Short Communication

A school-based comprehensive lifestyle intervention among Chinese kids against Obesity (CLICK-Obesity) in Nanjing City, China: the baseline data

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Background: urgent development of effective interventions to prevent rapidly rising childhood obesity in China is needed. Methods: Between May 2010 and December 2013, a cluster randomized controlled trial was conducted among 4th graders in eight urban primary schools randomly assigned to intervention or control groups in Nanjing, China. A multi-component intervention program was implemented within the treatment group, while students in the control group followed their usual health education curriculum without additional intervention. Results: At baseline, 638 and 544 students were enrolled in the intervention and control group, respectively. The prevalence of excess body weight was 26.8%, with 27.4% in the intervention group and 26.1% in the control group (p=0.61). The mean (SD) BMI and WC was 18.7 (3.0) and 63.0 (9.2) for participants in intervention schools, and 18.5 (2.9) and 63.6 (8.7) for students in control group, separately (p=0.24 and 0.41, respectively). Compared to those who were not aware of what lifestyle/behavior factors were unhealthy, students who were aware of the unhealthy lifestyle/behavior factors consumed fewer fried snacks (0.46±0.76 serves/week vs 0.65±0.91 serves/week; p<0.01), soft drinks (160±194 ml/week vs 199±227 ml/week; p<0.01), but larger amount of meat (502±429 g/week vs 449±344 g/week; p=0.03), and reported less screen time (214±232 minutes/week vs 252±264 minutes/week; p<0.01). Moreover, there was no difference within physical activity time between these two groups (257±341 minutes/week vs 218±324 minutes/week; p=0.13). Conclusions: Main characteristics of participants were balanced at baseline within intervention and control schools, but a gap existed between healthy lifestyle knowledge and actual healthy behavior in students. Trial Registration number: ChiCTR-ERC-11001819

Key Words: children, intervention trial, lifestyle, obesity, physical activity

INTRODUCTION

Childhood obesity is becoming a public health problem worldwide, including China, the most populous country in the world.[1-3] This obesity epidemic demands urgent population-based research on childhood obesity intervention to determine which programs are effective and sustainable in different societies. Schools are appropriate and critical settings for preventing childhood obesity through promoting lifelong healthy eating and physical activity (HEPA).[4-6]

Most of available school-based obesity intervention studies were conducted in Western countries,[7-17] whose results may not be directly applicable to the Chinese population, given obvious differences in school activities and structures between Western and Chinese societies (eg, Chinese school students spend much more time in academic study).[18] Contrastingly, to date, only four studies have investigated obesity prevention targeting obese and not the general school population in China, three in Chinese and one in English.[19-22]

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Manuscript received 25 March 2013. Initial review completed 6 June 2013. Revision accepted 15 August 2013.
doi: 10.6133/apjcn.2014.23.1.04
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Therefore, there is a need for a well-designed school-based intervention program for obesity prevention targeting students in China. We designed a cluster randomized controlled trial (C-RCT) to evaluate the feasibility and effectiveness of a school-based comprehensive lifestyle intervention among Chinese kids against obesity (CLICK-Obesity) in 8 urban primary schools in Nanjing City, China. This paper presents the participants' characteristics and preliminary findings from baseline data of the study.

METHODS

Study design and participants

The study rationale, design and methodology have been described in detail elsewhere.[23] Briefly, this school-based C-RCT has being conducted from May 2010 to December 2013 in Jainye, an urban district of Nanjing, a large city in eastern China. Of the total 13 primary schools in Jianye district, 8 were randomly selected as target schools and randomly assigned to either the control or intervention group (four schools in each group) using the random number generator. All the fourth graders (Mean age±SD =10.2±0.5) in each of the selected schools were invited to participate in the study. Finally, a total of 1182 eligible students were recruited in this trial, 638 students randomly assigned to the intervention group and 544 to the control group**.** The students' anthropometric status was blindly assessed between school groups. Written informed consents were obtained from both the schools and parents/students' guardians. The baseline survey was conducted in May 2010. This study was approved by the academic and ethical committee of Nanjing Municipal Center for Disease Control and Prevention (Nanjing CDC).

The intervention consists of four components: 1) classroom curriculum (including physical education and healthy diet education); 2) school environment support; 3) family involvement; and 4) fun programs/events. The intervention was developed after taking full consideration of Chinese cultural and familial tradition, social convention, and the current primary education and examination system. All developed intervention components were integrated into the regular academic schedule of each school.

A structured questionnaire was designed to collect information on students' and their parents' socio-demographic characteristics, knowledge regarding obesity and its risk factors, intake of meat and vegetables/fruits, consumption of high-dense-energy snacks and soft-drinks, and physical activity (PA). Parents/guardians also completed a short questionnaire focusing on their families' socio-demographic characteristics, including parental educational attainment, as well as family size and structure.

Trained research team members, each of whom had a university degree in a health-related discipline, conducted the physical examination and the survey in the classroom setting. A school teacher supervised and assisted the survey procedure in each class.

Study variables

Anthropometry

Students' body weight, height and waist circumference (WC) were measured by trained research staff. Each of these anthropometric variables was measured twice and the mean of the two readings for each were used in our analysis. Overweight was defined as BMI between the 85th and 95th percentile value, while obesity was defined as BMI≥95th percentile for age- and sex-specific reference data, according to the recommendation for Chinese children by the Group of China Obesity Task Force.[24] In this report we use the term 'excess body weight' (EBW) to describe being overweight or obese (BMI≥85th percentile value).

Socio-demographic characteristics

These included student's age, gender, grade, school, ethnicity, parental educational attainment (classified into 3 subgroups: ≤9 yrs, ＞9 but≤12 yrs, and ≥13 yrs), and family size and structure.

Dietary intake

Items from a specifically validated food frequency questionnaire (FFQ) were selected to gather information on dietary consumption including meat, vegetable/fruit, snack and soft-drinks.[25] All variables were categorized into tertiles for our analysis.

Physical activity and sedentary behavior

The time spent on out-of-school activities were assessed as continuous variables using the Chinese version of the International Physical Activity Questionnaire (CHN-IPAQ).[26] We calculated moderate-to-vigorous physical activity (MVPA) time based on time spent in jogging and doubled the time in ball playing and swimming. Time spent on homework, sleep and commuting to/from school were also collected.

Obesity-related knowledge

Selected questions were asked regarding knowledge about obesity and its related behavioral risk factors and long-term influence of childhood obesity, including frequent consumption of fatty meat and fried snacks, little intake of vegetable, frequent intake of soft drinks, physical inactivity and prolonged screen time. All these variables were categorized as "Yes" or "No or do not know". For example, the question about information on screen time use was "Do you think spending prolonged time in viewing TV or using the computer can increase the risk of gaining excess body weight?"

Statistical analysis

Descriptive statistics were calculated. Between group difference was examined for treatment assignment and overweight status. Differences were tested using independent t-tests for continuous variables (eg, BMI) and chi-square tests for categorical variables (eg, overweight, lifestyle factors and obesity related knowledge). Data were double entered and cleaned with EpiData 3.0 (The Epidata Association, Odense, Denmark), and managed and analyzed using SPSS 13.0 (SPSS, Chicago, Illinois). A p value of <0.05 was considered statistical significant.

RESULTS

Participants' characteristics at baseline

Table 1. The selected baseline characteristics and lifestyle patterns of participants by treatment, Nanjing, China. Continuous variables are presented as mean (SD). Categorical variables are presented as a percentage.

Characteristics	Treatment groups		p^*
	Intervention (n=638)	Control (n=544)	
Socio-demographics			
Boys (%)	53.9	59.2	0.07
Mean age (SD)	10.2 (0.51)	10.2 (0.52)	0.57
Parents' education ≤9yrs (%)	18.7	22.8	0.08
Anthropometric risk factors			
Excess body weight† (%)	27.4	26.1	0.61
Mean BMI‡ (kg/m^2, SD)	18.7 (3.0)	18.5 (2.9)	0.24
Mean WC §(cm, SD)	63.0 (9.2)	63.6 (8.7)	0.41
Food consumption			
Red/white meat (g/week)	503 (461)	461 (318)	0.07
Vegetables (g/week)	756 (821)	719 (513)	0.37
Fried snacks (serves/week)	0.55 (0.84)	0.49 (0.79)	0.23
Soft drinks (ml/week)	187 (215)	173 (211)	0.26
Out-of-school behaviors			
Moderate physical activity¶ (minutes/week)	285 (376)	210 (284)	<0.01
Visiting green parks (minutes/week)	104 (167)	84.4 (124)	0.02
Screen time (minutes/week)	274 (278)	199 (218)	<0.01
Walking to school (%)	40.1	39.5	0.44
Home work (hours/day)	1.9 (1.2)	1.9 (1.1)	0.25
Sleep time (hours/day)	9.0 (1.3)	8.8 (1.2)	0.01

*Independent t-test for continuous variables and chi-square tests for categorical variables.
†Excess body weight was defined as BMI≥85th percentile value for age- and sex-specific reference data according to the recommendation for Chinese children by the Group of China Obesity Task Force.
‡BMI, body mass index
§WC, waist circumference
¶Moderate Physical activity time was calculated based on time spent in jogging, and double the time in ball playing and swimming.

Table 2. Comparison of study participants' baseline knowledge and awareness (%) of selected risk factors for obesity by treatment, Nanjing, China

Risk factors	Treatment groups		p^*
	Intervention (n=638)	Control (n=544)	
1. Frequent consumption of fatty meat	70.4	59.2	<0.01
2. Frequent intake of fried snacks	69.4	66.0	0.21
3. Little consumption of vegetables	98.6	98.7	0.85
4. Frequent intake of soft drinks	48.0	48.0	1.00
5. Physical inactivity	84.8	80.0	0.03
6. Prolonged screen time	33.2	30.3	0.29

* Chi-square tests were used to test the difference between treatment groups

In this study, 1225 students were initially eligible for inclusion, and 1182 (96.5%) participated in the baseline survey with a mean (SD) of 148 (40) students in each school. The main reasons for those (n=43) not participating were that they did not return their parents'/guardians' signed written informed consents, were sick or had other scheduled events on the survey day. There were 638 students assigned to the intervention group and 544 to the control group**.** As shown in Table 1, the mean (SD) BMI and WC at baseline was 18.7 (3.0) and 63.0 (9.2) for participants in intervention schools, 18.5 (2.9) and 63.6 (8.7) for students in control group, separately (p=0.24 and 0.41, respectively). The prevalence of excess body weight (overweight plus obesity) was 26.8% in this sample population, with 33.3% in boys and 18.4% in girls (p<0.01), and 27.4% in the intervention group and 26.1% in the control group (p=0.61). There was no statistically significant difference with regard to gender, mean age, parents' educational attainment, or food consumption, including meat and vegetable intake, consumption of fried snacks and soft drinks, between the intervention and control groups. However, students in the intervention group were more likely to spend time in physical activity, visiting green parks, screen use and sleep relative to those in the control group.

The knowledge and awareness of obesity risk factors within intervention and control group

Table 2 displays the percentage of knowledge and awareness for selected obesity risk factors among participants in the intervention and control group at baseline. Compared with their counterparts in the control group, students in the intervention group were more likely to be aware that frequent consumption of fatty meat and physi-

Table 3. The lifestyle and behavior patterns of students by awareness of obesity risk factors, Nanjing, China

Unhealthy lifestyle and behaviors for obesity	Being aware of corresponding unhealthy behavior for obesity Mean±SD (n)			p*
	Total	Yes	No	
Red and white meat (g/wk)	484±402	502±429 (771)	449±344 (411)	0.03
Fried snacks (serves/wk)	0.52±0.81	0.46±0.76 (802)	0.65±0.91 (380)	<0.01
Vegetables (g/wk)	739±696	742±698 (1166)	513±453 (16)	0.19
Soft drinks (ml/wk)	180±212	160±194 (567)	199±227 (615)	<0.01
Moderate physical activity time† (minutes/wk)	250±339	257±341 (976)	218±324 (206)	0.13
Screen time (minutes/wk)	240±255	214±232 (377)	252±264 (805)	0.02

*Independent t-test for continuous variables and chi-square tests for categorical variables.
†Moderate-to-vigorous physical activity (MVPA) time was calculated based on time spent in jogging, and double the time in ball playing and swimming.

cal inactivity are potential risk factors for excess body weight. However, there was no statistical difference between two groups with regard to awareness of the fact that frequent consumption of fried snacks, frequent intake of soft drinks and prolonged use of screen might also increase the risk of gaining excess body weight.

The selected lifestyle/behavior patterns and knowledge of obesity risk factors between students with and without excess body weight

Students with excess body weight consumed fewer vegetables and were more likely to spend time in physical activity relative to those in the group with normal body weight, while more participants walked to and from school in the group with excess body weight compared to their counterparts with normal body weight. Interestingly, there were more students who knew that frequent consumption of fatty meat, fried snacks, soft drinks and being physical inactive might increase the risk of gaining excess body weight in the group of excess body weight than those in the group of normal body weight.

The link between knowledge and practice regarding excess body weight

We were interested in whether there was a gap between awareness and practice regarding lifestyle and behaviors for obesity, thus we compared lifestyle/behavior patterns between students who were, and were not, aware of the lifestyle/behavior factors leading to excess body weight gain (Table 3). As expected, compared to those who were not aware of what lifestyle/behavior factors were unhealthy, students who were aware of the corresponding unhealthy lifestyle/behavior factors consumed fewer fried snacks (0.46±0.76 *vs* 0.65±0.91; p<0.01), soft drinks (160±194 *vs* 199±227; p<0.01) and reported less screen time (214±232 *vs* 252±264; p=0.02). Contrastingly, the mean intake amount of red/white meat in the previous week was significantly larger in those who were aware it was unhealthy compared with their counterparts who did not know that frequent consumption of fatty meat might increase the risk of obesity (502±429 *vs* 449±344; p= 0.03). Interestingly, there was no statistical difference within these two subgroup populations regarding consumption of vegetable (742±698 *vs* 513±453; p=0.19) and engaging in physical activity (257±341 *vs* 218±324; p= 0.13).

DISCUSSION

The association of obesity and its lifestyle risk factors has been widely explored worldwide. We did not intend to examine the relationship between obesity and the influential factors using baseline data, but focused on the practicability and effectiveness of a school-based lifestyle intervention for obesity prevention among a general population of Chinese children, and have reported the study rationale and methodology elsewhere.[23] Due to the cluster random sampling method used in this study, potential bias might be caused by this approach. Therefore, it is reasonable to present the findings from this baseline data before reporting the differences in outcomes between intervention and control groups.

Our preliminary findings from baseline data indicated that there was no significant difference within mean BMI and WC (the primary outcome measures), gender, age and parents' educational attainment between intervention and control groups, suggesting that the participants within intervention and control groups were basically balanced at baseline with regard to these important characteristics.

Compared to their counterparts in the control group, students within intervention group consumed similar level of selected food (red/white meat, vegetables, fried snacks and soft drinks) and tended to spend more time on physical activity, visiting green parks, viewing screen and sleeping, while more of them were aware of risk factors for obesity. Students were less likely to adopt the selected lifestyles (frequent consumption of fried snacks and soft drinks, little intake of vegetable, physical inactivity and prolonged screen time) if they were aware of that these lifestyles might increase the risk of gaining excess body weight. This may explain, in part, that children with excess body weight were more likely to spent time on physical activity and to take active transport mode to/from schools relative to their counterparts with normal body weight, given that more children with excess body weight knew physical inactivity was a risk factor for obesity in this study. However, there was an exception that a gap existed between the awareness and practice regarding meat consumption. Even if they were aware of that eating much fatty meat was a risk factor for obesity, these students still consumed much more fatty meat. This might be related to how foods are provided to children in China, where parents chose and prepare family foods every day and children's diets may be significantly influenced by their parents' eating habit.[27,28] Considering this parents-

children resemblance in lifestyle and behavior patterns, we designed parent's health class program to educate parents/guardians on how to adopt healthy lifestyles and behaviors in the intervention.[23]

The finding that students with excess body weight were more likely to report more physical activity and also had greater knowledge about the risk factors for obesity (eg consumption of fatty meat, physical inactivity) compared to their counterparts with normal body weight was of interest. One explanation may be that overweight/obese students may have lower self-esteem and pay more attention to their body weight and shape,[29] and thus they might seek for more knowledge around obesity prevention measures. Another explanation is that participants with excess body weight are more likely to over-report their physical activity level relative to those with normal body weight.[30] However, the cross-sectional data from this baseline survey did not allow us to draw any causal direction between such associations. We intend to explore this issue in a subsequent manuscript which will include follow-up data and allow us to evaluate the intervention effectiveness and the potential role of awareness of risk factors on unhealthy behaviors.

The rapid economic growth and lifestyle transition that has recently taken place in Mainland China has coincided with a remarkable rise in the prevalence of overweight and obesity among children.[2,3] Thus population-based obesity interventions are urgently needed in China, especially in major cities such as Nanjing. To prevent obesity it is necessary for students to maintain a good balance between energy intake and energy expenditure with sufficient consideration of children's growth. This can be achieved through a healthy diet and adequate daily physical activity. Our intervention aims to increase healthy eating, physical activity and to reduce sedentary behaviors among all students allocated to receive the intervention program.

This study was specifically designed to develop a practicable and effective population-based intervention program that targeted lifestyle and behavioral factors contributing to excessive weight gain in school children under the current educational context in Mainland China. Our intervention program emphasized the need for multilevel interventions, including multiple intervention components that target the classroom curriculum (both healthy dieting and physical activity), school environmental support, family involvement (including parent's health class education) and fun programs/events. We integrated our intervention components into schools' academic programs, which was critical for such lifestyle intervention programs to be acceptable and feasible in China and was really crucial for us to successfully obtain sufficient support from school administrators, teachers, and students and their parents/guardians. We got such support and successfully implemented this study with limited impact on the schools' academic schedule.

In summary, we designed this lifestyle intervention project with due consideration of Chinese cultural and familial tradition, social convention, and current primary education and exam systems. The preliminary findings have demonstrated that characteristics of participants were balanced at baseline within intervention and control groups. The experience gained in this study will help guide future school-based childhood obesity prevention programs in China.

ACKNOWLEDGEMENT

The study was supported by Nanjing Municipal Science and Technique Foundation (200901088) and Medical Science and Technique Development Foundation (2009-ZKX09034) and the Nanjing CDC. When this manuscript was prepared, FX worked with Dept.of International Health, Johns Hopkins Bloomberg School of Public Health, supported by Jiangsu Provincial Government Scholarship for Overseas Studies (JS-2010-109) and The Young Medical Experts Project of Nanjing Medical Science and technique Development Foundation (QRX11038), China. YW's related effort is supported by research grants from The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK, R01 DK63383) and The Nestle Foundation and a Research and Training Center grant (U54HD070725) from the Eunice Kennedy Shriver National Institute of Child Health & Human Development (NICHD), which is co-funded by the NICHD and the Behavioral and Social Sciences Research (OBSSR). The content is solely the responsibility of the authors and does not necessarily represent the official views of the funders.

Our special thanks go to the following people for their support: Zhou Jiandong (Nanhu No 3 Primary School), Li Lixin (Nanhu No 1 Primary School), Wang Kerong (Mochouhu Primary School), Du Wenyan (Aoti Primary School), Zhou Jie (Jiangdongmen Primary School), Gai Jingsong (Nanhu No 2 Primary School), Jiang Haihong (Xiaozhuang No 1 Experimental Primary School), Lou Wei (Zhiyuan Foreign Language Primary School), all the students and their parents/guardians.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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中国南京学校为基础的儿童肥胖生活方式干预试验(CLICK-Obesity)：基线结果

背景：在中国需要研发可行且有效的干预策略，来应对快速增长的儿童肥胖。方法：2010年5月- 2013年12月在中国南京市选择8所城区小学，将4年级的小学生随机分为干预组和对照组。在干预组的学生中，除了学校通用的日常健康教育课程之外，另行实施多元的针对性干预措施；而在对照组中，则只进行通用的日常健康教育。结果：基线入组时，638名学生被分入干预组，544名学生被分入对照组。总的体重过多者的比例为26.8%，并且在干预组(27.4%)和对照组(26.1%)中没有显著差异(p＝0.61)。学生的体质指数的均数(标准差)在干预组和对照组中分别为18.7(3.0)和18.5(2.9)，差异没有统计学意义(p=0.24)；而腰围的均数(标准差)则分别为63.0(9.2)和63.6(8.7)，差异也没有统计学意义(p=0.41)。与不知道生活方式/行为是不健康者相比，知道生活方式/行为不健康的学生食用更少的油炸快餐(0.46±0.76次/周 比上 0.65±0.91次/周；p<0.01)和软饮料(160±194毫升/周比上199±227毫升/周; p<0.01) ，但食用较多的肉食(502±429克/周比上449±344克/周；p=0.03)；且看电视或使用电脑的时间较少(214±232分钟/周比上252±264分钟/周；p<0.01)。干预组与对照组的学生中，体力活动时间没有统计学差异(257±341分钟/周比上 218±324分钟/周；p=0.13)。结论：在试验开始时，干预组和对照组之中学生，其主要人口学特征是均衡可比的，但是了解健康生活方式相关知识并不意味着就采用相应的健康行为。临床试验注册号：ChiCTR-ERC-11001819

关键词：儿童、干预试验、生活方式、肥胖、体力活动