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Evaluation of the nutritional status of children with type 1 diabetes and their healthy siblings

Ocena stanu odżywienia dzieci z cukrzycą typu 1 i ich zdrowego rodzeństwa

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Abstract

Background: Although there are studies evaluating the psychological adjustment of healthy children when their siblings have type 1 diabetes mellitus (T1DM), no study evaluating their nutritional status exists. Thus, this study aimed to determine the nutritional status of children with T1DM and their healthy siblings.

Material and methods: Data from a control group, healthy siblings, and patients who were followed and treated for T1DM in the Paediatric Gastroenterology and Paediatric Endocrinology outpatient clinics of the Health Sciences University Gülhane Medical Faculty between November 2019 and November 2020 were analysed and compared. The groups were compared in terms of nutritional characteristics, daily macro and micronutrient intakes and classified according to their body mass index (BMI) *Z*-scores.

Results: The study population consisted of 29 children with T1DM (51.7% female, 48.3% male; age: 11.00 ±3.66 years), 36 healthy siblings of children with T1DM (50% female, 50% male; age: 9.61 ±4.84 years), and a control group of 58 healthy children (51.7% female, 48.3% male; age: 10.68 ±3.01years).The BMI *Z*-score of 28.6% of healthy siblings and 25% of children with T1DM was > 1 SD or overweight. All of the control group children were of normal weight. None of the children were obese; however, the overweight rate was significantly higher in the healthy siblings and diabetes groups compared to the control group ($p = 0.012$). Daily energy intake (%) was significantly higher in the control group than in the healthy siblings ($p < 0.001$).

Conclusions: A quarter of the children with T1DM over five years of age were overweight. In addition, healthy siblings were found to have higher BMI *Z*-scores than controls. This is the first study to evaluate the nutritional status of siblings of patients with T1DM and will hopefully lead to more comprehensive studies that will also assess their daily exercise and physical activity.

Key words: children, type 1 diabetes, nutritional status, healthy siblings.

Introduction

Type 1 diabetes mellitus (T1DM) is the most common chronic metabolic disease in children [1]. Although its incidence varies according to country, it is gradually increasing worldwide. The prevalence of T1DM in Turkish children is 0.75/1000 [2]. The components of T1DM treatment include insulin therapy, daily self-monitoring of blood glucose, age-adjusted diabetes nutritional education, and regular physical activity [3]. For children with T1DM to experience normal growth and development, they must maintain blood sugar in the normoglycemic range and receive sufficient nutrients. Restrictive diets or lack of food make providing the nutrients needed for growth and development difficult and should be avoided [4].

Studies conducted in recent years focusing on the quality of life have revealed that siblings of children with chronic diseases are affected psychosocially and physically. The development of depression and anxiety was more common in siblings of children with chronic conditions than in healthy controls. In addition, physical effects such as loss of appetite, eating disorders, weight loss or overeating, and sleep disorders have been documented in the siblings of sick children [5, 6].

Although there are studies evaluating the quality of life of siblings of children with T1DM, there are none that assess their

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nutritional status. Thus, this study aimed to determine the nutritional status of healthy siblings and children with T1DM and the associated factors.

Material and methods

This study analysed the data of patients and their healthy siblings who were followed and treated for T1DM in the Paediatric Gastroenterology and Paediatric Endocrinology outpatient clinics of the Health Sciences University Gülhane Medical Faculty between November 2019 and November 2020. The study inclusion criteria were follow-up for T1DM for at least one year with no concomitant chronic disease. Newly diagnosed patients and siblings of patients with T1DM who had another chronic illness were excluded from the study. Anthropometric measurements and nutritional status of previously diagnosed patients were evaluated between the 2019–2020 cross-sectional time frame. Children of similar age and gender who came to the paediatric outpatient clinics for routine evaluation were included as a control group.

Demographic, medical, and nutritional data of the patients, their siblings, and the control group, and laboratory results of the patients (blood glucose, HbA1c, and insulin levels) were obtained from the files and hospital information system and recorded on the prepared data collection forms. Laboratory tests were not routinely requested from healthy siblings of patients with T1DM; however, routine anthropometric measurements were made, and nutritional status was determined. One of the most used indicators in anthropometric measurements of paediatric patients is body mass index (BMI). According to World Health Organization (WHO) growth standards for children 0–5 years of age, BMI *Z*-score cut-off points of < -2.0, > 1.0, > 2.0, and > 3.0 are recommended to define underweight, at risk for being overweight, overweight, and obese, respectively [7]. In children 5–19 years of age, WHO recommends BMI *Z*-score cut-off points of < -2.0, > 1.0, and > 2.0 as being underweight, overweight, and obese, respectively [8]. All children with T1DM and their families were educated at the diabetes school about carbohydrate counting at the time of diagnosis or during the follow-up if they wished, and those who were successful in the exam at the end were considered as having completed the training.

The nutritional status of patients with T1DM, their healthy siblings, and the control group was determined using standard food consumption registration forms. A paediatric gastroenterology specialist and dietitian evaluated the three-day standard food consumption registration form of patients with T1DM, their siblings, and the control group using appropriate materials and recorded the information in the patient files. After the data were transferred to the Nutrition Information Systems Package Program (BeBiS, Version 7.2) (Ebispro for Windows, Stuttgart, Germany: Turkish Version), a special computer program created for this purpose to determine the average daily amount and content of nutrients, measurements were made. Factors related to nutritional status, such as socioeconomic status and the number of siblings, were recorded on the data collection form.

The ethics committee approved this study with the date and decision number of 2020-481/17.12.2020.

Statistical data was evaluated using the Statistical Package for the Social Sciences (SPSS) for Windows version 22.0. Categorical variables were expressed as numbers and percentages and numerical variables with mean ± standard deviation. Demographic variables, BMI and related parameters, diet properties, and the levels of vitamins and minerals were compared between the children with T1DM, healthy siblings, and the control group using one-way ANOVA. Chi-square tests were used for analyses among categorical variables. A 5% type 1 error was used to infer statistical significance and a *p*-value of 0.05 was considered significant.

Results

In this study, we included three groups of age- and gender-matched children. The study population consisted of 36 healthy siblings of children with T1DM (50% female, 50% male; age: 9.61 ±4.84 years), 29 children with T1DM (51.7% female, 48.3% male; age: 11.00 ±3.66 years), and a control group of 58 healthy children (51.7% female, 48.3% male; age: 10.68 ± 3.01 years) (Table I). The rate of carbohydrate counting of patients with T1DM was 82.8%.

When the patients were classified according to their BMI *Z*-scores, there were 9 children aged 0–5 years (1 child with T1DM and 8 healthy siblings), and there was no significant difference between the groups ($p = 0.667$). The remaining 114 children were over 5, including 28 children with T1DM, 28 healthy siblings, and 58 controls. The BMI *Z*-score of 28.6% of healthy siblings and 25% of children with T1DM was > 1SD or overweight. All of the control group children were of normal

Table I. Group demographic characteristics

	Children with T1DM ($n = 29$)	Healty siblings of children with T1DM ($n = 36$)	Control group ($n = 58$)	*p*-value
Gender (female/male)	15 (51.7%) female 14 (48.3%) male	18 (50%) female 18 (50%) male	30 (51.7%) female 28 (48.3%) male	0.52
Age (years)	11.00 ±3.66	9.61 ±4.84	10.68 ±3.01	0.27

weight. None of the children were obese; however, the overweight rate was significantly higher in the healthy siblings and diabetes groups compared to the controls ($p = 0.012$) (Table II).

Nutritional status of children with T1DM in relation to parameters:

- Daily protein intake (gr) in children with T1DM was significantly higher than in the control group ($p < 0.001$).
- Children with T1DM had a lower carbohydrate intake than age- and sex-matched controls.
- There was no significant difference between children with T1DM and their healthy siblings and the control group regarding saturated fatty acid ($p = 0.212$) and fiber intake ($p = 0.674$).
- In terms of micro-nutrient intake, higher antioxidant vitamin (vit. C) intake was found in diabetic patients compared to the control group ($p < 0.001$) (Tables III, IV).

Nutritional status of healthy siblings in relation to parameters:

- There was no difference between the healthy siblings and the control group regarding daily protein intake (gr).
- While daily fat (gr) intake was higher in healthy siblings than in the control group, carbohydrate, mono- and poly-unsaturated fatty acid intake (gr) was lower ($p < 0.001$).
- Daily vitamin D and iron intake were higher in the control group than in the healthy sibling group. Daily energy (daily caloric intake according to age and gender %), carbohydrate (gr), and mono- and poly-unsaturated fatty acid intake were significantly higher in the control group compared to healthy siblings ($p < 0.001$).
- When the daily micro-nutrient intake was compared, no difference was found between children with T1DM, their healthy siblings, and the control group for vitamin A ($p = 0.085$), vitamin B_1 ($p = 0.245$), folic acid ($p = 0.848$), potassium

Table II. Classification of BMI Z scores between the over 5 years children groups

Classification of BMI Z scores	Healty Siblings ($n = 28$)	Diabetic Children ($n = 28$)	Control group ($n = 58$)
Underweight	2 (7.1%)	2 (7.1%)	0 (0%)
Normal	18 (64.3%)	19 (67.9%)	58 (100%)
Overweight	8 (28.6%)	7 (25%)	0 (0%)
Obese	0 (0%)	0 (0%)	0 (0%)

Table III. Comparative analysis of dietary properties and vitamin-mineral levels of the groups

Parameter	Healthy siblings ($n = 36$)	Diabetic children ($n = 29$)	Control group ($n = 58$)	Statistics
Energy (kcal)	1236 ±298	1409 ±597	1648 ±286	$F = 13.21$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$***
Protein (gr)	15.6 ±4.6	18.0 ±4.1	14.2 ±3.2	$F = 9.06$, $p < 0.001$ Post-hoc: Diabetic child group > Control, **$p < 0.001$***
Fat (gr)	18.9 ±4.2	18.8 ±3.5	17.0 ±2.3	$F = 11.39$, $p < 0.001$ Post-hoc: Healthy sibling > Control, **$p < 0.001$***
Carbonhydrate (gr)	143.0 ±41.8	158.4 ±67.6	191.4 ±47.9	$F = 10.64$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$***
Fiber(gr)	16.1 ±7.9	17.5 ±6.4	17.2 ±6.1	$F = 0.39$, $p = 0.674$
Polyunsaturated fatty acid	10.0 ±5.0	12.6 ±9.7	17.7 ±7.3	$F = 12.54$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$***
Saturated fatty acid	19.4 ±7.8	22.1 ±10.8	22.4 ±7.0	$F = 1.57$, $p = 0.212$
Monounsaturated fatty acid	15.8 ±6.5	18.9 ±8.3	24.4 ±8.0	$F = 14.67$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$**

($p = 0.078$), magnesium ($p = 0.693$), phosphorus ($p = 0.674$), and zinc ($p = 0.212$) intake (Tables III, IV).

There was no significant difference between the groups regarding parental age, education level, monthly income, and number of family members or education level and income level, the age of diabetes diagnosis, and the rate of knowing the need for carbohydrate counting.

Discussion

Individualized nutrition therapy is recommended for children with T1DM. Monitoring carbohydrate intake with carbohydrate counting is essential for optimal glycemic control [9]. For carbohydrate intake, foods high in fiber and low in glycemic load are preferred, and those containing added sugar should be avoided. The intake of saturated fats should be limited [10]. Monitoring of daily calorie intake is important to ensure normal growth and development, considering that at least one-third of paediatric patients with T1DM are overweight or obese [10]. In a study by Akgül *et al.*, an increased risk of eating behavior disorders was found in the siblings of children with T1DM [11]. Eating disorders (weight loss or weight gain, change in eating habits, binge eating, or hoarding food) are notably more frequent in the adolescent population with T1DM, and their preva-

Table IV. Comparative analysis of dietary properties and vitamin-mineral levels of the groups

Vitamins and mineral	Healthy siblings ($n = 36$)	Diabetic children ($n = 29$)	Control group ($n = 58$)	Statistics
Vitamin A	946.3 ±489.7	1133.9 ±591.1	1220.9 ±2363.2	$F = 2.55$, $p = 0.085$
Vitamin B_1	12.1 ±69.2	0.7 ±0.3	±12.5	$F = 1.42$, $p = 0.245$
Vitamin B_2	18.9 ±4.2	18.8 ±3.5	17.0 ±2.3	$F = 4.96$, $p = 0.009$ Post-hoc: Healthy sibling > Control group, **$p = 0.047$***
Vitamin B_6	1236 ±298	1409 ±597	1648 ±286	$F = 13.21$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$***
Folic acid	60.8 ±74.3	63.2 ±41.7	57.4 ±17.2	$F = 0.16$, $p = 0.848$
Vitamin C	15.6 ±4.6	18.0 ±4.1	14.2 ±3.2	$F = 9.06$, $p < 0.001$ Post-hoc: Diabetic child group > Control, **$p < 0.001$***
Na (sodium)	18.9 ±4.2	18.8 ±3.5	17.0 ±2.3	$F = 11.39$, $p < 0.001$ Post-hoc: Healthy sibling > Control, **$p < 0.001$***
K (potassium)	1236 ±298	1409 ±597	1648 ±286	$F = 2.60$, $p = 0.078$
Ca (calcium)	143.0 ±41.8	158.4 ±67.6	191.4 ±47.9	$F = 10.64$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$***
Mg (magnesium)	47.8 ±8.3	46.3 ±8.8	47.7 ±7.4	$F = 0.36$, $p = 0.693$
P (phosphorus)	16.1 ±7.9	17.5 ±6.4	17.2 ±6.1	$F = 0.39$, $p = 0.674$
Fe (iron)	10.0 ±5.0	12.6 ±9.7	17.7 ±7.3	$F = 12.54$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$***
Zn (zinc)	19.4 ±7.8	22.1 ±10.8	22.4 ±7.0	$F = 1.57$, $p = 0.212$
Vitamin D	15.8 ±6.5	18.9 ±8.3	24.4 ±8.0	$F = 14.67$, $p < 0.001$ Post-hoc: Control > Healthy sibling, **$p < 0.001$***

lence varies from 1.6% to 21% according to psychiatric criteria [12]. In this study, in which we examined the nutritional status of healthy siblings of diabetic children, we found that 25% of children with T1DM and 28.6% of healthy siblings were overweight. Our results revealed that the rate of being overweight in healthy siblings of patients with T1DM was statistically significantly higher than in a control group. This dramatic result may be related to various factors, including nutritional status and physical activity.

High protein drinks and supplements are often unnecessary for children with diabetes. Vegetable protein sources such as legumes should be encouraged. Recommended animal protein sources include fish, lean cuts of meat, and low-fat dairy products. However, there is insufficient evidence to restrict protein intake [13]. The American Diabetes Association (ADA) concluded that children with diabetes should consume the recommended amount of protein for healthy children if their kidney function is normal [10]. In our study, while the daily protein intake (gr) of children with T1DM was significantly higher than the control group, consistent with previous studies [14–16], no difference was found between healthy siblings and the control group. While daily fat (gr) intake was higher in healthy siblings compared to the control group, carbohydrate, mono- and poly-unsaturated fatty acid (gr) intake was found to be lower. It has been observed that healthy siblings adjust to their diabetic siblings, limiting their carbohydrate intake and shifting their diet to a fat-rich diet.

Higher saturated fat intake contributes to cardiovascular disease. It is important to limit saturated fat intake to recommended levels, as adolescents with diabetes have been shown to have mildly impaired cardiovascular risk profiles compared to their healthy siblings [16]. Substituting low-glycemic index carbohydrates for high-glycemic index carbohydrates and increasing dietary fiber intake are beneficial dietary choices [17, 18]. The soluble fiber in vegetables, legumes, and fruit may be beneficial in helping to reduce lipid levels. Processed foods tend to be lower in fiber; therefore, unprocessed, fresh, whole foods should be encouraged. Increasing fiber intake can help improve glycemic outcomes and reduce the risk of cardiovascular disease [17, 19]. Our study showed no significant difference between children with T1DM and their healthy siblings and the control group regarding saturated fatty acid and fiber intake rates. Children with diabetes had a lower carbohydrate intake than control subjects, similar to previous study results [20, 21]. Daily energy (%), carbohydrate (gr), and mono- and poly-unsaturated fatty acid intake were significantly higher in the control group than in the healthy siblings. Healthy siblings may limit their daily calorie intake and keep their daily energy intake low, influenced by the carbohydrate and calorie counting in nutrition education of children with T1DM.

In terms of micro-nutrient intake, higher antioxidant vitamin (vit. C) intake was found more in patients with diabetes than in the control group. Since most biochemical pathways that increase oxidative stress are closely associated with hyperglycemia, high antioxidant vitamin intake may result from dietary counseling for children with T1DM [22, 23].

In children $>$ 5 years old, 28.6% of healthy siblings and 25% of children with T1DM had a BMI *Z*-score $>$ 1 SD or overweight. All of the control group children were of normal weight. While none of the groups were obese, the overweight rate was significantly higher in the healthy siblings and diabetes groups compared to the controls. Daily energy intake was higher in the control group. The higher BMI *Z*-scores in the healthy siblings' group compared to the control group could be because daily fat (g) intake was higher in the group of healthy siblings, and underreporting of energy intake increased as BMI increased, as evidenced previously [15, 24, 25]. All three groups had no difference in terms of parents' age, education level, monthly income, and number of family members.

Regular physical activity and exercise are recommended for children with diabetes, as it helps with cardiovascular, mental health, and weight management [13]. An important limitation of our study is that the daily physical activity and exercise levels were not compared between the groups.

In conclusion, this study showed that a quarter of diabetic children over the age of five were overweight. In addition, healthy siblings were found to have higher BMI *Z*-scores than the control group. Our study is important in that it is the first study to evaluate the nutritional status of siblings of patients with T1DM and will hopefully lead to more comprehensive studies that will also assess the daily exercise and physical activity of these groups.

References

1. Neu A, Bürger-Büsing J, Danne T, et al. Diagnosis, Therapy and Follow-Up of Diabetes Mellitus in Children and Adolescents. Exp Clin Endocrinol Diabetes 2019; 127 (S 01): S39–S72. doi: 10.1055/a-1018-8963.
2. Yeşilkaya E, Cinaz P, Andıran N, et al. First report on the nationwide incidence and prevalence of Type 1 diabetes among children in Turkey. Diabet Med. 2017; 34: 405–410. doi: 10.1111/dme.13063.
3. Ziegler R, Neu A. Diabetes in Childhood and Adolescence. Dtsch Arztebl Int 2018; 115(9): 146–156. doi: 10.3238/arztebl.2018.0146.
4. Sundberg F, deBeaufort C, Krogvold L, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Managing diabetes in preschoolers. Pediatr Diabetes 2022; 23: 1496–1511. doi: 10.1111/pedi.13427.
5. Dinleyici M, Çarman KB, Özdemir C, et al. Quality-of-life Evaluation of Healthy Siblings of Children with Chronic Illness. Balkan Med J 2019; 37: 34–42. doi: 10.4274/balkanmedj.galenos.2019.2019.7.142.
6. Van Riper M. The sibling experience of living with childhood chronic illness and disability. Annu Rev Nurs Res 2003; 21: 279–302.
7. Anderson LN, Carsley S, Lebovic G, et al. Misclassification of child body mass index from cut-points defined by rounded percentiles

instead of Z-scores. BMC Res Notes 2017; 10: 639. doi: 10.1186/s13104-017-2983-0.
8. Duggan MB. Anthropometry as a tool for measuring malnutrition: impact of the new WHO growth standards and reference. Ann Trop Paediatr 2010; 30: 1–17. doi: 10.1179/146532810X12637745451834.
9. American Diabetes Association. 4. Lifestyle Management: Standards of Medical Care in Diabetes-2018. Diabetes Care 2018; 41 (Suppl 1): S38–S50. doi: 10.2337/dc18-S004.
10. Chiang JL, Maahs DM, Garvey KC, et al. Type 1 Diabetes in Children and Adolescents: A Position Statement by the American Diabetes Association. Diabetes Care 2018; 41: 2026–2044. doi: 10.2337/dci18-0023.
11. Akgül S, Alikaşifoğlu A, Özon A, et al. Can having a sibling with type 1 diabetes cause disordered eating behaviors?. J Pediatr Endocrinol Metab 2018; 31: 711–716. doi: 10.1515/jpem-2017-0533.
12. Gregory JW, Cameron FJ, Joshi K, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes in adolescence. Pediatr Diabetes. 2022; 23: 857–871. doi: 10.1111/pedi.13408.
13. Annan SF, Higgins LA, Jelleryd E, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Nutritional management in children and adolescents with diabetes. Pediatr Diabetes 2022; 23: 1297–1321. doi: 10.1111/pedi.13429.
14. Galli-Tsinopoulou A, Grammatikopoulou MG, Stylianou C, Kokka P, Emmanouilidou E. A preliminary case-control study on nutritional status, body composition, and glycemic control of Greek children and adolescents with type 1 diabetes. J Diabetes 2009; 1: 36–42. doi: 10.1111/j.1753-0407.2008.00002.x.
15. Mayer-Davis EJ, Nichols M, Liese AD, et al. Dietary intake among youth with diabetes: the SEARCH for Diabetes in Youth Study. J Am Diet Assoc 2006; 106: 689–697. doi: 10.1016/j.jada.2006.02.002.
16. Helgeson VS, Viccaro L, Becker D, et al. Diet of adolescents with and without diabetes: Trading candy for potato chips?. Diabetes Care 2006; 29: 982–987. doi: 10.2337/diacare.295982.
17. Nansel TR, Lipsky LM, Liu A. Greater diet quality is associated with more optimal glycemic control in a longitudinal study of youth with type 1 diabetes. Am J Clin Nutr 2016; 104: 81–87. doi: 10.3945/ajcn.115.126136.
18. Ryan RL, King BR, Anderson DG, et al. Influence of and optimal insulin therapy for a low-glycemic index meal in children with type 1 diabetes receiving intensive insulin therapy. Diabetes Care 2008; 31: 1485–1490. doi: 10.2337/dc08-0331.
19. Wheeler ML, Dunbar SA, Jaacks LM, et al. Macronutrients, food groups, and eating patterns in the management of diabetes: a systematic review of the literature, 2010. Diabetes Care 2012; 35: 434–445. doi: 10.2337/dc11-2216.
20. Särnblad S, Ekelund U, Aman J. Physical activity and energy intake in adolescent girls with Type 1 diabetes. Diabet Med 2005; 22: 893–899. doi: 10.1111/j.1464-5491.2005.01544.x.
21. Alemzadeh R, Goldberg T, Fort P, Recker B, Lifshitz F. Reported dietary intakes of patients with insulin-dependent diabetes mellitus: limitations of dietary recall. Nutrition 1992; 8: 87–93.
22. Shamir R, Kassis H, Kaplan M, Naveh T, Shehadeh N. Glycemic control in adolescents with type 1 diabetes mellitus improves lipid serum levels and oxidative stress. Pediatr Diabetes 2008; 9: 104–109. doi: 10.1111/j.1399-5448.2007.00313.x.
23. Varvarovská J, Racek J, Stetina R, et al. Aspects of oxidative stress in children with type 1 diabetes mellitus. Biomed Pharmacother 2004; 58: 539–545. doi: 10.1016/j.biopha.2004.09.011.
24. Braam LA, Ocké MC, Bueno-de-Mesquita HB, Seidell JC. Determinants of obesity-related underreporting of energy intake. Am J Epidemiol 1998; 147: 1081–1086. doi: 10.1093/oxfordjournals.aje.a009402.
25. Voss S, Kroke A, Klipstein-Grobusch K, Boeing H. Is macronutrient composition of dietary intake data affected by underreporting? Results from the EPIC-Potsdam Study. European Prospective Investigation into Cancer and Nutrition. Eur J Clin Nutr 1998; 52: 119–126. doi: 10.1038/sj.ejcn.1600525.

