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April 22, 2019

# The Influence of School Curricular, Environmental and Traffic Intervention on the Physical Activity Level of Student Groups Based on Socio-ecological Model

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**Abstract**—According to the international research and the socio-ecological model, this paper reviews and analyzes school-based interventions and influences on adolescents' physical activity. The results show that because most adolescents are school-aged students, school-based interventions are the key to promote adolescents' physical activity. It is necessary to fully consider the combined influence of sub-factors such as curriculum setting, school environment and school-related transportation. And simultaneously, the school-based interventions should play a role with other levels of socio-ecological model. Long-term systematic multiple interventions can promote physical activity of young people and improve their physical fitness. (Abstract)

**Keywords**—school-based intervention; students' physical activity; socio-ecological model (key words)

## I. INTRODUCTION (HEADING 1)

With the improvement of living standards and development of economy, the physical fitness of students has shown a downward trend in recent years, which is mainly reflected in the sustained surge in obesity and obvious decrease in various physical functions. Epidemiological studies of many physical activities have confirmed that there is a "dose-effect" relationship between physical activity levels and physical health. The lack of physical activity in adolescents can cause obesity [1] and various metabolic diseases [2]. Therefore, how to improve the physical activity level of adolescents through interventions is the key to improving the status of adolescents' physical health. Recently, relevant researches on promoting the physical activity of adolescents based on social ecological models have emerged in and have gradually been recognized by Chinese domestic scholars.

Nowadays, there has been a trend to transform adolescents' "physical activity", which is an "independent variable" that produces a health effect, into a "dependent variable", and explore the influence factors of adolescents' physical activity through the construction of socio-ecological model. Since majority of adolescents are students, the school-based intervention is the main influence factor of adolescents' physical activity. This paper summarizes and analyzes the research on the impact of school-based interventions on the physical activity level of adolescents in the international field, and provides reference for the promotion of students' physical health in China.

## II. RESEARCH PROCESS OF SOCIO-ECOLOGICAL MODEL OF ADOLESCENTS' PHYSICAL ACTIVITY

The discussion about the influence factors of physical activity has been dominated by the individual-centered theory and individual internal variables until the 1980s. Later, people began to focus on more levels, especially environmental factors, to study physical activity. In the past decade, several socio-ecological models aimed at physical activity have been proposed internationally, which provide a more comprehensive and specific framework for understanding the potential influence factors of physical activity [3].

The socio-ecological model was first proposed by the famous psychologist Bronfenbrenner when he criticized the traditional classical behavioral genetic model in 1970s. The model highlights the impact of the entire environmental system of different elements on individuals, including interpersonal relationships, organizations, community policies and so on [4]. But Professor Bronfenbrenner only emphasized the impact of the environment on individuals, didn't involve individual internal variables. In 1988, Mclerory and his partners proposed five intervention levels of the socio-ecological model: individual level, interpersonal level, organizational level, community level and public policy level. These five levels of intervention can work together on individual physical activity behavior [5]. Because of the enrichment and revision of many scholars, the model was finally constructed completely by Professor Spence in 2003. And he applied it to physical activity and physical exercise [6]. The "Socio-ecological Model Based on Adolescents' Physical Activity", which is now highly recognized and widely used, is shown in Figure 1.

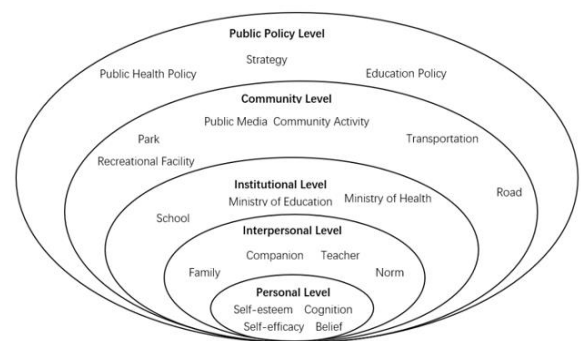


Fig. 1. Social ecological model based on adolescent physical activity

The famous American physical activity epidemiologist Sallis found that the level of physical activity of adolescents

is directly or indirectly affected by different factors at different levels by applying some comprehensive intervention models to the practice of adolescents' physical activity in the United States and other countries [7]. Annamari Aura systematically reviewed the relevant literature published from 2002 to 2014 and he thought Most of the research evidence indicates that the sub-factors of the socio-ecological model are related to adolescents' behaviors including smoking, drinking, physical activity and diet. And these behaviors affect the physical health of adolescents indirectly. It is worth mentioning that it is considered that some key sub-factors are highly correlated with behavioral outcomes in this systematic review, such as health-education interventions in schools are an important way to reduce unhealthy behaviors among adolescent students [8]. Under the influence of foreign research, China has also begun to pay more attention to the impact of systematic comprehensive interventions on adolescents' physical activity.

### III. SCHOOL-LEVEL INTERVENTION STRATEGIES FOR PROMOTING PHYSICAL ACTIVITY LEVELS OF STUDENT GROUPS

The overwhelming majority of adolescents are students in school, which include elementary schools, junior high schools, senior high schools and some other schools. Therefore, most of the non-sleeping time of adolescent students is spent in school and most of the daily physical activities are accumulated in the school environment. In general, students need to spend 6-7 hours in a typical "school day", so the school should be an ideal venue for students to conduct more physical activities [9].

Physical activity promotion measures based on school can effectively improve the physical activity of students in school, and also improve adolescents' academic performance, cognitive ability, attention and concentration [10-12], which provide further evidence for the importance of school-level interventions.

Promoting adolescents' physical activity through school-level interventions is not a single intervention that works, but the effects of multiple interventions [13]. Lohrmann believes that the multi-intervention strategy at the school level should also be based on the socio-ecological model, should involve other levels of interventions related to the school including the individual level, interpersonal level, community level, organizational level and public policy level. [14].

The figure 2 below is a diagram of the various intervention strategies for improving the level of physical activity of adolescents at the school level designed for the study.

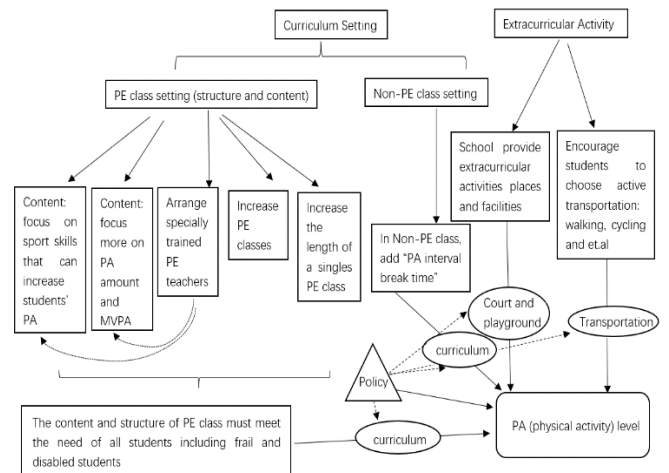


Fig. 2. School-based intervention strategies for promoting physical Activity of adolescents

### IV. THE INFLUENCE OF SCHOOL CURRICULUM INTERVENTION ON THE PHYSICAL ACTIVITY LEVEL OF STUDENT GROUPS

At the school level, the level of physical activity of adolescents is related to the content, organizational and structural characteristics of physical activity of students in school. That is, how the school infiltrates the concept of physical activity in the curriculum to conduct reasonable organizational construction directly affects the physical activity of adolescents [15].

The school curriculum setting is a sub-factor of school-level multi-intervention strategy aimed at promoting physical activity among adolescent students. By improving the structure and content of the curriculum, the level of physical activity of students can be promoted to a large extent. The school curriculum is divided into two parts: physical education curriculum and non-physical-education curriculum.

#### A. The Influence of Physical Education Class Setting on the Physical Activity Level of Student Groups

Physical education not only provides sports-related knowledge and skills to students, but also enables students to understand the benefits and ways of improving physical activity deeply. thereby it can provide a motivation for students to begin and maintain an active lifestyle. Therefore, the setting of physical education class is the key to the sub-factor "curricular intervention" in school-level interventions [16].

In terms of the content of physical education class, in the past, schools and teachers only focused on imparting sports knowledge and skills, and ignore whether these knowledge skills can be effectively transformed into students' physical activity level or physical health level. Nowadays, schools can pay more attention to the increase of physical activity amount of every student, especially Moderate-Vigorous Physical Activity (MVPA) by adjusting course content [17]. Different types of sports can cause different impact on adolescents' physical activity [18], PE teachers can choose this kind of sports which is in favor of increasing MVPA to improve students' physical condition.

When it comes to the capacity of physical education class, it is possible to extend the duration of every PE class or increase the number of weekly PE classes to increase the physical activity time of adolescents. A regression analysis of 189 adolescents in nine high schools in Spain found that the

capacity of PE classes and the number of students in each PE class were significantly correlated with the MVPA time of students [19]. In addition, it is necessary to improve the utilization efficiency of PE classes in a limited duration through various strategies [20]. There was a positive correlation between physical activity and the number of PE classes per week and the length of time that students spent participating in school sports [21]. And for both boys and girls, the number and quality of weekly PE classes are significantly correlated with their physical activity levels [22].

Beyond that, the training of PE teachers is also an important part. Physical education plays a significant role in the physical activities of students. Therefore, PE teachers are very vital for the “first experience” of physical activities for students. An excellent PE teacher can use his teaching ability and skills to stimulate students' attention and enthusiasm for physical activities. Moreover, the training of PE teachers can directly influence the changes in the content of PE courses.

In the “Physical Activity Guidelines for Americans Midcourse Report: Strategies to Increase Physical Activity Among Youth” promulgated by the American Physical Activity Guidelines Committee in 2012,[17]it is pointed out that interventions in physical education curriculum, whether single intervention of individual factors or joint intervention of all factors, can improve the physical activity level of adolescents, but the most effective way is to combine the physical education curriculum content and PE teachers' management ability training to conduct multiple interventions.

#### *B. The Influence of Non-Physical-Education Class Setting on the Physical Activity Level of Student Groups*

The intervention of non-physical-education curriculum is mainly about increasing the internal breaktime in class and the physical activity time during a break between two classes.

The latest experimental study found that "physically active learning" that combine physical activity with non-PE courses can not only make more students reach the physical activity recommendation that proposed by WHO, but also improve students' arithmetic skills significantly [23]. There is an evidence that increasing the physical activity interval during non-PE classes is as effective as extending the duration of PE classes [24]. In indoor non-PE classes, the attention that teachers pay to the physical activity and health of students and themselves will directly affect the amount of physical activity of adolescents in non-PE classes [25]. Therefore, the training of teachers should not be limited to PE teachers, but should also be extended to other curriculum teachers, which includes training on their awareness of physical activity, nutrition and other related topics [26]. Studies in the United States have shown that about 42% of students receive most of their daily physical activity during breaks between 2 non-PE classes. In particular, the physical activity of pupils in grades 5-6 during class breaks even exceeds the amount of physical activity in PE classes [17]. Schools can extend the idea to the setting of non-PE classes.

The American organization “ Playworks” believes that the design of breaks should focus on seven dimensions: time, space, rules, teachers, students' rights, school environment, and indoor classes [27]. In addition, many school-level policies also contribute a lot to the physical activities promoting in non-PE classes and other duration in school, such as the “Sports Festival”, “Sports Week” or

“Sports Month” in many primary and secondary schools in China. These policies and projects can effectively stimulate the motivation of physical activity of students.

The design of school curriculum (both PE curriculum and non-PE curriculum) is the foundation of the school-level intervention strategy. To make it work best, it should be complemented by other measures, such as providing healthy food and off-school physical activity and carrying out some policies that can provide education to students' parents. [28]. Therefore, only the effect of intervention around the curriculum itself for the improvement of adolescents' physical activities is limited. It is necessary to intervene in multiple factors to achieve this goal.

#### V. THE INFLUENCE OF SCHOOL ENVIRONMENTAL INTERVENTION (VUNUES&FACILITIES) ON THE PHYSICAL ACTIVITY LEVEL OF STUDENT GROUPS

When it comes to school environment, several researches indicate that the accessibility, availability, quantity and quality of sports equipment, such as balls and elliptical machine, and sports venues in the school have evident correlations with students' physical activities [29].

In the 1990s, McKenzie and other scholars found that although schools can make students more active through the setting of the PE curriculum, the increase of the PE curriculum duration and quantity are limited. So to some extent, how many available sports equipment, sports venues and how much extracurricular sports time can be provided by school directly influence students' physical activity. [30]. Sports equipment and sports venues are the school physical environment, and PE teachers are the school social environment.

Whether students can choose their activity types in extracurricular time and breaks or not also have a great impact on the level of physical activity. In the non-class time of school life, the students, especially girls prefer to conduct some independent non-fixed physical activity program [31], which has higher requirements on the number and the quality of sports venues and facilities. In some schools with better monitoring security and a wide variety of sports venues, students will be more active. Boys and girls have different requirements for the school environment. The physical activity level of boys is normally related to the availability of outdoor sports venues, while girls prefer to be active indoors [32]. The commonality of different studies lies in affirming the effective promotion of the school environment (vunues & facilities) to students' physical activities.

Not only that, but some researchers conduct an objective survey of the area of school building and game entertainment places. The public health scholars of Harvard University in the United States say that each student's average area of school building and game entertainment (m<sup>2</sup>/person) are positively correlated with and the objectively measured students' physical activity during school [33, 34]. Even some studies have found that the number of facilities and equipment provided by the school is also highly correlated with the level of physical activity of students during non-school time [35].

In recent years, with the development of sensor technology and some classroom technology equipment, scholars who study the physical activities of students are also interested in some technological equipment related to physical activity promotion. One study about Active Classroom Equipment (ACE) in a primary school in

Minnesota, USA, found that after a one-year pilot trial, students who are exposed to "Active Classroom Equipment" for 30 minutes to 40 minutes per day, compared with other school students, have an evident improvement on both physical activity and literacy skills [36]. The "Active Classroom Equipment" are mainly to remove the normal tables and chairs in a classroom, and replace them with ladders, balance beams, rotators and some other sport facilities to promote students' physical activity in school through the establishment of neuro-motor skills. This type of classroom equipment can be used in primary schools.

Nowadays, research on the physical activity of adults has indicated that some wearable devices that measure physical activity, such as wristband accelerometers, pedometers, heart rate monitors and other sport sensors, have a promoting effect on adults' physical activity. A quantity of researches suggest that using sport sensors such as pedometers as an effective motivational tool can promote physical activity and healthy quality of life in adults with osteoarthritis [37]. In the field of physical activity of students, the sport sensor are mostly regarded as an objective measurement tool to monitor the physical activity amount and intensity. Therefore, I think, in the future, research on students' physical activity, the should pay more attention to the incentive intervention effect of sport sensor.

#### VI. THE INFLUENCE OF SCHOOL TRAFFIC INTERVENTION ON THE PHYSICAL ACTIVITY LEVEL OF STUDENT GROUPS

In recent years, research on school-related transportation and physical activity of students has gradually been taken seriously. The school-related active transportation methods mainly refer to the way of walking and cycling between school and home [38]. Choosing a more active traffic approach to school can motivate students to obtain higher levels of daily physical activity and higher levels of cardiorespiratory function [39-41]. Since walking or cycling is Moderate Physical Activity (MPA), walking or riding a bicycle between school and home can directly increase a student's MVPA level.

Although active transportation methods can provide students with more daily physical activities, walking and cycling is unlikely to be chosen by students in most cases, because it is often influenced by their parents' opinion on the school-related traffic environment, such as distance and security. [42]. Distance is the dominant factor in the way that students choose to go to school [43], and students who live far from school often show less walking or cycling to school. To solve this problem, the National Education Department or other government departments can consider increasing the density of schools in residential areas so that more students can live around a school that is within a walking distance to home. Sidewalks and traffic safety may be the most important criteria for students and parents to change the way they arrive in school. In response to this problem, relevant departments can optimize the route around school, such as adding more appropriate walk or bicycle lanes for students, optimizing pedestrian barriers and improving traffic lights. These measures can be used as school-level traffic intervention strategies.

According to a US survey, from 1969 to 2001, school-related active transportation (walking & cycling) has dropped from 41% to 13% [44], which means that because of the development of transportation, the complexity of road conditions and parents' concerns about the safety of the traffic environment, fewer and fewer students will choose

school-related active transportation. The emergence of this phenomenon has also attracted the attention of the American Education Department and other government departments and schools. These relevant departments have joined schools to formulate some policies to deal with this phenomenon, such as the US "Safe Routes to School (SRA)" Project and the "Walking To School (WTS)" Project, and received positive results [45]. These policies and projects related to school transportation can also be used in china and provide reference and inspiration for the Chinese Education Departments and schools.

#### VII. CONCLUSION

Based on the concept of "socio-ecological model", the school-level intervention strategy for students' physical activity promotion pays more attention to the comprehensive role of different interventions with different priorities. At the school level, it is necessary to fully consider the function of sub-elements such as curriculum, school internal environment and school-related transportation, and simultaneously attach importance to the role of the individual level intervention, the interpersonal level intervention, the community level intervention and public policy level intervention which are related to the school level intervention. Based on the above research, it is found that the improvement of students' physical activity level cannot be achieve immediately. It requires a long-term joint intervention process. As the most common organizational environment for students, schools have the strongest operability, so the intervention strategy of school is the easiest strategy to implement. The intervention strategies at the school level in China are still relatively backward and traditional. China should learn more from the intervention strategies of countries around the world, and enrich their content to promote the improvement of the physical activity of students from the perspective of "socio-ecology".

#### ACKNOWLEDGMENT (*Heading 5*)

This research was financially supported by Beijing Educational Science Planning. Research on the Quantitative Tracking and Evaluation System of Students' Physical Activities, AGA14157, a project of Beijing Educational Science Planning.

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