57.3 %) in 1997. Due to different educational system, 211 students of grade 6 in 1997 were dropped out from the analysis. Of the remaining 1079 students, 1997 GPA of 886 children could be obtained i.e. 39.3 % of initial data or 68.7 % of 1997 children.

Chi-square tests showed that cases having GPA (non-missing group) and the missing group did not differ in baseline BMI and parental education, but differred in parental occupation and income and grade level in 1992 (Table 1). The selected group had more observations in grades 7-9 than the number of grades 10-12. Since the principal variable, baseline BMI status, was not different, the selected set of data was taken as valid for further analysis. To acknowledge the different distribution of grades between the selected and the missing groups, analysis was done by stratification by grades into two groups, grades 7-9 and grades 10-12. Mean GPA of the grades 7-9 (2.48, sd =0.81) was also significantly higher than that of the grades 10-12 (2.62, sd=0.60), $p = 0.0196$, supporting the choice of subgroup analysis.

We used one-way ANOVA to compare mean GPA of each baseline variable of both subgroups. For the grades 7-9 group, the mean 1997 GPA was found to associate with sex, school, father's and mother's education, father's and mother's occupation, and parental monthly income. (Table 2) For the grades 10-12 group, the mean 1997 GPA was associated with sex, school, and mother's education.

Bonferroni's tests showed that children of parents with primary education had the lowest mean GPA ($p<0.001$). Test for trends indicated the dose response relationship of parental education of the grades 7-9 students and of mother education of the grades 10-12 with children's mean GPA.

Regarding parental occupation, Bonferroni's test showed that children of the casual group had the lowest mean GPA. There was also a trend of the grades 7-9 group that the higher the income, the higher is the mean GPA.

There was a trend that GPA was associated with the weight status. Being overweight at any time over the five years tended to associate with low mean GPA. However the association was statistically significant in the grades 7-9 group of the most recent years (1996 and 1997). (Table 3) Becoming overweight at any time, except the year 1994,

also tended to associate with low mean GPA. Statistical significance was detected only for the most recent years (1997). (Table 4)

Multiple linear regression was performed to check the GPA-BMI association found in the univariate analysis. The models were adjusted for sex, school, mther's education and parental monthly income. Mother's education was regroupped into 2 levels: primary education and secondary education and above. Parental monthly income was re-categorized into 3 levels: 5,000 baht, 5-<10,000 baht and $\geq$ 10,000 baht. The results of the grades 7-9 group confirmed that being overweight in the recent years (1996-1997) was significantly associated with having a GPA of 0.20-0.24 point lower than the normal weight group. (Table 5) Such association was not significant for becoming overweight. The inverse associaiton of overweight and becoming overweight with GPA was not statistically significant in the grades 10-12 group. Graphic presentation of the association between the BMI status and GPA were shown in the Figures 1-2, association ctween the changes of BMI status and GPA were in the Figures 3-4.

Discussion

We found that school performance as measured by GPA was associated with curresnt and recent BMI status in young adolescents. Being overweight in the past year lowered GPA 0.24 point from that of the normal weight group, while being overweight in the current year decreased GPA by 0.20 point. This association could not be demonstrated in the late adolescence.

Our findings of poor school performance of the overweight adolescents confirm the adverse social consequence of obesity of previous reports.[4-9,17] We previously reported that being overweight and becoming overweight during adolescence (grades 7-9) was associated with poor school performance over the two years follow-up.[14] Women who had been overweight during adolescence had completed fewer years of schooling, were less likely to be married, had lower household incomes, and had higher rates of household than the women who had not been overweight, independent of their base-line socioeconomic status and aptitude-test scores. Men who had been overweight during adolescence were less likely to be married.[8] Thus, the social burden of pediatric obesity, especially during middle childhood and adolescence, may have lasting effects on self-esteem, body image and economic mobility.[18]

Whether the inverse relationship of overweight with GPA is causal or consequent has been debated.[19] Follow-up studies of adolescent and young adult cohorts for 7-12.5 years [7-8,17] suggest that it may be causal. In these studies the association between baseline obesity and subsequent socioeconomic attainment was controlled for other possible determinants of SES such as, parental SES and test scores for intelligence. On the contrary, our previous findings[14] of no association of academic performance with the previous BMI status over the two years follow-up do not support these studies. The present study of the same cohort for a longer period of five years confirms that this inverse relation exists only in the recent year. Since the subjects remaining in the cohort were mostly from the upper income group and in the school system, our findings may have to be interpreted carefully. Those who were overweight and underprivileged might have dropped out in the early years of follow-up. This self-

selected cohort might limit the ability of this study to demonstrate the linkage of former weight status with school performance.

The inverse relationship between academic performance and overweight was demonstrated only in the early adolescents (grades 7-9). The small number of overweights limits the detection of significant association among the late adolescent subjects (grades 10-12), yet the negative trend was still observed. Adolescents have been shown to use eating as a means to cope with stress.[20] In the National Longitudinal Survey of Youth, significantly lower levels of self-esteem were observed among 13-14-year-old obese boys, obese Hispanic girls, and obese white girls compared with their nonobese counterparts.[21] Putting on weight, as well as the poor academic performance, in our grades 7-9 group could possibly be the consequence of social environmental factors or mental stress.

In a transitional society setting, we found that the socioeconomic-obesity relation was typical of developing countries,[12] whereas the school performance-obesity relation was similar to that of industrialized countries. We have shown that being overweight during early adolescence (grades 7-9, 12-18 years old) is associated with poor school performance. This unwanted association may be persistent if our society adopts the social value of slimness as it is now being highly publicized in most commercial advertisements. Health informations for all parties caring for children and adolescents should include this important issue.

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Table 1 Baseline characteristics of the cases having GPA and the missing cases

Variables	Cases having GPA(n)	Missing cases (n)	P-value
Baseline BMI group	*886*	*1366*	NS
Underweight	199	328	
Normal	521	827	
Overweight	156	211	
Grade in 1992	*886*	*1366*	<0.001
Grade 1	1	209	
Grade 2	243	123	
Grade 3	224	173	
Grade 4	195	175	
Grade 5	118	243	
Grade 6	79	318	
Grade 7	26	125	
Father's occupation	*717*	*1078*	<0.001
No	2	8	
Casual	139	282	
Farmer	10	45	
Trader	343	410	
Government officer	161	259	
Office worker	62	74	

Table 1 (continued)

Variables	Cases having GPA(n)	Missing cases (n)	P-value
Mother's occupation	*734*	*1118*	<0.001
No	140	198	
Casual	86	204	
Farmer	6	37	
Trader	331	461	
Government officer	138	186	
Office worker	33	32	
Parental monthly income (baht)	*751*	*1116*	<0.001
<5,000	106	246	
5-<10,000	232	425	
1-<30,000	315	338	
≥30,000	98	107	

Table 2 Mean 1997 GPA of grades 7-9 and grades 10-13 by baseline variables.

	Grades 10-12				Grades 10-12			
Variables	n	Mean (sd)	p-val. [a]	p-trend[b]	n	Mean (sd)	p-val. [a]	p-trend[b]
Sex			<0.0001	-			0.0004	-
Male	291	2.28 (0.82)			87	2.45 (0.65)		
Female	373	2.64 (0.77)			135	2.74 (0.53)		
School			<0.0001	-			0.0047	-
School 1[c]	127	2.00 (0.63)			0	-		
School 2	162	2.75 (0.76)			83	2.74 (0.54)		
School 3	133	2.25 (0.79)			46	2.37 (0.55)		
School 4	77	3.13 (0.77)			92	2.66 (0.64)		
School 5 [a]	16	2.24 (0.78)			0	-		
School 6 [a]	10	2.17 (0.55)			0	-		
School 7 [a]	139	2.54 (0.72)			0	-		
Father's education			<0.001	<0.0001			NS	NS
No	12	2.40 (0.87)			4	2.71 (0.47)		
Primary	120	2.22 (0.76)			42	2.50 (0.55)		
Secondary	158	2.50 (0.81)			63	2.69 (0.57)		
higher	248	2.70 (0.79)			65	2.69 (0.66)		
Mother's education			<0.001	<0.0001			0.02	0.01
No	20	2.28 (0.83)			7	2.46 (0.51)		
Primary	211	2.27 (0.76)			62	2.48 (0.64)		
Secondary	107	2.57 (0.75)			40	2.74 (0.50)		
higher	224	2.75 (0.79)			63	2.78 (0.56)		

Table 2 (continued)

Variables	Grades 7-9				Grades 10-12			
	n	Mean (sd)	p-val [a]	p-trend[b]	n	Mean (sd)	p-val. [a]	p-trend[b]
Father's occupation			0.0007	-			NS	-
No	2	2.25 (1.12)			0	(0)		
Casual	117	2.26 (0.79)			22	2.51 (0.56)		
Farmer	8	2.07 (0.94)			2	2.70 (0.37)		
Trader	237	2.63 (0.78)			106	2.73 (0.55)		
Gov officer	130	2.60 (0.81)			31	2.52 (0.68)		
Off worker	49	2.60 (0.79)			13	2.62 (0.60)		
Mother's occupation			0.0000	-			NS	-
No	99	2.53 (0.78)			41	2.47 (0.51)		
Casual		75			11	2.52 (0.30)		
Farmer	6	2.32 (0.89)			0	(0)		
Trader	246	2.53 (0.78)			85	2.76 (0.60)		
Gov officer	106	2.73 (0.79)			32	2.64 (0.61)		
Off worker	28	2.84 (0.81)			5	2.71 (0.56)		
Income			<0.0001	<0001			NS	NS
<5,000	95	2.08 (0.70)			11	2.35 (0.62)		
5-<10,000	176	2.38 (0.78)			56	2.57 (0.63)		
1-<30,000	235	2.71 (0.77)			80	2.71 (0.53)		
≥30,000	67	2.77 (0.83)			31	2.65 (0.68)		

[a] One-way ANOVA, [b] non parametric test for trend, [c] these schools had only the grades 7-9.

Table 3 Mean 1997 GPA of the grades 7-9 and grades 10-12 students by the BMI group

	Grades 7-9				Grades 10-12			
BMI status	N	Mean (sd)	p-val [a]	p-trend [b]	n	Mean (sd)	p-val [a]	p-trend [b]
1992			NS	NS			NS	NS
Underweight	148	2.38 (0.82)			51	2.75 (0.57)		
Normal	405	2.52 (0.81)			126	2.60 (0.61)		
overweight	111	2.48 (0.81)			45	2.54 (0.60)		
1993			NS	NS			NS	NS
Underweight	161	2.46 (0.85)			44	2.77 (0.52)		
Normal	367	2.51 (0.80)			141	2.60 (0.62)		
Overweight	129	2.46 (0.81)			36	2.54 (0.58)		
1994			NS	NS			NS	NS
Underweight	147	2.45 (0.84)			29	2.62 (0.57)		
Normal	366	2.52 (0.81)			148	2.64 (0.61)		
overweight	134	2.45 (0.79)			34	2.53 (0.61)		
1995			NS	NS			NS	NS
Underweight	134	2.42 (0.89			33	2.63 (0.63)		
Normal	371	2.54 (0.79)			136	2.64 (0.57)		
overweight	128	2.42 (0.81)			26	2.53 (0.60)		
1996			0.005	NS			NS	NS
Underweight	120	2.41 (0.87)			28	2.70 (0.67)		
Normal	391	2.58 (0.79)			130	2.64 (0.57)		
overweight	116	2.33 (0.78)			18	2.50 (0.67)		
1997			0.002	NS			NS	NS
Underweight	121	2.34 (0.88)			39	2.65 (0.66)		
Normal	423	2.57 (0.80)			170	2.64 (0.58)		
overweight	120	2.34 (0.78)			13	2.34 (0.60)		

[a] One-way ANOVA analysis, [b] non parametric test for trend

Table 4 Mean 1997 GPA of the grades 7-9 and grades 10-12 students by the change of BMI status from the preceeding year from 1992-1997 ([a] One-way ANOVA analysis, [b] non parametric test for trend)

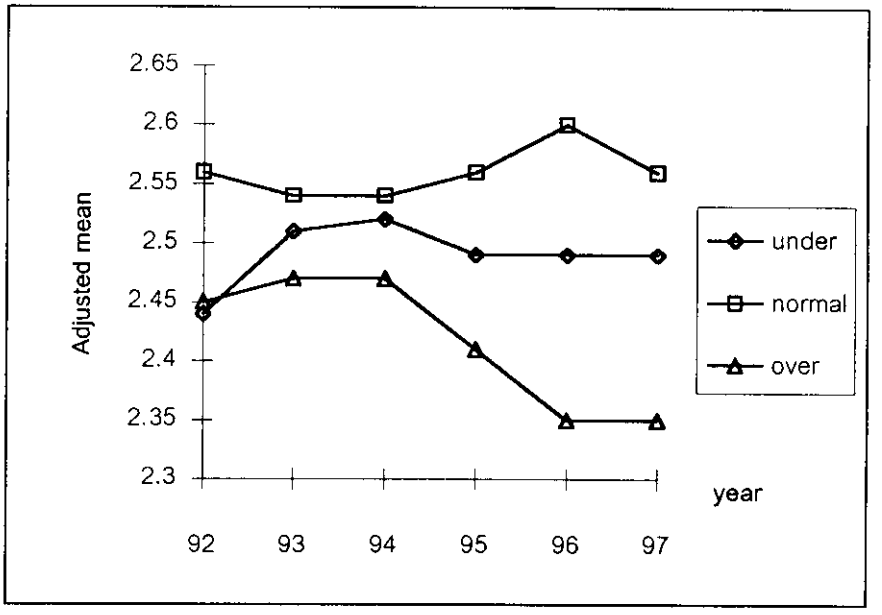
	Grades 7-9				Grades 10-12			
Change of BMI status	N	Mean (sd)	p-val [a]	p-trend [b]	n	Mean (sd)	p-val [a]	p-trend [b]
1993			NS	NS			NS	NS
Thinner	9	2.93 (0.61)			11	2.47 (0.69)		
Stable non-overwt	519	2.49 (0.82)			174	2.65 (0.60)		
Stable overwt	100	2.45 (0.81)			33	2.58 (0.59)		
Becoming overwt	29	2.48 (0.83)			3	2.09 (0.28)		
1994			NS	NS			NS	NS
Thinner	13	2.74 (0.80)			7	2.20(0.40)		
Stable non-overwt	499	2.49 (0.82)			170	2.66 (0.60)		
Stable overwt	115	2.44 (0.80)			28	2.58 (0.58)		
Becoming overwt	17	2.63 (0.70)			6	2.28 (0.79)		
1995			NS	NS			NS	NS
Thinner	19	2.57 (0.56)			9	2.48 (0.53)		
Stable non-overwt	478	2.50 (0.83)			153	2.64 (0.59)		
Stable overwt	113	2.43 (0.83)			22	2.60 (0.62)		
Becoming overwt	13	2.43 (0.66)			3	2.10 (0.33)		
1996			NS	0.02			NS	NS
Thinner	23	2.61 (0.89)			6	2.72 (0.52)		
Stable non-overwt	473	2.53 (0.81)			142	2.64 (0.58)		
Stable overwt	98	2.35 (0.80)			17	2.47 (0.67)		
Becoming overwt	15	2.22 (0.72)			0	0		
1997			0.036	0.02			NS	NS
Thinner	15	2.38 (0.71)			8	2.65 (0.66)		
Stable non-overwt	499	2.55 (0.81)			158	2.65 (0.58)		
Stable overwt	101	2.33 (0.80)			10	2.39 (0.68)		
Becoming overwt	12	2.19 (0.66)			0	0		

Table 5 Multiple linear regression analysis of 1997 GPA and 1992-1997 BMI status[a]

	Grades 7-9			Grades 10-12		
BMI status	**Coefficient**	**95% CI**	**p**	**Coefficient**	**95% CI**	**p**
1992						
Underweight	-0.08	-0.22-0.06	NS	0.29	0.06-0.52	NS
Overweight	-0.11	-0.28-0.05	NS	-0.37	-0.25-0.15	NS
1993						
Underweight	-0.02	-0.16-0.12	NS	0.27	0.05-0.50	NS
Overweight	-0.08	-0.24-0.08	NS	0.01	-0.23-0.25	NS
1994						
Underweight	0.01	-0.13-0.16	NS	0.18	-0.11-0.48	NS
Overweight	-0.08	-0.24-0.81	NS	-0.05	-0.31-0.20	NS
1995						
Underweight	-0.05	-0.20-0.10	NS	0.14	-0.13-0.42	NS
Overweight	-0.06	-0.33-0.00	0.053	-0.06	-0.33-0.20	NS
1996						
Underweight	-0.09	-0.25-0.06	NS	0.23	-0.06-0.52	NS
Overweight	-0.24	-0.40-(-0.07)	0.005	-0.07	-0.38-0.23	NS
1997						
Underweight	-0.05	-0.21-0.11	NS	0.17	-0.06-0.41	NS
Overweight	-0.20	-0.36-(-0.03)	0.017	-0.20	-0.52-0.13	NS

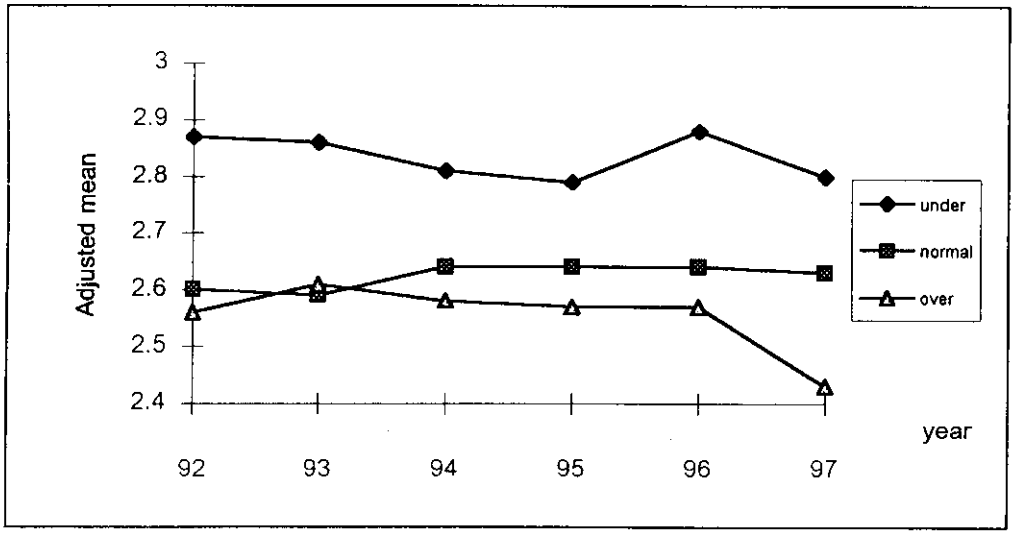
[a] Adjusted for sex, school, mother's education and parental monthly income. Reference group is the normal BMI group.

Figure 1. Adjusted means of 1997 GPA of the grades 7-9 by 1992-1997 BMI status from multiple linear regression.



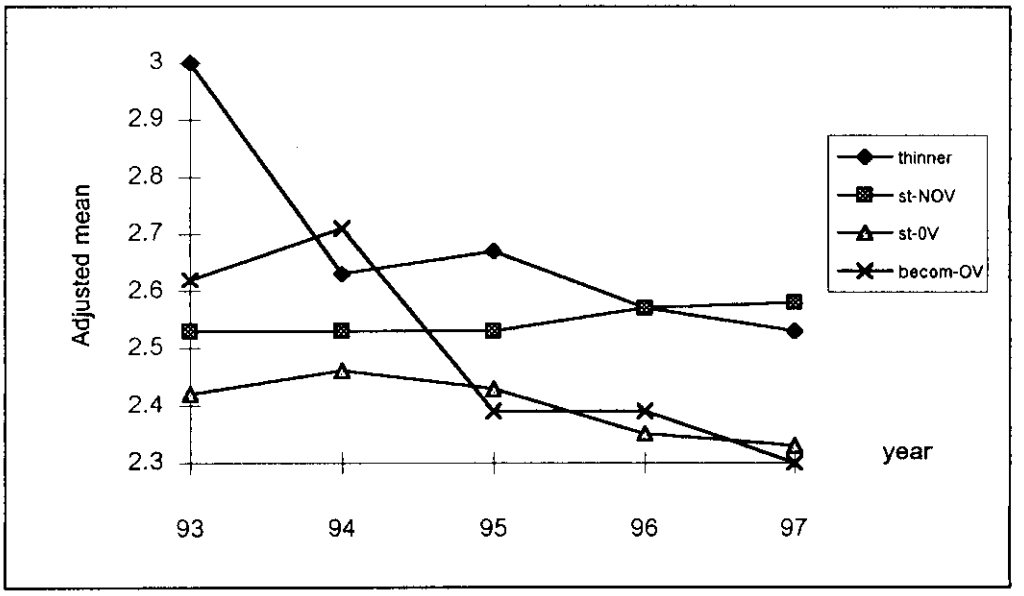
Note: under = underweight group, over = overweight group

Figure 2. Adjusted means of 1997 GPA of the grades 10-12 by 1992-1997 BMI status from multiple linear regression.



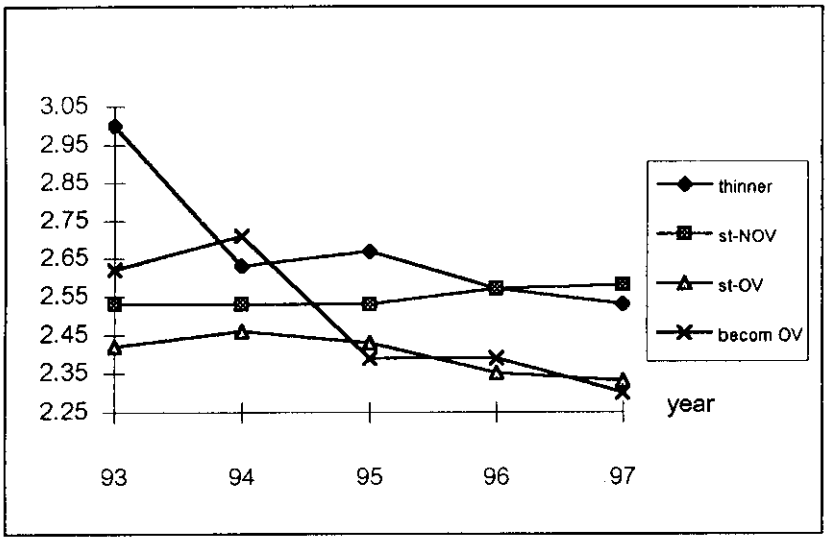
Note: under = underweight group, over = overweight group

Figure 3. Adjusted means of 1997 GPA of the grades 7-9 by 1992-1997 BMI status changes from multiple linear regression.



Note: st-NOV = stable non-overweight, st-OV = stable overweight, becom OV = becoming overweight.

Figure 4. Adjusted means of 1997 GPA of the grades 10-12 by 1992-1997 BMI status changes from multiple linear regression.



Note: st-NOV = stable non-overweight, st-OV = stable overweight, becom OV = becoming overweight.