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Original Article

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Relationship in Quality of Diet, Food Habit and Feeding Practice in Children with Pervasive Developmental Disorder and Their Caregiver

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ABSTRACT

This study aimed to assess the dietary quality and food habits in children with pervasive developmental disorder (PDD) and to evaluate the relationship between diet quality of children with PDDs and their caregivers' feeding practice and nutritional perceptions. Twenty-one pairs of caregivers and their children with PDD were surveyed. The caregivers completed surveys regarding their children's weight status, food habits, and dietary quality and their food habits, nutritional perceptions, knowledge, and feeding practices. Dietary quality was assessed as mean adequacy ratio, dietary diversity score (DDS), dietary variety score (DVS), and Index of Nutritional Quality (INQ). The children were in the normal ranges of body mass index (BMI) and Röhrer index. Having three times a meal, regular meal time, salty taste of the caregiver were related to those of the children with PDD ($\beta = 0.533$, 0.447, and 0.886, respectively; $p < 0.05$). Child control, food as reward, involvement, pressure, and restriction for the health of the caregiver were positively related to DDS, DVS, and INQ of the children with PDD ($p < 0.05$). High feeding stress and nutritional knowledge of the caregiver were related to the high BMI of the children with PDD ($\beta = 0.445$ and 0.602, respectively; $p < 0.05$), whereas emotion regulation, encourage balance and variety, and involvement of caregiver were negatively related to BMI ($\beta = -0.426$, -0.430, and -0.388, respectively; $p < 0.05$). In conclusion, food habits of children with PDD were closely related to those of caregiver. To improve nutritional status, more insightful understand will be required by considering their developmental differences in this population.

Keywords: Diet; Food habits; Developmental Disabilities; Caregivers; Feeding behavior

INTRODUCTION

Pervasive developmental disorders (PDD) is a group of five disorders characterized by Autism disorder, Asperger's syndrome (AS), Rett's syndrome, childhood disintegrative disorder (CDD), and pervasive developmental disorder (PDD)-not otherwise specified (NOS) [1]. These are combined into one category of autism spectrum disorder (ASD) and characterized by development deficits that commonly produce impairments in social interaction, communication and language, including repetitive or stereotypic behaviors [2]. The

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Conflict of Interest
The authors declare that they have no competing interests.

worldwide prevalence of PDD has increased over the past 15 years and is reported to be 62.6 per 10,000 in the UK [3], and 2.64% in South Korea [4]. In line with that trend, studies for PDD which focused nutritional status were conducted [3,5]; however, most previous studies compared to dietary intake or nutritional status between children with PDD and normally developing children [3] and few studies have investigated the comparison of these factors in children with PDD.

Problematic feeding and mealtime behaviors in children with PDD have been reported in several studies. In a previous publication, gastrointestinal problems, frequent dislikes of new foods have been documented as higher rates of feeding problems in children with ASD compared to their counterparts [6-8]. Furthermore, disruptive behaviors such as refusing to come to the table, and not staying seated [9] were shown a higher correlation with stressful meals and family life in high rates children with ASD [10]. Negative impacts of the dysfunctional and stressful mood affected to families of children diagnosed with a neurodevelopmental disability than “typical” families [11]. These Eating difficulties in children with ASD were reported that higher rates of caregiver stress and nutritional deficiencies caused by sensory food aversions such as food neophobia and food selectivity.

Children's eating behaviors, food preferences and consumption pattern are shaped by caregiver feeding style. Furthermore, not only the mother's educational status, job and food management skills but also the interest, eating habits, attitudes, and knowledge of parents directly influence to the nutrient intakes of children [12]. Between 80% to 90% of dietary intake problems observed in children with PDD result from organic disorders [13], but other possible reasons include the attitudes or behaviors of parents towards their children's dietary problems [14]. Parents of children with PDD tend to have more negative opinions of their children's food intake, eating habits or behaviors, including preferences for certain textures, refusal of new foods and selective behavior that differs from that of normally developing children. Although the behaviors and influence of primary caregivers are closely associated with childhood dietary intake, food habits and behaviors, only a few studies have been undertaken in this area [15]. In addition, research exploring the relationships between dietary quality in children with PDD and the nutritional perceptions or knowledge of primary caregivers has never been undertaken in Korea.

Current study aimed to evaluate food habits and quality of diets in children with PDD and their relationship with nutritional perceptions, knowledge and feeding practices of their primary caregivers.

MATERIALS AND METHODS

Participants

The participants in this study included 21 children with PDD and their primary caregivers. All children were between 6 and 12 years and had been diagnosed with a PDD by a doctor. The 13 boys and 8 girls were recruited from medical centers and community welfare centers, Seoul, Korea. Primary caregivers included parents and grandparents. Informed consent was obtained from all participants. Trained researchers conducted interviews to children with PPD and their primary caregivers, and they completed a survey that included demographic information, anthropometric data and perceptions of nutrition, knowledge and feeding

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practices of primary caregivers. The study protocol was approved by the Institutional Review Board of Kyung Hee University, Seoul, South Korea (KHU IRB 2010-017).

Anthropometric data measurement of children with PDD

Primary caregivers reported their children's height and weight, and these data were used to calculate body-mass index (BMI, kg/m^2) and Röhrer index. The Röhrer index was used to classify the children into 5 categories; obese, overweight, normal weight, underweight, and severely underweight. Z-scores were also calculated using 2007 Korean National Growth Charts and were assessed using the following range: ± 2 was normal, less than −2 was indicative of malnutrition, less than −3 was indicative of severe malnutrition [16].

Dietary quality and food habit of children with PDD

A trained dietitian educated the primary caregivers regarding how to complete three-day (2 weekdays and 1 weekend day) diet records of children with PDD. If the primary caregiver did not know what the child ate for lunch at school, the primary caregiver asked the child's teachers directly. All completed records were evaluated for daily intake using the Computer Aided Nutritional Analysis Program version 3.0 (Korean Nutrition Society, Seoul, Korea).

Children's daily intakes were compared with Dietary Reference Intakes for Koreans (KDRIs) and re-evaluated to estimate dietary quality using the nutrient adequacy ratio (NAR), the mean adequacy ratio (MAR), and the Index of Nutritional Quality (INQ). NAR represents the adequacy ratio of each nutrient compared to KDRIs, and MAR is the average level of NARs. INQ is the ratio of nutrient intake for 1,000 kcal and recommended intake for 1,000 kcal; children have good dietary quality vs. dietary quantity if this score is over 1 [17,18].

The INQ was also used to assess food variety, food group intake pattern, dietary diversity score (DDS), and dietary variety score (DVS). DDS was used to measure the diversity of the children's food intake. We used the same method to calculate the food group intake pattern, with scores of 1 or 0 points for the different food groups. DVS was the number of foods per day and showed a variety of dietary intake [19].

Food habits of children with PDD and their caregiver were assessed using questionnaire [20], which is includes 7 questions covering the following: regular meals, regular time, balance, over-eating, eating speed, salty taste, and picky eating.

Nutritional perception and knowledge of primary caregiver

The nutritional perceptions of primary caregivers were scored according to three aspects using the Nutritional Perception Assessment, which is based on Behavioral Pediatric Feeding Assessment Scale [21], which is modified to make it more appropriate for Korean society. This questionnaire included 21 items such as nutritional beliefs, perception of nutritional status and feeding stress during meals. A 5-point Likert-type scale was used to score each question.

We used a previously-developed instrument to assess the nutritional knowledge status of primary caregivers that was tailored to the Korean context [22]. Using this scale, a correct answer received 1 point; a wrong answer received 0 points. The highest possible score was 25 points. This tool included 3 questions about carbohydrates, 2 questions about protein, 3 questions about fat, 5 questions about minerals, 4 questions about energy metabolism, and 4 questions about general knowledge. A score over 21 points was considered very good; 16 to 20 was good; 11 to 15 was average; and less than 10 points was poor.

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Feeding practices of primary caregiver

The 12 factors of the primary caregiver's feeding practices were assessed using the Comprehensive Feeding Practice Questionnaire (CFPQ, 2007). This parental self-report is an adequate method to measure parental feeding practices, and it can be used to assess parents of children with wide age ranges [23]. The 12 domains are child control, emotion regulation, encouragement balance and variety, environment, food as a reward, involvement, modeling, monitoring, pressure, restriction for health, restriction for weight control, and teaching about nutrition. The CFPQ used a 5-point, Likert-type scale in which 1 point meant never or strongly disagree while 5 points meant always or completely agree. A higher score indicated a better use of particular feeding behaviors [24].

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, version 18.0; IBM Corporation, Chicago, IL, USA). The results were expressed as mean and standard deviation for continuous variables and number (%) for discrete variables. To compare the means of the two groups by gender, we conducted Student's t-test. A χ^2 test was used to verify significance between categorical variables. Pearson's correlation coefficient was evaluated to show patterns of associations among variables. Statistical significance was set at $p < 0.05$.

RESULTS

Sociodemographic characteristics and anthropometric data of children with PDD and primary caregiver

Sociodemographic characteristics and anthropometric data of children with PDD and their primary caregiver are presented in **Table 1**. The mean age was 9.8 years for boys and 10.9 years for girls. The average BMI for boys was 16.4 kg/cm^2 and 17.6 kg/cm^2 for girls. Rörher index scores were 122.8 ± 27.3 for boys and 122.2 ± 17.4 for girls. Children with PDD who were participated in this study within the normal range of BMI and Rörher index scores according to 2007 Korean pediatric growth charts. The participants' Z-score calculated included the BMI for age (Z_{BMI}) results were mostly negative but still in the normal range of Z-scores: $-2 < x < +2$.

Mean age of the primary caregiver was 44.4 ± 8.5 years and including 3 of grandmothers (10.0%). 42.9% of the primary caregiver graduate college or university and 46.7% were housewives (data not shown). More than 3 million (won) of monthly incomes were reported from 41.1% of the primary caregiver.

Nutrient intake and dietary quality of children with PDD

When compared with KDRI, almost all nutrients met over 100% of KDRIs but calcium, potassium, and folate were less than 100% of the KDRIs in both genders. Mean energy intakes of children with PDD were 1,716.5 ± 400 kcal/day. Boys consumed 1,772.7 ± 471.3 kcal, 69.7 g of protein, and 55.8 g of fat, and the total calorie:protein:fat (C:P:F) ratio was 56:16:28. Meanwhile, girls took in 1,625 kcal, 62.8 g of protein and 48.6 g of fat, and the C:P:F ratio was 58:15:27 (data not shown).

NAR of calcium, potassium and folate were deficient these nutrients were under 1.0 (NAR = 0.7 ± 0.3, 0.5 ± 0.2, and 0.8 ± 0.3, respectively). Overall dietary quality assessed using MAR were 0.9 ± 0.1. In addition, INQ also showed similar results as NAR, and calcium (0.8 ± 0.3),

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Table 1. Sociodemographic characteristics and anthropometric data of children with PDD and primary caregiver

Variables	Boy (n = 13)	Girl (n = 8)	Total (n = 21)
Children with PDD			
Age (yr)	9.8 ± 1.9	10.9 ± 1.7	10.2 ± 1.8
Height (cm)	133.8 ± 10.7	145.6 ± 14.8	138.3 ± 13.4
Weight (kg)	29.9 ± 10.2	37.8 ± 8.7	32.9 ± 10.2
BMI (kg/cm^2)	16.4 ± 3.7	17.6 ± 2.0	16.9 ± 3.2
Rörher index*	122.8 ± 27.3	122.2 ± 17.4	122.6 ± 23.5
Z-Score†			
Z_{BMI}	−1.1 ± 2.4	−0.2 ± 0.9	−0.8 ± 2.0
Z_{HA}	−0.4 ± 1.7	0.3 ± 1.0	−0.1 ± 1.4
Z_{WA}	−0.8 ± 1.8	−0.01 ± 0.8	−0.5 ± 1.6
Primary caregiver			
Age (yr)		44.4 ± 8.5	
Relationship			
Mother		18 (90.0)	
Grandmother		3 (10.0)	
Education			
Middle school		4 (19.0)	
High school		8 (38.1)	
College or University		9 (42.9)	
Income per month (won)			
1,000.000–1,999,000		6 (28.6)	
2,000.000–2,999,000		6 (28.6)	
3,000.000–4,999,000		1 (3.3)	
> 4,000,000		8 (38.1)	

Values are presented as mean ± standard deviation or number (%). BMI, body mass index; PDD, pervasive development disorder; Z_{BMI}, Z-score calculated included the BMI for age; Z_{HA}, Z-score calculated included the height for age; Z_{WA}, Z-score calculated included the weight for age.
*Rörher index: Severely underweight ≤ 92, underweight 92–110, normal 110–140, overweight 140–156, obese ≥ 156; †Z value: normal: $-2 < x < +2$, mild malnutrition: $-2 > x$, and moderate malnutrition: $-3 > x$.

potassium (0.6 ± 0.1), and folate (0.8 ± 0.2) were less than 1.0. For the indicators of food diversity assessed using DDS and DVS, 33% of children achieved the highest score (5 points), 48% of children scored 4 points, and 19% of children had lower DDS score than 3 points. Children with PDD ate an average of 11 different kinds of foods per day. For vegetables, the DDS score of boys was 0.5, but those of girls had 0.9 (data not shown).

Correlations between food habit of children with PDD and primary caregiver

Table 2 was shown the relationship between the food habit of children with PDD and primary caregiver. A regular time of the children's eating habits was positively correlated to regular meals, regular time and balance of primary caregiver during their mealtime. However, overeating, salty taste and picky eating of children were positively correlated to unhealthy eating habits such as overeating and salty taste of the primary caregiver.

Correlations of nutritional perception of primary caregivers and weight status, and dietary quality of children with PDD

The relationship between the nutritional perception of the primary caregivers and weight status and dietary quality of the children with PDD was shown in **Table 3**. BMI was positively correlated to feeding stress, nutritional knowledge, and restriction for weight control. However, negative correlation was shown in emotion regulation, encourage balance and variety and involvement in the feeding practices of the primary caregivers. In Röhrer index and Z_{BMI} (including Z-score calculated included the height or weight for age) of the children with PDD was shown similar results.

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Table 2. Correlations between food habit of children with PDD and their primary caregiver

Primary caregiver	Children with PDD						
	Regular meals*	Regular time	Balance	Overeating	Eating speed	Salty taste	Picky eating
Regular meals	0.535‡	0.384†	−0.225	0.177	−0.383†	0.009	−0.093
Regular time	0.287	0.447†	−0.318	0.208	−0.011	0.279	−0.064
Balance	0.344	0.541†	−0.130	0.020	−0.238	−0.105	−0.235
Overeating	0.105	−0.167	0.284	0.266	−0.040	0.529‡	0.564‡
Eating speed	−0.080	−0.058	0.253	−0.092	−0.323	0.234	0.091
Salty taste	0.011	−0.160	0.346	0.434†	0.161	0.886‡	0.633‡
Picky eating	0.344	0.482†	−0.032	0.066	−0.351	−0.013	0.049

Data are presented as correlation coefficients.
PDD, pervasive development disorder.
*Seven food habits (regular meals, regular time, balance, over-eating, eating speed, salty taste, picky eating) of children with PDD and their caregiver were assessed using 5-likert questionnaire. Significant different at †$p < 0.05$, ‡$p < 0.01$.

Table 3. Correlations among nutritional perception and feeding practice of primary caregiver and weight status and dietary quality of children with PDD

Primary caregiver	Children with PDD								
	Weight status					Dietary quality			
	BMI	Röhrer	Z_{BMI}	Z_{HA}	Z_{WA}	MAR	DDS	DVS	INQ
Nutritional perception									
Nutritional beliefs	0.226	0.148	0.120	−0.083	0.028	0.173	−0.202	0.296	0.113
Nutritional perception	0.051	0.026	0.030	−0.115	−0.065	0.097	−0.084	0.215	0.109
Feeding stress	0.445*	0.363	0.376*	0.311	0.478*	−0.017	−0.017	0.333	0.049
Nutritional knowledge	0.602†	0.533†	0.391*	0.108	0.394*	0.220	−0.392*	0.090	0.320
Feeding practices									
Child control	0.007	0.038	0.058	−0.308	−0.163	0.347	−0.279	−0.005	0.380*
Emotion regulation	−0.426*	−0.337	−0.430*	−0.117	−0.368	−0.299	0.076	0.166	−0.107
Encourage balance and variety	−0.430*	−0.400*	−0.218	−0.454*	−0.522†	−0.169	−0.196	0.262	0.680
Environment	0.133	0.186	0.063	−0.056	0.061	−0.100	−0.410*	0.323	0.113
Food as reward	−0.129	−0.147	−0.080	−0.179	−0.183	0.005	0.468*	0.412*	0.005
Involvement	−0.388*	−0.378*	−0.308	−0.514†	−0.562†	−0.146	−0.154	0.473*	0.031
Modeling	0.215	0.086	0.257	−0.199	−0.015	0.170	−0.097	0.281	0.035
Monitoring	0.038	0.027	0.122	0.276	0.216	−0.180	−0.337	−0.043	0.044
Pressure	−0.333	−0.184	−0.173	−0.426*	−0.415*	−0.023	0.471*	0.103	−0.292
Restriction for health	−0.337	−0.245	−0.224	−0.236	−0.337	−0.092	0.210	0.494*	−0.072
Restriction for weight control	0.404*	0.262	0.328	0.153	0.300	0.088	0.060	0.368	−0.195
Teaching about nutrition	−0.171	−0.139	−0.143	−0.609†	−0.472†	0.153	0.008	0.259	−0.209

Data are presented as correlation coefficients.
BMI, body mass index; PDD, pervasive development disorder; Z_{BMI}, Z-score calculated included BMI for age; Z_{HA}, Z-score calculated included the height for age; Z_{WA}, Z-score calculated included the weight for age; MAR, mean adequacy ratio; DDS, dietary diversity score; DVS, dietary variety score; INQ, Index of Nutritional Quality.
Significant correlation between 2 variables at *$p < 0.05$, †$p < 0.01$.

We observed correlations between the children's dietary quality and the primary caregivers' nutritional perceptions. DDS was positively correlated to food as reward and pressure, but the only environment was shown negative association in the feeding practices of the primary caregivers. DVS was positively correlated to food as reward, involvement and restriction for health. INQ was correlated only with child control, and MAR was not associated with any other dietary quality index.

DISCUSSION

The present cross-sectional study aimed to assess the dietary quality and food habits in children with PDD and their weight status and dietary quality correlation with primary caregiver's food habits, nutritional perception, and feeding practice. The findings demonstrate that the food habits of primary caregiver were related to those of children with PDD. Active feeding practices of caregiver (e.g. food as reward, pressure, involvement, and

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restriction for health) were positively related to dietary quality assessed using DDS, DVS, and INQ of children with PDD. High feeding stress of nutritional perception and nutritional knowledge of caregiver was related to the high weight status of children with PDD, whereas emotion regulation, encourage balance and variety, involvement and pressure among feeding practices of caregiver were negatively related to weight status.

The anthropometric data of children with PDD were compared with the 2007 Korean National Growth Charts to determine whether they were within the normal range [25]. A previous study reported that children with disabilities were more at risk of high BMI, but the participants in our study were in the normal range of weight. Previous studies also reported that children with PDD had more risk of growth retardation and weight gain or loss [26].

In the current study, energy intakes of the children with PDDs were met estimated energy requirement for energy (103.2% for males and 102% for females), and not more than reference value, which were not consistent with previous results that concerns about obesity resulting from excessive energy intake [26]. We found that the children with PDDs had less calcium, potassium and folate than KDRI reference value. With respect to calcium, a previous study reported that children with PDDs have consumed plenty of milk and dairy products, but they did not consume enough of other sources of calcium, such as anchovies [27]. In agreement, we found that 80% of children ate dairy products enough assessed using DDS score as a source of calcium. In addition, our findings are consistent with other studies that reported folate and potassium intakes were lower compared to KDRIs. A Chinese study investigated the nutritional status of autistic children, who did not have an adequate intake of calcium, folate or vitamin A [28]. The researchers found that children with autistic disorders consume only small amounts of green vegetables and fruits, which are sources of these nutrients. We found that about 30% of the children with PDD had inadequate intakes of vegetables.

Problematic eating behaviors in children with PDD were induced by food neophobia, sensory problems and sensory factors such as smell, texture, color and temperature [29-31]. One meta-analysis study has been reported that 46% and 89% of children with ASD had their eating problems [32]. Other previous studies mentioned that the resemblance of the family's dietary preferences and food habits in children with ASD and typical development children [33]. In the present study, similar result was shown in children's food habits and that of their primary caregiver's. Regular meal, time and balanced eating habits of caregiver were related to children's eating behavior during their meal time. Meanwhile, unhealthy eating behaviors such as overeating, salty taste preference and picky eating were also related to those of primary caregivers. In line with this, we suggest children's food preferences and selectivity might be influenced by their mothers' food preferences.

Previous studies have investigated how child characteristics or lifestyle were influenced by parents. Several factors directly affect to diets of children with PDD, such as family members, family environment and schooling hours, but the mother had the greatest factor among them on the child's eating practices [34]. Moreover, the mother's food habits, attitudes and interest in the children influenced the child's dietary perceptions [35]. It also has been reported parenting stress against children with autistic disorder, in a previous study [36]. These factors were represented in the correlations between weight status (BMI and Röhrer index) and the nutritional perception of primary caregiver in this study. Particularly, between higher BMI and z-score of the children and higher scored parents' feeding stress and nutritional knowledge were positively correlated. A previous study reported that parents restricted

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foods because they believed their children were overweight or obese [24,37]. When primary caregivers restrict foods, they also watch while the children have their meal and assess the quantity what children had; these practices might lead to feeding stress in caregiver of children with PDD. In contrast, weight status was negatively correlated with emotion regulation, encourage balance and variety and involvement during mealtime. Furthermore, the quality of diet in children with PDD was related to food as reward, pressure, involvement and restriction for health. Lazarou et al. [38] reported that children had higher intakes and better eating behaviors when their parents had better perceptions of nutrition and food habits themselves. In accordance with these reports, the present results were shown active efforts with careful approach of the primary caregiver toward their children's meal and diet.

This cross-sectional study has some limitations. First, the food recall was assessed only for children with PDD without that of primary caregivers. Therefore, it was not performed to compare the dietary resemblance of the children with PDD and their primary caregiver. Secondly, the participants were recruited only from the Seoul metropolitan area in Korea; therefore, our results could not represent of subjects. Lastly, it is not possible to determine which factors caused other factors even the correlations were present and meaningful, no causality was found. Nonetheless, this study was the first to the best of our knowledge that tried to understand the relationship among dietary quality of children with PDD and their caregiver's nutritional perception and feeding practice in Korea. Further evidence-based research is needed to understand the features in children with PDD and their family to build the adequate nutritional strategy in this population.

CONCLUSIONS

In conclusion, we found a relationship between PDD children's dietary quality and primary caregivers' food habit, nutritional perception, and feeding practice. Caregiver's food habits and feeding practices were positively related to the weight status and diet quality of children with PDD. Problematic eating behaviors of children with PDD caused by several familial and environmental factors around them. To improve nutritional status, healthy growth and development of children with PDD, more insightful understand will be required by considering their developmental differences in this population.

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