A multifaceted intervention to prevent obesity in primary school children: protocol of a cluster-randomized controlled trial (the DECIDE-Children study)

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Background

The global prevalence of obesity among children and adolescents has increased eightfold in the last four decades. The increase has recently plateaued in high-income countries, but continued to accelerate in low- and middle-income countries. Childhood obesity can affect a child’s physical and psychological health, academic attainment, and quality of life and, in the longer term, heighten risks for cardio-metabolic diseases, musculoskeletal problems, and cancer. From an economic perspective, an investment in preventing childhood obesity is cost-effective considering the lifetime health benefits and improved quality of life. Since 2017, the World Health Organization (WHO) has called for all countries to take greater action to end childhood obesity.

China’s recent economic growth has been accompanied by a rapid increase in overweight and obesity among school-aged children and growing interest in its prevention. Earlier Chinese obesity intervention studies in school-aged children were generally poorly evaluated with unclear reporting of randomisation, non-blinding of primary outcome assessments, attrition bias, selective reporting of outcomes, and the failure to consider clustering effects. Subsequent school-based obesity prevention studies in various cities across China, have had inconsistent findings possible due to the use of heterogeneous intervention packages (different combination of intervention elements). Moreover, each of these studies took place in single developed city, limiting generalisability. To date, there has been no Chinese multi-center trial of a multifaceted intervention for prevention of childhood obesity, which is the strategy most likely to bring sustained gains across the child and adolescent years.
Objectives

Overall Objective:

To develop effective lifestyle interventions for the prevention and control of cardiovascular disease in China, the Diet, ExerCIse and CarDiovascular hEalth (DECIDE) project was initiated in 2016. As one of five independent DECIDE studies, the DECIDE-Children study aims to develop a multifaceted childhood obesity prevention programme targeting school children aged 8-10 years in three different regions of China and rigorously test its effectiveness in preventing excessive weight gain in Chinese primary school settings.

Specific Objectives:

The specific objectives of the DECIDE-Children study will be

(1) to assess the effectiveness of the intervention compared with the usual practice in preventing childhood overweight and obesity;

(2) to evaluate the process of the intervention.

Design

DECIDE-Children is a cluster-randomized, parallel-group controlled trial. The intervention will be implemented for one school year from late September 2018 to June 2019. Figure 1 shows the flow of the study. The study has been registered at ClinicalTrials.gov (number NCT03665857).

Setting

To accommodate the social and economic variations within the country, we will intentionally select
schools from three different regions of China: the above average developed area in the east (Beijing),
the average developed area in central China (Shanxi) and the below average developed area in the
west (Xinjiang). A total of 24 primary schools (clusters) equally distributed among three regions
will be selected. In Beijing, 4 schools will be selected from the Dongcheng district (located in the
centre of the city), and 4 will be selected from the Mentougou district (located in a rural suburban
area). In Xinjiang, all 8 schools will be selected from Urumchi, the capital city of the autonomous
region; four of the schools will be selected from the Shayiba district (an urban district), and the other
four schools will be selected from the Shuimogou district (a rural district). In Shanxi, all 8 schools
will be selected from only one urban district, Changzhi, a small- to medium-sized city in the
province. The reason for excluding rural schools in Changzhi is that most of the rural schools are
boarding schools, and parents are difficult to reach in boarding schools. Thus, a total of 24 primary
schools from five sites in three regions will be selected and randomized into two groups, the obesity
prevention intervention group and the usual practice group.

Recruitment of Participants

Recruitment of schools

The present study will be carried out in Grade 4 students (8 to 10 years old), as they are sufficiently
mature to understand health education information and are able to remain in the same school to
complete the two-year study before they graduate. For a school to be eligible, the school principal
must agree with the randomization procedure and comply with the study protocol. The total number
of Grade 4 students must be greater than 50 in the school, and schools that have implemented or are
planning to implement an obesity prevention intervention or similar intervention programme will
not be eligible. Boarding schools and specialty schools for children with talents or minority ethnic
groups will be excluded. Schools will also not be included if they have a definite plan for relocation
or cancellation in the next two years. For the schools participating in the programme, the size of a
class will vary between fewer than 30 children and approximately 60 children per class. If the
number of students in each class is less than 50, we will recruit two classes from the school, and if
the number of students is greater than 50, we will recruit one class to meet the sample size
requirement. If there are more classes in one school than needed for the study, the school principal
will recommend which classes we should select.

School recruitment will take three steps. First, project staff will contact the local education
authorities to gain their opinion, support, and approval of the study and basic information of the
schools (type of schools and the number of students and teachers). Second, project staff will contact
the schools by phone or visit the schools to determine the eligibility of the selected schools for the
study. Third, the principal investigator will make the final list of eligible schools, and local research
partners will invite schools to participate in the study.

Recruitment of children

After school recruitment, written informed consent will be provided by all children and their primary
caregivers (parents in most cases) in the selected classes. Then, the parents who provide informed
consent will be required to complete a questionnaire about the health status of their children. The
project staff will collect the questionnaires and if a parent reports one of the following conditions,
his or her child will be excluded:
1) medical history of heart disease, hypertension, diabetes, tuberculosis, asthma, hepatitis or nephritis;

2) obesity caused by endocrine diseases or side effects of drugs;

3) abnormal physical development like dwarfism or gigantism;

4) physical deformity such as severe scoliosis, pectus carinatum, limp, obvious O-leg or X-leg;

5) inability to participate in school sport activities;

6) a loss in weight by vomiting or taking drugs during the past three months.

**Randomization**

The random sequence of allocation of the schools (clusters) to the intervention or control group will be stratified by the study sites. Schools in the same study site will be randomly allocated in a 1:1 ratio to either the intervention or control group using a computer-generated random number system (the simple random sampling method). Randomization will be performed by an independent person at the central coordinating centre at Peking University Clinical Research Institute. The randomization will take place only after the baseline measurements are completed to ensure allocation concealment.

**Intervention**

We used the Social Ecological Model to identify intervention elements in this multifaceted health promotion programme\(^3\). As shown in Figure 2, the programme will target the influencing factors of childhood obesity at both individual (child-focused activities) and environmental levels (a supportive family and school environment), with the intent to influence the knowledge, attitude and
behaviours of school children.

**Description of the intervention components**

The intervention components are described in Tables 1 and 2.

**Child-focused activities:** These activities will include health education activities for children, the reinforcement of children’s physical activity at school and the regular monitoring of children’s weight and height.

**Activities towards parents:** These activities will include health education activities for parents and encouragement of children to increase their physical activity level outside of school.

**Activities towards schools:** These activities will include school policies related to obesity prevention and health education activities for teachers.

**The smartphone app:** Project staff, school teachers and parents will be suggested to install the app titled “Eat Wisely, Move Happily”. The app, which was developed based on behaviour change techniques\(^{14}\), will aid in information diffusion, behaviour monitoring, weight management, assessment and feedback.

**Quality control of the intervention**

Two manuals (“An Operation Manual for Project Staff Involved in the Multi-component Obesity Intervention among Primary School Students” and “An Operation Manual for School Team Members Involved in the Multi-component Obesity Intervention among Primary School Students”) have been developed for implementing and managing this complex intervention. The manuals describe in detail the duties of project staff and school team members (school principals, class
teachers, physical education teachers, school doctors/health care teachers) in delivering the intervention. The manuals also describe the detailed workflow of the implementation of each intervention component, i.e., by whom, when, how, and to what extent the specific intervention element should be delivered. All of the project staff and school team members will be required to conduct the intervention in accordance with the operation manuals.

During implementation of the intervention, regular field observations will be made and the smartphone app records will be checked. If it is found that schools are not complying with the study protocol, project staff will communicate with school team members in a timely manner and conduct follow-ups to improve the fidelity of the study results.

**Control**

The twelve schools in the control group will not carry out any of the DECIDE-Children intervention components and will continue their usual practice according to their own teaching curriculum during the study period. Participants in the control group will receive the same health education materials that will have been delivered to those in the intervention group immediately after the trial ends.

**Outcomes**

**Primary outcome**

The primary outcome is the difference between groups in the change in children’s body mass index (BMI=weight (kg)/(height (m))^2) immediately after the intervention completion (9 months after the baseline measurements are conducted).
**Secondary outcomes**

The secondary outcomes include the following indices between groups at the 4-month and 9-month follow-up investigations: 1) change in BMI z-score (standard deviation score will be calculated based on the WHO criteria\(^{15}\)); 2) change in prevalence and incidence of overweight/obesity defined according to the criteria for Chinese children and adolescents\(^{16}\); 3) change in waist circumference, waist-to-hip circumference ratio and systolic and diastolic blood pressures; and 4) change in body fat percentage, physical fitness measures, behavioural outcomes (including screen time, duration of moderate-to-vigorous physical activity, eating behaviour and sedentary behaviour) and other outcomes (including knowledge related to energy balance and stage of readiness for behaviour change related to weight management).

**Outcome evaluation**

Table 3 describes the study outcomes, including when and how the study outcomes will be evaluated. Baseline measurements will be conducted in September 2018 for both the intervention and the control groups. Follow-up measurements will be conducted 4 months after the baseline measurements in January (after one school semester and half way through the intervention), and 9 months after the baseline measurements in June 2019 (after one school year and immediately after the whole intervention programme is completed).

At the baseline and all follow-up visits, anthropometric measures (height, weight, waist and hip circumference, systolic and diastolic blood pressures, body fat percentage) and physical fitness
measures (one-minute rope jumping, one-minute sit-up, long standing jump, shuttle run (50 m×8)) will be collected by the trained outcome assessors using the same device and/or forms according to the standard methods and procedures. The assessors measuring children’s height and weight will be blinded to the group allocation of the schools. We will use questionnaires to measure children’s behaviours (duration of moderate-to-vigorous physical activity, eating behaviour, sedentary behaviour), and other potential moderators/mediators of the intervention (e.g., stage of readiness for behaviour change related to weight management). The questionnaires were developed based on previous studies and the pilot study. The questionnaires were found to be feasible for this study and acceptable to children and their parents.

**Sample size estimation**

We assumed that the difference between the two groups in the change in BMI (effect size) would be 0.50 kg/m², the standard deviation (SD) of the BMI would be 1.40 kg/m², the intra-cluster correlation coefficient would be 0.05 and the rate of attrition would be 10% for the sample size calculation in our study. We aimed to recruit a total of 1,200 children from 24 schools with an average cluster size of 50 children per school. This sample size will provide 88% power with \( \alpha = 0.05 \) to detect a mean difference of 0.50 kg/m² in the change in BMI between groups after the intervention lasting one school year.

**Statistical analyses**

Statistical analyses will be performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). All statistical tests will be two-sided at the 5% level of significance. Baseline characteristics at both
the school and individual levels will be reported by using descriptive statistics.

The primary analysis will be based on the intention-to-treat principle and include all children recruited with the baseline BMIs measured. Generalized linear mixed models will be used to compare the primary and secondary outcomes at 4 and 9 months after the baseline measurements are conducted, and the models will adjust for the clustering effect and baseline outcome values. The missing data will be treated in the maximum likelihood estimates assuming they are missing at random. The intra-cluster correlation coefficient will also be estimated. Sensitivity analysis will be performed on the primary outcome using the last-value-carry-forward imputation if the percentage of missing data exceeds 5%. For continuous outcomes, we will report pre-, and post-intervention means for the intervention and control groups and model-adjusted mean differences between groups. For binary outcomes, we will report pre- and post-intervention percentages for the intervention and control groups and adjusted odds ratios (ORs) between groups. The 95% confidence intervals (CIs) and associated P-values will be calculated. We will also examine whether the differences in the outcomes between the control and intervention groups vary by the three regions (Beijing, Shanxi, Xinjiang), the sex of children, socioeconomic status (mother’s education), BMI status at baseline (overweight or obese, not overweight or obese), and primary caregivers of the children (parents compared with non-parents).

**Process evaluation**

Based on the steps and principles described in the conceptual framework by Saunders et al.,¹⁷ we will identify the process evaluation elements including fidelity (the extent to which the intervention
will be implemented as initially planned), dose delivered (the frequency and intensity of the actual implementation of the programme), dose received (the extent to which children/primary caregivers (parents in most cases)/teachers will be exposed to the intervention, as well as the degree of their satisfaction with the intervention and materials), reach (the proportions and the characteristics of children/primary caregivers/teachers completing or dropping out of the intervention) and context (family environment and school policies related to obesity prevention and management).

The implementation process data collection procedure will include (1) direct regular field observation and records which will be collected for the quality control of the intervention (e.g., quality and quantity of the intervention sessions and number of children attending the lectures) and will be recorded by the trained project staff; (2) the user logs (e.g., frequency and duration) which will be collected by the smartphone app; (3) interviews with participants (6–8 children per school) which will be conducted in both the intervention and the control groups.

**Ethical consideration**

This study was reviewed and approved by the Peking University Institution Review Board (IRB00001052-18021). Any amendments to the study protocol will be submitted for IRB approval prior to implementation. Written informed consent will be obtained from all students and their parents. All data collected will be entered into an electronic database with de-identified information. The database will be accessed only by designated staff with a password. The results will be disseminated through publication in peer-reviewed journals, presentation at conferences and in lay summaries provided to school staff and participants.
References


Implementation plan: executive summary.

http://apps.who.int/iris/bitstream/handle/10665/259349/

WHO-NMH-PND-ECHO-17.1-eng.pdf?sequence=1&isAllowed=y


15 de Onis M, Onyango A, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO


Table 1 Description of the intervention components implemented in the DECIDE-Children study

<table>
<thead>
<tr>
<th>Intervention components</th>
<th>Descriptions of the content, frequency, and duration</th>
<th>Delivery personnel</th>
</tr>
</thead>
</table>
| Health education activities for children | (1) Frequency and duration  
A total of ten activities (each lasting 40 minutes) will be provided once every two to three weeks (six activities will be arranged in the first semester, and four will be arranged in the second semester).  
(2) Different kinds of activities  
The ten activities will include seven health education lectures and three theme class meetings. The focus of the health education lectures will be on information diffusion, while the focus of theme class meetings will be on consolidation of the key messages learned in health education lectures through interactive and interesting group work (e.g., “Let me guess”).  
(3) Content  
1) Information diffusion  
Key messages will include the benefits of healthy weight, measurements and assessments of weight, and methods of achieving a healthy weight (not eating excessively; not drinking sugar-sweetened beverage; eating less high-energy food; less sedentary behaviours; performing more physical activity). Health education books and “nutrition evaluation turnplate for Chinese primary and middle school students” will be delivered to children. Health education messages will also be spread through posters on campus or in the classroom.  
2) Promotion for translating knowledge into | The trained class teachers |
### Reinforcement of children's physical activity within school

1. **Children will be instructed by physical education teachers to perform physical activities with moderate-to-vigorous intensity at school for at least one hour per school day (including physical education classes, class-break exercise, extracurricular activities).** The aim of this component will be to improve the adherence to the Chinese national requirement for ‘One-Hour Physical Activity On Campus Every School Day’. If a school has met this requirement, no extra physical activities will be added at the school; otherwise, extra physical activities (i.e. physical education classes, exercises during breaks in class or extracurricular activities) will be added to the school schedule. The monitoring of the implementation of these extra physical activities will be continuous within the intervention period for the intervention group; 2. **Physical education teachers will be advised to teach students at least one sports game during each extracurricular activity.**

### Regular monitoring of children's weight and height

1. **Monthly monitoring**
Children's weight and height will be monitored monthly, and the data will then be input into the computer management system in a timely manner and shown in the smartphone app.

---

- Action
  - “Small hand in big hand” homework (e.g., “challenge of three days away from screen”) will be arranged at the end of each health education activity.

3. **Feedback and encouragement for BMI and behaviour change**
Feedback of regular monitoring results of children's BMIs and behaviours will be provided in each health education activity. The children with good performance will be encouraged.

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- The trained physical education teachers
- The trained school doctors/health care teachers with the assistance of the trained project staff (for
2. Activities towards parents (providing a supportive family environment)

<table>
<thead>
<tr>
<th>Health education activities for parents</th>
<th>Reinforcement of children's physical activity outside school</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Frequency and duration</td>
<td>1) Parents will be instructed to encourage children to perform physical activities outside of school for 30 minutes per weekday and 1 hour per weekend day;</td>
</tr>
<tr>
<td></td>
<td>2) Recommendations for physical activity outside of school will be provided through the smartphone app once every two months;</td>
</tr>
<tr>
<td></td>
<td>3) Children will be encouraged to participate in sports games outside of school that will be taught by their physical education teachers during extracurricular activities.</td>
</tr>
<tr>
<td>2) Contents</td>
<td>The trained project staff will provide feedback about children's weight status and behaviours to parents. Face-to-face group discussions will be established between the project staff and parents.</td>
</tr>
<tr>
<td>➢ For the first activity</td>
<td>➢ For other activities</td>
</tr>
<tr>
<td>Key messages will be similar to those</td>
<td>Project staff will provide feedback about children's weight status and behaviours to parents. Face-to-face group discussions will be established between the project staff and parents.</td>
</tr>
<tr>
<td>for the health education activities</td>
<td>for the first activity Key messages will be similar to those for the health education activities for children (described above). Parents will also be taught to use the smartphone app.</td>
</tr>
<tr>
<td>for children (described above)</td>
<td>➢ For other activities</td>
</tr>
<tr>
<td>Parents will also be taught to use</td>
<td>➢ For other activities</td>
</tr>
<tr>
<td>the smartphone app</td>
<td>Project staff will provide feedback about children's weight status and behaviours to parents. Face-to-face group discussions will be established between the project staff and parents.</td>
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<tr>
<td></td>
<td>for the first activity Key messages will be similar to those for the health education activities for children (described above). Parents will also be taught to use the smartphone app.</td>
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<td></td>
<td>➢ For other activities</td>
</tr>
</tbody>
</table>

3. Activities towards schools (providing a supportive school environment)
### School policies related to obesity prevention

The following school policies will be suggested:

1) “Not selling”:
   Not selling unhealthy snacks or sugar-sweetened beverages within school;

2) “Not eating”:
   Telling students not to eat unhealthy snacks or drink sugar-sweetened beverages at school;

3) “Not buying”:
   Children being educated by class teachers not to buy unhealthy snacks or sugar-sweetened beverages around school.

### Health education activities for school teachers

1) Frequency and duration
   The activity will be held once (lasting for approximately 40 minutes) in the first month of the intervention. School teachers participating in this programme at each school (school principal, class teachers, school doctors/health care teachers and physical education teachers) will be required to attend the activity.

2) Content
   Key messages will be similar to those for the health education activities for children (described above). School teachers will also be taught to use the smartphone app.

### 4. A smartphone app assisted in implementation of the intervention

1) Information diffusion (the behaviour change technique (BCT) used: providing information on consequences of behaviours)
   The smartphone app will provide information to parents, class teachers and project staff in accordance with the health education activities.

2) Behaviour monitoring (the BCT used: prompting the self-monitoring of behaviours)
   Parents together with their children will be asked to record the diet and physical activity behaviours of students in the app weekly, and then they will receive individualized feedback related to these behaviours (described in Table

| The smartphone app (“Eat Wisely, Move Happily”) | The trained school principal; The trained class teachers | The trained project staff | The smartphone app (installed by parents, school teachers and project staff) and the computer management system (utilized by project staff) |
2) 3) Weight management (the BCT used: prompting self-monitoring)
According to the monthly monitoring of children's weight and height (described above), parents, school teachers and project staff will view the recent weight status (categorized according to the BMI percentile criteria), changes compared with previous records of the children and the individualized feedback related to weight management (described in Table 2).

4) Assessment and feedback (the BCT used: providing feedback on performance)
The smartphone app will also provide a synthetic and individualized assessment that will combine changes in the behaviours and weight status of the children. The four kinds of feedback are shown in Table 2.
Table 2 The four kinds of regular evaluation feedback messages provided to all stakeholders by the smartphone mobile app on the basis of data from the regular monitoring of children’s weight, height and behaviours

<table>
<thead>
<tr>
<th>Results automatically judged according to the diet and physical activity behaviours recorded regularly</th>
<th>Results automatically judged according to the heights and weights measured at the regular monitoring intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive results</td>
</tr>
<tr>
<td></td>
<td>(BMI decreases in students who are overweight or obese, or BMI increases in students who are underweight)</td>
</tr>
<tr>
<td></td>
<td>Feedback 1: “Your child is doing a great job. The weight changes are consistent with the changes in the diet and physical activity behaviours. Keep it up!”</td>
</tr>
<tr>
<td></td>
<td>Feedback 3: “Your child has improved or maintained a healthy body weight, but there is still room for improvement in the diet and physical activity behaviours. Keep working!”</td>
</tr>
<tr>
<td></td>
<td>Feedback 4: “Your child’s weight has not improved, and the diet and physical activity behaviours also need improvement. Please continue to work hard!”</td>
</tr>
<tr>
<td></td>
<td>Negative results</td>
</tr>
<tr>
<td></td>
<td>(BMI increases in students who are overweight or obese, or BMI decreases in students who are underweight)</td>
</tr>
<tr>
<td></td>
<td>Feedback 2: “Your child’s weight has not improved, but the diet and physical activity behaviours are good. It might be that weight improvement requires long-term adherence to a reasonable diet and physical activity behaviour, or that the behaviour records are inaccurate. Please continue to improve!”</td>
</tr>
</tbody>
</table>
### Table 3 Outcome measurements in the DECIDE-Children study

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Time points</th>
<th>Instrument</th>
<th>Number of measures at each time point</th>
<th>Method of assessment</th>
<th>Outcome variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>4 months</td>
<td>9 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adiposity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Stadiometer (Huateng GMCS-1)</td>
<td>Twice (third measure if difference &gt; 0.5 cm)²</td>
</tr>
<tr>
<td>Weight</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Lever scale (Wujin RGT-140)</td>
<td>Twice (third measure if difference &gt; 0.1 kg)²</td>
</tr>
<tr>
<td>Body fat percentage</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Body component instrument (Tanita MC-780 MA)</td>
<td>Once</td>
</tr>
<tr>
<td>Waist circumference</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Tape (MyoTape)</td>
<td>Twice (third measure if difference &gt; 1.0 cm)³</td>
</tr>
</tbody>
</table>
### Hip Circumference

| Yes | Yes | Yes | Tape (MyoTape) | Twice (third measure if difference > 1.0 cm) | Measured to the nearest 0.1 cm |

### Physical Activity and Dietary Behaviors

| Stage of behavior change for weight management | Yes | No | Yes | The validated items measuring stages (in the action stage versus in the pre-action stage) of behavior change for the purpose of weight management [9] | Once | Percentage of children in the action stage of behavior change for weight management (children actually being initiated come behavioral change, in comparison with those in the pre-contemplation (i.e., not thinking about becoming engaged in the behavior change) or contemplation (i.e., not involved in the behavior change but was considering getting involved in the behavior in the near future) stage) |
| Screen viewing behavior | Yes | No | Yes | An updated version of a previously validated screen viewing questionnaire [5] | Once | Children finished the questionnaires in the classroom in the presence of the trained outcome assessors who can provide guidance and help. |

- Number of days performing moderate-to-vigorous physical activity ≥1 hour per week (this cut-off was defined based on “Global Recommendations on Physical Activity for Health” [4])
### Eating behavior

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>Once</th>
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<tbody>
<tr>
<td>Percentage of children who did not drink sugar-sweetened beverages, percentage of children who did not eat high-energy food (fried food, western fast food), excessive eating behavior (scores of satiety responsiveness, scores of emotional over-eating scores)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Obesity-related knowledge

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>Once</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children finished the questionnaires in the classroom in the presence of the trained outcome assessors who can provide guidance and help.</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Physical fitness

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>Once</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured to unit of number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of rope jumps within one minute</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured to unit of number</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Number of sit-ups within one minute</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Measured to the nearest 1 cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance of long standing jump</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shuttle run (50 m × 8)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>----------------------</td>
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<td>----</td>
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<td>----------------</td>
</tr>
<tr>
<td><strong>Blood pressure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic and diastolic blood pressures</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Electronic sphygmanomanometer (Omron HBP-1300)</td>
</tr>
</tbody>
</table>

1 Where two values were ≤ 0.5 cm, a definitive measurement value was calculated as the average of the two. For individuals with three values recorded, a definitive measurement value was calculated as average of the closest pair or average of all three readings (if there were no two closest readings). 2 Where two values were ≤ 0.1 kg, a definitive measurement value was calculated as the average of the two. For individuals with three values recorded, a definitive measurement value was calculated as average of the closest pair or average of all three readings (if there were no two closest readings). 3 Where two values were ≤ 1.0 cm, a definitive measurement value was calculated as the average of the two. For individuals with three values recorded, a definitive measurement value was calculated as average of the closest pair or average of all three readings (if there were no two closest readings). 4 For example, children were asked "Is it correct that drinking sugar-sweetened beverage cannot substitute drinking water?" and three choices were provided ("correct"; "wrong"; "unknown"). Children who chose "correct" would be given 1 score, and those choosing "wrong" or "unknown" would be given 0 score. 5 A definitive measurement value was obtained from the maximum of the three measurements. 6 Where two values were ≤ 5 mmHg, a definitive measurement value was calculated as the average of the two. For individuals with three values recorded, a definitive measurement value was calculated as average of the closest pair or average of all three readings (if there were no two closest readings).
Recruitment of 24 eligible primary schools, 1-2 classes per school (8 schools from Beijing, Changzhi and Urumachi respectively) (September 2018)

Recruitment of eligible children (September 2018)

Baseline investigation (September 2018)

Randomization (September 2018)

The intervention group (12 schools):
1. Student-focused activities
2. Activities towards parents
3. Activities towards schools
4. A smartphone application to facilitate school-family partnership

The control group (12 schools):
Usual practice

4-month follow-up investigation (January 2019)

9-month follow-up investigation (June 2019)

Figure 1 Study flow
Figure 2 The social ecological model as applied to the DECIDE-Children study