2012

Reducing Overweight and Obesity among Elementary Students in Wuhan, China

Ling Qian
Chinese Center for Health Education

Ian Newman
University of Nebraska-Lincoln, inewman1@unl.edu

Duane F. Shell
University of Nebraska-Lincoln, dshell2@unl.edu

Cheng Maojin Cheng
Tongji Medical College, Huashong University

Reducing Overweight and Obesity among Elementary Students in Wuhan, China

Ling Qian MD, PhD[1], Ian M. Newman PhD[2], Duane F. Shell PhD[3], Cheng Maojin Cheng MD, MpH[4]

Author[1] is affiliated with the Department of Training, Chinese Center for Health Education. Authors [2] & [3] are affiliated with the Department of Educational Psychology, University of Nebraska-Lincoln. Author [4] is affiliated with the School of Public Health, Tongji Medical College, Huashong University for Science and Technology.. **Contact author**: Ian Newman, PhD Department of Educational Psychology, University of Nebraska-Lincoln, P.O. Box 880345, Lincoln, NE 68588-0345; Phone: (402) 472-3844; Fax: (402) 472- 9454 Email: inewman1@unl.edu

Submitted September 9, 2011; Revised and Accepted April 20, 2012

Abstract

Obesity and overweight among children in China is a growing concern. The curriculum and organization of Chinese schools focuses on academic achievement leaving little time for other programs. This pilot program illustrated that it is possible to involve schools and parents in a program to reduce obesity and overweight. Teachers, school staff, parents and elementary students were involved in an all-school educational initiative based on WHO's Health Promoting School Model. The program was evaluated with a mixed modal ANOVA using a 3-level within subjects repeated factor (baseline, 1st follow-up, 2nd follow-up) and a 2-level between subjects factor (gender: boys and girls). Results indicated that it was possible to successfully involve a whole school and its parents in an innovative program aimed at reducing child obesity. Knowledge significantly increased between baseline and 1st follow-up but not between 1st and 2nd follow-up. Attitude scores increased across all assessments. Behavior scores increased significantly across all assessment periods. Boys maintained positive decreases in their BMI Z scores, while girls, after initial gains, reverted back to their initial baseline BMI Z scores. It is concluded that it was possible to conduct an effective comprehensive school health education program aimed at reducing obesity in Chinese elementary schools.

***Key words**: Obesity, overweight, comprehensive school health programs, elementary school children, school policy*

Introduction

In China there is now evidence of increasing overweight and obesity among school-age youth in urban areas. Data from China's National Student Physical Examination Survey (NSPES) reported that among young people aged 7 to 18 years living in urban areas the obesity prevalence for boys increased from 4.0% in 1995 to 8.9% in 2000 and to 11.5% in 2002. For girls the rate increased from 3.5% to 5.6% to 7.7% in the same period.[1] Results from the National Student Health Survey (NSHS) conducted in 2000 and 2005 by the Ministry of Education indicated from 2000 to 2005 the proportion of overweight people ages 7–22 increased from 1.4% to 13.3% for males and from 0.7% to 8.7% for females. The proportion of obese males increased from 2.7% to 11.4%, and the proportion of obese females grew from 0.9% to 4.6%.[2]

Data from provincial surveys also suggested this trend and showed overweight and obesity were more pronounced in certain areas. In Shandong province the percentage of overweight urban boys increased from 3.1% in 1985 to 17.5% in 2005. For girls the increase was from 2.7% to 10.6%. For students classified as obese the percentages rose from 0.5% for boys in 1985 to 14.5% in 2005 and for girls from 0.4% to 6.8%. In rural areas the pattern is similar but lags behind urban areas. In rural Shandong the percentage of overweight boys increased from 0.7% in 1985 to 11.1% in 2005 and for rural girls from 1.5% to 7.0%. The percent of obese boys increased from 0.0% in 1985 to 7.1% in 2005 and for girls from 0.1% to 4.7%.[3]

Data from Shenzhen, a special economic zone adjacent to Hong Kong, indicated that 19% of boys and 11% girls were overweight and/or obese with prevalence peaking at age 11 for boys and age 10-11 for girls.[4]

Ji and Cheng tracked changes in the prevalence of child and adolescent overweight and obesity between 1985 and 2005 using data from the Chinese National Survey on Student Constitution and Health. They noted significant geographic variations based on economic development. Northern coastal residents, especially those in the upper socioeconomic status, had the earliest onset of overweight and obesity and showed the largest percent increases. They were followed successively by residents in other urban regions of moderate and low socioeconomic status and finally the affluent rural regions. No changes were found in the developing rural areas.[5]

In Beijing, an affluent city, 38.5% of the boys were overweight or obese compared to 24.6% in China's urban populations as a whole; 19.8% of females in Beijing were overweight or obese compared to 9.6% in the country as a whole.[2]

As Ji and Cheng pointed out, rural areas lagged behind urban areas in terms of economic development and in the proportion of young people who were overweight and obese. However, in the last several years government policies directed at rural economic development increased rural family incomes and may also have had the effect of increasing rural child and adolescent obesity. Du, et al., found that increased income among the poor was associated with a dietary change from high carbohydrate foods to high-fat, high energy dense foods.[6] The National Student Health Survey 2005 indicated that among rural males ages 7–22 the overweight proportion increased from 1.8% to 8.2% from 2000 to 2005; among rural females it grew from 1.2% to 4.6%. The proportion of obese rural males increased from 1.8% to 5.1%; among females obesity increased from 0.4% to 2.6%. The problem of overweight and obesity differs between males and females, urban and rural populations, and between specific areas compared to China as a whole, but the trend in all cases is increasing overweight and obesity among young people.[2]

Several reasons can be suggested for this trend. China's one child policy means two parents and four grandparents can dote on their child, with no competition from brothers and sisters or cousins. The strong preference for sons might account for higher proportions of overweight among boys compared to girls. China's considerable economic changes in the last 25 years have contributed to increased discretionary household spending, greater availability and variety of foods in the marketplace, and more consumption of popular fast foods and prepackaged foods. At the same time, urbanization, mechanization, and expanded public transportation have decreased caloric expenditure. Traditional active recreation has given way to sedentary diversions like television, internet, and computer games. An extreme emphasis on academic achievement for future career success has reduced the time children play outdoors and engage in recreational or relaxing activities.

Xie, et al., found that higher levels of parent education and family income were significant risk factors for Chinese adolescent overweight and obesity,[7] which suggests that the higher levels of education associated with higher income do not necessarily lead to increase in knowledge related to behavioral issues such as the relationship between food intake, active versus sedentary lifestyle, overweight/obesity, and disease. Li, et al., found overweight and obesity in Xi'an were associated with living in urban areas, limited use of school sports facilities, living in a wealthy household, having parents who restricted the purchase of snacks, having an overweight/obese parent, and consuming soft drinks more than four times a week.[8]

The government of China has initiated a number of approaches to slow the increase in obesity rates. Approaches include policies that promote exercise and healthy eating,[9] monitoring nutrition status through national health surveys and annual physical examinations,[10,11] developing prevention strategies focusing on weight control, balanced diet and exercise,[12] and supporting the development of health promoting schools.[13]

An analysis of 17 school-based interventions designed to prevent or reduce excessive weight among Chinese children and adolescents showed most such programs focused on improving knowledge of physical activity and diet among adolescents. Most reported beneficial effects on one or more of the study outcomes, though none presented convincing evidence of efficacy in preventing overweight or obesity.[14]

It was this lack of effect of health programs that focus on the individual or on a single variable like knowledge that led the WHO (mainly through initiatives in Europe) to develop the concept of Health-Promoting Schools (HPS). Health promoting schools are centered on the principle that effective school health programs incorporate all aspects of school, and involve student families and the community in health education and health promotion programs rather than merely offering health classes.[13]

Some HPS programs have focused successfully on specific health issues such as smoking control, sexually transmitted diseases, hygiene, food safety, worm infections and the prevention of HIV/AIDS. Even when HPS schools did not intentionally set out to reduce obesity, data suggested they often did.[15]

Sharma,[16,17] in reviews of school-based obesity programs, concluded results were mixed, but programs that involved parents appeared to be more effective than those that did not. Sharma noted that many US obesity control programs were founded on behavioral theory, but they tended to focus on individual level behavior changes and not address policy and environmental factors.[17] Obesity control programs outside US often lacked a theoretical basis but had some advantages in that educational planners had greater freedom to involve parents and the community in programs, considered both policy and environmental influences and strategies, and to had a longer time-frame for follow-up evaluation.[16]

There are many reports of US school-based obesity interventions but evidence of long-term effectiveness is limited.[18] This is not surprising given that most are of short duration and focus on a narrow range of outcomes, typically increasing physical activity, increasing knowledge and improving attitudes, changing eating behavior, and behavior modification. There is an absence of comprehensive obesity interventions in the US based on the principles of Comprehensive School Health (outlined by Allensworth and Kolbe,[19] and similar to WHO's Health Promoting Schools principles).

The purpose of this study was to assess the effectiveness of a school-based obesity control program, based on the principles of WHO's Health-Promoting Schools that aimed to change students' obesity-related knowledge, attitude, behaviors and their BMI scores.

Methods

Setting and participants

This study was conducted in two of 46 elementary schools in one district of Wuhan, a city of 7.0 million people in Hubei Province in Central China. The two schools with enrolments around 1000 students each were randomly selected from schools with obesity rates that approximated the median obesity rate for the city (8%). Students were in Grades 3 and 4, average age 10 years, at the beginning of this project. Seven hundred ten (710) students completed all three surveys. Children were the primary focus of the program; their parents, their teachers, and school staff were the secondary focus.

Intervention

This study evaluated the effectiveness of a school-based obesity control program based on the six Health Promoting School principles: (1) developing or reforming healthy school policies, (2) improving school physical environment, (3) changing school social environment, (4) strengthening family and community involvement, (5) developing individual health skills, and (6) providing comprehensive health services.[13]

These principles were operationalized in the following ways:

1) School policy changed to regularize the time and intensity of student physical activity, improve the management of school food services, and regularize school work demands.

2) The school's physical environment improved with the provision of balanced and nutritional food in the school cafeteria, water fountains in the school building, paved playground surfaces outdoors, and installation of physical activity equipment.

3) The project contained various social activities to help students develop healthy and effective interpersonal relationships.

4) Links between the school and the students' families were created by conducting lectures and discussions for parents and for school staff emphasizing knowledge about health and the balance between eating and physical exercise, and behaviors like preparing healthy foods at home and monitoring their child's exercise patterns.

5) Health education and health information were integrated into all academic subjects with an emphasis on active learning by involving students in activities like writing compositions about nutrition, calculating caloric and nutritional values of food, composing verse and songs about health, and creating paintings about health.

6) The school provided medical services for all students and special services to overweight students. These included recording height and weight measures each year, providing individual counseling and instruction, helping students maintain a seven-day diet and activity log, and for students who brought their lunch to school, providing a nutritional evaluation of their lunches accompanied by advice on how to improve their lunches to help with weight control. In addition students who were overweight/obese were provided specific exercise programs and involved in organized sports teams.

Evaluation

The HPS obesity prevention program was introduced after a baseline survey assessed knowledge, attitudes, behaviors and BMI sores. A follow-up survey and BMI assessment was completed one year later and a second follow-up survey and BMI assessment one additional year later. All data were collected in classrooms by trained survey administrators. Teachers were not involved in data collection.

The questionnaire was developed by a team of Chinese nutrition and health education professionals and was based on a review of Chinese and western research reports, a review of other available questionnaires, and the objectives of the HPS program. The initial version of the questionnaire was reviewed by other health professionals, revised and then pretested with students of the same grade and age as the program to be evaluated. After pre-testing, small changes were made to improve comprehension and clarity of questions. The final questionnaire included 13 knowledge items about nutrition and physical activity, 5 attitude questions, and 15 behavior questions about personal eating and exercising.

Weight and height data for the BMI assessments were collected in the spring of each year by the school doctor as part of the required annual physical examination. Weight was measured in light indoor clothing without shoes using a beam balance scale. Height was measured without shoes. Age was measured in one full year of life (survey year minus birth year).

Age-gender specific BMI values were based on those proposed by the International Obesity Taskforce and reported by Cole *et al*[20] based on nationally representative cross-sectional growth studies in Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States. BMI scores were compared with a reference data set (the entire sample) and reported as a Z score according to the following formula:

$$\frac{\text{(observed value) - (median reference value of a population)}}{\text{standard deviation of reference population}}$$

Thus, a *Z* score of 0 is equivalent to the median, or 50th percentile, and a *Z* score of +2.00 is approximately equivalent to the 97th percentile. BMI-for-age *Z* scores allow a more detailed statistical description of individuals, particularly individuals at extremes of BMI. The statement that an individual has a BMI greater than the 97th percentile does not describe how far above the percentile that individual is, but the BMI *Z* score does.

Analysis

The completed questionnaires were screened for errors. Questionnaires were eliminated if student codes were missing, there were inconsistent data for birth year, gender, height and weight, or four or more questions were not answered. Seven hundred and ten students completed all three surveys (745 completed the first and third survey, 778 the first and second, 725 the second and third). The students not completing all surveys did not differ by gender, age, grade or BMI from the students completing all surveys.

Analysis was done using SPSS v.18, general linear model procedure. A mixed model ANOVA was done with a 3-level within subjects repeated factor (baseline, 1st follow-up, 2nd follow-up) and 2-level between subjects factor (gender: boys and girls). Huynh-Feldt adjustments to degrees of freedom were made based on significant Mauchly's Test of Sphericity. Repeated planned contrasts were used to test for significant differences in the within subjects factor and the interaction. Repeated contrasts compared changes across contiguous time periods: time 1 (baseline) to time 2 (1st follow-up) and time 2 (1st follow-up) to time 3 (2nd follow-up). The 710 students in the analysis included 391 boys (55%) and 319 girls (45%).

Results

Knowledge

Knowledge and gender did not have a significant interaction, $F(1.64, \text{Huynh-Feldt}) = 2.21$, $p = .121$. Knowledge significantly increased between baseline and 1st follow-up. There was no significant difference between 1st and 2nd follow-up. This suggests that initial gains were maintained through the 2nd follow-up. Partial $\underline{Eta^2}$ suggested a large effect size (Table 1).

Attitude

There was a significant interaction between attitude and gender, $F(1.66, \text{Huynh-Feldt}) = 4.99$, $p =.011$. However, partial Eta^2 of .007 suggests a very small effect size that is likely not meaningful. Attitude scores increased across all assessment periods. Repeated contrasts for the interaction indicated that between baseline and 1st follow-up girls' scores increased significantly more than boys, $F(1) = 4.20$, $p = .041$, partial $Eta^2 = .006$. There was no difference between boys and girls from 1st follow-up to 2nd follow-up $F(1) = 1.18$, $p = .227$, partial $Eta^2 = .002$. Partial Eta^2 for main effects for boys and girls and total sample indicated a moderate to large effect size (Table 2).

Behavior

Behavior and gender did not have a significant interaction, $F(1.95, \text{Huynh-Feldt}) = .46$, $p =.625$. Behavior scores increased significantly across all assessment periods. Partial $\underline{Eta^2}$ suggested a large effect (Table 3).

BMI Z scores

There was a significant interaction between BMI *Z* score and gender, $F(1.94, \text{Huynh-Feldt}) = 10.00$, $p < .01$. The partial Eta^2 of .014 suggests a small interaction effect size. Repeated contrasts for the interaction indicated that between baseline and 1st follow-up there was no difference between boys and girls, $F(1) = .261$, $p = .610$. Both decreased significantly. From 1st follow-up to second follow-up boys' BMI *Z* scores continued to decrease but not significantly while girls BMI *Z* scores increased significantly, $F(1) = 17.09$, $p < .01$, partial $Eta^2 = .024$. The results suggest that boys continued to maintain positive decreases in their BMI *Z* scores while girls reverted back to their initial baseline BMI *Z* scores. The partial Eta^2 for main effects for boys and girls and total sample suggested small effect sizes (Table 4).

Discussion and Conclusion

This study evaluated the effects of a two-year HPS program intended to improve knowledge and attitude scores related to overweight/obesity, improve eating and exercise behavior, and reduce BMI scores among students in grades 3 and 4 in two schools in Wuhan, China. Results suggested that after two years the program had positive effects on each of the variables assessed: knowledge, attitudes, behaviors, and BMI scores.

Knowledge scores increased significantly in the first year but not in the second year. The early gains may have resulted from initial low levels of knowledge, making these gains easy. The knowledge part of the program may have been more appealing and more effective to younger students and less so as they increased in age. A school-based program should stimulate knowledge gains continuously across time. If active teaching continued in the second year the absence of knowledge gains could represent an ineffective curriculum, teachers not well prepared for teaching about this topic, or limitations in the evaluation questionnaire. A broader assessment of knowledge than the 13 questions used in this evaluation may be needed. Similarly an assessment of teacher competence may give insight into the program's failure to be as effective in promoting knowledge gains in the second year.

The small gender differences in attitude at the beginning of the project were likely insignificant in practical terms. Attitudes became increasingly positive as the program developed, possibly reflecting the changes in the school's policy and physical environment changes. Similarly the continued improvement in behaviors throughout the project likely reflected an environment increasingly supportive of physical activity and healthy eating.

As expected these positive cognitive and affective changes were reflected in BMI scores, although not as consistently as hypothesized. Improvements in the first year were recorded for both boys and girls but in the second year only boys reported continued improvement in BMI scores. The reason for the gender difference is unknown. Possibly the project effectiveness for girls was limited as a result of growth patterns related to their age. Boys may have made greater use of the increased opportunities for physical activity. As noted in the introduction,[1,2] boys in China are more likely to be obese than girls, so the finding that this program's effect was greater for boys than for girls was positive.

No doubt there will be many educational efforts to influence obesity among Chinese young people in the future. In the process it will be useful if investigators consider the following three questions: 1) What is the relationship between obesity and academic performance?[21] Chinese place great importance on educational achievement. Such a relationship would likely catch the attention of policy makers and could martial increased support for expanded obesity control endeavors. 2) What are the educational dangers of regular BMI screening[22] and how can they be minimized? How young people interpret BMI screening results can affect body image, peer relations, parenting styles, and self confidence, encourage weight related teasing, and possibly contribute to eating disorders. Poorly planned educational programs that do not consider these questions could be counterproductive. Lastly and most likely overlooked, 3) How do young people perceive eating, obesity and exercise?[23.24] Expectancies are one of the best predictors of behaviors.[25] A better understanding of nutrition expectancies and exercise expectancies would provide some clear direction for educational content and the possible differing educational needs of boys and girls. Other research has shown that expectancies among Chinese youth can be measured and, while some expectancies are similar to expectancies among same-age groups in the west, a few are quite different and culturally specific,[26,27] indicating that western education and policy models may have limited utility unless adapted to Chinese culture.

Limitations should be noted when these results are interpreted. This study was one of the first of its kind in China evaluating an educational intervention based on the HPS model. Only two of 46 schools in the district were involved. Teachers knew they were part of a special program. Repeated questionnaires used in the evaluation were unusual for the students. The absence of a control group weakened the design. A number of students did not complete all three evaluation questionnaires, though there were no differences of the salient measures among dropouts compared to participants. The psychometric qualities of the questionnaire used in the evaluation had not been fully assessed.

Despite its limitations, the project indicated that it was possible to successfully involve schools and their communities of parents in an educational program to reduce obesity. Teachers were willing to change their regular teaching patterns to accommodate the program, and students benefitted. While gains in knowledge, attitude, and behavior were modest they were measurable and the project clearly showed that programs of this type are possible and beneficial in Chinese schools, which typically have not deviated from the traditional academic curriculum.

Implications for School Health

These school-specific results are encouraging and the program clearly addresses the government's priorities to counter the effects of nutrition transition.[9,10] As found by Li (et al),[14] this project noted some improvements in specific knowledge and attitudes; but unlike the studies in Li et al's review this project showed clear changes in behavior associated with BMI scores. Compared with the non-US studies described by Sharma[16] this program did have a clear conceptual basis, the HPS model, and unlike most US studies described in Sharma[17] it did have a long term follow-up evaluation.

While these results are encouraging they need to be considered in the context of the larger society. Schools cannot be expected to solve social problems like obesity without major changes also occurring in the larger society. In fact, schools will be limited in their effectiveness unless their policies and education are reinforced by family and community initiatives. School officials should be careful not to suggest that their programs alone will make a significant difference to the problems of overweight and obese students. Birch and Davison[28] have made this point clearly. The planners of this project acknowledged the need for community involvement by including students, teachers, school staff, and parents. In addition, program initiatives occurred at several levels—direct education, school policy and environmental changes, community (parents) involvement, and additional services to overweight and obese students.

Reviews of school-based obesity control efforts have led to the conclusion that despite a variety of approaches real success in reducing obesity is difficult.[16-18,29-32] Reasons have been suggested for why the results of obesity control programs for children and youth have been disappointing: programs were rarely based on a stated theoretical framework, their evaluation designs were often confounded, program implementation often lacked rigor, and evaluation timelines were short.[16-18, 33] This project was likely more successful than many because its planners addressed many of the earlier identified obstacles to program success.

Human subjects approval statement

This study was approved by the University of Nebraska-Lincoln institutional review board and by the appropriate educational authorities in China.

Acknowledgments

We thank the staff and students of the schools who participated in the study and the officials of the Bureau of Health and the Bureau of Education for their support. We acknowledge the assistance and editing provided by Colin Bell and Michelle Maas.

References

1. Ministry of Education, China. *Report on China National Student Physical Examination Survey (NSPES) in 2002* [in Chinese]. Beijing: Ministry of Education; 2003.

2. Ministry of Education, China. *Report on the National Student Health Survey 2005* [in Chinese]. Beijing: Ministry of Education, 2006.

3. Zhang YX, Wang SR. Distribution of body mass index and the prevalence changes of overweight and obesity among adolescents in Shandong, China from 1985 to 2005. *Ann Hum Biol.* 2008 Sep;35(5):547-555.

4. Hui L, Bell AC. Overweight and obesity in children from Shenzhen, People's Republic of China. *Health Place.* 2003;9(4):371–6.

5. Ji CY, Cheng TO. Epidemic increase in overweight and obesity in Chinese children from 1985 to 2005. *Int J Cardiol.* 2009 Feb;132(1):1-10.

6. Du SF, Mroz TA, Zhai FY, Popkin BM. Rapid income growth adversely affects diet quality in China—particularly for the poor! *Soc Sci Med.* 2004;59:1505-1515.

7. Xie B, Chou CP, Spruijt-Metz D, et al. Socio-demographic and economic correlates of overweight status in Chinese adolescents. *Am J Health Behav.* 2007;31(4):339-352.

8. Li M, Dibley MJ, Sibbritt D, Yan H. Factors associated with adolescents' overweight and obesity at community, school and household levels in Xi'an City, China: results of a hierarchical analysis. *Eur J Clin Nutr.* 2008;62(5):635-643.

9. Zhai FY, Fu DW, Du SF, et al. What is China doing in policy-making to push back the negative aspects of the nutrition transition? *Public Health Nutr.* 2002;5(1A):269-73.

10. Ministry of Education, China. *Implementation Plan on National Student Health Surveillance Network* [in Chinese]. Beijing: Ministry of Health; 2002.

11. Ministry of Education, China. *Regulation on School Health Work* [in Chinese]. Beijing: Ministry of Health; 1990.

12. Malina RM. Childhood and adolescent obesity: selected issues and implications. In Johnston FE, Foster GD, eds. In *Obesity, Growth and Development*. London: Smith-Gordon; 2001:1-20.

13. World Health Organization. *Regional guidelines: Development of health-promoting schools—a framework for action.* Health Promoting Schools Series 5. Manila: WHO, Western Pacific Regional Office; 1996.

14. Li M, Li S, Baur LA, Huxley RR. A systematic review of school-based intervention studies for the prevention or reduction of excess weight among Chinese children and adolescents. *Obes Rev.* 2008;9(6):548-559.

15. Bell AC. *Using the health promoting schools principles to prevent childhood overweight and obesity in China: A review of existing data and the outline of an intervention project*. A report to the Western Pacific Regional Office. Manila: World Health Organization, WPRO; 19 Mar, 2002.

16. Sharma M. International school-based interventions for preventing obesity in children. *Obes Rev.* 2007;8(2):155-167.

17. Sharma M. School-based interventions for childhood and adolescent obesity. *Obes Rev.* 2006;7:261-269.

18. Shaya FT, Flores D, Gbarayor CM, Wang, JS. School-based obesity interventions: a literature review. *J Sch Health.* 2008;78(4):189-196.

19. Allensworth DD, Kolbe LJ. The Comprehensive School Health Program: exploring an expanded concept. *J Sch Health.* 1987;57(10):407-412.

20. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ.* 2000;320:1240-43.

21. Judge S, Jahns L. Association of overweight with academic performance and social and behavioural problems: an update from the early childhood longitudinal study. *J Sch Health.* 2007;77(10):672-8.

22. Ikeda JP, Crawford PB, Woodward-Lopez G. BMI screening in schools: helpful or harmful. *Health Educ Res.* 2006;21(6):761-9.

23. Shepherd J, Harden A, Rees R, et al. Young people and healthy eating: a systematic review of research on barriers and facilitators. *Health Educ Res.* 2005;21(2):239-57.

24. Xie B, Chou CP, Spruijt-Metz D, et al. Weight perception, academic performance and psychological factors in Chinese adolescents. *Am J Health Behav.* 2006;30(2):115-124.

25. Wigfield A, Eccles JJ. The development of achievement task values: a theoretical analysis. *Development Review.* 1992;12:265-310.

26. Newman IM, Qian L, Shell DF, et al. Development of Chinese adolescent alcohol expectancy questionnaire [in Chinese]. *Zhongguo Xing Wei Yi Xue Ke Xue [Chinese Journal of Behavioral Medical Science].* 2006;15(3 March):274-276.

27. Newman IM, Qian L, Shell DF, et al. Measurement of alcohol expectancy and development of Chinese adolescent alcohol expectancy questionnaire (CAEQ) [in Chinese]. *Zhongguo Wiesheng Tongji [Chinese Journal of Health Statistics].* 2006;23(5):426-429.

28. Birch LL, Davison KK. Family environmental factors influencing the developing behavioural controls of food intake and childhood overweight. *Pediatr Clin of Nrth Am.* 2001;48(4):893-907.

29. Story M. School-based approaches for preventing and treating obesity. *Int J Obes Relat Metab Disord.* 1999;23(Suppl. 2):S43-51.

30. Resnicow KA, Robinson TN. School-based cardiovascular disease prevention studies: review and synthesis. *Ann Epidemiol.* 1997;7(7):S14-31.

31. McArthur DB. Heart healthy eating behaviours of children following a school-based intervention: a meta-analysis. *Issues Compr Pediatr Nurs.* 1998;21:35-48.

32. Glenny AM, O'Meara S, Melville A *et al*. The treatment and prevention of obesity: a systematic review of the literature. *Int J Obes.* 1997;21:715-37.

33. Thomas H. Obesity prevention programs for children and youth: why are their results so modest? *Health Educ Res.* 2006;21:783-795.

Table 1 Mixed Model ANOVA Results for Knowledge

	Baseline		1st Follow-up		2nd Follow-up			Partial
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*Eta²*
Boys	4.77_a	1.62	9.22_b	2.52	9.34	.81	1052.4*	.730
Girls	4.89_a	1.39	9.59_b	2.22	9.38	.87	1105.2*	.777
All	4.82_a	1.52	9.39_b	2.39	9.36	.84	2109.8*	.749

Note. Possible score: 0–13. Huynh-Feldt adjusted *df* = 1.64 for all, 1.64 for boys, and 1.63 for girls; means with different subscripts are different at $p < .05$ in repeated contrasts of baseline vs 1st follow-up and 1st follow-up vs 2nd follow-up.
* = $p < .01$.

Table 2 Mixed Model ANOVA Results for Attitude

	Baseline		1st Follow-up		2nd Follow-up			Partial
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*Eta²*
Boys	4.02_a	1.17	4.69_b	.64	4.91_c	.47	130.7*	.251
Girls	4.29_a	.95	4.78_b	.54	4.94_c	.50	94.4*	.229
All	4.14_a	1.08	4.73_b	.60	4.93_c	.49	214.2*	.232

Note. Possible score: 0–5. Huynh-Feldt adjusted *df* = 1.66 for all, 1.58 for boys, and 1.81 for girls; means with different subscripts are different at $p < .05$ in repeated contrasts of baseline vs 1st follow-up and 1st follow-up vs 2nd follow-up.
* = $p < .01$.

Table 3 Mixed Model ANOVA Results for Behavior

	Baseline		1st Follow-up		2nd Follow-up			Partial
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*Eta*^{2}
Boys	8.56_a	2.24	10.82_b	2.02	12.09_c	1.53	411.0*	.513
Girls	8.85_a	1.97	11.05_b	1.81	12.22_c	1.35	379.4*	.544
All	8.69_a	2.13	10.92_b	1.93	12.15_c	1.45	773.0*	.522

Note. Possible score: 0–15. Huynh-Feldt adjusted *df* = 1.95 for all, 1.93 for boys, and 1.97 for girls; means with different subscripts are different at $p < .05$ in repeated contrasts of baseline vs 1st follow-up and 1st follow-up vs 2nd follow-up.
* = $p < .01$.

Table 4 Mixed Model ANOVA Results for BMI Z scores

	Baseline		1st Follow-up		2nd Follow-up			Partial
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*Eta*^{2}
Boys	$.020_a$	1.147	$-.110_b$	1.173	-.175	1.237	16.1*	.040
Girls	$-.432_a$	.975	$-.587_b$	1.017	$-.440_c$	1.061	10.4*	.032
All	$-.183_a$	1.096	$-.324_b$	1.130	-.294	1.168	16.0*	.022

Note. Huynh-Feldt adjusted *df* = 1.94 for all, 1.86 for boys, and 2.00 for girls; means with different subscripts are different at $p < .05$ in repeated contrasts of baseline vs 1st follow-up and 1st follow-up vs 2nd follow-up.
* = $p < .01$.