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Key rules of Pediatric obesity

- # of words in abstract: 200
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Effect of the Adapted National Aeronautics and Space Administration (NASA) Mission X international child fitness program on young children and their parents in South Korea

Running title: NASA child fitness promotion program in young children in South Korea

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Abstract

Background: Effective and sustainable intervention programs are needed to promote health in children and halt the global obesity epidemic.

Objectives: To adapt the NASA Mission X Program for South Korean children and to evaluate its feasibility and effectiveness.

Methods: Children aged 5 years old (n=212) and their parents recruited from 3 kindergartens in 3 cities participated in a 6-week intervention program in fall 2014. We assessed children's physical activity (PA) and its related changes and parental changes in attitude and beliefs after participation in the intervention.

Results: Girls reported less PA than boys (40.7 vs. 59.0, $p<0.01$). Children with a normal body mass index BMI were more likely to be active than those children being underweight (<10%tile) or overweight (≥ 85%tile). After intervention, some children had increased their level of PA (49.4%), interest in PA (59.1%), and psychological need satisfaction in exercise (52.6%). The majority of parents became aware of the necessity of childhood PA (94.2%), child's PA capability (64.3%), child's happiness after PA (80.5%) and its relationship with self-esteem (79.9%).

Conclusions: The adapted NASA child fitness program was feasible and effective in promoting PA in children and in improving their parents' attitude and beliefs about child's PA in South Korea. This study provided a model for promoting childhood fitness.

Key words: child, obesity, prevention, fitness, physical activity
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What is already known about this subject:

- Childhood obesity is global public health concern including in South Korea where 16.2% of boys and 9.9% of girls are overweight or obese in 2011.
- Effective and sustainable intervention programs are needed for prevention of childhood obesity.
- Obesity prevention programs for young children may have a greater intervention effect than in older children.

What this study adds:

- The adapted NASA international child fitness promotion program was feasible and effective in young children in South Korea.
- Building a community network among kindergarten, day-care center and family is a key strategy for health promotion in young children.

1. Introduction

Childhood obesity is a serious global public health concern (WHO, 2015; Wang Y & Lobstein T, 2006). Low self-esteem and related mental health problems are common in obese children (Strauss RS, 2000) as well as poor academic performance and career development (Gurley-Calvez T, 2010).Westernized dietary habits and sedentary lifestyles are identified as the major risk factors of current alarming rate of obesity along with genetic susceptibility (Popkin BM, 1999). Children in many countries, including South Korea, have become increasingly sedentary due to urbanization changes in their respective societies (Ng SW, et al. 2009, Salmon J et al. 2011). In particular, South Korea had abundant dissemination of mobile technology, such as tablet and smart phone devices. Children have become reliant on mobile devices and are less likely to perform physical activities (Do, et al, 2013).

Effective and sustainable intervention programs are needed to fight the global obesity epidemic (IOM, 2012; Wang Y et al, 2013; Wang Y et al, 2015). Previous studies suggested focus on prevention strategies that begin in early childhood, a period when children establish their life habits. (Salmon J et al. 2011). Recent systematic reviews and meta-analysis including ours found that obesity prevention programs for young children have a greater intervention effect (Waters E, et al, 2011; Wang Y et al, 2013; Wang Y et al, 2015).

The NASA Mission X: Train Like an Astronaut (MX) program was developed to promote children's exercise and healthy eating with excitement for training like an astronaut (Lloyd C, 2012).At present, the NASA MX Program covered 28 countries, enrolled children through their teachers in school setting (MX report 2014, 2015).

This pilot study adapted the NASA MX intervention program for young children in South Korea. We assessed its feasibility and effectiveness in promoting physical activity (PA) in children and in improving parents' perspectives. We also examined the status of PA in young children. More than 80% of five-year-old children go to a Kindergarten or day care center in South Korea (MH Suh et al, 2013).Thus, reaching young children through child care and education settings could be a good approach for early childhood obesity prevention.

2. Materials and methods

2.1 Study design and subjects

This intervention pilot study was designed as a Korean adaptation of the NASA MX program for preventing childhood obesity. The study investigated the current status of PA among children in South Korea and whether the MX program increased children's PA. Other research questions assessed parental belief regarding healthy behaviors and improvement in their knowledge of child health. The Korea Institute of Child Care and Education (KICCE) recruited healthy children through kindergartens and daycare centers in the three months before the program started. After screening the facility quality and interviewing directors and teachers, three kindergartens and eight lead teachers were selected to participate.

We included 5-year old children from three specified kindergartens in the city of Seoul, O-san, and Yong-in, but not younger children as they could verbally express their ideas and feelings during the discussion section activity. It was important that children were able to participate in the discussion so that we could monitor their comprehension of the intervention curriculum. After excluding those children without parental consent for participation (n=8), there

were 212 children in eight classes at baseline. Parents of all participating children were involved in activities and baseline survey; 154 parents participated in post-intervention survey. To address possibility of selection bias due to the follow-up loss in post-intervention survey, we compared children's baseline characteristics in between follow-up (n=154) and non-follow-up group (n=58) using t-test and X^2 test. There was no significant difference in children's sex (p=0.67), BMI status (p=0.31), score of leisure time activity at home (p=0.47) and physical activeness levels (p=0.40) at baseline. This study was approved by the Institutional Review Boards of the Kyung-Hee University in South Korea (KHU IRB 2014-G20).

2.2 Intervention program

The Mission X intervention materials were designed for children aged 8-12 years old. We adapted and developed an age-appropriate curriculum and teacher guidebook in Korean work with an advisory committee. The teachers' guidebook provided aims, a list of necessary equipment, length of the activity, directions with introductory scripts and questions to bring children in, an astronaut toy, discussion topics during activity, figures and video clips to see actual practices, evaluation questions for group monitoring and assessment after the activity. It also had additional guidelines for fitness acceleration, background information on the purpose of the main activity, and safety. All teachers had training one month before the program started and received quality control monitoring and focus group discussion at least two times during this program.

The 6-week Korean adapted version of the Mission X curriculum selected topics on PA and two topics on nutrition education from the 18 modules provided in the standard NASA MX program. These modules were selected according to the recommendations of the KICCE advisory committee members of early child care and education, sports science and preventive medicine fields and current kindergarten and childcare center teachers (**Table 1**). Each activity took about 40-60 minutes in the classroom or outside of the classroom dependent on the lead teacher's preference. The first activity launched at the last week of October 2014 and the last activity took place during the first week of December 2014.

We provided weekly flyers to parents, which included the aims and background knowledge on the activity and provided detailed direction for family activities at home that paralleled the classroom learning to encourage continued practice of the activities at home. To monitor children's changes at home, we had 4 times of focus group interviews with total 20 parents in about 1.5 hours.

--Table 1 about here --

2.3 Assessment and measures

To understand the child's PA, diet and nutrition knowledge status and changes in parental attitude and belief on child health, a set of measures were collected at baseline and post-intervention from children and their parents, including children's baseline BMI status, leisure time activity at home, psychological need satisfaction in exercise scale, 2 days 24hr dietary recall, dietary quality and habits (Kim H et al, 2012), nutrition knowledge (Yang I et al, 1995), parents attitude and beliefs in child's PA. Baseline weight and height were reported by their parents after measuring them at home. Others were collected from their parents by survey

questionnaire. Lead teachers sent participating parents the pre questionnaire two weeks before the program began and the post questionnaire within one week of the program's end.

Preschool children are sensitive to examiners who score their PA and exercise ability, therefore, we asked parents to respond to the questionnaires to mitigate unnecessary biased results reported by children.

Baseline body mass index (BMI) status

BMI status was classified using the sex-age specific BMI percentiles from the Korean CDC Growth Chart (KCDC, 2007): 85th percentile and above to present those who are at risk of overweight (called "overweight" in this report), and under 10th percentile to present those who are at risk of underweight (called "underweight" in this report). The rest were considered as normal BMI.

Leisure time activity at home

We used the Godin Leisure-Time Exercise Questionnaire (Godin G, Shephard RJ. 1997), which calculated the Weekly Leisure-Time Activity Score at home from the following equation:

Leisure-Time Activity Score= (9 × average frequency of strenuous exercise/ week) + (5 × average frequency of moderate exercise/ week) + (3 × average frequency of mild exercise/ week)

The questionnaire also included the definitions and examples of three types of exercise to guide parents and it had been used to measuring children's PA (Krebs N et al, 2007) and validated for Korean children as well (Kim Y et al, 2010). To monitor children's change in PA we asked parents the differences in frequency, types of activity as well as interests, overall PA level of their children in the pre-and-post questionnaires. The level of PA was classified as active and insufficiently active by the cut point of 24 units, obtained with two intensities of strenuous and moderate. This cut point is closest to the public health recommendation "minimal weekly volume with strenuous and/or moderate PA," (Godin & Shephard, 1985). In addition, we asked children's preferred type of PA, and their additional routine exercise with lessons (i.e. private sport club, recreational program in community facilities, etc.).

Psychological need satisfaction in exercise scale

Psychological need satisfaction after exercise is related to happiness and continued motivation towards performing PA, which is based on the self-determination theory (Deci & Ryan, 2002). Our research team used the Psychological Need Satisfaction in Exercise scale that Wilson PM, Rogers WT, Rodgers WM et al. (2006) developed and Kim SK (2007) validated in Korean. We asked parents to help children identify the visual representation of the Likert scale that most closely matched their feelings. To perceive psychological need satisfaction in PA settings, the components of competence, autonomy and relatedness were chosen to assess the satisfaction of various exercises (Wilson PM et al, 2006). We used the three sub-scores and a total score to present results in this study.

Parental attitude and beliefs

We asked parents the degree of change in their attitude and beliefs on 1) how PA is important to their child's health and development, 2) if their child can endure difficult exercise for a prolonged time, 3) if their child is happy/satisfied during exercise, 4) whether children's self-confidence in exercise is related to a positive self-image at the end of the program. We also had four focus group interviews with 12 parents to understand the social norms of children's PA and fitness.

2.4 Statistical analyses

To present children's positive changes after this program, we used percentage of post positive change (PPC %).

For data analysis, firstly we tested sex differences in children's anthropometric measurements, their leisure time PA at home, and physical activeness levels using t-test and X^2 test. Second, we used paired t-test and wilcoxon signed rank test whether there was significant difference between pre and post in children's level of PA and psychological need satisfaction in exercise. Lastly, to examine whether there was a difference in demographic characteristics among those groups with a high PPC%, we assessed the measures (actual PA, children's satisfaction with exercise, and parental attitudes and beliefs) by sex, BMI status, and PA levels using X^2 test. Data management and analysis were conducted using SAS 9.3 Cary, NC.

3. Results

Baseline characteristics of study subjects

At baseline, 12.8% of children were overweight, 18.2% underweight, the rest had a normal BMI. Boys were generally heavier and taller than girls, but their BMIs were not significantly different.

Comparison of physical activity level by sex and BMI status at baseline

Girls had significantly lower leisure time activity scores (mean: 40.7 (SD: 24.5)) than boys (59.0 (23.6)), the difference was 18.3 ($p<0.001$). Girls were 2.4 times more likely to be insufficiently active than boys (43.3% vs. 17.9%, $p<0.001$) **(Table 2)**.

Participating rate of the after-school PA program (private education) was significantly different by sex: Fewer girls (47.9%) joined the PA program than Boys (71.7%). Also children at risk of being overweight (50.0%) showed lower rate of participation in the program than others (Insufficient: 69.7%, normal: 58.1%). The children's preferred physical activities differed by sex. Boys were more likely to do Taekwondo (41.3%), soccer (40.4%) and swimming (26.9%), while girls preferred jump roping (36.3%), biking (33.0%) and water playing (33.0%), which require less active motions than those in boys.

Level of PA did not differ significantly by children's BMI status ($p>0.05$). Those who were underweight (32.4%) or overweight (37.5%) tended to be slightly more inactive than children had normal BMIs (27.9%) **(Table 2)**.

--Table 2 about here --

Pre- vs. post changes in children's PA, interest in PA and their satisfaction in exercise

According to parental report, about half of children became more physically active (49.4%) and more interested in exercise (59.1%) after the intervention than at baseline. More than half of the children had better psychological need satisfaction in exercise (competence: 60.4%, relatedness: 69.5% and autonomy: 52.6%) than at baseline. There were statistically significant pre and post differences in children's level of PA and psychological need satisfaction in exercise ($p<0.001$) **(Table 3)**.

There was no significant difference in the level of changes on children's physical activeness and interest in exercise by sex, BMI status or children's previous activeness level after the MX program ($p>0.05$). However the positive changes in level of physical activeness and interested in exercise were quite different by children's BMI status: children at risk of being underweight were 1.6 times more likely to improve their physical activeness (45.2 vs. 27.8%) and they were 1.8 times more likely to increase their interest in exercise (68.2 vs. 38.9%) than those children at risk of overweight after the program. Overweight children were less likely to increase PA or interest in exercise than others after the intervention program. Girls had a slightly higher percent of positive change in psychological need satisfaction in exercise in terms of competence and relatedness than boys, although they were not significantly different ($p>0.05$) **(Table 3)**.

Parents reported that 26.6% children changed their preferred type of PA, 34.4% children increased their frequency of PA and 27.9% children spent more time on PA than before this program. However there was no significant difference in the change of type, frequency and time spent on PA after this MX program by sex, BMI status, and children's previous activeness level ($p>0.05$).

--Table 3 about here --

Parental changes in their attitude and beliefs about their children's PA

Table 4 showed how parents described their changes in attitude and beliefs on children's PA and their health after the intervention. A majority of parents reported that PA was a necessity for their children (94.2%); 64.3% of the participating parents said they had underestimated their children's capability and found their children can do more strenuous exercise than they had expected; 80.5% of parents became aware of an improvement in their children's happiness after PA; and 80% parents found there was a positive relationship between children's self-competence in PA and their self- esteem **(Table 4)**.

In particular, those parents of overweight children were more likely to recognize that PA was a necessity for their children (100.0%), to reassess their children's PA capability (77.8%) and to be aware of increased happiness after PA (94.4%) than others. There was no significant difference in parental attitude and beliefs about children's PA by children's sex, BMI status and previous physical activeness level ($p>0.05$) **(Table 4)**.

--Table 4 about here --

4. Discussion

This study adapted the NASA MX Program for young children in South Korea and found that the program was feasible and effective in promoting PA in children and in improving their parents' attitude and beliefs about child's PA. After the intervention, 49.4% of children increased their physical activeness and 59.1% of children became more interested in exercise. Children also gained psychological need satisfaction in exercise regarding to competence, relatedness and autonomy. Parents increased their recognition of the necessity of childhood PA (94.2%), reassessment of child's PA capability (64.3%), awareness of child's happiness after PA (80.5%). There was no significant difference in children and their parental changes by children's sex, BMI status and PA level at baseline. The results of this pilot study suggest that the newly adapted MX program is an affordable early childhood obesity prevention program.

Health promotion programs in young children may be more effective and easier to implement than those in older children (Wang Y et al, 2013; Wang Y et al, 2015; Water E et al, 2011). Children format their behavior patterns in preschool years along with proficient basic motor and physical skill development (Lakshman R et al. 2013). Although few studies have been developed for obesity intervention among preschool-aged children, preschool-aged children have shown greater intervention effects (-0.26kg/m^2) when compared to older children (-0.15kg/m2 in aged 6-12, -0.09kg/m^2 in aged 13-18) the 2011 updated Cochrane review (Waters E, et al, 2011). This evidence highlights the importance of early childhood obesity prevention programs.

In addition, due to the linkage between self-determination theory and health promotion attempts (Frederick-Recascino, 2002), the future PA levels of preschool-aged children can be self-motivated by their psychological need satisfaction in exercise from this early exposure of routine physical movement. In this study we found more than half of children increased psychological need satisfaction in exercise than before as well as their changes in physical activeness and interests in PA after participating in this program. Childhood obesity prevention program should take this benefit to build children's healthy habits from early exposure of regular physical movement.

In particular, the overweight children did not show much increase in interest in exercise or satisfaction when performing exercise, although there was no significant difference, which we believe is due to the small sample size of this study. A systematic review for the association between health benefits and PA in school-aged children from 86 original papers showed similar results. Only moderate to vigorous intensity PA were consistently and strongly related to obesity reduction (Janssen L et al, 2010), because obese children have reduced aerobic and anaerobic capacities (Lafortuna CL, 2002). Further attention is needed to develop self-motivated PA strategies for overweight and obese children than others.

We found sex difference in level of PA. Girls were less physically active than boys, as they were two times more likely to be in insufficiently active group. Fewer girls (47.9%) joined in the afterschool PA promotion program than Boys (71.7%). The preferred types of activities among Korean girls requires less active motions than those in boys. This result was similar to several previous reports in other countries. Girls were less likely to engage in vigorous activity than boys during recess in U.S. schools (Ridgers ND, et al, 2010). Seven studies in Australian,

Canadian, Spain, Estonian, Singaporean, and other countries' consistently showed female children spent less time on exercise, organized sports, and were less active than boys (Bailey R et al, 2005). In addition girls are expected to be more inactive after the transition period from early childhood to adolescence (Craig et al, 2001).

Studies suggest that inactive behavioral characteristics and the ecological influence of built environments increase the sex difference gap. Ridgers and colleges found that girls preferred to chat in a small group and engage in verbal games, conversation and socializing rather than physically moving (Ridgers et al, 2010). Additionally, girls can be more influenced by safety issues in their neighborhood, and accessibility of recreational parks and facilities than boys, which have been shown to have a significant association with children's PA levels (Pradinuk M, et al, 2011). Another possible barrier is the indirect impact of peer pressure and cultural expectations, which may reduce the amount of PA performed by girls. Conversely, boys may experience more peer pressure for PA than girls, as this study showed 71.7% of boys (vs. 47.9% in girls) participated in the afterschool PA program. Girls may be encouraged to seek certain activities which their peers perceived as feminine (Bailey R et al, 2005).

Different gender norms in PA may exist in the Korean culture. A study reported that boys were deemed more aggressive and competitive, and girls were perceived to promote fun-based learning environments in Indian children (Ramanathan S, et al, 2009). In this study, parents of female participants were more likely to report improvement in happiness among their children than those parents of male participants (86.1 vs. 75.6%) and the relationship between children's competence in PA and self-esteem (83.3 vs. 76.8%). Still, post-positive changes were not significantly different by sex. Further studies are needed to identify how peer influence and cultural differences act on the sex-differences in PA levels in South Korea.

Build a community network among kindergartens, day-care centers and families are key for successful health promotion programs in young children. In this program, the kindergarten teachers taught children how to perform certain PA and why it is important for their health. Many childhood obesity prevention studies had school based setting (83.9% from all interventional study by 2012 in Wang Y et al, 2013). Schools have been identified as the most important channel of obesity intervention for school-aged children because they offer access to large populations of students and provide the opportunity to institutionalize obesity prevention programs in communities (Wang Y et al, 2013; Wang Y et al, 2015). In particular, more than 80% of Korean children who are four and five go to kindergarten or a daycare center. The Korean government recently started to support all tuition for early child care and education regardless of family income level, which has increased attendance (Seo MH et al 2013). In South Korea, kindergarten and daycare centers could be the best network to empower young children to develop healthy habits.

We found parents changed their beliefs and attitudes on children's PA even though they only had the program through the weekly family flyers and one time focus group interviews. Previously our team examined the effectiveness of childhood obesity prevention programs in high-income countries, and found that the most effective programs were those were delivered a PA intervention in a school-based setting with a family component, or diet and PA interventions in a school-based setting with home- and community components (Wang Y et al, 2013; Wang Y et al, 2015). Parental belief changes may lead to a family focus on PA. In a previous focus group study children mentioned that they did not perform activity outside of the home or kindergarten

due to parents' and teachers' perceived risk that children could be hurt or catch a cold (Cammisa M et al. 2011). Childhood obesity prevention programs should involve parents and primary child care providers to get their children active and improve children's health outcomes.

Limitations of this study included its small sample size, the relatively short intervention during six weeks (which might not be long enough to change children's PA behaviors and BMI), follow-up loss in post-intervention survey, and that BMI was not assessed post-intervention. However, this is the first pilot study to develop pre-school age curriculum for obesity prevention though the network with kindergarten and child care center setting with a parent component in South Korea. Therefore, we investigated the intervention effect on various aspects of children's physical activeness as well as their psychological need satisfaction. Psychological change in children is important as it may promise their future motivation for PA and overall health. Early child care and education system is a strategic network for preventing childhood obesity. Parents will play a key role. Our study showed that after the intervention, the majority of parents showed changes in their attitude and beliefs regarding their children's PA, thus may allow their children to have more PA at home and in school.

In conclusion, this pilot child obesity prevention program adopted from the NASA child fitness promotion program showed benefits on young children and their parents in South Korea. Further research needs to test its long-term effects on child BMI and other health outcomes.

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Table 1. Intervention modules: Topic, aims and activities of the 6 week curriculum for young children adapted from the 18 modules from the NASA MX program*

Week	Topics	Aims	Activities
1	Do a space walk	Muscle strength, coordination	Bear crawl, crab walk
2	Jump for the moon	Bone strength, cardiovascular & muscular endurance	Jump training with a rope
3	Agility astro-course	Agility, coordination, speed	Running a specific course
4	Energy of an astronaut	Understanding specific nutritional needs	Categorizing different food items
5	Reduced gravity, Low-fat	Formulating balanced meal	Discovering fat contents
6	Building an astronaut core	Abdominal and back muscle strength	Commander crunch, pilot plank

*The 6 week curriculum was selected from the 18 modules of the NASA Mission X: Train Like an Astronaut (MX) by advisory committee members of early child care and education, sports science and preventive medicine fields and current kindergarten and childcare center teachers.

Table 2. Baseline characteristics of participating Korean children (n=212) from 3 kindergartens

	All	Boys	Girls	p-value testing sex differences
Sample size	212	106	97	
Height (cm)	117.9 (5.0)	119.4 (4.8)	116.2 (4.6)	<.0001
Weight (kg)	21.5 (3.2)	22.7 (3.3)	20.7 (2.9)	0.0002
BMI (kg/m^2)	15.5 (1.8)	15.7 (1.8)	15.3 (1.7)	0.103
BMI status (%)[2)]				
At risk of underweight ($<10^{th}$ percentile)	18.2	18.8	18.0	
Normal weight (10- 84^{th} percentile)	69.0	68.0	69.7	0.977
At risk of overweight ($\geq 85^{th}$ percentile)	12.8	13.3	12.3	
Leisure time activity at home (score)[3)]	50.2 (25.6)	59.0 (23.6)	40.7 (24.5)	<.0001
Physical activeness levels (%)[4)]				
Active	69.9	82.1	56.7	<.0001
Insufficiently active	30.1	17.9	43.3	

All of participants were age five.

T-test and X^2 test were used.

Data were presented by mean (SD) or percent.

1) Numbers are varied by missing data.

2) BMI percentile was assigned according to the Korea CDC growth chart.

3) Godin Leisure-Time activity score= (9 X average times of strenuous exercise/ week) + (5 X average times of moderate exercise/ week) + (3 X average times of mild exercise/ week) (Godin, G., Shephard, R. J. 1997).

4) The physical activeness levels at baseline was classified as active and insufficiently active by the cut point at 24 units, obtained with two intensities of strenuous and moderate according to Godin & Shephard, 1985.

Table 3. Intervention effects: Percentage of positive changes (%) in children's levels of physical activeness, interest in exercise and the Psychological Need Satisfaction in Exercise Scale after intervention (n=154)

	Physical activeness	Interested in exercise	The Psychological Need Satisfaction in Exercise		
			Competence	Relatedness	Autonomy
Boys and girls	49.4***	59.1[3)]	60.4***	69.5***	52.6***
Boys	52.4	59.8	58.5	64.6	52.4
Girls	45.8	58.3	62.5	75.0	52.8
BMI status[1)]					
At risk of underweight	45.5	68.2	63.6	72.7	45.5
Normal weight	55.0	64.0	64.0	73.0	56.0
At risk of overweight	27.8	38.9	50.0	50.0	55.6
Physical activeness levels at baseline[2)]					
Active	52.3	59.8	58.9	71.0	53.3
Insufficiently active	41.9	58.1	65.1	67.4	51.2

Parent reported children's changes in behaviors and psychological satisfaction by 5-point Likert scale (from not at all (1) to strongly agree (5)) and marked as positive change if parent chose 4 and above.
The Psychological Need Satisfaction in Exercise Scale which made by Wilson et al. (2006) and Korean version was validated by Kim (2007) and includes three subgroups competence, autonomy and relatedness.
1) BMI percentile was assigned according to the Korea CDC growth chart.

2) The physical activeness levels at baseline was classified as active and insufficiently active by the cut point at 24 units, obtained with two intensities of strenuous and moderate according to Godin & Shephard, 1985.
All of X^2 tests for the difference of PPC% by sex and BMI status had no significant difference.

***There were significant pre and post differences in children's level of PA and psychological need satisfaction in exercise using paired t-test and wilcoxon signed rank test ($p<0.001$).

3) We asked children's interest in exercise in post questionnaire only, we didn't test it change in pre and post.

Table 4. Intervention effects: Percentage of positive changes (%) in parental attitude and beliefs on their children's physical activity (PA) and health after intervention (n=154)

	Recognize necessity of PA for their children	Reassess their children's PA capability	Aware of their children's happiness after PA	Understand relationship between child competence in PA and self-esteem
Boys and girls	94.2	64.3	80.5	79.9
Boys	96.3	62.2	75.6	76.8
Girls	91.7	66.7	86.1	83.3
BMI status[1)]				
At risk of underweight	86.4	63.6	86.4	90.9
Normal weight	91.0	63.0	76.0	76.0
At risk of overweight	100.0	77.8	94.4	88.9
Physical activeness levels at baseline[2)]				
Active	95.4	62.8	79.1	81.4
Insufficiently active	93.5	65.4	82.1	80.2

Parents scored their positive changes in attitude and beliefs on their children's PA and their health by 5 likert scale (from not at all (1) to strongly agree (5)) and marked as positive change if parent chose 4 and above.
All of X^2 tests for the difference of PPC% by sex and BMI status had no significant difference.
1) BMI percentile was assigned according to the Korea CDC Growth Chart.
2) The physical activeness levels at baseline was classified as active and insufficiently active by the cut point at 24 units, obtained with two intensities of strenuous and moderate according to Godin & Shephard, 1985.

We asked parental change in their attitude and beliefs about their children's PA in post questionnaire only, we didn't test it change in pre and post.