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Association between physical activity and self-rated health among pediatric patients with type 1 diabetes mellitus who lack diabetes care

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Author Note

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Abstract

Background: Even though a number of studies have verified the positive effect of physical activity (PA) on self-related health (SRH) no previous research has examined this association among pediatric patients with Type 1 diabetes mellitus (T1DM).

Objective: The purpose of this study was to investigate the association between regular physical activity (PA) and self-rated health (SRH) in pediatric patients with Type 1 diabetes mellitus (T1DM) who lacked diabetes care.

Methods: We conducted a retrospective study among pediatric patients with T1DM who lacked diabetes care and were enrolled in a diabetes education program between January 2011 to January 2015 at the endocrinology clinic of [redacted] University Children's Hospital in South Korea. The eligible participants for this study were 37 pediatric patients with T1DM aged 9 to 17 years. PA was divided into regular PA and muscle strength exercise to analyze the relationship with SRH using binomial logistic regression analysis.

Results: The results showed SRH of pediatric patients with T1DM who did not engage in regular PA was significantly lower than those who did (OR in regular PA = .199 [95% CI: .040, .995]; OR in regular muscle strength exercise = .097 [95% CI: .023, .825]).

Conclusions: In conclusion, regular PA and muscle strength exercise in pediatric patients with T1DM who lacked diabetes care were effective in improving their SRH. A systematic plan is required to enhance regular PA for pediatric patients with T1DM.

Key words: pediatric patient with T1DM, physical activity, muscle strength exercise, self-rated health

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Interest in the health management of Type 1 diabetes mellitus (T1DM) patients has increased in recent years. Research has revealed a three percent rise annually in pediatric patients around the globe [1]. Although South Korea is known to have a relatively low incidence rate of T1DM, the incidence rate is rapidly increasing according to recent data [2,3]. A number of complicating issues tend to be experienced by those with T1DM diagnoses. For example, T1DM patients may suffer psychologically through a long period of self-sugar management during childhood [4]. These psychological issues tend to be complicated further by the pressure of academic work throughout one's education [4,5]. Of additional concern, these issues can change with hormone development during puberty [6–9]. T1DM patients may also have trouble managing their blood sugar [10,11]. Concern about managing blood sugar can influence high levels of stress, depression, and anxiety among pediatric patients with T1DM [12–16]. These concerns for pediatric patients with T1DM might affect their quality of life. For example, research has indicated that quality of life indices tend to be lower among this population when compared to patients with Type 2 diabetes mellitus [10,17].

Among pediatric patients with T1DM, those who lack diabetes care could experience more serious psychological problems and glycemic control in a vicious circle [18,19]. Therefore, it is important to give attention to pediatric patients with T1DM who lack diabetes care. Self-rated health (SRH) is regarded as one of the most important factors to pediatric patients with T1DM because they have to self-manage their disease for their entire lifetime after being diagnosed. SRH is considered a measure of overall health which considers biological, psychological, social, and functional health levels [20]. Researchers have identified that poor SRH tends to be associated with obesity [21] or low-grade inflammation [22] among this population. Even though a number of studies have verified the positive effect of physical activity (PA) on SRH [23–26],

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no previous research has examined this association among pediatric patients with T1DM. Therefore, the purpose of this study was to investigate the association between regular PA and SRH in pediatric patients with T1DM who lacked diabetes care.

Materials and Methods

Participants

The eligible participants of this study were 37 pediatric patients with T1DM that attended a diabetes education program at the endocrinology clinic of [redacted] University Children's in South Korea. This study included children and adolescents aged 9-18 years who participated in the program between January 2011 to January 2015. The specific selection criteria were individuals who had: (a) received a T1DM diagnosis at least six months prior, (b) over 7.5% of glycosylated hemoglobin (HbA1c), which is a biological value used when monitoring diabetes, (c) consented to the study.

Data Collection and Instruments

This retrospective study involving a chart review of patients diagnosed with T1DM was approved by the institutional review boards (IRB No. H-1606-046-769) of [redacted] University Hospital. Data that were collected included demographic data, body fat (%), HbA1c levels, PA, muscle strength exercise, and SRH of participants at the time of their enrollment in the education program.

Regular PA. Regular PA was measured using two questions and responses. The question for moderate PA was "Over the past 7 days, how many days did you engage in moderate physical activity (for at least 30 minutes) that caused a slight increase in your breathing or heart rate (e.g.

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tennis doubles, volleyball, badminton or table tennis, or any other activity)?". The vigorous PA question was, "over the past 7 days, how many days did you engage in vigorous physical activity such as running, mountain climbing, soccer, basketball or any other activity (for at least 10 minutes) that caused a substantial increase in your breathing or heart rate?". Using these two questions, regular PA was defined as follows: vigorous PA ≥ 3days/week, moderate PA ≥5 days/week. Participants who did not meet the guidelines were classified as 'nonregular PA' group [27].

Regular Muscle Strength Exercise. One question was used to measure regular muscle strength exercise. This question read "over the past 7 days, how many days did you engage in muscle strength exercise such as push-ups, sit-ups or weight lifting etc.?" Using the question, regular muscle strength exercise was coded as a dichotomous variable of regular (≥3 days/week) or not-regular muscle strength exercise.

SRH. SRH status was measured by one item, originally derived from SF-36 [28]: "In general, how would you rate your current health?" and the response options were ① very good, ② good, ③ fair, ④ poor, and ⑤ very poor. According to the responses, the variable was classified to a dichotomous variable of 'optimal SRH' and 'poor SRH'. Scores 1–2 were coded as optimal SRH [25,29].

Statistical Analysis

SPSS 21.0 version (SPSS Inc., Chicago, IL, USA) was used to analyze the data. Descriptive statistics were conducted for the demographic characteristics of the participants, and we performed Chi-square tests to examine the differences in SRH by regular PA and muscle strength exercise. Odds ratio and 95% Confidence Interval (CI) through the logistic regression analysis were calculated to analyze the relationship among regular PA, regular muscle strength exercise,

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and self-rated health. The adjusting variables were gender and age in the analyzing process. Statistical significance was accepted as $p<.05$.

Results

Characteristics of Participants

Participant demographics and descriptive PA and SRH statistics are shown in Table 1. The total number of the participants was 37, which consisted of 13 (35.1%) and 24 females (64.9%), and their mean age was 12.38±2.45. Though not statistically significant (p=0.690), the level of SRH of female students was better than the male students. Further, the level of SRH of the elementary school students was higher than the middle or high school students (p=0.293). Participants who engaged in regular PA or in regular muscle strength exercise had significantly better SRH (p=0.046).

Association between Physical Activity and Self-Rated Health

Table 2 showed the odds ratio with 95% CI of the SRH association with participating in regular PA and regular muscle strength exercise, respectively. All odds ratio scores were calculated after adjusting for age and gender. The SRH of the participants who did not have regular PA showed 0.199 times lower than those who had. The SRH of the participants who did not perform regular muscle strength exercise was 0.097 times lower than those who did.

Insert Table 1 here

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Insert Table 2 here

Discussion

Approximately 20% to 40% of people with diabetes in South Korea appropriately manage their blood sugar [30]. However, an interest in the health management for pediatric patients with T1DM is a pressing concern in South Korea because only about 13 to 15 percent of pediatric patients with T1DM are in good management [31]. According to the results of this study, pediatric patients with T1DM who did not perform regular PA or muscle strength exercise had lower SRH than those who did. This result was synonymous with the many preceding studies that showed that regular PA and muscle strength exercise positively affected the development of SRH [26,32]. Although difficult to compare because of a lack of concrete guideline on PA for maintaining health in pediatric patients with T1DM, the American Diabetes Association (ADA) recommended that pediatric patients with diabetes perform moderate and vigorous PA over 60 minutes every day and muscle strength exercises more than 3 days a week [33].

The present study showed that moderate PA of more than 150 minutes per week or vigorous aerobic excise of more than 75 minutes per week can have an effect on increasing SRH in pediatric patient with lack of diabetes care. However, the amount of physical activity they engaged in did not reach the recommended amount of PA per week by ADA. The results also showed that pediatric patients who lacked diabetes care and engaged in muscle strength exercise more than 3 days per week had higher SRH than those who did not meet these exercise thresholds. This result is aligned with Copeland et al. [33], who presented the muscle strength exercise guidelines for this population. Having higher SRH in pediatric patients who lack

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diabetes care who got regular PA and muscle strength exercise than those who did less exercise could be explained. First, gaining confidence may come from an improvement in body shape and physical fitness through participating in regular PA or muscle strength exercise [34–36]. Second, children and adolescents with plenty of PA are more likely to realize their health condition positively because they tend to have low levels of negative mental health [37–39]. Furthermore, this was regarded to influence the SRH of pediatric patients with T1DM positively by increasing happiness [40] which came from social interaction effects in attending PA with peers [41].

The limitations in this study included the small sample size to analyze the data due to only targeting patients in a diabetes education program with intensified treatment at a specific location. Thus, a careful interpretation is necessary to generalize the result. A further limitation is the inability to establish a causal connection between the independent and dependent variable based on analyzing cross-sectional data. The present study did not adjust to use other variables to explore effects on the SRH. In the future research, an advanced PA data analysis is needed to consider gender or other demographic variables as well as colleting the data to use objective instruments, such as accelerometers and pedometers.

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Table 1. Characteristics of subjects by self-rated health status

Variables		Optimal SRH (n=10)		Poor SRH (n=27)		X^2/t	*p*-value[a]
		Mean	SD	Mean	SD		
Age (yrs)		12.00	2.11	12.52	2.59	-0.565	0.575
Height (cm)		149.19	12.81	44.20	11.73	-0.771	0.446
Weight (kg)		44.42	11.73	46.51	10.47	-0.523	0.605
BMI (kg/m²)		19.67	2.84	19.68	2.35	-0.013	0.989
Body fat (%)		26.87	9.55	23.14	5.85	1.119	0.403
HbA1c (%)		9.36	0.98	9.39	1.47	-0.065	0.949
		n	%	n	%		
Sex	Male	3	23.1	10	76.9	0.159	0.690
	Female	7	29.2	17	70.8		
School grade	Elementary	8	36.4	14	63.6	2.455	0.293
	Middle	1	11.1	8	88.9		
	High	1	16.7	5	83.3		
Regular physical activity	Yes	7 (43.8)		9 (56.3)		3.997	0.046*
	No	3 (14.3)		18 (85.7)			
Regular Muscle strength exercise	Yes	4 (57.1)		3 (42.9)		3.970	0.046*
	No	6 (20.0)		24 (80.0)			

mean + SD or Values are N (%).
*$P < 0.05$.

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Table 2. Association between physical activity and self-rated health

	Pediatric patients with Type 1 DM in lack of diabetes care
	OR (95% CI)
Regular physical activity	
Yes	Reference
No	0.199 (0.040-0.995)*
Regular muscle strength exercise	
Yes	Reference
No	0.097 (0.012-0.815)*

OR, Odds Ratio; CI, 95% Confidence interval.
Adjusted for age and gender, *$P < 0.05$.