Social and Family Factors as Determinants of Exercise Habits in Japanese Elementary School Children: The Super Shokuiku School Project

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Abstract

Background Many studies have already reported on the relationship between exercise habits and health among schoolchildren. However, few have examined social and/or family factors as determinants of exercise habits. This study investigated factors related to both dislike and lack of physical activity among schoolchildren. **Methods** This study's participants included 1,984 school children (1,001 boys and 983 girls) aged between 6 and 13 from the Super Shokuiku School Project in January 2016. A survey was conducted to assess sex, grade level, physical activity, lifestyle, overall health, enrichment of school life, social background, and parental lifestyles. Both the dislike and lack of physical activity were defined as poor exercise habits; correlates were analyzed using a logistic regression. **Results** "Lack of close friends" had the strongest links with both dislike (adjusted odds ratio [OR] 5.30; 95% confidence interval [CI], 2.78-10.1) and lack of (adjusted OR 5.40; 95%CI, 2.81-10.4) physical activity. Further, children who engaged in long periods of screen time and lacked parental communication also tended to dislike and lack physical activity. Children with mothers who were unemployed (housewife) and had undesirable lifestyles as well as those with poor health were also more likely to lack physical activity. **Conclusion** Social and family factors (e.g., close friends) may be determinants of exercise habits among schoolchildren independently of their own lifestyle factors. Although a longitudinal study is needed to determine causality, substantial attention should thus be paid to these factors when promoting physical activity.

Background

The Physical and Athletic Aptitude Survey [1] conducted by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) indicates that there is a widening physical ability gap between children who engage in physical activity and those who do not [2]. Moreover, the number of children who do not exercise increases with age [3]. Such reductions may be associated with lower levels of motivation, emotional strength, and the ability to form interpersonal relationships. Unfortunately, these problems may also negatively influence psychosocial development [4]. The Japan Sports Agency has thus proposed a goal of increasing the rate of sports participation from 58.7% to 80% while decreasing the percentage of junior high school students who dislike sports from 16.4% to 8% by the year 2022 [5]. As such, it is important to research the reasons for the growing lack of physical activity and sedentary lifestyles among these children to determine what measures are needed to develop good exercise habits during early childhood.

Children are now spending less time playing outside and/or participating in sports. By contrast, they are spending longer hours indoors while watching television and playing games. Many studies have linked such physical inactivity to overweightness and obesity [6], peer problems [7], and school-avoidant emotions [8]. Further, children with overweight or obese mothers tend to engage in less physical activity and spend more time watching television and playing games [9]. Similarly, children who are in poorer health and have parents that are heavy internet users tend to engage in longer screen times [10]. These conditions provide evidence that child health is significantly influenced by health-related parental behavior [9-11]. On the other hand, studies have reported that even short durations of physical activity

effectively reduce anxiety and/or boost self-esteem [7], while consistent physical activity can help mitigate emotional problems [12]. Moreover, elementary schools that successfully reduced the rate of child inactivity were also able to increase the number of students who enjoyed such engagement [13]. This indicates that physical activity can be encouraged through enjoyment, thus promoting wholesome physical and mental health while providing fulfilling school experiences.

Meanwhile, Japan has one of the highest rates of child poverty among all Organisation for Economic Co-operation and Development (OECD) nations. In this context, widening socioeconomic disparities and their effects on child health are serious concerns [14,15]. As such, health education should be mandatory in the school setting for both parents and children regardless of academic achievement [14] or socioeconomic status [14-17]. These measures are now highly anticipated. Notably, previous studies have reported that lifestyle is a major influencing factor for children who dislike and lack physical activity [18,19]. However, few studies have examined how these factors are related to the family environment and other social factors surrounding the child. This study therefore comprehensively investigated the factors related to both the dislike and lack of physical activity among children, including habits that relate to health and lifestyle, the family environment, and other social factors.

Methods

(1) Participants and the survey outline

A total of 2,129 children aged between 6 and 13 from the Super Shokuiku School Project (Phase 3: January 2016) [10,20] and who belonged to one of five elementary schools in Takaoka City, Japan participated in this study. The Super Shokuiku School Project was designed to investigate food education and was supported by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). The overall purpose of the project was to promote healthy lifestyles in school children and improve their health. The survey was approved by the Ethics Committee of University of Toyama. Written informed consent was obtained from the participants' parents, and participation was voluntary.

(2) Questionnaire

Participants were asked to complete questionnaires asking about sex, grade level, physical activity, lifestyle, overall health, enrichment of school life, social background, and parental lifestyles. The children responded with their parents if necessary. The child responded to items concerning sex, grade, physical activity, lifestyle, overall health, and enrichment of school life by themselves, while their parents responded to items concerning social background and parental lifestyles. All completed questionnaire were returned to the respective schools of each participant.

Physical Activity

The physical activity portions of the questionnaire included the items of “frequency of physical activity” [21] and “preference for physical activity.” [18] Responses to “frequency of activity” were answered according to a 4-point scale and divided into the two following categories: “Very often (very often, often)” or “Not often (rarely, almost never).” Responses to “preference for physical activity” were also answered according to a 4-point scale, and were divided into the two following categories: “Like very much (like very much, like)” or “Dislike (don’t like so much, dislike).” Validity for both these items had already been determined by a previous study [21]. In this context, a high frequency of physical activity was significantly associated with an increasing trend in energy expenditure originating from physical activity.

Social background and parental lifestyles

Social background was assessed based on the following items: Mother’s employment status, family structure, perceived family affluence, communication with parents, individual parental internet usage at home h/day (i.e., both the mother and father), and parental health behaviors according to Breslow (1980) (i.e., both the mother and father). The item concerning “mother’s employment status” [20,22] included three response categories (i.e., “full-time,” “part-time,” and “unemployed (housewife)”), while “family structure” [22,23] was categorized as either “three-generation family” or “nuclear family.” Further, “socioeconomic status” was determined according to perceived “family affluence” [20,22] (i.e., “affluent,” “neither,” or “not affluent”), while “communication with parents” [22,24] was categorized as either “often” or “rarely.” We also asked for the total time parents spent using the internet at home h/day. Here, responses were given according to a 6-point scale and divided into the two categories of “< 2hr (no or almost none, <1hr, and 1hr to <2hr)” and “ $\geq$ 2hr (2hr to <3h, and $\geq$ 3hr).” This was based on a 2018 report indicating that Japanese adults in their 30s spent an average of about 1.5 hours per day on the internet [10,25]. Breslow’s (1980) seven good health-related behaviors have been widely accepted for use in Westernized countries, and were thus used as parental health indicators in this study [26]. The behaviors include (1) adequate sleep time, (2) no smoking, (3) appropriate weight control, (4) not drinking excessively, (5) regular physical activity, (6) no skipping of breakfast, and (7) not frequently snacking. We divided respondents into three groups based on their indicated number of behaviors (i.e., “low (0-3),” “middle (4-5),” and “high (6-7)”; higher numbers indicated healthier behaviors.

Child lifestyle factors

Child lifestyles were assessed based on breakfast consumption, wake-up time, bedtime, nighttime sleep duration, screen time h/day, and cram schools after school. Here, “breakfast consumption” [10,27] was classified into the two categories of “eat every day” and “skipping,” while “wake up time” [23] was classified into the three categories of “before 06:30,” “06:30-07:00,” and “after 07:00.” Further, “bedtime”

[23] was classified into the three categories of “before22:00,” “22:00-23:00,” and “after23:00,” while “nighttime sleep duration” [23] was categorized according to the number of sleeping hours (i.e., “more than 8 hours” and “less than 8 hours”). This was based on previous research indicating that Japanese elementary school children average approximately 8.5 hours of sleep per night [25].

The question about “screen time h/day” for children included television and film viewing, gaming, and internet use[20]. Here, responses were given according to a 6-point scale and divided into the two categories of “< 2h (no, almost none, <1h, and < 2h)” and “ $\geq$ 2h (< 3h, 3 to < 4h, and $\geq$ 4h).” In this context, the Japan Pediatric Association recommends that total screen time be limited to < 2h per day[25].

Overall health among child participants

A question from a validated Japanese version of the Dartmouth Primary Care Cooperative Information Project (COOP) was used to evaluate overall health among children [18,19,28]. They were specifically asked the following: “During the past 4 weeks, how would you rate your physical and mental health in general?” Subjects who rated their overall health as “excellent,” “very good,” or “good” were classified as having “good health status,” while those who answered “fair” or “poor” were classified as having “poor health status.”

Enrichment of school life

We asked two questions to subjectively assess “enrichment of school life,” including “Do you have close friends?” [29] and “Are you able to understand school lessons well?” [20] Responses were given according to 4 and 5-point scales, respectively, and then divided into the following respective categories for each question: “yes (many, a few)” or “no (not many, no friends)” and “understand well (well, relatively well)” or “do not understand (neither, relatively poor, and poor).”

(3) Statistical analyses

Logistic regression analyses were conducted to evaluate the strengths of the associations between child physical activity and the items of social background, parental lifestyles, child lifestyles, child health, and enrichment of school life. All variables were simultaneously entered into the model during multivariate analyses. Odds ratios (ORs) and 95% confidence intervals (CIs) were also calculated. Finally, logistic regression analyses were performed to determine the strengths of the associations between “lack of physical activity” regardless of “prefer physical activity” with the items of social background, parental lifestyles, child lifestyles, overall child health, and enrichment of school life. All analyses were conducted

using the statistical package for social scientists (SPSS) software version 22.0 J (SPSS, Chicago, IL, USA). Two-tailed *P*-values less than 0.05 were considered statistically significant for all tests.

Results

Participant characteristics are shown in Table 1. Of the 2,129 respondents who returned their questionnaires, 1,984 (1,001 boys and 983 girls) answered all relevant items and were thus included for analysis. Regarding child physical activity, 13.2% of respondents (*n*=260) did not like physical activity, while 27.4% (*n*=540) lacked physical activity. Regarding social background factors, the most frequent answers to the items assessing the mother's employment status, family structure, and perceived family affluence were "part time," "nuclear family," and "neither," respectively. Regarding parental lifestyles, the most frequent answers to the questions assessing parental internet use at home were "< 2h, and parental (e.g., mother and father) health behaviors according to Breslow (1980) [26] were "father is low," and "mother is middle," respectively.

The results of the logistic regression analyses conducted to determine the strengths of the associations between "do not like physical activity" and social background, parental lifestyles, child lifestyles, overall child health, and enrichment of school life are available in Table 2. The multivariate analysis revealed the following results: "do not like physical activity" for children in middle grades (3rd and 4th graders, ages 8-10) (adjusted OR, 2.39; 95%CI, 1.59-3.58), high grades (5th and 6th graders, ages 11-12) (adjusted OR 2.73; 95%CI, 1.83-4.08), poor communication with parents (adjusted OR 1.57; 95%CI, 1.10-2.25), long screen times of child (adjusted OR 1.38; 95%CI, 1.02-1.87), and do not have close friends (adjusted OR 5.30; 95% CI,2.78-10.1).

The results of the logistic regression analyses conducted to determine the strengths of the associations between "lack of physical activity" and social background, parental lifestyles, child lifestyles, overall child health, and enrichment of school life are available in Table 3. The multivariate analyses revealed the following: girls (adjusted OR 1.40; 95% CI,1.11-1.76), middle grades (3rd and 4th graders, ages 8-10) (adjusted OR 1.53; 95%CI, 1.15-2.04), high grades (5th and 6th graders, ages 11-12) (adjusted OR 1.82; 95%CI, 1.37-2.42), unemployed mother (housewife) (adjusted OR 1.92; 95%CI, 1.37-2.68), poor communication with parents (adjusted OR 1.59; 95%CI,1.19-2.13), mothers with middle health behaviors (adjusted OR 1.50; 95%CI, 1.13-1.99), mothers with low health behaviors (adjusted OR 1.53; 95%CI, 1.07-2.20), long screen times of child (adjusted OR 1.47; 95%CI, 1.17-1.86), bad overall health (adjusted OR 1.66; 95%CI, 1.12-2.47), and do not have close friends (adjusted OR 5.40; 95%CI, 2.81-10.4) were associated with "lack of physical activity."

While children who lacked physical activity comprised 27.4% of the total, more than half said that they did prefer physical activity. However, many still did not engage in physical activity. The logistic regression analysis results conducted to determine the strengths of the associations between "lack of physical activity" regardless of "prefer physical activity" and social background, parental lifestyles, child lifestyles, overall child health, and enrichment of school life are available in Table 4. The multivariate analyses

revealed that girls (adjusted OR 1.52; 95%CI, 1.13-2.04), unemployed mothers (housewife) (adjusted OR 2.30; 95%CI, 1.52-3.47), poor communication with parents (adjusted OR 1.50; 95%CI, 1.03-2.19), mothers with middle health behaviors (adjusted OR 1.55; 95%CI, 1.08-2.24), long screen times of child (adjusted OR 1.54; 95%CI, 1.15-2.08), and those without close friends (OR 4.14; 95% CI, 1.80-9.51) were associated with “lack of physical activity” regardless of “prefer physical activity.”

Discussion

Among the potential determinants of child exercise habits, this study revealed that a lack of close friends was likely the most influential factor for both disliking and lacking physical activity. Further, the status of having close friends was independently associated with child exercise habits even after adjusting for other potential confounding factors, the social and family environment, and child lifestyle factors. Previous studies have already shown that peer support is important for promoting exercise habits [7], while the presence of friends promotes activeness [30] and reduces the time spent sitting [31]. These results have important implications for educational policies, behavioral practices, and future research.

While children with depression often have problems in their relationships with friends and peers [24], increasing the level physical activity can help reduce these issues [7]. Our findings showed that child mental and physical health conditions were linked to their exercise habits. Specifically, children with screen times of ≥ 2 hours per day were more likely to dislike and lack physical activity when compared to those with screen times of less than 2 hours. In this context, internet addiction and gaming disorders are both recognized as diseases by the World Health Organization [32]. Recent surveys have also highlighted that these disorders especially affect young children and that experiences related to physical activity and increased peer communication are effective for prevention and treatment [33]. Offline interactions between children are increasingly becoming scarce. As such, approaches to ensure sound childhood relationships are essential educational goals [34].

Previous studies have also noted that poor childhood exercise habits are common in low-income families [35]. However, this study found other family-related factors that influenced the dislike and lack of physical activity, including the presence of stay-at-home mothers, unhealthy parental lifestyles, and infrequent communication with parents; children in these conditions were more often sedentary despite answering that they liked physical activity. The odds ratios for mothers of children who preferred physical activity but lacked engagement and who were full-time housewives were higher than that of children who simply lacked physical activity. This suggests that childhood exercise habits may be influenced by maternal lifestyles and that children may be deficient in physical activity due to social and family factors even when they like physical activity. Previous studies have shown that families lacking in parent-child communication were more sedentary and had lower health satisfaction [22]. Conversely, children who frequently talked with their parents had better bowel movements, thus indicating proper digestion [24]. Further, children develop an attachment to their parents through physical touch and communication [36]. Accordingly, healthy parent-child communication is essential for childhood mental and physical health as well as the development of healthy exercise habits. Previous studies have also reported that longer screen

times, later bedtimes, and poorer lifestyle habits were more common among children with mothers with who worked full time. However, such evidence is inconclusive; more recent studies have shown that children with mothers who worked full time had higher levels of physical activity [9], thus suggesting they were less affected by maternal employment status [24]. This study's results further support the idea that maternal employment status and/or the way children spend their after-school hours have changed over time. For example, afterschool clubs and services are now available [37] for children whose parents or legal guardians are away from home during the initial after-school hours. This is partially the result of the Act on the Promotion of Female Participation and Career Advancement in the Workplace, which was passed in August 2015. Further, a 2017 survey [38] indicated that such afterschool clubs provide space for and promote physical activity. It is therefore possible that children with working mothers are able to engage in physical activity outside the home. As previous studies have shown [31], childhood sedentary behaviors can be substantially reduced by providing support and increasing the parental awareness about the importance of exercising. As such, it is highly important to provide environments that are conducive to physical activity during afterschool hours and on weekends.

Children with mothers who have unhealthy habits also tend to have sedentary lifestyles despite liking physical activity. Other studies using similar indicators have shown that children with parents who have unhealthy lifestyles were more likely to have sedentary lifestyles and eat meals alone [22]. The UNICEF Report Card on Child-Wellbeing in a Sustainable World [39] also suggested that family relationships were the most important factors for childhood wellbeing, followed by friends and school. Perhaps the importance of close friends and family communication for developing good exercising habits as found in this study reflect the "wellness" that children in developed countries experience. It is clear that increased communication and common health awareness are needed to promote good exercise habits in children.

This study had several limitations. First, it used a cross-sectional design that employed a self-reported survey about exercising habits. Thus, a longitudinal survey is needed to investigate the causal relationships behind these results to measure both the quality and quantity of physical activity through objective indicators. Second, more detailed surveys on social context (e.g., community characteristics, maternal employment status, and social assistance) are required to investigate the measures that are best-suited for community-specific needs.

This study found that a fulfilling school life, family environment, parental lifestyle-related habits, and the activities of the children themselves were factors that influenced childhood exercise habits. This indicates that educational policies and interventions should consider linking these items to healthy exercise habits.

Ideal childhood exercise habits are most effectively promoted through the establishment of a fulfilling school life. Thus, related initiatives should encourage children to develop close friendships through physical activity at lower grade levels. Home-life is also important. Changes to both afterschool activities and those on the weekends can be improved by promoting shorter screen times, better parental lifestyles, and improved parent-child communication. Collectively, these efforts will lead to better childhood exercise habits. Finally, communities and schools should cooperate to build safe environments and spaces in

which children can freely and securely engage in physical activity regardless of their parents' employment status or home environments.

Conclusions

This study investigated factors related to both dislike and lack of physical activity among schoolchildren as part of The Super Shokuiku School Project in Japan. "Lack of close friends" have the strongest links with both dislike and lack of physical activity. Children who engaged in long periods of screen time and lacked parental communication also tended to dislike and lack physical activity. In addition, children were highly influenced by parental lifestyles, even those who like physical activity. Although a longitudinal study is needed to determine causality, substantial attention should thus be paid to these factors when promoting physical activity.

Declarations

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Authors' Contributions

S.S conceptualized and designed the study, carried out statistical analysis, drafted the initial manuscript, and reviewed and revised manuscript. M.S, M.Y obtained the fund, designed the study, collected data, and critically reviewed the manuscript. Y.F, Y.H critically reviewed the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

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Availability of data and materials

The data we used to derive our findings are unsuitable for public deposition due to ethical restrictions and specific legal framework in Japan. It is prohibited by the Act on the Protection of Personal Information (Act No.57 of 30 May 2003, amended on 9 September 2015) to publicly deposit data containing personal information. The Ethical Guidelines for Epidemiological Research enforced by the Japan Ministry of

Education, Culture, Sports, Science, and Technology and the Ministry of health, Labor and Welfare also restrict the open sharing of the epidemiologic data.

Ethics approval and consent to participate

The survey was approved by Ethics Committee of University of Toyama (H28-137). Written informed consent was obtained from all the school children and their parents, and participation was voluntary.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1. Participant characteristics (n=1,984)

Variable		n	%
Sex	Boys	1,001	50.5
	Girls	983	49.5
Grade	Low	657	33.1
	Middle	624	31.5
	High	702	35.4
Social background and parental lifestyles			
Mother's employment status	Full time	804	41.5
	Part time	871	44.9
	Unemployed (housewife)	264	13.6
Family structure	3-generation family	635	32.3
	Nuclear family	1,331	67.7
Perceived Family Affluence	Affluent	491	25.0
	Neither	932	47.5
	No Affluent	540	27.5
Communication with parents	Often	1,608	81.8
	Rarely	357	18.2
Father's IU at home, h/day	< 2h	1,553	85.8
	≥ 2h	256	14.2
Mother's IU at home, h/day	< 2h	1,835	94.4
	≥ 2h	109	5.6
Father's health behaviors in Breslow's	High [6,7]	390	19.6
	Middle [4,5]	771	38.8
	Low [0-3]	825	41.5
Mother's health behaviors in Breslow's	High [6,7]	506	25.5
	Middle [4,5]	1,043	52.5
	Low [0-3]	437	22.0
Child lifestyle factors			
Breakfast eating	Every day	1,817	92.0
	Skipping	159	8.0
Sleep duration	More than 8 hours	1,539	78.5
	Less than 8 hours	422	21.5
Preference for physical activity	Like very much	1,709	86.8
	Dislike	260	13.2
Frequency of physical activity	Very often	1,430	72.6
	Not often	540	27.4
Children's ST, h/day	< 2h	1,174	59.3
	≥ 2h	805	40.7
Cram schools	≥ 2 times / week	372	18.9

	1 times / week	104	5.3
	0 time	1495	75.8
Children's health			
Overall health	Good	1,824	92.6
	Poor	146	7.4
Enrichment of school life			
Have close friends	Yes	1,914	97.3
	No	54	2.7
Understand the school study	Understand well	1,575	80.2
	Not understand	390	19.8

Table 2. Logistic regression analysis results for “Don't like physical activity” (n=1,984)

Variable		Don't like physical activity %	Univariate OR (95%CI)	Multivariate OR (95%CI)
Sex	Boys	12.8	1	1
	Girls	13.6	1.07(0.83-1.39)	1.25(0.93-1.69)
Grade	Low (1st-2nd)	7.2	1	1
	Middle(3rd-4th)	15.2	2.30(1.59-3.33) ‡	2.39(1.59-3.58) ‡
	High(5th-6th)	17.1	2.66(1.86-3.80) ‡	2.73(1.83-4.08) ‡
Social background and parental lifestyles				
Mother's employment status	Full time	13.0	1	1
	Part time	12.8	0.98(0.74-1.31)	0.91(0.66-1.24)
	Unemployed(housewife)	16.0	1.72(0.86-1.88)	1.33(0.86-2.06)
Family structure	3-generation family	14.0	1	1
	Nuclear family	12.9	0.97(0.69-1.20)	0.88(0.65-1.19)
Perceived Family Affluence	Affluent	12.7	1	1
	Neither	12.6	0.99(0.71-1.38)	1.11(0.77-1.59)
	No Affluent	14.6	1.18(0.82-1.68)	1.21(0.81-1.82)
Communication with parents	Often	12.1	1	1
	Rarely	18.5	1.65(1.22-2.24) ‡	1.57(1.10-2.25) *
Father's IU at home, h/day	< 2h	13.5	1	1
	≥ 2h	13.7	1.01(0.69-1.49)	0.89(0.58-1.36)
Mother's IU at home, h/day	< 2h	13.1	1	1
	≥ 2h	15.7	1.24(0.72-2.11)	1.02(0.55-1.90)
Father's health behaviors in Breslow's	High[6,7]	11.3	1	1
	Middle[4,5]	13.3	0.79(0.54-1.14)	1.04(0.69-1.56)
	Low[0-3]	14.0	0.95(0.71-1.26)	1.24(0.81-1.91)
Mother's health behaviors in Breslow's	High[6,7]	10.7	1	1
	Middle[4,5]	14.1	1.36(0.98-1.90)	1.33(0.92-1.92)
	Low[0-3]	14.0	1.35(0.91-2.00)	1.25(0.79-2.01)

Child lifestyle factors				
Breakfast eating	Every day	13.4	1	1
	Skipping	10.9	0.79(0.47-1.33)	0.60(0.33-1.07)
Sleep duration	More than 8 hours	12.2	1	1
	Less than 8 hours	17.1	1.49(1.11-2.00) †	1.33(0.96-1.86)
Children's ST, h/day	< 2h	11.0	1	1
	≥ 2h	16.3	1.57(1.21-2.04) ‡	1.38(1.02-1.87) *
Cram schools	≥ 2 times / week	11.6	1	1
	1 times / week	13.5	1.19(0.62-2.27)	1.09(0.52-2.27)
	0 time	13.6	1.20(0.84-1.70)	1.24(0.84-1.82)
Children's health				
Overall health	Good	12.6	1	1
	Poor	20.5	1.79(1.17-2.74) †	1.32(0.81-2.16)
Enrichment of school life				
Have close friends	Yes	12.2	1	1
	No	48.1	6.66(3.84-11.6) ‡	5.30(2.78-10.1) ‡
Understand the school study	Understand well	12.7	1	1
	Not understand	15.4	1.25(0.91-1.71)	1.08(0.76-1.54)

OR, odds ratio; 95%CI, 95% confidence interval; IU, Internet use; ST, Screen time

* $p < 0.05$, † $p < 0.01$, ‡ $p < 0.001$.

Table 3. Logistic regression analysis results for "Lack of physical activity" (n=1,984)

Variable		Lack of physical activity %	Univariate	Multivariate
			OR (95%CI)	OR (95%CI)
Sex	Boys	25.6	1	1
	Girls	29.2	1.20(0.99-1.46)	1.40(1.11-1.76) †
Grade	Low (1st-2nd)	21.3	1	1
	Middle(3rd-4th)	28.6	1.48(1.15-1.91) †	1.53(1.15-2.04) †
	High(5th-6th)	31.9	1.74(1.36-2.22) ‡	1.82(1.37-2.42) ‡
Social background and parental lifestyles				
Mother's employment status	Full time	24.1	1	1
	Part time	27.5	1.20(0.96-1.49)	1.18(0.92-1.51)
	Unemployed(housewife)	37.0	1.86(1.38-2.50) ‡	1.92(1.37-2.68) ‡
Family structure	3-generation family	27.6	1	1
	Nuclear family	27.2	0.98(0.79-1.21)	0.95(0.75-1.20)
Perceived Family	Affluent	25.8	1	1
Affluence	Neither	27.4	1.08(0.85-1.39)	1.06(0.81-1.39)
	No Affluent	28.2	1.13(0.86-1.49)	0.93(0.68-1.27)
Communication with parents	Often	25.8	1	1
	Rarely	35.0	1.55(1.21-1.98) ‡	1.59(1.19-2.13) †
Father's IU at home, h/day	< 2h	27.0	1	1
	≥ 2h	31.6	1.25(0.94-1.67)	1.06(0.77-1.46)
Mother's IU at home, h/day	< 2h	26.8	1	1
	≥ 2h	37.0	1.61(1.07-2.41) *	1.38(0.87-2.21)
Father's health behaviors in Breslow's	High[6,7]	22.2	1	1
	Middle[4,5]	27.4	1.33(1.00-1.77)	1.15(0.84-1.58)
	Low[0-3]	29.9	1.50(1.13-1.99) †	1.28(0.92-1.78)
Mother's health behaviors in Breslow's	High[6,7]	20.5	1	1
	Middle[4,5]	29.4	1.62(1.26-2.09) ‡	1.50(1.13-1.99) †
	Low[0-3]	30.6	1.71(1.27-2.31) ‡	1.53(1.07-2.20) *

Child lifestyle factors				
Breakfast eating	Every day	27.6	1	1
	Skipping	25.6	0.90(0.62-1.31)	0.74(0.48-1.15)
Sleep duration	More than 8 hours	27.0	1	1
	Less than 8 hours	29.5	1.13(0.89-1.43)	1.03(0.78-1.36)
Children's ST, h/day	< 2h	23.4	1	1
	≥ 2h	33.1	1.62(1.32-1.97) ‡	1.47(1.17-1.86) ‡
Cram schools	≥ 2 times / week	26.6	1	1
	1 times / week	24.0	0.87(0.53-1.45)	0.78(0.44-1.37)
	0 time	27.8	1.06(0.82-1.37)	0.97(0.73-1.29)
Children's health				
Overall health	Good	26.1	1	1
	Poor	41.1	1.97(1.40-2.79) ‡	1.66(1.12-2.47) *
Enrichment of school life				
Have close friends	Yes	26.2	1	1
	No	68.5	6.12(3.42-11.0) ‡	5.40(2.81-10.4) ‡
Understand the school study	Understand well	26.3	1	1
	Not understand	31.5	1.29(1.01-1.64) *	1.02(0.77-1.36)

OR, odds ratio; 95%CI, 95% confidence interval; IU, Internet use; ST, Screen time

* $p < 0.05$, † $p < 0.01$, ‡ $p < 0.001$.

Table 4. Logistic regression analysis results for "Lack of physical activity" regardless of "Prefer physical activity" (n=1,709)

Variable		Lack of physical activity %	Univariate	Multivariate
			OR (95%CI)	OR (95%CI)
Sex	Boys	13.1	1	1
	Girls	16.5	1.33(1.03-1.71) *	1.52(1.13-2.04) †
Grade	Low (1st-2nd)	14.3	1	1
	Middle(3rd-4th)	13.9	1.08(0.78-1.48)	1.12(0.78-1.59)
	High(5th-6th)	15.8	1.30(0.96-1.76)	1.33(0.94-1.88)
Social background and parental lifestyles				
Mother's employment status	Full time	11.7	1	1
	Part time	15.1	1.35(1.02-1.81) *	1.36(0.99-1.87)
	Unemployed(housewife)	21.8	2.26(1.55-3.27) ‡	2.30(1.52-3.47) ‡
Family structure	3-generation family	14.0	1	1
	Nuclear family	14.9	1.06(0.81-1.40)	1.01(0.74-1.37)
Perceived Family	Affluent	13.9	1	1
Affluence	Neither	15.3	1.12(0.82-1.54)	0.99(0.71-1.39)
	No Affluent	14.0	1.04(0.72-1.48)	0.72(0.48-1.08)
Communication with parents	Often	14.3	1	1
	Rarely	17.1	1.36(0.99-1.87)	1.50(1.03-2.19) *
Father's IU at home, h/day	< 2h	14.1	1	1
	≥ 2h	18.4	1.39(0.97-1.97)	1.16(0.78-1.71)
Mother's IU at home, h/day	< 2h	14.3	1	1
	≥ 2h	21.3	1.72(1.05-2.81) *	1.55(0.89-2.69)
Father's health behaviors in Breslow's	High[6,7]	11.3	1	1
	Middle[4,5]	14.5	1.37(0.94-1.99)	1.17(0.78-1.75)
	Low[0-3]	16.7	1.64(1.14-2.37) †	1.24(0.81-1.89)
Mother's health behaviors in Breslow's	High[6,7]	10.3	1	1
	Middle[4,5]	15.9	1.74(1.24-2.43) ‡	1.55(1.08-2.24) *
	Low[0-3]	17.2	1.91(1.30-2.81) ‡	1.57(0.99-2.49)

Child lifestyle factors

Breakfast eating	Every day	14.8	1	1
	Skipping	15.4	1.01(0.64-1.61)	1.01(0.60-1.71)
Sleep duration	More than 8 hours	15.3	1	1
	Less than 8 hours	13.3	0.91(0.66-1.25)	0.86(0.59-1.24)
Children's ST, h/day	< 2h	12.7	1	1
	≥ 2h	17.7	1.60(1.24-2.07) ‡	1.54(1.15-2.08) †
Cram schools	≥ 2 times / week	15.6	1	1
	1 times / week	12.5	0.79(0.41-1.51)	0.65(0.32-1.34)
	0 time	14.7	0.96(0.70-1.32)	0.80(0.57-1.14)
Children's health				
Overall health	Good	14.1	1	1
	Poor	21.2	1.90(1.23-2.92) †	1.63(1.00-2.68)
Enrichment of school life				
Have close friends	Yes	14.6	1	1
	No	20.4	3.25(1.50-7.01) †	4.14(1.80-9.51) ‡
Understand the	Understand well	14.3	1	1
school study	Not understand	16.4	1.23(0.90-1.67)	0.91(0.63-1.32)

OR, odds ratio; 95%CI, 95% confidence interval; IU, Internet use; ST, Screen time

* $p < 0.05$, † $p < 0.01$, ‡ $p < 0.001$.