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Laporan Kes/*Case Report*

Integrating Nutrition Intervention and Education in the Management of an Adolescent with Type 1 Diabetes Mellitus: A Case Report

Mengintegrasikan Intervensi Pemakanan dan Pendidikan dalam Pengurusan Remaja yang Menghidapi Diabetes Mellitus Jenis 1 (T1DM): Satu Laporan Kes

WENG KHEE ENG[1], ROKIAH ISMAIL[2], YEE XING YOU[1,3*]

[1]Dietetic Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Wilayah Persekutuan Kuala Lumpur, Malaysia

[2]Department of Dietetics, University Malaya Medical Centre, 59100 Lembah Pantai Wilayah Persekutuan Kuala Lumpur Malaysia

[3]Centre for Healthy Ageing and Wellness (H-Care), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Wilayah Persekutuan Kuala Lumpur, Malaysia

*Corresponding Author; e-mail: youyeexing@ukm.edu.my

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ABSTRACT

This case study presents a 13-year-old boy diagnosed with Type 1 Diabetes Mellitus (T1DM) at age three, admitted for worsening glycaemic control, and referred to a dietitian for intensive diabetes education for the patient. The patient, with a BMI of 25.6 kg/m² placed him at 90th–95th percentile (overweight). Blood glucose controlled unsatisfactory with Blood glucose was controlled unsatisfactory with an HbA1c of 10.7% and usual SMBG ranging 13-20mmol/L Fasting serum lipid profile revealed elevated total cholesterol, triglycerides, and LDL-cholesterol, attributed to non-compliance with medications and a diet high in saturated fats and carbohydrates. Dependency on his mother for diabetes management resulted in limited knowledge of carbohydrate counting, insulin-to-carbohydrate ratio (ICR), and insulin unit correction techniques, except for insulin injection. A comprehensive nutritional intervention and diabetes education plan were implemented to improve glycaemic control, foster independence, and minimize diabetes-related complications. Two follow-ups assessed his progress, enabling effective adjustments in diabetes management to achieve optimal glycaemic outcomes. Two follow-ups were done to assess his progress, enabling effective adjustments in diabetes management to achieve optimal glycaemic outcomes.

Keywords: Type 1 Diabetes Mellitus (T1DM), Glycaemic Control, Diabetes Education

ABSTRAK

Kajian kes ini menggambarkan seorang kanak-kanak lelaki berusia 13 tahun yang didiagnosis dengan Diabetes Mellitus Jenis 1 (T1DM) pada usia tiga tahun. Pesakit dimasukkan ke hospital akibat kawalan glisemik yang semakin merosot dan dirujuk kepada pegawai dietetik untuk pendidikan diabetes yang intensif. Pesakit mempunyai BMI 25.6 kg/m², yang meletakkannya dalam persentil ke-90 hingga ke-95 (kategori berlebihan berat badan). Kawalan glukosa darahnya tidak memuaskan, dengan HbA1c 10.7%. Profil lipid serum menunjukkan peningkatan jumlah kolesterol, trigliserida, dan LDL-kolesterol. Keadaan ini dikaitkan dengan ketidakpatuhan terhadap pengambilan ubat serta diet yang tinggi lemak tepu dan karbohidrat. Kebergantungan pesakit kepada ibunya dalam pengurusan diabetes menyebabkan pengetahuannya terhad dalam pengiraan pertukaran karbohidrat, nisbah insulin-ke-karbohidrat (ICR), dan teknik pembetulan unit insulin. Oleh itu, intervensi pemakanan yang komprehensif serta pelan pendidikan diabetes telah dilaksanakan untuk meningkatkan kawalan glisemik, menggalakkan kebergantungan kendiri, dan mengurangkan risiko komplikasi berkaitan diabetes. Dua sesi susulan telah dijalankan bagi menilai kemajuan pesakit, membolehkan pelarasan yang lebih berkesan dalam pengurusan diabetes agar dapat mencapai kawalan glisemik yang optimum.

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Kata Kunci: Diabetes Mellitus Jenis 1 (T1DM), Kawalan Glisemik, Pendidikan Diabetes

BACKGROUND

Type 1 diabetes mellitus (T1DM) is the most common form of diabetes in children and adolescents, accounting for over 90% of cases (Libman et al. 2022). Its incidence and prevalence continue to rise globally, increasing the burden on healthcare systems (International Diabetes Federation 2021).

In Malaysia, data on T1DM incidence is limited, but the Malaysian Diabetes in Children and Adolescents Registry (2006–2008) reported that 71.8% of diagnosed children under 20 had T1DM (Jalaludin et al. 2012). The International Diabetes Federation (2019) later documented 977 cases among Malaysian children aged 0 to 19 years, highlighting the significance of T1DM in this population.

Adolescence is a critical period for glycaemic control, often marked by deterioration due to physiological insulin resistance, puberty-related hormonal changes, and psychosocial factors (Gregory et al. 2022). Comprehensive education and a structured self-management plan including insulin therapy, blood glucose monitoring, physical activity, and a balanced diet, are crucial for maintaining optimal glycaemic control and preventing complications such as diabetic ketoacidosis (DKA), hypoglycaemia, and retinopathy (Bjornstad et al. 2022; International Diabetes Federation. 2021).

CASE PRESENTATION

A 13-year-old boy diagnosed with T1DM at the age of three was admitted due to worsening glycaemic control and referred for intensive diabetes education. Initially was managed by his grandmother with stable HbA1c levels (8.0%) until 2020. Initially, the patient was cared for by his grandmother with a stable HbA1c 6-8 mmol/L. His glycaemic control deteriorated when his mother took over, struggling with carbohydrate counting and insulin administration. However, his glycaemic control deteriorated when his mother took over after his grandmother relocated to Singapore in 2020. The mother struggled with carbohydrate counting and insulin administration despite being seen by a dietitian 2 times. Between 2020 and 2024, his HbA1c ranged from 9.3% to 11.7%, and in 2022, he was hospitalized with diabetic ketoacidosis (DKA) due to missed insulin injections. Despite re-education efforts and insulin regimen adjustments, his mother's effort to adhere to the dietary and diabetes management guidance remained poor, with the patient's continuous dependence on his mother for diabetes management.

During his recent admission, the patient demonstrated limited understanding of carbohydrate counting, insulin-to-carbohydrate ratio (ICR), and insulin adjustments, relying on rough estimations On the admission day, the mother claimed difficulty understanding the concept of diabetes education, which led to poor guidance to the patient. This case highlights the urgent need for tailored diabetes education and support for both the patient and caregiver to enhance self-management skills, improve glycaemic outcomes, and prevent complications.

NUTRITION CARE PROCESS

Upon admission, the patient with a BMI of 25.6 kg/m² placed him at 90th–95th percentile (overweight) with no weight gain or loss history. Despite no significant weight changes, optimal growth remained crucial during puberty. His latest HbA1c was 10.7%, exceeding the targeted HbA1c level of 7.0mmol/L for adolescents with diabetes, indicating poor glycaemic control with elevated total cholesterol (6.9 mmol/L), triglycerides (2.0 mmol/L), and LDL-cholesterol (4.6 mmol/L) due to medication non-compliance and a diet high in saturated fats and carbohydrates. HDL-cholesterol (1.38 mmol/L) remained normal, likely due to regular physical activity. Renal and liver function tests were normal. Clinically, he was ADL-independent, stable, and mobile within the ward but reported polydipsia and frequent urination at home. He engaged in regular physical activity, including daily cycling and weekly badminton.

In this admission, the patient received his first dietitian consultation for diabetes education. He was prescribed with a regular 1800 kcal diet (15 carbohydrate exchanges), estimated energy intake was 1659 kcal (12 exc CHO). On the first day, his pre-meal SMBG readings were pre-BF:17.0/post-BF: 14.7/pre-L:12.4/post-L:13.7/pre-D:11.3/post-D: 9.4/pre-bed:11.7/midnight: 10.1mmol/L. Noted inaccurate CHO counting led to wrong insulin and correction units calculation, however, the self-injection technique was done correctly. His medications included long-acting insulin (Toujeo SoloStar 32 units ON), rapid-acting insulin (NovoRapid, ICR 1:3)300 units for a week, T. Metformin 500mg BD, and T. Atorvastatin 10mg OD.

At home, his pre-prandial blood glucose ranged from 10 to 19 mmol/L, with elevated levels due to inaccurate carbohydrate estimation, skipped correction doses, and missed insulin at school due to stigma fear of peer judgement as he claimed that

Diet during School Days					
Meal Time	**Foods**	**Total carbohydrates**	**Total insulin should be injected by patient (unit) ICR 1:3**	**Total insulin injected by patient (unit)**	**Blood Glucose Pre-prandial (mmol/L)**
Before school (6.30am)	2-3 scoops full cream milk (powder)	15g (1 exc CHO)	3	0 (patient skipped injection)	11-15
Breakfast during recess (10am)	1 whole burger with chicken patty, vegetables and sauce + 1 moderate plate mac and cheese + 1 stick Ice cream + 2-3 pieces doughnut	45g (3 exc CHO) 45g (3 exc CHO) 15g (1 exc CHO) 30g (2 exc CHO) Total: 135g (9 exc CHO)	27	18-20	Patient did not check blood glucose at school
Lunch at home (2pm)	6 scoops of white rice with vegetable soup (green-leafy) + 3 exc Chicken breast with skin cooked with soysauce + Plain water + 1 whole red Apple (195g)	90g (6 exc CHO) - 15g (1 exc CHO) Total: 105g (7 exc CHO)	21	16-18	15-19
Exercise (5-7pm)	1 bottle 100 Plus Active (250ml)	15.5g (1 exc CHO)	3	0	Patient did not check blood glucose pre-exercise
Dinner at home (7-8pm)	8 scoops soup noodles +2 fish ball +3 beef balls +vegetables	120g (8 exc CHO) 5g (0.5 exc CHO) Total: 125g (8.5 exc CHO)	26	16-18	11-15
Supper (11pm-12am)	3-6 pieces cream crackers	30g (2 exc CHO)	6	0 + Toujeo 30U	13-17

Diet during Weekend					
Meal Time	**Foods**	**Total carbohydrates**	**Total insulin should be injected by patient (unit) ICR 1:3**	**Total insulin injected by patient (unit)**	**Blood Glucose Pre-prandial (mmol/L)**
Breakfast (10am)	1 cup carrot milk -250ml full cream milk -1 whole carrot 6 scoops fried rice + 1 egg	 14.8g (1 exc CHO) 2g (0.1 exc CHO) 90g (6 exc CHO) Total: 105g (7 exc CHO)	21	16-18	10-12
Lunch at home (2pm)	6 scoops of white rice with vegetable soup (green-leafy) + 3 exc Chicken breast with skin cooked with soysauce + Plain water + 1 whole red Apple (195g)	90g (6 exc CHO) - 15g (1 exc CHO) Total: 105g (7 exc CHO)	21	16-18	11-15
Dinner at home (7-8pm)	8 scoops fried spaghetti +Bolognese OR +Oyster sauce and black sauce (amount used not known)	120g (8 exc CHO)	24	16-18	15-19
Supper (11pm-12am)	3-6 pieces cream crackers	30g (2 exc CHO)	6	0 + Toujeo 30U	13-17

FIGURE 1 Dietary intakes during school days and weekends.

his friends made fun of him while he was injecting the insulin. High pre-breakfast glucose was linked to supper intake without insulin, while elevated pre-lunch levels resulted from missed breakfast insulin and correction doses. His home dietary habits were assessed and summarised in the figure below. On school days, the patient's estimated energy intake was 2255 kcal (35.8 kcal/kg/day), while on weekends, it was 1785 kcal (28.3 kcal/kg/day). Carbohydrate intakes were inconsistent, with distributions of Breakfast:1/Recess:9/Lunch:7/Exercise:1/Dinner:8/ Supper:2 on school days and Breakfast:7/Lunch:7/Dinner:8/Supper:2 on weekends. The dietary assessment highlighted large portion sizes, a preference for high-carbohydrate and high-saturated-fat foods, and frequent missed insulin doses. He often skipped insulin for supper, assuming it was unnecessary for small snacks, and missed insulin doses at school, depending on his mother to inject after recess.

NUTRITION DIAGNOSIS

Food and nutrition-related knowledge deficit related to limited prior nutrition-related education and limited support from family in implementing changes as evidenced by dietary assessment (large portion size, high CHO food intake & inconsistent CHO intake), mother and patient verbalised low knowledge on diabetes management and HbA1c showed abnormal value (10.7%).Altered nutrition-related laboratory values (DXT) related to metabolic disorder (Type 1 Diabetes Mellitus) as evidenced by dietary assessment (large portion size, high CHO food intake & inconsistent CHO intake) and high DXT values > 10mmol/L.

NUTRITION INTERVENTION & RESULTS

ESTIMATED ENERGY REQUIREMENT (EER)

According to the Recommended Nutrient Intakes for Malaysia (RNI 2017) for adolescents aged 13 to 15 years, a daily energy intake of 1930 kcal is recommended for a physical activity level (PAL) of 1.4. This PAL was selected as the patient is active, engaging in leisure cycling for 1 hour daily and playing badminton with friends once a week.

THE ESTIMATED REQUIREMENTS ARE CALCULATED AS BELOW (ISPAD 2020):

Carbohydrate: 1930kcal x 45% =
≈ 14 exchanges/day

This dietary allocation aligned with the endocrinologist's prescription of 300U SC Novorapid per week with a total of 294U dosage required for a week.

Protein: 1930kcal x 20% = 386kcal/day =96.5g/day

During the first visit upon admission, the patient was educated with basic diabetic diet education, focusing on types of carbohydrates, consistency, and meal timing. He was taught carbohydrate counting, insulin-to-carbohydrate ratio (ICR) calculations, and correction dosing (>9mmol/L +1 unit, >11mmol/L +2 units, >13mmol/L +3 units, >15mmol/L +4 units, >17mmol/L +5 units). For example, if pre-meal BGL is >9 mmol/L, add 1 unit of insulin on top of the mealtime dose. A 'Diet and Diabetes' booklet was provided which included a checklist of carbohydrate-containing foods to assist with carbohydrate counting. Healthy balanced eating concept was educated and he was encouraged to walk 15–30 minutes after meals in the ward. He practiced recording blood glucose, carbohydrate intake, and insulin doses in a T1DM food diary under staff nurse supervision. Progress was monitored through his food diary and reassessed in the next visit. Ward to indent 1800kcal regular diet with 14 exchanges CHO distributed in a day (45% of TEI). There were two follow-ups done after the first visit and the intervention plans were summarized.

During the second follow-up via WhatsApp application, the patient reported adherence to the meal plan, consistent SMBG, and no missed insulin doses. However, weekend breakfast skipping led to high pre-lunch glucose (13.5–17.0 mmol/L). Prolonged meal gaps cause glycaemic variability, with levels peaking at 17.3 mmol/L after a 10-hour gap and dropping to 9.4 mmol/L after a 3-hour gap. Miscalculations in carbohydrate exchanges, especially with noodles, contributed to elevated glucose levels. SMBG at school remained inconsistent due to fear of stigmatization. He increased badminton sessions to three times weekly while adhering to pre-exercise SMBG protocols to maintain levels below 15 mmol/L.

Nutrition education was focused on reinforcing carbohydrate counting, meal timing, and using The Malaysian Food Composition Database (MyFCD) for portion accuracy. However, challenges included occasional neglect of SMBG during school hours due to fear of peer judgement and privacy concerns, as well as reliance on estimations rather than measuring food portions at school. These gaps in SMBG data and self-reported dietary habits limited accurate assessment of his glycaemic trends and compliance. Persistent high blood glucose levels may indicate factors beyond dietary intake, such as the need for insulin adjustments or puberty-related hormonal changes, which can complicate glycaemic control. Other than that, the mother was emphasized to inform school authorities about his

DAY 2 ADMISSION	Pre-BF: 15.5 mmol/L	2H Post-BF: 8.4 mmol/L	Pre-L: 12.6 mmol/L	Post-L: 7.6 mmol/L	Pre-D: 6.4 mmol/L	2H Post-D: 5.8 mmol/L	Pre-Bed: 3.4 mmol/L (hypo)	Midnight: 11.4 mmol/L (Overcorrection)
Food taken	-Bread (30g) -Milk (10.8g) -Jam (5g)		-Mashed potato (45g) -Carrot & Corn (5g) -Jelly (5g)		-Fried rice (45g) -Milk (15g) -Banana (15g)		Corrected with 250ml ice lemon tea Post 15 min: 5.9 mmol/L +Toujeo 32U	
CHO exc	3		4		5			
Insulin needed	9+4		12+2		15			
Insulin injected	13 (✓)		12 (✓)		20 (✗) ⚠			
DAY 3 ADMISSION	Pre-BF: 8.2 mmol/L	2H Post-BF: 8.4 mmol/L	Pre-L: 8.6 mmol/L	Post-L: 13.2 mmol/L	Pre-D: 10.4 mmol/L	2H Post-D: 8.4 mmol/L	Pre-Bed: 11.0 mmol/L	Midnight: 4.5 mmol/L
Food taken	-Chocolate milk (12g) -Fried rice (45g)		-Rice (60g) -Sweet sauce (10g) -Watermelon (15g) -Bread with jam filling (45g)		-Rice (30g) -Pizza 2 pcs (30g) -Melon (15g) -Biscuit (30g)		-Chocolate cake (32g)	
CHO exc	4		9		7		2	
Insulin needed	12		27		21 + 1		6+3	
Insulin injected	12 (✓)		21 (✗)		22 (✓)		9 (✓) + Toujeo 32U	

DAY 4 ADMISSION	Pre-BF: 7.8 mmol/L	2H Post-BF: 11.7 mmol/L	Pre-L: 5.6 mmol/L	Post-L: 8.3 mmol/L	Pre-D: 6.8 mmol/L	2H Post-D: 9.0 mmol/L	Pre-Bed: 7.8 mmol/L	Midnight: 6.8 mmol/L
Food taken	-Porridge chicken (45g) -Papaya (15g) -Milk (15g)		-Spaghetti (45g) -Banana (15g) -Biscuits (30g)		-Butter rice (45g) -Ice cream (15g)		Toujeo 32U	
CHO exc	5		6		4			
Insulin needed	15		18		12			
Insulin injected	15 (✓)		18 (✓)		12 (✓)			
DAY 5 ADMISSION	Pre-BF: 8.6 mmol/L	2H Post-BF: 7.4 mmol/L	Pre-L: 9.2 mmol/L	Post-L: 9.7 mmol/L	Pre-D: 10.0 mmol/L	2H Post-D: 6.8 mmol/L	Pre-Bed: 7.8 mmol/L	Midnight: 5.8 mmol/L
Food taken	-Chocolate milk (12g) -Fried rice (45g)		-Rice (60g) -Watermelon (15g)		-Fried rice (45g) -Milk (15g) -Banana (15g)		-Biscuit (15g)	
CHO exc	4		5		5		1	
Insulin needed	12		15+1		15+1		3	
Insulin injected	12 (✓)		16 (✓)		16 (✓)		3 (✓) + Toujeo 32U	

FIGURE 2 T1DM Food and Blood Glucose Diary

WEEKDAY 1	Pre-BF (6.30am): 6.8 mmol/L	School Recess (10am): Unclear readings reported	Pre-L (2pm): 8.4 mmol/L	Post-L (10pm): 9.5 mmol/L
Food taken	-3 scoops full cream milk (powder) (15g)	-1 burger (45g) -1 pizza (15g)	-Black sauce (15g) -Rice (60g)	-Rice (30g) -Sweet sauce (15g)
CHO exc	1	4	5	3
Insulin needed	3	12	15	9
Insulin injected	3 (✓)	9 (✗)	15 (✓)	9 (✓)
WEEKDAY 2	Pre-BF (6.30am): 6.8 mmol/L	2H Post-BF (10am): Unclear readings reported	Pre-L (1.21pm): 16.6 mmol/L	Post-L (7.30pm): 16.8 mmol/L
Food taken	-3 scoops full cream milk (powder) (15g)	-Fried rice (45g)	-Noodles (90g) *weight 200g	-Rice (30g) -Sweet sauce (15g)
CHO exc	1	3	6	3
Insulin needed	3	9	18+4	9+4
Insulin injected	3 (✓)	9 (✓)	18 (✗)	13 (✓)

WEEKEND 1	Pre-BF: Patient often sleep until 12pm and skipped breakfast		Pre-L (12.30pm): 17.0 mmol/L	Post-L (7.30pm): 17.3 mmol/L
Food taken			-Noodles (60g) *weight 150g -Ketchup sauce 38g	-Noodles (90g) *weight 200g -Black sauce (15g)
CHO exc			6	7
Insulin needed			18+5	21+5
Insulin injected			18 (✗)	18 (✗)
WEEKEND 2	Pre-BF: Patient often sleep until 12pm and skipped breakfast	Pre-L (12pm): 13.5mmol/L	Pre-L (4.12pm): 7.8 mmol/L	Post-L (7.30pm): 9.4 mmol/L
Food taken		-Sweet sauce (15g) -Rice (45g) -Pork sauce (sweet) (15g)	-Rice (45g) -Black sauce (15g)	-Fried rice (30g) -Sweet and sour sauce (15g) -Sweet sauce (15g)
CHO exc		5	4	4
Insulin needed		15+3	12	12+1
Insulin injected		18 (✓)	12 (✓)	13 (✓)

FIGURE 3 Food Diary Recorded by Patient Post-discharged (4 days in 1 month)

condition to provide T1DM care and peer support. The patient was advised to maintain detailed daily records of meal timings, food intake, insulin doses, and blood glucose levels to support a comprehensive review during his next endocrinology appointment. The patient acknowledged and agreed to follow the recommendations.

DISCUSSION

Diabetes education is essential for adolescents and children with T1DM to effectively manage their condition from an early age. This education must increasing independence and significant physiological changes, including heightened insulin resistance and an associated rise in HbA1c levels, as documented in multiple international registries. Behavioural and social factors, such as defiance and fear of peer judgment, may discourage adolescents from performing SMBG or weighing food in social settings, such as schools (Gregory et al. 2022). To address these challenges, adolescent- and culturally-appropriate education tools are needed to reinforce individualized care plans that align with glycaemic targets while considering lifestyle and psychological factors. Schools must also foster acceptance, create a supportive environment, and encourage peer involvement in supporting students with T1DM.

Physiological changes during puberty further complicate glycaemic control. Increased levels of growth hormone (GH) during this period contribute to heightened insulin resistance, reducing the effectiveness of insulin in glucose uptake. This necessitates higher insulin doses and adds complexity to glycaemic management (Gregory et al. 2022). Additionally, changes in body composition, including increased weight, are commonly observed during puberty and exacerbate hyperglycaemia, increasing the risk of complications. Achieving and maintaining healthy body weight is, therefore, an important goal in the clinical management of diabetes in young people (Fröhlich-Reiterer et al. 2014).

Establishing and adhering to glycaemic targets is critical for adolescents with T1DM, as optimized glycaemic control minimizes the risk of long-term microvascular and macrovascular complications (De Bock et al. 2022). SMBG levels should ideally range between 4–10 mmol/L for pre-prandial and post-prandial whereas 6.7-10 mmol/L for bedtime, corresponding to an HbA1c level of less than 7.5%. (CPG: Management of T1DM in Children & Adolescents. 2019) In addition, SMBG before exercise is crucial to prevent exercise-induced hypoglycaemia. A combination of insulin adjustments and nutritional strategies can help maintain glucose levels within the recommended be tailored to the individual's age, stage of diabetes, cognitive abilities, maturity, lifestyle, cultural background, and learning pace. Familial support is equally important, as parents and caregivers play a pivotal role in fostering an environment conducive to effective diabetes management (Lindholm Olinder et al. 2022). However, many families and adolescents report communication barriers with healthcare providers, often stemming from differing priorities and difficulties in obtaining essential diabetes management information (J. Howe et al., 2012; Datye et al. 2015). Adolescence is a critical period marked by exercise range of 5.0–15.0 mmol/L (Adolfsson, P. et al. 2022).

CONCLUSION

Effective diabetes management in adolescence requires a holistic approach that addresses education, behaviour, physiology, and social factors, while ongoing support empowers adolescents to manage their condition, improving long-term health outcomes and quality of life. A dietitian plays an important role in managing T1DM adolescents by providing patient-centered and age-appropriate diabetes education with structured follow-ups to enhance glycaemic control. Effective diabetes management during adolescence necessitates an integrated approach that addresses diabetes education, behavioural, and hormonal changes during puberty, peer and family support, and multidisciplinary collaboration. These holistic strategies help to improve quality of life, improve glycaemic management and minimize risk of diabetes-related complications.

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REFERENCES

Adolfsson, P., Taplin, C. E., Zaharieva, D. P., Pemberton, J., Davis, E. A., Riddell, M. C., McGavock, J., Moser, O., Agnieszka Szadkowska, Lopez, P. E., Jeerunda Santiprabhob, Frattolin, E., Griffiths, G. & DiMeglio, L. A. 2022. ISPAD Clinical Practice Consensus Guidelines 2022: Exercise in children and adolescents with diabetes. *Pediatric Diabetes* 23(8): 1341–1372.

Bjornstad, P., Dart, A., Donaghue, K. C., Dost, A., Feldman, E. L., Tan, G. S., Wadwa, R. P., Zabeen, B., & Marcovecchio, M. L. 2022. ISPAD Clinical Practice Consensus Guidelines 2022: Microvascular and

macrovascular complications in children and adolescents with diabetes. *Pediatric Diabetes* 23(8): 1432–1450.

Cheah, Y. K. 2019. *CPG Management of Type 1 Diabetes Mellitus in Children & Adolescents. MEMS*; Malaysia Health Technology Assessment Section (MaHTAS).

Datye, K. A., Moore, D. J., Russell, W. E., & Jaser, S. S. 2015. A Review of Adolescent Adherence in Type 1 Diabetes and the Untapped Potential of Diabetes Providers to Improve Outcomes. *Current Diabetes Reports* 15(8):1-17.

De Bock, M., Codner, E., Craig, M. E., Huynh, T., Maahs, D. M., Mahmud, F. H., Marcovecchio, L. & DiMeglio, L. A. 2022. ISPAD Clinical Practice Consensus Guidelines 2022: Glycemic targets and glucose monitoring for children, adolescents, and young people with diabetes. *Pediatric Diabetes* 23(8): 1270–1276.

Fröhlich-Reiterer, E. E., Rosenbauer, J., Pozza, S. B.-D., Hofer, S. E., Schober, E., Holl, R. W., & Obesity, on behalf of the D.-W. S. G. and the G. B. C. N. D. 2014. Predictors of increasing BMI during the course of diabetes in children and adolescents with type 1 diabetes: data from the German/Austrian DPV multicentre survey. *Archives of Disease in Childhood* 99(8): 738–743.

Jalaludin, Y., Fuziah, M., Hong, J., Adam, B. M. & Jamaiyah, H. 2012. Reliability and Validity of the Revised Summary of Diabetes Self-Care Activities (SDSCA) for Malaysian Children and Adolescents. Malaysian Family Physician : *The Official Journal of the Academy of Family Physicians of Malaysia* 7(2-3): 10-20.

Gregory, J. W., Cameron, F. J., Joshi, K., Eiswirth, M., Garrett, C., Garvey, K., Agarwal, S. & Codner, E. 2022. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes in adolescence. *Pediatric Diabetes* 23(7): 857–871.

Howe, C.J., Ayala, J., Dumser, S., Buzby, M. & Murphy, K. 2012. Parental Expectations in the Care of Their Children and Adolescents With Diabetes. *Journal of Pediatric Nursing* 27(2):119–126.

International Diabetes Federation. 2019. *IDF Diabetes Atlas* 2019. IDF Diabetes Atlas,. Edisi ke-9.

International Diabetes Federation. 2021. *IDF Diabetes Atlas 2021*. IDF Diabetes Atlas,. Edisi ke-10.

Libman, I., Haynes, A., Lyons, S., Pradeep, P., Rwagasor, E., Tung, J. Y., Jefferies, C. A., Oram, R. A., Dabelea, D. & Craig, M. E. 2022. ISPAD Clinical Practice Consensus Guidelines 2022: Definition, epidemiology, and classification of diabetes in children and adolescents. *Pediatric Diabetes*: 23(8): 1160–1174.

Lindholm Olinder, A., DeAbreu, M., Greene, S., Haugstvedt, A., Lange, K., Majaliwa, E. S., Pais, V., Pelicand, J., Town, M., & Mahmud, F. H. 2022. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes education in children and adolescents. Pediatric Diabetes, 23(8): 1229–1242.