Determinants of moderate to vigorous physical activity and obesity in children: a structural equation modeling analysis

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Original article

Background: **The determinants of physical activity (PA) and body fatness in Chinese adolescents are rarely examined. This study aimed to investigate the effect of attitude toward PA, screen time, parents' socioeconomic status (SES), and exercise habit on PA and body fatness among Chinese children by using structural equation modeling (SEM) analysis.**

Methods: **Data obtained from the second Community Fitness Survey in Hong Kong were utilized, in which students from one secondary school of each of the 18 districts of Hong Kong were recruited. A total of 2517 questionnaires with physical fitness items were successfully distributed to students aged 13-19 years in these districts. Families' SES, parents' exercise habit, children's intention to participate in PA, amount of moderate to vigorous PA (MVPA), screen time, children's attitude toward PA, and children's body fat percentage were measured and analyzed with SEM. The structural equation model was composed of a measurement model and a structural model. The model was tested with Mplus 6. The Chi-square test, root mean square error of approximation, comparative fit index, and Tucker-Lewis index were calculated to evaluate model fit. The model was then modified based on the model fit indices.**

Results: **Children's intention to participate in PA was a strong predictor of their engagement in MVPA. Parents' exercise habit had both direct and indirect (via attitude) effects on their children's intention to participate in PA. Screen time was not a predictor of body composition. Children's intention to participate in PA directly affected their body composition. Children's attitude toward PA, parents' exercise habit, and SES had significant effects on the children's intention to participate in PA. Furthermore, obesity had a negative effect on the children's attitude toward PA.**

Conclusions: **To promote MVPA and prevent obesity in Chinese children of Hong Kong, it is important to design intervention that enhances children's intention and attitude in PA, as well as parent's exercise habits. Tailor-made programs that take SES into consideration are also essential. Further studies are necessary to extend the results and test the model in other metropolitan areas in China.**

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Key words: **adolescent obesity;**
behavior;
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Introduction

Childhood obesity is a growing global epidemic. High prevalence and increasing rates of childhood obesity are reported globally. A summary of 450 national surveys in different countries showed that 43 million children worldwide were estimated to be overweight and obese in 2010.[1] The prevalence of childhood obesity has also increased in the US, China, Russia, and other economically developed countries and urbanized populations.[2] In the past two decades, the prevalence of childhood obesity drastically increased in China, particularly in the urban areas.[3] From 1985 to 2000, the prevalence of overweight children (age: 7-22 years) in urban areas in China increased from 1.13% to 10.38% for boys and 1.50% to 5.94% for girls. The prevalence of childhood obesity in Hong Kong (age: 3-18 years) also doubled in the past decade from 11.3% to 22.5% for boys and from 10.5% to 16.8% for girls.[4] These figures are alarming because childhood and adolescent obesity will have adverse consequences on morbidity and

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premature mortality in later years of life.[5] To address this problem, it is necessary to identify the determinants associated with childhood obesity in China. This task is critical in order to establish recommendations and strategies for reducing and preventing obesity incidence and its complications in China.

A sedentary lifestyle is known to be one of the main causes of obesity and the leading cause of mortality. Mokdad et al[6] found that poor diet and physical inactivity are the second leading cause of death in the USA (400 000 deaths, 16.6%). The American Heart Association reports that, "Physical inactivity is a major risk factor for developing coronary artery disease. It also contributes to other risk factors, including obesity, high blood pressure, high triglycerides, a low level of high-density lipoprotein cholesterol, and diabetes".[7] Children are required to perform at least 60 minutes of moderate to vigorous physical activity (MVPA) daily.[8] However, Chinese children almost do not participate in MVPA outside of school.[9] They do not perform housework, an attribute considered unique compared with those in other developing countries.[9] These children are also under pressure to achieve academically.[9]

Banks and colleagues[10] conducted a cross-sectional analysis of 91 226 people and found that obesity increases with screen time. Tandon et al[11] further investigated the issue and suggested that a low socioeconomic status (SES) also promoted sedentary behavior. They found that children in low SES families had a daily screen time (time spent on the computer and/or television) of 2.4 hours per day compared with 1.7 hours per day for children in high SES families. Hesketh et al[12] found that parental education and employment level are inversely associated with television viewing. Specifically, maternal education level is positively associated with MVPA for young children, whereas maternal employment is positively associated with MVPA for older children. Kelly and colleagues[13] tested the hypothesis that habitual physical activity (PA) and/or sedentary behavior is associated with SES in young Scottish children. They found that SES is not a significant factor in explaining the amount of time spent in PA or sedentary behavior once gender and month of measurement are considered.

While most previous studies on PA in Hong Kong have investigated specific environmental and social factors, a limited number of studies have focused on theories of behavioral intervention. The theory of planned behavior (TPB) and reasoned action approach (RAA) explore the relationship among behavior, beliefs, attitudes, and intentions.[14,15] These models indicate that intention is the immediate determinant of behavior. Behavioral intention is influenced by a person's attitude toward performing a behavior, by beliefs on whether individuals important to the person approve or disapprove of a behavior (subjective norm), and by people's beliefs that they can control a particular behavior (perceived behavioral control). The objective of the present study was to investigate the effect of attitude toward PA, screen time, parents' SES, and exercise habit on MVPA and body fatness among Chinese children with structural equation modeling (SEM) analysis. The hypothetical structural equation model adapted from the RAA, as shown in Fig. 1, addresses the relationship among the variables previously mentioned. In the measurement model, the father's and mother's exercise frequencies were used to measure the latent variable parents' exercise habit, whereas the mother's educational level, mother's occupation status, family income, father's occupation status, and father's educational level were used to estimate the value of the latent variable parents' SES. The structural model specified the relationship between two latent variables and other observed variables, including children's attitude toward PA, intention to

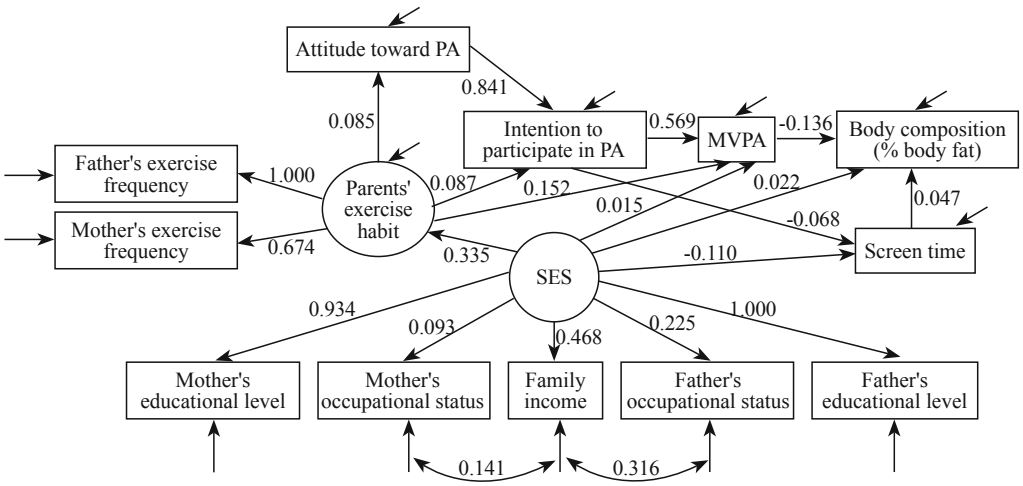

Fig. 1. The hypothetical model tested in this study. PA: physical activity; MVPA: moderate to vigorous PA; SES: socioeconomic status.

participate in PA, MVPA, screen time, and body fatness.

Methods

Data were obtained from the second Community Fitness Survey in Hong Kong. The survey was organized by the Leisure and Cultural Services Department (LCSD) of Hong Kong in 2010-2011. The survey is a citywide survey implemented every five years by the government of Hong Kong. The study protocol was approved by the respective research committee designated by the Hong Kong government. All participants signed informed consents at the time of participation.

Random sampling was used to select one secondary school from each of the 18 districts of Hong Kong. A total of 2805 participants aged 13 to 19 years were recruited, of which 2517 participants (89.73%) completed both the questionnaire surveys and field physical fitness tests. The secondary schools were asked to randomly select one class from three to four alternative grades to participate in the study. Field physical fitness tests, which involved body weight and height, skinfold thickness, handgrip strength, 1 minute sit-up, sit-and-reach test, and the 9-minute endurance run test, were administered to the students in the schools during their physical education (PE) classes on two separate days. As suggested in the literature,[16] the participants' body fat percentage was calculated with the use of ethnic-specific equations based on the participants' skinfold thickness and age. All fitness tests were conducted by certified fitness testers recruited from the Physical Fitness Association of Hong Kong. Approximately 20 fitness testers attended an additional training session offered by the principal investigator of this study and passed the practical examination on fitness test implementation to ensure that the testers implemented the same standards of testing procedures and attitudes. During each field testing day in school, only eight testers were required to complete all testing items.

The questionnaire was adopted from the Hong Kong Community Fitness Survey implemented by the LCSD of the Hong Kong government every five years (Supplementary information).[17,18] The questionnaire had three sections with a total of 43 question items. The first section obtained data on the PA participation of the respondents by using the International Physical Activity Questionnaire-Short Form (IPAQ-SF), which is extensively used in many international studies. The details can be found in the following uniform resource locator: http://www.ipaq.ki.se/ipaq.htm.[19] The validity and reliability of IPAQ-SF can be found in another source.[20] The IPAQ-SF derives an estimate of MVPA in terms of minutes/week. The second section contained questions that were extracted from the China National Fitness Surveillance Project.[21] These questions included attitude and preference of PA participation, reasons for engaging and not engaging in PA, other lifestyle information, such as the amount of time spent on watching TV and/or using the computer, the amount of time spent on doing homework, sleeping, and awareness of exercise promotion launched by the government. Questions in section three included other demographic information such as parental education, parents' PA participation, profession, and family income. Due to the fact that these questions were adopted from the China National Fitness Surveillance Project, no information on validity was reported. However, these question items had logical validity. The questionnaire was distributed to the students during their PE classes on one of the fitness testing days, and the students were guided in answering by a trained research assistant.

Statistical analysis

A structural equation model was used to test and estimate the relationship among the variables. A hypothesized structure of the model from the TPB depicted in Fig. 1 was modified.[14] The structural equation model is composed of two parts, a measurement model and a structural model. The measurement model specifies the relationships between measured and latent variables, whereas the structural model defines the relationships between latent variables and other observed variables.

Missing data patterns were checked in the entire data set. A total of 11 720 values out of 72 993 were missing (16.06% of the total number of values). According to the three types of missing data mechanisms defined by Rubin (1976): missing completely at random (MCAR), missing at random (MAR), and missing not at random,[22] the data of this survey were not MCAR but MAR. For example, 267 values out of 2521 (about 10.59%) were missing in the variable of mother's educational level. These missing values can be significantly predicted by the mother's job. In particular, mothers with longer work hours tended not to provide a response to the question on educational level than those with shorter work hours. Therefore, merely deleting the missing data may result in a biased estimation. Multivariate imputation by chained equations (MICE), also known as fully conditional specification, was conducted to address this problem on missing data.[23] Data were imputed with the use of the MICE approach on a variable-by-variable basis through the multivariate model specified by a series of conditional models for each incomplete variable. MICE provides tremendous flexibility in creating multivariate models, is easy to apply, and efficiently works in many applications, especially when no suitable multivariate distribution can be found,[24] such as in the present study in which most of

the variables were categorical variables. The predictors for the missing data in each variable were selected, and five imputations were implemented on the data set through predictive mean matching under the MICE approach. Rubin's rule to combine the results across multiple imputed sets of data was used to estimate the parameter (averaging the data set), compute the standard errors (with the use of the average of standard errors over the set of analyses and between analysis of parameter estimate variation), and conduct the significance test (through the parameters estimated and the total variation).[25]

The proposed model was tested with Mplus 6. More binary and ordered categorical dependent variables were involved; therefore, the estimator weighted the least square parameter estimates by using a diagonal weight matrix with standard errors, and a mean- and variance-adjusted Chi-square test statistic that uses a full weight matrix was used by default. DELTA parameterization is the default because it performs well in many situations. However, the models in this study can be estimated only with THETA parameterization because some models have been found to impose improper parameter constraints with the DELTA parameterization, as in the present case in which several categorical dependent variables are both influenced by and influenced other observed dependent variables.[26] The Chi-square test, root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI) were calculated to evaluate whether the models fit the data well. According to Hu and Bentler,[27] cutoff values of RMSEA <0.06 and both CFI and TLI >0.95 are considered as models fit.

The relationship between the latent and observed variables in both measurement and structural models was evaluated by Student's *t* test and at 95% confidence intervals calculated through bootstrap resampling method. The bootstrap method was used to resample the data with replacement and create a large number of "phantom samples" known as a bootstrap sample to calculate the statistic of interest.

Table 1. Descriptive statistics of the physical and demographic characteristics of the participants

Variables	*n* (%)	Mean (SD)
Gender		
Male	1283 (51.0)	NA
Female	1233 (49.0)	NA
Age (y)	NA	15.65 (1.71)
Body mass index (kg/m^2)	NA	20.48 (3.62)
Body fat percentage (%)	NA	19.84 (7.40)
MVPA (min/wk)	NA	121.32 (210.80)
Father		
Education		
Primary or below	413 (18.5)	NA
Secondary	1488 (66.9)	NA
Tertiary and above	324 (14.6)	NA
Working full-time	1969 (79.5)	NA
Job type		
Professional	252 (21.6)	NA
Managerial	237 (20.3)	NA
Clerical	199 (17.1)	NA
No exercise training	1137 (47.3)	NA
Exercise training three times or more/wk	414 (17.3)	NA
Mother		
Education		
Primary or below	434 (19.3)	NA
Secondary	1581 (70.2)	NA
Tertiary and above	236 (10.5)	NA
Working full-time	1236 (49.8)	NA
Job type		
Professional	450 (40.8)	NA
Non-technical worker	294 (26.7)	NA
Managerial	116 (10.6)	NA
No exercise training	1255 (52.1)	NA
Exercise training three times or more/wk	362 (15.1)	NA

MVPA: moderate to vigorous physical activity; SD: standard deviation; NA: not applicable.

Results

The descriptive statistics of the physical and demographic/parental characteristics of the participants are shown in Table 1. For the test of model fit, the Chi-square test value was large (χ_{45}^2=518.586), and the test result was significant (P<0.01). This significant result indicated that the structural equation model did not fit the data well. Other indices (RMSEA=0.065, CFI=0.947, TLI=0.922) also suggested that the model did not fit the data well. The RMSEA was greater than 0.06 and both CFI and TLI were lower than 0.95, which did not meet the criteria of model fit.

Not all the paths in the hypothetical model were significant, so the paths in the initial model were modified (Fig. 2). The results of the hypothesis tests showed that the path of MVPA on family SES was insignificant and was therefore removed from the

Table 2. Factor loadings for the measurement model

Variables	Estimate	LCI	UCI	SE
SES by				
Father's educational level	Reference	Reference	Reference	NA
Mother's educational level	0.940	0.850	1.034	0.099
Father's occupation status	0.229	0.197	0.260	0.038
Mother's occupation status	0.098	0.077	0.118	0.022
Family income	0.474	0.437	0.511	0.035
Parents' exercise habit by				
Father's exercise frequency	Reference	Reference	Reference	NA
Mother's exercise frequency	0.682	0.553	0.807	0.134
Residual covariance				
Family income with the father's occupation status	0.313	0.279	0.346	0.053
Family income with the mother's occupation status	0.137	0.113	0.160	0.032

All coefficients are significant at P<0.01. LCI: lower confidence interval; UCI: upper confidence interval; SE: standard error; SES: socioeconomic status; NA: not applicable.

model. Screen time was not a predictor of body fat percentage and was also removed from the final model. One significant path, "attitude toward PA" on their body fat percentage, was added to the structural model.

A list of factor loadings of the resulting model is shown in Table 2. The model yielded a significant Chi-square test value (χ_{38}^2=228.568, P<0.01) but demonstrated a good fit in the other fit index tests. The RMSEA (0.045) was lower than 0.06, and both CFI (0.978) and TLI (0.968) were above 0.95. These values were desirable for achieving model selection.[27]

Overall, the measurement model fit the data well. The variables associated with the latent variable SES were, in order of strength of association, father's educational level, mother's educational level, family income, father's occupation status, and mother's occupation status. The variables associated with the latent variable parents' exercise habit were, in order of strength of association, father's exercise frequency and mother's exercise frequency. The correlated errors indicated a significant association between father's occupation status and family income, as well as between mother's occupation status and family income.

The results of hypothesis testing for the relationship between the latent and observed variables in the structural model are shown in Table 3. The results confirmed the hypothesis that SES is a predictor for parents' exercise habit. In families with a higher SES, parents do exercise more frequently than those in a lower SES, and both parents' exercise frequency and children's attitude toward PA are positively correlated with children's intention to participate in PA. Furthermore, parents' exercise habit significantly affects children's attitudes toward PA, with both parents' exercise habit and children's intention to participate in PA positively associated with children's MVPA. More MVPA was also found to lower children's body fat percentage.

Different from the hypothesis, no significant relationship between family SES and children's MVPA was found in this study. Screen time for children cannot significantly predict their body fat percent. Furthermore, children with a higher body fat percentage had a more negative attitude toward PA than those with a lower body fat percentage.

Table 3. Results of the hypothesis tests for the structural model

Coefficients	Estimate	LCL	UCL	SE
Children's intention to participate in PA on				
Parents' exercise habit	0.085	0.056	0.241	0.030
Children's attitude toward PA	0.803	0.766	0.837	0.036
MVPA on				
Parents' exercise habit	0.182	0.131	0.241	0.048
Children's intention to participate in PA	0.514	0.466	0.556	0.024
Children's body fat % on				
MVPA	-0.041	-0.053	-0.027	0.015
Children's attitude toward PA on				
Parents' exercise habit	0.088	0.065	0.120	0.029
Children's body fat %	-0.203	-0.221	-0.190	0.016
Parents' exercise habit on				
Family SES	0.332	0.293	0.386	0.048

All coefficients are significant at P<0.01. LCI: lower confidence interval; UCI: upper confidence interval; SE: standard error; PA: physical activity; MVPA: moderate to vigorous PA; SES: socioeconomic status.

Discussion

This study found that PA is associated with children's body composition. Similar results have been reported in the literature.[28,29] Obesity was also found to have a negative effect on children's attitude toward PA. Obese children find exercising difficult because of their body weight. Stigma related to obesity and exercise may also

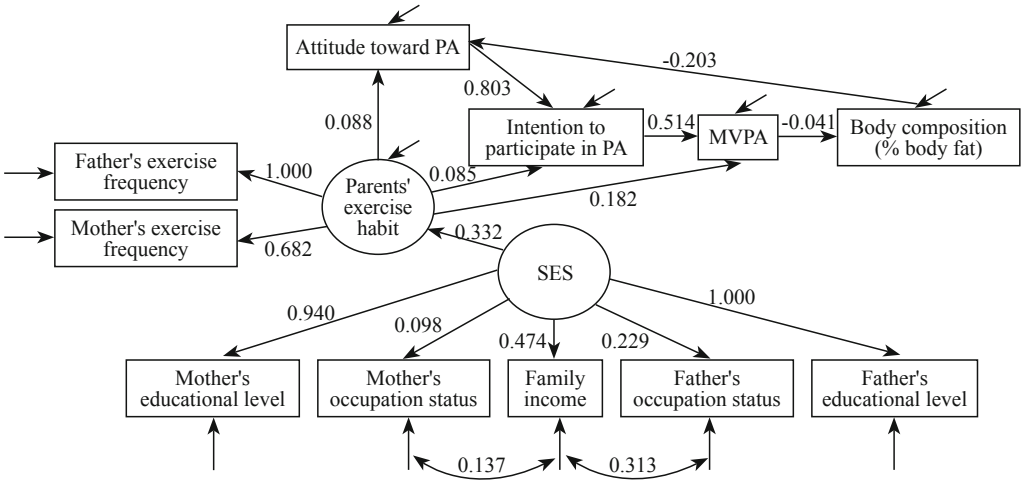

Fig. 2. The structural equation model after modification (all paths are significant at P<0.01). PA: physical activity; MVPA: moderate to vigorous PA; SES: socioeconomic status.

exist.[30] Faith and colleagues[31] found that children who are targets of weight criticism have negative attitudes toward PA. Smolak et al[32] reported that parental comments concerning their children's weight are moderately correlated with weight loss attempts and body esteem. Such stigma may have psychological, social, and health-related effect on obese children.[30]

In this research, parental exercise habit was found to have a positive effect on children's attitude and intention to participate in PA and MVPA. The literature, however, shows mixed results.[33] The findings of the current study support the hypothesis that parent modeling affects children's PA. In terms of the TPB, such a relationship may be mediated through injunctive norm and/or parental attitudes toward PA.[14]

The results of this study also suggest that SES has a direct effect on parental exercise habit but not on children's MVPA or intention to participate in PA. This finding agrees with those of other studies reporting that SES is unrelated to PA in youth.[33] Interestingly, the present research found no association between screen time and obesity.[24,34] The failure of children to substitute the time for doing PA with screen time may explain this result.[1,35]

The results of most fit indices show that the final model in this study fit the data well. Although the Chi-square test indicated that the structural parameters were significantly different from the covariance matrix of the observed variables, this did not mean that the null hypotheses should be rejected. SEM is based on maximum likelihood or generalized least squares estimation developed for covariance structure models. Large sample theory provides a Chi-square goodness-of-fit test to compare a model against a general alternative model on the basis of correlated variables. This model comparison is insufficient for model evaluation because any model virtually tends to be rejected as inadequate in large samples.[16] Although the model fits the data very well, the large sample size can therefore still lead to significant results in the Chi-square test. Apart from this, the results of the other model fit indices were all desirable. After modification, the model provided an excellent fit to the data.

This study has some limitations. The survey questions were not specifically designed for structural equation analysis and thus can still be refined to further improve the results. The questions could have been designed to test each construct, so that more constructs could have been measured. The questionnaire also failed to assess the relationship between social norms and children's intention to participate in PA.

Nonetheless, this study has several strengths. First, it used the random sampling approach. Second, a large sample size was used. Third, the participants of the study were recruited from all districts of Hong Kong. With random sampling, the study sample is representative of the population, so the findings can be generalized to all children aged 13 to 19 years in Hong Kong. The findings are also generalizable to Chinese children living in Hong Kong and cities with characteristics similar to Hong Kong. Furthermore, the results reflect the characteristics of children in urban areas in China, so they can also be generalized to other metropolitan areas in China. Rural areas, however, may have very different characteristics, so future studies are needed to be conducted in rural settings.

The results of this study provide scientific evidence for educators and policy makers to determine priorities of exercise and health promotion initiatives for children and adolescents in Hong Kong. The findings that parental exercise habits are associated with children's attitude toward PA and actual MVPA participation suggest that emphasis should be given on parental education and encouragement of parents' PA. Once parental PA is increased, children's attitude and behavior toward MVPA may also improve, and as a result, childhood obesity would be reduced. SES is in fact an issue that affects parents' PA and not children's PA. The findings may encourage policy makers to consider the provision of PA-related financial support to parents and families as a whole, such as the distribution of community PA enrolment coupons and tax and/or health insurance reduction for PA participants, among other initiatives, to promote the overall health and PA of both parents and children. SES alone does not affect children's PA.

In conclusion, children's intention to participate in PA directly influences their body composition, and attitude toward PA. Parents' exercise habit also has significant impact on children's intention to participate in PA. Obesity has a negative effect on children's attitude toward PA. Further studies should be conducted to extend this research and test the model in other metropolitan and rural areas in China.

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Supplementary information

Questionnaire on Physical Activity Participation
Hong Kong Community Fitness Survey

Section 1: Physical activity participation

Q1. In the past year, for how many days did you do vigorous-intensity physical activity (PA) for at least 10 minutes at a time on an average week?

Vigorous-intensity physical activities: these activities cause feelings of exhaustion and induce significantly rapid breathing and profuse sweating. You find talking to others difficult when performing these activities. Vigorous-intensity physical activities should have similar intensity levels as running or lifting heavy weights of 10 kg (such as 20 lunch boxes or five 2 L bottles of soft drinks).

Examples are playing ball games (such as basketball, soccer, single tennis), continuous swimming (excluding slow swimming), fast and continuous ice skating, rope skipping, uphill climbing, non-stop walking upstairs, aerobic dance, fast cycling, judo, taekwondo, and rock climbing.

In the rating of perceived exertion (RPE), vigorous-intensity physical activities are scored 8 or 9, which refers to the intensity between very strong and extremely strong.

□ 0 day □ 1 day □ 2 days □ 3 days
□ 4 days □ 5 days □ 6 days □ 7 days

Q2. During these days, how much time did you spend on vigorous physical activities on an average day?

□ 11-20 minutes □ 21-30 minutes
□ 31-40 minutes □ 41-50 minutes
□ 51-60 minutes □ 61-120 minutes
□ 121-180 minutes □ 81-240 minutes
□ 241 minutes and above

Q3. In the past year, for how many days did you perform moderate-intensity (including vigorous) physical activity for at least 10 minutes at a time on an average week?

Moderate-intensity physical activities: these activities cause a slight feeling of exhaustion and induce quicker-than-normal breathing and slight sweating. You find crooning difficult when doing the activities. Moderate-intensity physical activities should have similar intensity levels as brisk walking or walking while carrying 4.5 kg to 9 kg weights (such as a heavy schoolbag, two packs of A-4 size paper, two to four bottles of 2 L soft drinks, or 24 cans of soft drinks).

Examples are playing ball games (such as baseball, softball, badminton, volleyball, table tennis, double tennis), downhill climbing, swimming at a normal speed, cycling at a normal speed, non-stop walking downstairs, dancing (such as hip hop, social dance, ballet, folk), skateboarding, horizontal bar gymnastics, playing frisbee, intensive cleaning work (such as removing desks and chairs in the classroom, floor cleaning by hand, window cleaning).

In the rating of perceived exertion (RPE), moderate-intensity physical activities are scored from 4 to 7, which refer to the intensity from moderate up to very strong.

□ 0 day □ 1 day □ 2 days □ 3 days
□ 4 days □ 5 days □ 6 days □ 7 days

Q4. During these days, how much time did you spend on moderate-intensity (including vigorous) physical activities on an average day?

□ 11-220 minutes □ 21-230 minutes
□ 31-240 minutes □ 41-250 minutes
□ 51-260 minutes □ 61-2120 minutes
□ 121-2180 minutes □ 181-2240 minutes
□ 241 minutes or above

Section 2: Attitudes toward PA and lifestyle

Q5. Do you like to attend PE classes?

□ Like □ Generally like □ Dislike □ No comment

Q6. Do you actively participate in sports activities (extra-curricular activities, sports day, swimming gala, sports team trainings in schools, exercise classes, etc.)?

□ Actively participate □ Participate □ Not participate

Q7. What is (are) your reason(s) for participating in sports activities (three at most)?

□ Improve health/prevent disease
□ Enhance sports capability
□ Reduce stress, regulate emotions
□ Lose weight, be fit □ Social interaction
□ No specific reason □ Others

Q8. What is (are) your reason(s) for not participating in sports activities (three at most)?

□ Fatigue □ Laziness □ Lack of time □ No interest
□ Weakness or health reasons, not suitable to participate
□ Lack of facilities
□ Already engaged in many physical activities, no participation needed
□ No companion □ Bad weather
□ Healthy condition, no participation needed
□ Lack of instruction □ Lack of a group to join
□ Lack of money □ Afraid of ridicule
□ Affects bodily figure □ Don't know/not sure
□ Others

Q9. What is (are) your favorite sport activities (three at most)?

□ Ball games (basketball, soccer, volleyball, table tennis, badminton, etc.)
□ Ice skating or roller skating
□ Rope skipping or rubber band skipping

□ Gymnastics □ Dance □ Swimming
□ Wushu □ Track and field
□ Distance runs (1500 m and above)
□ None □ Others

Q10. What is (are) your major sports training (activities that you regularly participate in, including organized and non-organized activities) (three at most)?
□ Ball games (basketball, soccer, volleyball, table tennis, badminton, etc.)
□ Ice skating or roller skating
□ Rope skipping or rubber band skipping
□ Gymnastics □ Dance □ Swimming
□ Wushu □ Track and field
□ Distance runs (1500 m and above)
□ None □ Others

Q11. On average, what is the duration of your sports training (including PE lessons or extra-curricular sport activities) each day?
□ Below 30 minutes □ 30-59 minutes
□ 1 hour-1 hour 59 minutes □ 2 hours-2 hours 59 minutes
□ 3 hours-3 hours 59 minutes □ 4 hours and above

Q12. What do you think are the reason(s) for your poor physical conditions (three at most)?
□ Inadequate sports training □ Inadequate sleep
□ Inadequate nutrition □ Excessive nutrition
□ Too much playing time □ Too little playing time
□ Too much homework □ Stress
□ Heredity □ Others

Q13. Do you like to participate in distance run (1500 m and above) trainings?
□ Like □ Generally like □ Dislike

Q14. What is (are) your reason (s) for participating in distance run (1500 m and above) trainings?
□ Improve health/prevent disease
□ Enhance sports capability
□ Reduce stress, regulate emotions
□ Lose weight, be fit □ Social Interaction
□ No specific reason □ Others

Q15. What is (are) your reason(s) for NOT participating in distance run (1500 m and above) trainings?
□ Fatigue □ Laziness
□ Lack of time □ No interest
□ Weakness or health reasons, not suitable to participate
□ Lack of facilities
□ Already engaged in many physical activities, no participation needed
□ No companion □ Bad weather
□ Healthy condition, no participation needed
□ Lack of instruction □ Lack of organization
□ Lack of money □ Afraid of ridicule
□ Affects bodily figure □ Don't know/not sure
□ Others

Q16. Do you like strength training (such as chin-ups, sit-ups, push-ups, or lifting dumbbells)?
□ Like □ Generally like □ Dislike

Q17. What is (are) your reason(s) for participating in strength training (such as chin-ups, sit-ups, push-ups, or lifting dumbbells) (three at most)?
□ Improve health/prevent disease
□ Enhance sports capability
□ Reduce stress, regulate emotions
□ Lose weight, be fit □ Social interaction
□ No specific reason □ Others

Q18. What is (are) your reason(s) for NOT participating in strength training (such as chin-ups, sit-ups, push-ups, or lifting dumbbells) (three at most)?
□ Fatigue □ Laziness
□ Lack of time □ No interest
□ Weakness or health reasons, not suitable to participate
□ Lack of facilities
□ Already engaged in many physical activities, no participation needed
□ No companion □ Bad weather
□ Healthy condition, no participation needed
□ Lack of instruction □ Lack of a group to join
□ Lack of money □ Afraid of ridicule
□ Affects bodily figure □ Don't know/not sure
□ Others

Q19. How do you find dealing with homework or your studies?
□ Very difficult □ Generally difficult □ Easy

Q20. Did your parents suggest that you decrease your sports activity participation because of your studies?
□ Always □ Sometimes □ None

Q21. How much time do you spend doing homework (including hand writing homework and computer homework) at home on an average day?
□ Below 30 minutes □ 30-59 minutes
□ 1 hour-1 hour 59 minutes □ 2 hours-2 hours 59 minutes
□ 3 hours-3 hours 59 minutes □ 4 hours and above

Q22. How much time do you spend watching TV, using cell phones, using the computer (apart from homework), or playing video games on an average day?
□ Below 30 minutes □ 30-59 minutes
□ 1 hour-1 hour 59 minutes □ 2 hours-2 hours 59 minutes
□ 3 hours-3 hours 59 minutes □ 4 hours and above

Q23. In general, what is (are) your major extra-curricular activity(ies) during weekends (three at most)?
□ Extra-curricular learning □ Sports and exercise
□ Visual/audio entertainment □ Shopping
□ Web browsing or playing computer games
□ Hanging out with friends □ Outing
□ Family gathering □ Others

Q24. In the past year, what time did you usually go to bed during school days? (use a 24-hour time format.)
_ _ : _ _

Q25. In the past year, what time did you usually get up during school days? (use a 24-hour time format.)

_ _ : _ _

Q26. In the past year, what time did you usually go to bed during non-school days? (use a 24-hour time format.)

_ _ : _ _

Q27. In the past year, what time did you usually get up during non-school days? (use a 24-hour time format.)

_ _ : _ _

Q28. Did you feel tired while studying in the past month?
□ None □ Slightly tired
□ Average □ Seriously tired

Q29. How do you rate your sleeping quality in the past month?
□ Very good □ Good □ General
□ Poor □ Very poor

Q30. For the past two years, the LCSD has been organizing the "Sports for All Days" event to allow the general public to use community sports facilities for free. Are you aware of this "Sports for All Days" event?
□ Yes □ No □ Not sure

Q31. Have you ever used the free community sports facilities during the LCSD "Sports for All Days" event?
□ Yes □ No □ Not sure

Q32. Do you think the LCSD "Sports for All Days" campaign will help increase your interest in PA/sports participation?
□ Yes □ No

Section 3: Demographic information

Q33. Father's educational level
□ Pre-school education/no schooling
□ Primary school (P1-P6)
□ Secondary school (S1-S3)
□ Secondary school (S4-S5)
□ Diploma, certificate courses (S6-S7)
□ Tertiary education (non-degree/higher diploma/associate degree)
□ Tertiary education (Bachelor's degree)
□ Graduate school or higher (above Bachelor's degree)

Q34. Mother's educational level
□ Pre-school education/no schooling
□ Primary school (P1-P6)
□ Secondary school (S1-S3)
□ Secondary school (S4-S5)
□ Diploma, certificate courses (S6-S7)
□ Tertiary education (non-degree/higher diploma/associate degree)
□ Tertiary education (Bachelor's degree)
□ Graduate school or higher (above Bachelor's degree)

Q35. Father's nature of job
□ Full-time job □ Part-time job
□ Unemployed □ Retired
□ Student □ Housekeeping at home
□ Unknown/not sure

Q36. Father's occupation
□ Managers or administrators □ Craft or related workers
□ Associate professionals □ Non-technical workers
□ Professionals
□ Skilled agricultural and fishery workers □ Clerks
□ Service workers or shop sales workers
□ Plant and machine operators or assemblers
□ Unknown/not sure □ Others

Q37. Mother's nature of job
□ Full-time job □ Part-time job
□ Unemployed □ Retired
□ Student □ Housekeeping at home
□ Unknown/not sure

Q38. Mother's occupation
□ Managers or administrators □ Craft or related workers
□ Associate professionals □ Non-technical workers
□ Professionals
□ Skilled agricultural and fishery workers
□ Clerks
□ Service workers or shop sales workers
□ Plant and machine operators or assemblers
□ Unknown /not sure
□ Others

Q39. What is the total monthly household income of all your family member(s)?
□ $4999 or less □ $5000-$9999
□ $10 000-$19 999 □ $20 000-$29 999
□ $30 000-$39 999 □ $40 000-$49 999
□ $50 000-$59 999 □ $60 000-$99 999
□ $100 000 or more □ No income
□ Unknown/not sure

Q40. How many family members comprise your household, including yourself (not including domestic helper(s))?
□ 2 □ 3 □ 4 □ 5 □ 6 □ 7 or more

Q41. On average, how many times in a week did your father participate in sports in the past year (ball games, swimming, tai chi, etc.)?
□ No sports training □ Less than once □ 1-2 times
□ 3-5 times □ More than 5 times

Q42. On average, how many times in a week did your mother participate in sports in the past year (ball games, swimming, tai chi, etc.)?
□ No sports training □ Less than once □ 1-2 times
□ 3-5 times □ More than 5 times

Q43. During weekends or holidays in the past year, how often did you participate in physical activity with the family (cycling, walking, swimming, ball games, etc.)?
□ None □ At least once a week
□ 1-2 times a month □ Once in several months