Determinants of students' physical activity: a 12-month follow-up study in Ningxia Province

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Abstract

Background Physical activity has many health benefits for children and adolescents. However, the prevalence of physical inactivity in school-aged children and adolescents remains high in China. Many factors impact student’s moderate- and vigorous- physical activity (MVPA). This study investigated the factors associated with student’s MVPA level, and the determinants of the change of student’s MVPA behavior.

Methods This is a longitudinal study with a 12-month follow-up. The study samples came from 2016 and 2017 Physical Activity and Fitness in China—The Youth Study, 1597 students (aged 9-18 years) from 31 primary, junior high, and high schools, in Ningxia province, were included. Factors about the individual and external environment were measured by questionnaire at baseline and after 12 months. Multiple logistic regression was analyzed to examine the factors that impact student’s MVPA level and the determinants of the change of student’s MVPA behavior.

Results There is no difference in students MVPA level between 2016 and 2017. Boys were more physically active than girls at baseline (RR 1.55, 95%CI 1.10, 2.20), as well as children than adolescents but not significant (RR 1.33, 95%CI 0.93, 1.90). Neighborhood factors associated students MVPA level significant, but all of these factors were removed from the longitudinal model (neighborhood sport event, organization, facility, et al). Individual and school factors were important for students MVPA maintaining and positively development (i.e. gender, attitude, school PE class and PA time, et al).

Conclusions In conclusion, both neighborhood and school factors affect students MVPA behavior, but school play a more meaningful role in maintaining and promoting students MVPA level. In addition, the internal motivation may be more important than external environment for students MVPA level. Our research provide some evidences for future intervention program for promoting MVPA behavior, but more large samples and objective-assessed researches should be conduct to explore the determinants of MVPA.

Background

Cumulative evidence has demonstrated that physical activity (PA) is beneficial for physical and mental health in children and adolescents, such as reduce the prevalence of overweight/obesity, cardiovascular disease, and Type 2 diabetes and even mental health[1, 2]. In contrast, the disadvantage of sedentary behavior (SED) has also been identified[3–5]. Childhood physical activity (PA) behavior in childhood can be traced to adulthood[6], indicating that PA-related health benefits at adulthood may derive from the early active lifestyle in the early lifespan. Although the benefit of PA is evident, approximately 80% of adolescents globally (13-15 years old) are not meeting the recommended guidelines (Hallal et al., 2012). As early as 2010, the World Health Organization has recommended that children and adolescents aged 5-17 years need at least 60min moderate- to vigorous-intensity physical activity (MVPA) daily, but only 22.7% of students met the recommendation in China[7]. Until 2016, approximately 70% of Chinese
students not met the PA recommendation[8]. At the moment, a national health policy named “Healthy China 2030” was issued in 2016 to promote healthy lifestyles and physical fitness, which asks school-aged children to participate in physical activity 1-hour daily to achieve the goal of 25% “excellent” ratio of physical fitness assessment. Even so, only 34.1% of students met the recommendation of 60-minutes MVPA[9].

Both school and neighborhood are important for students PA participation[10], lots of researches have explored the factors associated with MVPA to develop an intervention for encouraging MVPA. For example, the school environment plays a crucial role for students to engage in physical activity (PA) [11, 12]. The PA-friendly school environment is positively associated with student’s PA participation[13]. Meanwhile, the extramural activity also promotes MVPA effectively, which provides more opportunities for students to participate in PA, such as neighborhood-based PA facilities, organization, and so on[14–17]. Moreover, student’s PA behavior also be influenced by others when they are in school and neighborhood, including others’ support for PA or behaviors. The systematic review has revealed that students with physically active parents are more likely to have an active lifestyle[18], as well as peer support [19, 20]. However, most of these studies were cross-sectional investigations. Little is known about the determinants for change of PA behavior and MVPA level. [21], policy and environment are two important components for behavior changing, which can influence active living through a variety of mechanisms, such as improving neighborhood PA environment[22]. Compared to small scale intervention programs, the policy is more impactive and it will be effective in national wide. A well-known example of policy intervention for health promotion is U.S Surgeon General’s report “Smoking and Health” that adult smoking rate from 50% in 1965 to 18% in 2014 after 50 years of the intervention[23]. A comprehensive health policy named “Health China 2030” issued during follow up that has made a request not only for MVPA but also for the neighborhood PA friendly environment. Therefore, these may also be effective for improving student’s MVPA level.

In the current study, we investigated the associations of student's MVPA level with environmental factors in school and neighborhood in a 12-month follow-up. In a 12-month follow-up. The outcomes of this investigation could help develop effective interventions to promote awareness of PA and increase MVPA level for children and adolescents and identify the guidance for the next step in policy-making in health for students.

**Methods**

**Study design**

This was a longitudinal survey study. The baseline sample was taken from 2016 Physical Activity and Fitness in China—the Youth Study (PAFCTYS) project, a nationwide survey of PA and fitness among Chinese school-aged children and adolescents. Thirty-one primary, junior-high and high schools were randomly selected from 8 counties/cities at Ningxia province in China. The schools were evenly distributed in urban and rural areas. The students were requested to take the same survey questionnaire
again after 12 months. The surveys took place between October and November. Details of the study protocol were described in a previous study[8]. This study was approved by the Ethics Review Committee of Shanghai University of Sport in 2016. Because of the study nature with minimum risk, only verbal assent and consent were required for in the study.

**Study participants**

A total of 1611 school-aged children and adolescents(aged 7-18 years) were included in the baseline survey in 2016 (T0) and were followed to make the same survey after 12 months (T1),14 of them in 2017(T1) have been excluded due to the missing data in some item. Among them, boys and girls were 48.2% (n = 770) and 51.8% (n = 827), respectively (see Table 1); 725 (45.4%) of them attended the schools in urban area and 872 (54.6%) in rural area; 629 (39.4%) of them were adolescents (13 to 17 years old) and 968 (60.6%) children (9 to 12 years old).

**Study procedure**

Two trained research assistants were sent to the participant school for assisting the surveys conducted in 2016 and 2017. Before starting the initial survey, verbal assents from parents and teachers, and verbal consent from students were obtained. Detailed instructions for the survey were provided and all questions were answered. The survey questionnaires were completed in the classroom within ≤20 minutes, which included the perceived PA environment of the neighborhood and school. Besides, the parents’ survey including weekly PA days was conducted off-campus by a parent questionnaire. The numeric identification code was assigned to the questionnaire. An experienced research assistant input data into a computer database, which was only accessed by authorized project staff.

**Study variables**

**PA levels**

The modified Chinese-version of the International Physical Activity Questionnaire Short Form (IPAQ-SF) was used to assess the PA levels of the students, which has been used in previous studies[8, 16, 24]. Student's responses to the question “How many days did you have moderate to vigorous physical activity (MVPA), i.e., increased breathing rates and felt sweating, more than 60 minutes in last 7 days” were categorized into three groups: the sedentary group with exercise 0 to 1 day, physically inactive group with exercise 2 to 4 days, and physically active group with exercise 5 to 7 days. Similarly, parent's PA levels (provided by parent survey) also were categorized into three groups according to their response for MVPA days in the past week more than 30 min, i.e., sedentary, physically inactive, and physically active groups.

**Neighborhood factors**

Students were requested to answer 4 questions about the neighborhood (Qn): Qn-1 “There were game/sport events held for children and/or adolescents in your neighborhood during last year”(neighborhood sport events) with possible answers scored from 1 - never, 2 - not often, 3 - so-so, 4 -
often, or 5 - very often. Qn-2 “There were free sport and/or exercise skills/training for children and/or adolescents in your neighborhood during last year” (neighborhood exercise skill training) with the same 5-score answers as in Qn-1. Qn-3 “Are there sport organizations available for children and/or adolescents in your neighborhood” (1 – yes or 2 – no)(neighborhood sport organization). Qn-4 “Are there sport facilities for children and/or adolescents conveniently located in your neighborhood” (1 – yes or 2 – no) (neighborhood sport facility). The answers for Qn-1 and Qn-2 were grouped into three categories, i.e., groups with negative (answers 1 and 2), neutral (answer 3), and positive (answers 4 and 5) neighborhood PA environment for simplicity.

School factors

Questions for school PA environment (Qs) included Qs-1 “School exercise facilities and equipment can meet my needs for physical activity and exercise”(School exercise facility); Qs-2 “PE class plays an important role for me to participate in physical activity and exercise”(School PE class); Qs-3 “School teachers encourage me to participate in physical activity and exercise”(School teacher encourage); Qs-4 “School provides extra time for physical activity and exercise”(School extra PA time); and Qs-5 “School has a desirable culture/environment for physical activity and exercise”(School PA culture/environment). All these questions had five possible answers: 1 – completely disagree, 2 – disagree, 3 – not sure, 4 – agree, or 5 – completely agree. Also, there were two more questions about student's friends: Qs-7 “Friends often encourage me to participate in physical activity and exercise training”(Friend encouragement) and Qs-8 “Friends often participate in physical activity and exercise training with me”(Friend accompany) with 5-score answers from completely disagree (score 1) to completely agree (score 5). These questions were also categorized into three groups: non-desirable/negative (combined answers 1 and 2), neutral (answer 3), and desirable/positive (combined answers 4 and 5) school PA environment groups, respectively.

Attitude to PA/exercise

Student's attitude to PA/exercise was assessed by the survey question “Your attitude to participating in physical activity and/or exercise in future” 1 – don't like PA/exercise and won't plan to participate; 2 – will start PA/exercise; 3 – will do more PA/exercise, but not every day; 4 – will try to do PA/exercise every day; or 5 – will keep exercise every day. The responses were grouped into three categories: negative attitude (answer 1); positive attitude (combined answers 2 and 3); and a very positive attitude (combined answers 4 and 5).

Statistical analysis

Continuous variables were presented as means±standard deviations and categorical variables as percentages. Differences in numeric scores between T0 and T1 were examined using paired t-test. Chi-square test and logistic regression analysis were applied to examine the associations of MVPA with sex (boys vs girls) and age (children vs adolescents). Furthermore, multiple logistic regression analysis was applied to predict the neighborhood and school PA/exercise factors for MVPA, i.e., the students who had a physically active lifestyle (exercise ≥ 5 days during the last 7 days). All factors were included the model,
and any factors was at least some indication for an association with the outcome (i.e., p< 0.2) was subsequently included in the final model.

Multiple logistic regression was used to explore the determinants for change of students MVPA in a 12-month follow-up. The full model was built to explore the potential factors for change of student's MVPA level (i.e. positive, PA days in 2017 > 2016; negative MVPA days in 2017 < 2016 and maintenance MVPA days in 2017 = 2016). Similar with the cross-sectional model, factors with p < 0.2 will be included in the final model.

Relative risk (RR) and 95% confidence interval (CI) were estimated to quantify the difference based on Chi-square test or logistic regression analysis. P-value < 0.05 was taken to indicate statistical significance. All statistical analyses were performed using Stata software ((Stata 15.0, Stata Corporation, College Station, TX)

Results

Data for the current analysis was taken from 2016 Physical Activity and Fitness in China—the Youth Study (PAFCTYS) project, and they were follow-up after 12 months. Table 1 describes the basic sample characteristics and scores of the question. There are no significant difference of students’ MVPA days between 2016 (3.8±2.0 days) and 2017 (3.7±2.0 days) (p=0.106), as well as their parents’ PA behavior (p= 0.23). Overall, the students’ MVPA was relatively low, only 36.8% (2016) and 33.6% (2017) students were physically active, boys were more physically active than girls (RR 1.52, 95%CI 1.08, 2.15). But there were no different between adolescent and children (Supplementary material table). Furthermore, more sport organizations and sport facilities available for students in 2017 compared to 2016 (Table 1).

The cross-sectional results has shown that the correlates of student’s MVPA level in Table 2 (the results of full model were presented in supplementary material table 3). In 2016 may in a relatively relaxing environment, more extracurricular factors contributed to the MVPA with 5 to 7 days (physically active). Students who answered “yes” to having sport facilities (RR 1.82, 95%CI 1.28, 2.58) and sport organizations (RR 2.60, 95%CI 1.42, 5.00) in the neighborhood were 82% and 160% more likely to be physically active. Moreover, students will have a higher MVPA level, if students lived in a community with more sports events (RR 2.16, 95%CI 1.17, 4.00), as well as with more actively parents (RR 1.99, 95%CI 1.25, 3.16). Students in good PA environment will spend more time in MVPA compared to who in negative school PA environment (RR 2.07, 95%CI 1.21, 3.54) spent more time in MVPA. Noticeably, student’s attitude to PA was the most significant factor associated with students’ MVPA level (RR 4.64, 95%CI 1.46, 14.76).

Table 3 summarizes the factors that predict maintaining and increasing of student’s MVPA level (the results of full model were presented in supplementary material table 3). Results demonstrated that girls (RR 1.38, 95%CI 1.10, 1.73) are more likely to positively develop their MVPA compared to their counterpart, and students’ MVPA level was more likely to be decreasing instead of increasing (RR 0.95, 95%CI 0.91, 0.99) with age. Interestingly, all neighborhood factors not contributed to maintain and promote the MVPA
behavior. School play an important role in maintain and develop students' PA behavior. “School extra PA time” (RR 1.20, 95%CI 0.98, 1.47) was the determinant for maintaining student's MVPA level, but not significant for promoting. Meanwhile, the “School PE class” may be the potential factors for student's MVPA level maintaining (RR 1.25, 95%CI 0.96, 1.63) and development(RR 1.31, 95%CI 0.99, 1.72). Furthermore, friends encourage for PA behavior is an important determinant for MVPA development (RR 1.35, 95%CI 1.11, 1.63), but the parents’ PA behavior was helpful for their child's MVPA maintenance (RR 1.42, 95%CI 1.16, 1.75). Similar with cross-sectional model, students' attitude to PA not only affect MVPA level but also the maintenance (RR 1.37, 95%CI 1.02,1.84) and development (RR 1.31, 95%CI 1.04,1.64) of MVPA.

Discussion

In the current study, we have explored the factors that associated with students MVPA level at baseline and the change of MVPA days in a 12-month follow-up. Our result demonstrated that there was no significant difference in MVPA level after a 12-month follow-up. Both school factors and neighborhood factors contribute to students MVPA level. In the longitudinal model, student's attitude to PA has been found both affect the MVPA maintenance and development, meanwhile the PE class may also the be potential factor with a similar effect. Furthermore, the extra PA time and MVPA behavior of student's parents are the contributor for maintaining the MVPA level, but not significantly for increasing MVPA level. However, students with more encourage from friends will increase their MVPA days in 12-month follow-up.

In the present study, there are no significant difference in MVPA days and levels between 2016 and 2017, although some of them change their PA behavior positively or negatively. However previous studies identified that MVPA decreasing with age in children and adolescent[25–27].Two large-scale questionnaire investigation studies have shown that the proportion of students met the MVPA guideline from 29.9% in 2016 to 34% in 2017 in China[8, 9]. It indicates that some factors influence the change trend. As the case might be influenced by “Healthy China 2030” partially, which issued in October 2016 has appealed that students should participate MVPA more than 60min/day and having more than 25% of them achieve an “excellent” rating in fitness.

The results manifested that boys were more physically active than girls, this is similar with previous studies [28, 29].However, the attitude to PA, the most significant contributor to MVPA level in our study, was not different between girls and boys, indicating that the sex difference in MVPA level was from other aspects. Whereas, attitude to PA was a powerful predictor for MVPA level, which has been identified by the previous study that students who think PA is good and engage in PA enjoyable spent more time in MVPA at school[30]. Neighborhood PA facilities were also a significant contributor to student's MVPA level. This is consistent with other studies that available PA facilities are positively associated with MVPA[17, 31]. In addition, students live in a neighborhood with sport organization and events are more likely to be physically active, which will provide more PA opportunities for children and adolescents. A study from the UK suggested that neighborhood-based PA is critical for helping students to increase
MVPA, but not for sedentary behavior reduction [15]. Moreover, active students have active parents, the
model effect of parents for their child PA behavior have been identified[32]. In addition, there is a positive
relationship between neighborhood PA opportunities availability and parents MVPA days (not shown in
result). Maybe there is a mutually promoting relationship, but this is not the scope of this study. Clearly,
both the neighborhood PA environment and parents PA behavior associated with students MVPA level
significantly. Therefore, neighborhood-based activity may be an effective measurement to increase
student's MVPA out of school. As for the school factors, the results demonstrated that school PA
culture/environment associated students physically active significantly, but school PA facilities and PE
classes were not. A possible reason may be that these two factors were similar among different schools,
as a unique request for the number of PE class and the infrastructures of PA, such as basketball and
football court. Besides this, a systematic review has found that facilities and equipment are considered
important for physical activity promotion, if the wider school policies do not encourage and support the
use of these by all students, the overall impact on physical activity is likely to be negligible[12]. Therefore,
a good school PA culture may be more important than physical environment. However, we have not found
the promoting role of friends in MVPA level, neither encourage nor accompany. This finding differs from
previous studies that friend's encouragement and engagement were positively associated with MVPA [20],
but a recent study found that the relationship between friends support and MVPA mediated by self-
efficacy and enjoyment[33]. This may indicate that the difference of MVPA level in school-aged children
may from family rather than school by bringing together of these evidences. Overall, it appears to be the
combination and interaction of school and neighborhood factors that influence adolescent physical
activity, rather than a single characteristic of the school or neighborhood.

In the longitudinal model, we found that the students MVPA days will more likely to decrease the MVPA
level with age. This is consistent with a meta-analysis of cohort studies[34], it is also the a global issue
that cause many health problem. Noticeably, student’s attitude to PA not only associated with a higher
MVPA level but also indicate the positive change of MVPA behavior, a previous study supported this result
[35]. This can also be explained by autonomous motivation, a component of Self-determination
theory(SDT)[36], that autonomously motivation positively predict PA participation[37, 38]. In addition,
higher PE motivation associated with PA and sport participation positively[39], which can be explained by
the trans-contextual model of motivation, this also the reason why PE class and extra PA time was the
potential factors for maintaining and promoting MVPA level[40]. Interestingly, we found that girls are
more likely to increase their MVPA level in 12-month follow-up than boys, which consistent with previous
a systematic review that non-organized PA declined among adolescent boys but girls[41]. Moreover,
basing on the relatively lower MVPA level among girls at baseline, a higher possibility will happen in
increasing MVPA level among girls. Finally, compared to a negative change in the MVPA level, students
with physically active parents had a trend to remain a stable MVPA level and positively developed their
MVPA level with more friend support. Both cross-sectional and longitudinal studies have identified the
positive effect of parents and friends on students’ PA behavior[42, 43], and our results strengthen this
evidences.
Our study has some obvious weaknesses. First, we assess the MVPA level by self-report, which will cause bias of MVPA assessment and we cannot distinguish the school-day and after-school MVPA by this method. Moreover, we used the days of students participating in MVPA for more than 60 min, as many students cannot estimate the precise duration of MVPA behavior and they cannot distinguish the low-intensity physical activity, moderate-intensity physical activity, and vigorous-intensity physical activity clearly. Therefore, many students did not fill this question. This may cover some information due to the lower precision. Future, more studies need to develop an accurate and efficient tool for students especially for lower age student to estimate the PA time in large scale investigation. Second, we measure the school and neighborhood PA environment by self-perceived instead of the objective assessment instruments, this may limit the implementation of environmental improvement. Future studies should apply the objective assessment instrument to examine the association between these influential factors and MVPA in detail. Consequently, we can understand the association between different influential factors and the distribution of area and time of PA behavior. In addition, more studies need to explore the transformation of influential factors of PA behavior with age, this will be more effective for precise intervention for PA behavior.

Findings from our study provide epidemiological evidence for children and adolescents MVPA intervention in the future. Moreover, this evidence is also important for developing policies for promoting school-aged children MVPA participating. In our results, improvement of neighborhood PA environment and attitude can’t translate to MVPA level evaluating, indicated that there are some influential factors impacted MVPA of school-aged children significantly with age and school grade increasing. A study from China has reviewed the role of policy to prevent fitness decreasing, and revealed that the policy alone did not seem to work[44]. Therefore, a single health policy can't improve the MVPA level of school-aged children. In China, the study is the top priority for school-aged children, result that most of their time is used in the study rather than PA. In the future, concurrent education and health policy may be effective for increasing MVPA level of school-aged children. Furthermore, change of behavior is not an isolated problem, as it influenced by many factors and from a distinct level[21, 22]. Future studies should explore influential factors more comprehensively, and the intervention should be full-scale and multilevel.

**Conclusion**

In conclusion, both neighborhood and school factors affect students MVPA behavior, but school play a more meaningful role in maintaining and promoting students MVPA level. In addition, the internal motivation may be more important than external environment for students MVPA level. Our research provide some evidences for future intervention program for promoting MVPA behavior, but more large samples and objective-assessed researches should be conduct to explore the determinants of MVPA.

**Abbreviations**

PA: physical activity; MVPA: moderate and vigorous physical activity; SED: sedentary behavior; BMI: body mass index; RR: relative-risk; CL: confidence interval; Qn: question about neighborhood; Qs: questions for
Declarations

Ethics approval and consent to participate

Our study protocol has been approved by the Ethics Review Committee of Shanghai University of Sport (ERCSUS) (#2017037). We have been approved by ERCSUS for students to participate in this study just need the verbal consent by their teacher, principal of participating school, and student’s parents, due to the minimal risk for participants and the enormous sample size. Potential risks and benefits for participants have been elaborated for every participant before data collection, the same protocol has been declared for the teachers and principals of participating schools, and student’s parents. Each verbal consent/assent was entered into a subject file with a numeric identification code by the research assistant and, subsequently, saved into a computer database accessed exclusively by authorized project staff.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

We have no competing interests.

Consent for publication

Not applicable.

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Authors’ contributions

WH analyzed the data and drafted the manuscript. XS help analyze the data, and revised the manuscript. YW clear up the data. XL, PG, JL help collected the data. JZ conceived and designed the study, supervised...
all aspects of its implementation, interpreted the data, and revised the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. Descriptive statistical analysis of the numeric variables.
| Study variables                                  | Year 2016 Mean ±SD (95% CL) | Year 2017 Mean ±SD (95% CL) | P value |
|------------------------------------------------|-----------------------------|-----------------------------|---------|
| Age                                            | 11.90(11.78,12.03)          | 12.90(12.78,13.03)          |         |
| Gender (% boys)                                | 48.22(45.77,50.67)          | 48.22(45.77,50.67)          |         |
| BMI(kg/m²)                                     | 18.46(18.31,18.61)          | 19.16(18.99,19.33)          | <0.001  |
| MVPA days (0 – 7 days)                         | 3.83±1.95 (3.73, 3.92)      | 3.74±1.93 (3.65, 3.84)      | 0.106   |
| Attitude to PA (0 – 5 score)                   | 3.73±1.10 (3.68, 3.79)      | 3.98±1.05 (3.93, 4.03)      | <0.001  |
| Neighborhood sport events                      | 2.37±1.67 (2.31, 2.43)      | 2.70±1.24 (2.64, 2.76)      | <0.001  |
| Neighborhood exercise skill training           | 1.97±1.09 (1.92, 2.03)      | 2.34±1.26 (2.28, 2.40)      | <0.001  |
| Neighborhood sport organization(%YES)          | 20.66(18.75,22.72)          | 32.37(30.12,34.71)          | <0.001  |
| Neighborhood sport facility(%YES)              | 61.24(58.82,63.60)          | 71.95(69.69,74.10)          | <0.001  |
| School exercise facility                       | 4.11±0.99 (4.06, 4.16)      | 4.20±0.97 (4.15, 4.24)      | 0.013   |
| School PE class                                | 4.37±0.88 (4.33, 4.41)      | 4.42±0.82 (4.38, 4.46)      | 0.042   |
| School teacher support                         | 4.15±1.07 (4.10, 4.20)      | 4.27±0.99 (4.22, 4.31)      | 0.001   |
| School extra PA time                           | 3.92±1.14 (3.87, 3.98)      | 4.14±1.04 (4.09, 4.19)      | <0.001  |
| School PA environment                          | 3.94±1.08 (3.89, 3.99)      | 4.16±1.02 (4.11, 4.21)      | 0.001   |
| Friend support                                 | 3.92±1.18 (3.87, 3.98)      | 4.13±1.05 (4.08, 4.18)      | <0.001  |
| Friend accompany                               | 3.96±1.18 (3.91, 4.02)      | 4.14±1.07 (4.09, 4.19)      | <0.001  |
| Parent PA days (0 – 7 days)                     | 3.06±2.15 (2.95, 3.16)      | 3.15±2.15 (3.01, 3.22)      | 0.227   |

MVPA: moderate and vigorous physical activity
PA: physical activity
All neighborhood and school questions have a score range from 1 to 5.

Table 2 Positive contributors predict students to be physically active at baseline.
| Variables                                      | RR  | 95% CI | p    |
|------------------------------------------------|-----|--------|------|
| Children vs Adolescent                        | 1.33| 0.93   | 1.90 | 0.117|
| Gender                                        | 1.55**| 1.10   | 2.20 | 0.013|
| Boys vs girls                                 |     |        |      |      |
| Attitude to PA                                | 4.61**| 1.43   | 14.89| 0.011|
| Positive vs negative                          |     |        |      |      |
| Neighborhood sport event                      | 2.15**| 1.16   | 3.99 | 0.015|
| positive vs. negative                         |     |        |      |      |
| Neighborhood sport organization                | 2.60**| 1.38   | 4.87 | 0.003|
| Yes vs. no                                    |     |        |      |      |
| Neighborhood sport facility                   | 1.75**| 1.23   | 2.49 | 0.002|
| Yes vs. no                                    |     |        |      |      |
| School PA culture/environment                 | 2.07**| 1.21   | 3.54 | 0.008|
| Positive vs negative                          |     |        |      |      |
| Friends accompany                             | 1.60**| 1.00   | 2.55 | 0.048|
| Positive vs negative                          |     |        |      |      |
| Parents PA days                               | 1.64**| 1.10   | 2.44 | 0.015|
| neutral vs negative                           |     |        |      |      |
| Positive vs negative                          | 1.97**| 1.23   | 3.13 | 0.005|

RR: relative risk
CI: confidence interval
*: represent the p < 0.1; **: represent the p < 0.05

Table 3 Factors determining maintain and increase in MVPA days from 2016 to 2017
| Variables                                      | RR  | 95% CI | p    |
|-----------------------------------------------|-----|--------|------|
| Negative Reference                            |     |        |      |
| Stable                                        |     |        |      |
| Age                                           | 1.02| 0.97   | 1.08 | 0.407|
| Gender                                        | 0.87| 0.66   | 1.15 | 0.339|
| Girls vs boys                                 |     |        |      |
| Attitude to PA                                | 1.36**| 1.01 | 1.83 | 0.040|
| Neighborhood sport facility                   |     |        |      |
| yes vs no                                     | 1.01| 0.73   | 1.40 | 0.940|
| School PE class                               | 1.31| 0.91   | 1.89 | 0.141|
| School extra PA time                          | 1.25*| 0.96 | 1.63 | 0.092|
| Friends encourage                             | 1.13| 0.89   | 1.44 | 0.250|
| Parents PA behavior                           | 1.42**| 1.15 | 1.74 | 0.001|
| Positive                                      |     |        |      |
| Age                                           | 0.95**| 0.91 | 0.99 | 0.024|
| Gender                                        | 1.38**| 1.10 | 1.73 | 0.005|
| Girls vs boys                                 |     |        |      |
| Attitude to PA                                | 1.31**| 1.04 | 1.64 | 0.022|
| Neighborhood sport facility                   |     |        |      |
| yes vs no                                     | 1.14| 0.89   | 1.47 | 0.308|
| School PE class                               | 1.31*| 0.99 | 1.72 | 0.055|
| School extra PA time                          | 1.20*| 0.98 | 1.47 | 0.077|
| Friends encourage                             | 1.35**| 1.11 | 1.63 | 0.003|
| Parents PA behavior                           | 1.13| 0.96   | 1.33 | 0.150|

Negative: students’ MVPA days in 2017 < 2016  
Stable: students’ MVPA days in 2017= 2016  
Positive: students’ MVPA days in 2017 > 2016  
RR: relative risk  
CI: confidence interval  
*: represent the p < 0.1; **: represent the p < 0.05